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ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges:

IAA (A-10000 Series)

A79-10001 – A79-20476

STAR (N-10000 Series)

N79-10001 – N79-15897

Previous publications announced in this series/subject category include:

<i>DOCUMENT</i>	<i>DATE</i>	<i>COVERAGE</i>
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NASA SP-7043(02)	November 1974	April 1, 1974 – June 30, 1974
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NASA SP-7043(16)	January 1978	October 1, 1977 – December 31, 1977
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ENERGY

A Continuing Bibliography

With Indexes

Issue 21

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced from January 1 through March 31, 1979 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*



Scientific and Technical Information Branch

1979

National Aeronautics and Space Administration

Washington, DC

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(21)) lists 1873 reports, journal articles, and other documents announced between January 1, 1979 and March 31, 1979 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974 and succeeding issues are published quarterly.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

Five indexes -- subject, personal author, corporate source, contract number, and report number -- are included. The indexes are of the cumulating type throughout the year, with the fourth quarterly publication containing abstracts for the fourth quarter and index references for the four quarterly publications.

AVAILABILITY OF CITED PUBLICATIONS

IAA ENTRIES (A79-10000 Series)

All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc (AIAA), as follows. Paper copies of accessions are available at \$6.00 per document up to a maximum of 20 pages. The charge for each additional page is \$0.25. Microfiche⁽¹⁾ of documents announced in *IAA* are available at the rate of \$2.50 per microfiche on demand, and at the rate of \$1.10 per microfiche for standing orders for all *IAA* microfiche. The price for the *IAA* microfiche by category is available at the rate of \$1.25 per microfiche plus a \$1.00 service charge per category per issue. Microfiche of all the current AIAA Meeting Papers are available on a standing order basis at the rate of \$1.35 per microfiche.

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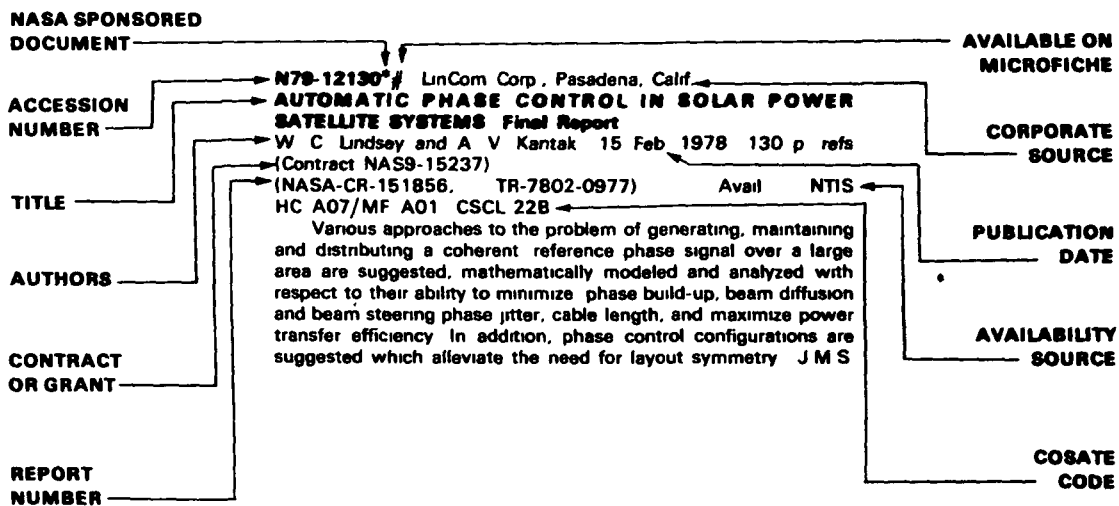
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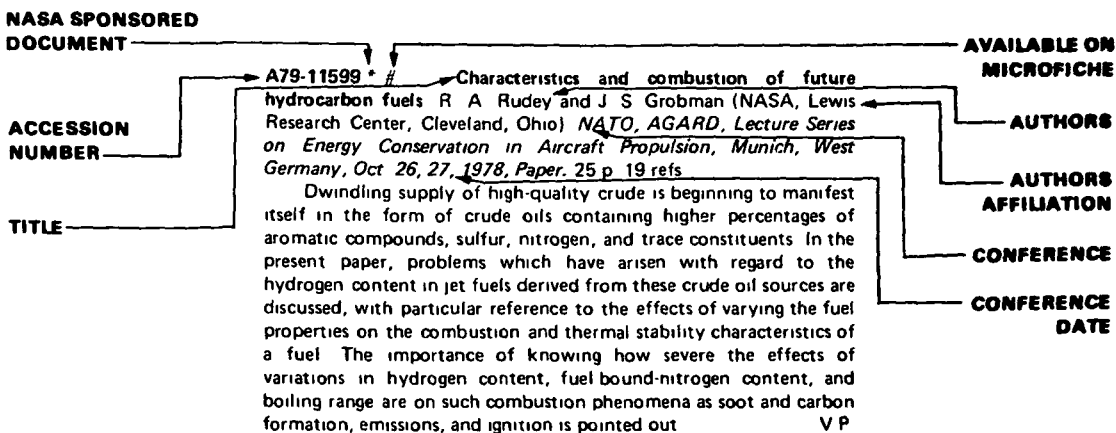
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APRIL 1979

IAA ENTRIES

Vertical junction silicon solar cells were fabricated with AMO efficiencies of greater than 14%. Textured cells typically had higher efficiencies than planar cells because of higher absorptance. The paper describes the procedure for fabricating vertical junction silicon solar cells, with special attention given to the orientation dependent etch
P.T.H.

A79-10001 Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings. Volumes 1, 2 & 3 Conference sponsored by SAE, ACS, AIAA, ASME, IEEE, AIChE, and ANS Warrendale, Pa., Society of Automotive Engineers, Inc., 1978 Vol 1, 926 p, vol 2, 821 p, vol 3, 734 p Price of three volumes, members, \$95, nonmembers, \$110

These proceedings deal with advances and research developments in both conventional and nonconventional energy-conversion systems as well as engineering applications. The papers cover such areas as aerospace, biomedical, electrochemical, geothermal, and wind power, the Brayton, Rankine, and Stirling cycles, alternate fuels, coal, shale, and tar sands, electric propulsion, energy conversion in general, energy storage systems and transport, hydrogen and marine energy systems, magnetohydrodynamics, nuclear fission and fusion, solar and thermionic energy conversion, space nuclear power, thermoelectric energy, unique power systems, and urban energy advances. Specific topics include synchronous-orbit power systems, energy storage systems and solar-cell developments for space, space power and satellite power systems, aerospace applications of nuclear reactors, various aspects of coal conversion and liquefaction, fluid bed combustion and coal conversion technology, solar concentrators, and thermoelectric-photovoltaic systems
F G M

A79-10014 * Status of wraparound contact solar cells and arrays C R Baraona (NASA, Lewis Research Center, Cleveland, Ohio) and L E Young (NASA, Marshall Space Flight Center, Huntsville, Ala) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 84-90 13 refs

The paper describes the development of wraparound contact solar cell technology. Future development trends are distinguished. The current method of module fabrication with wraparound contact cells is briefly reviewed. The prospects for automated cell assembly are discussed
P T H

A79-10016 The NTS-2 satellite solar cell experiment. R L Statler and D H Walker (U.S. Navy, Naval Research Laboratory, Washington, D.C.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 97-104 10 refs Navy-USAF-supported research

Telemetered data from the 14 silicon and gallium arsenide solar cell modules on the NAVSTAR Global Positioning System Navigation Technology Satellite Two (NTS 2) indicate that the trapped electron flux in a 63.5 degree 20,190 km circular orbit is about twice as great as the nominal value predicted by published space environment models. Over the 3-year mission the main solar array comprising Spectrolab Helios solar cells will degrade 27 percent in maximum power output. The solar cell electronic data acquisition system functions extremely well, providing detailed I-V curves for 15 experimental modules every two minutes. Solar cell temperatures have attained 103 degrees C on the test modules, thus providing favorable conditions for evaluating the gallium arsenide solar cell module which exhibits partial recovery from radiation damage at this temperature. This cell has sustained the least degradation thus far after 8 months of operation, with a maximum power loss of only 4.6 percent, as compared to an average power loss of 12.0 percent for the six best silicon cells on NTS 2
(Author)

A79-10012 Silver-hydrogen, a long life light weight energy storage system R J Haas and J D Armantrout (Ford Aerospace and Communications Corp., Western Development Laboratories Div., Palo Alto, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 74-79

The paper describes initial component and configuration experimentation on lightweight designs for silver hydrogen energy storage systems. The discussion covers electrolyte management, electrolyte reservoir material, and the separator membrane materials. A single-cell assembly consisting of a prismatic pressure vessel with demountable cover assembly and a cell stack with lightweight silver electrodes, fuel cell hydrogen electrodes, chemically inert capillary type separator, ceramic-to-metal electrical connection and direct cell stack thermal interface with cell container was life tested. Design optimization procedures are discussed
P T H

A79-10017 Orbiting Solar Observatory /OSO-8/ solar panel design and in-orbit performance G R Brooks, S W Gelb, and L J Goldhammer (Hughes Aircraft Co., Space and Communications Group, El Segundo, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 105-109

The paper describes the in-orbit performance of the OSO-8 solar array as predicted through use of computer techniques and compared to available array telemetry data. The predicted and actual telemetry derived current vs voltage curves are in relatively close agreement

A79-10013 Vertical junction silicon solar cell J H Wohlgemuth, C Y Wrigley, and J Lindmayer (Solarex Corp., Rockville, Md.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 80-83 5 refs

through 420 days in orbit After that, agreement is not so good, with telemetry values being above predicted values P T H

A79-10018 **Intelsat V solar array design and development summary** D C Briggs, H E Pollard (Ford Aerospace and Communications Corp., Washington, D C), H Brodersen, and I Rizos (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 110-117 Research sponsored by the International Telecommunications Satellite Organization

The paper focuses on the mechanical and electrical design of the Intelsat V satellites. The solar array consists of two identical deployable wings, each with three 1.6 x 2 m panels and an interconnecting yoke frame Panel construction consists of carbon fiber beams, making the framework for the aluminum honeycomb covered on both sides by woven carbon fiber faceskins Dynamic behavior of the panels was analyzed by a finite element method, and comparison was made with vibration tests Deployment tests and tests of the release system, hold-downs, and hinges validated the design and material processes The solar cell cover integrated cell (CIC) consists of a 20.95 x 40.35 mm rectangular 10 ohm-cm N or P shallow diffused solar cell with a TiO₂ anti-reflection coating Characterization tests were performed on the CIC's to determine average current-voltage curve for individual CIC's, to determine average current-voltage curve for individual CIC's, series resistance, angle of incidence effects, spectral response, and temperature coefficients. P T H

A79-10019 **Design features of the TDRSS solar array** F G Kelly, W Luft, and R M Kurland (TRW Defense and Space Systems Group, Redondo Beach, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 118-123 12 refs

This paper describes both mechanical and electrical features of a large lightweight long-life oriented solar array The array is comprised of six deployable panels The aluminum honeycomb substrate has Kapton facesheets with edge-rolled adhesive and a graphite fiber reinforced plastic supporting structure for stiffness and light weight The GFRP frame is adhesively bonded to the real facesheet, which is perforated 50% for thermal control 20 x 40 x 0.20 mm high efficiency solar cells with pad contacts are used with uncoated ceria glass covers which overhang the cells on all four sides for positive protective protection from low energy protons An extensive development test program was conducted to provide a solid data base for critical design decisions The end result is a thoroughly tested, reliable design which provides over 2.2 kW at end of mission in 29.5 sq m of substrate area The array weighs 86.1 kg, 39% of which is electrical (Author)

A79-10022 * **Satellite power systems /SPS/ overview** R I LaRock (NASA, Office of Energy Programs, Solar Energy Div., Washington, D C) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 146-148

The concept of using a number of very large satellites in geostationary equatorial orbit to convert solar energy into electricity and then to microwave energy transmitted back to earth is given a brief historical overview The major program elements and organizational responsibilities in the DOE/NASA program for satellite power systems are schematized The timetable calls for preliminary program recommendations in May, 1979, and final program recommendations in June, 1980 With the exception of the microwave effects studies, all work will be analytical Overall funding for the effort has been set at \$15.6 million P T H

A79-10023 **Evolution of satellite power system /SPS/ concepts** G M Hanley (Rockwell International Corp., Space Div., Downey, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 149-155

The paper summarizes the analyses and trade studies leading to selection of concepts for a satellite power system (SPS) For a concentration ratio of unity, both silicon and GaAlAs solar blankets were considered For higher concentration ratios only GaAlAs blankets were considered Two basic thermal cycles, Brayton and Rankine, were considered for solar thermal concepts A GaAlAs solar cell concept is currently considered the leading candidate because of (1) high efficiency, (2) high output power-to-mass ratio, and (3) ability to self-anneal natural space radiation damage A stripline rectenna array is preferred because it is mass produceable and easily installed, increases rectenna efficiency as compared with individual dipole antennas, and reduces the diode count to only 2% of the dipole rectenna count Satellite construction in geosynchronous orbit with a dedicated solar-electric stage using an argon ion-bombardment thruster is preferred to either partial or total low-earth orbit construction P T H

A79-10024 **The design and evaluation of a 5 GW GaAlAs solar power satellite /SPS/** A D Tonelli (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.) and A A Nussberger (Rockwell International Corp., El Segundo, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 156-161 9 refs

The solar power satellite (SPS) system described has overall dimensions of 3.85 km wide by 21.3 km long and GaAlAs solar cell area of 30.6 million sq m The SPS employs reflective mirrors to enhance the solar energy impinging on the cells, which results in a significant weight and cost savings Overall efficiency is about 6.1% P T H

A79-10025 **A microwave power transmission system for space satellite power** O S Denman, R J Gwin, W W Lund, Jr., E J Nalos, and S M Rathjen (Boeing Aerospace Co., Seattle, Wash.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 162-168

The results of a system definition study of a baseline microwave transmission design for a solar satellite power system are presented Emphasis in this paper is primarily on the spaceborne element, but some recent rectenna design factors are also discussed An integrated design approach is outlined resulting in a 5 gigawatt RF System configuration which observes the Solar Power Satellite (SPS) structural and thermal constraints and is detailed to a level adequate for parametric costing purposes The paper deals with (1) design aspects of the RF transmitter, specifically a high power klystron, (2) antenna array phase control, including an error budget representative of probable tolerances, and (3) discussion of the interface integration factors such as power distribution and thermal design (Author)

A79-10026 **Power distribution study for a 5-GW space power satellite** J S Jandras and C T Kleiner (Rockwell International Corp., Anaheim, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 169-177 6 refs

The SPS power-distribution study had two objectives (1) to determine design tradeoffs for various configurations capable of delivering 5 GW of power to the grid on the ground, and (2) to make a detailed analysis of power distribution for a particular configuration (solar photovoltaic) It was found that dc power distribution appears promising for the SPS In addition, switching array power as

a means of regulation for the RF load may not be adequate versus the use of dc-to-dc regulators. It is also shown that high voltages (40 kV) are desirable since they reduce the overall mass requirement. B J

A79-10027 * From sunlight in space to 60 Hz on earth - The losses along the way. O S Denman (Boeing Aerospace Co., Seattle, Wash.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 178-184. 8 refs. Contract No NAS9-15196

The space-to-ground links for the Solar Power Satellite System are discussed in terms of worst, best, and nominal efficiency used in the development of the preliminary design. An uncertainty analysis of this design illustrates the effect of link efficiency on SPS size and mass. It is shown that a solar power satellite can deliver power to a ground-based utility for 4 to 5 cents per kWh, depending on the efficiency of the solar cells available in 1987. The overall efficiency of converting sunlight in space to electric power delivered to utilities ranged from 3.83% for the worst combination of efficiencies to 9.5% for the best, with a nominal efficiency of 7.12%. B J

A79-10028 Solar Power Satellite thermal analysis. M Manoff (Rockwell International Corp., Space Div., Downey, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 185-188

The influence of temperature levels and thermal gradients on Solar Power Satellite (SPS) performance capabilities and mass requirements has been investigated. These studies include comprehensive evaluation of candidate power conversion concepts (photovoltaic, solar thermal and nuclear). It is shown that even for these systems in which thermal control elements represent only a small fraction of the total satellite mass, thermal considerations are a major contributing element in the definition of design concepts and ultimate system feasibility. (Author)

A79-10029 Construction of a 10GWe solar power satellite. E E Davis and K H Miller (Boeing Aerospace Co., Seattle, Wash.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 189-194

This paper describes the major systems and operations associated with the construction of a 10 GWe photovoltaic power satellite. Eight satellite modules and two antennas are constructed at a LEO earth orbit construction base. Structure for the satellite is fabricated in orbit while solar arrays, power distribution and microwave units are fabricated on earth and only require installation. Each module is constructed in 40 days while each antenna requires 140 days for a total construction time of one year. A LEO crew size of 480 is required while the mass and unit cost of the base are estimated at 5.9 million kg and 7 billion dollars, respectively. Transfer of modules and antennas to geosynchronous earth orbit (GEO) is accomplished using electric propulsion. A base is provided at GEO to assist in the docking of the modules to form the complete satellite and the final deployment and checkout operations. A crew size of 70 is estimated at this GEO base while the mass and unit cost are respectively 0.8 million kg and \$1.2 billion. (Author)

A79-10030 * Environmental considerations for the microwave beam from a solar power satellite. G D Arndt and L Leopold (NASA, Johnson Space Center, Houston, Tex.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 195-200. 12 refs

Solar power satellite (SPS) systems in geosynchronous orbit are possible future energy sources. The SPS concept uses a highly focused microwave beam to transmit the energy to the earth. The microwave power transmission system parameters are summarized,

emphasizing those parameters which may affect the earth's environment. Environmental impacts of the microwave beam are discussed. The power levels for the main beam, sidelobes, grating lobes, and ground receiving antenna reradiation patterns are presented. Ionospheric/microwave beam interaction studies, experimental and theoretical, are reviewed. Possible radio frequency interference sources and the magnitude of expected interference levels are discussed.

(Author)

A79-10031 Microwave phased array design considerations for SPS. W W Lund, Jr and S M Rathjen (Boeing Aerospace Co., Seattle, Wash.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 201-204. 5 refs

The paper describes the basic radiating array configuration of a 1 km-diameter solar power satellite microwave antenna and presents results of a dimensional error analysis which relates power loss to tolerance. Results of several radiation pattern analyses are presented, including basic relationships of beam efficiency, aperture power density distribution, and sidelobe levels. A beam shaping analysis and far-out sidelobe and grating lobe considerations are also examined.

B.J.

A79-10033 * A 5-GWe nuclear satellite power system conceptual design. M Goodman and W B Thomson (Rockwell International Corp., Atomics International Div., Canoga Park, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 211-217. 6 refs. Contract No NAS8-32475

This paper presents the results of a brief study performed for MSFC on the conceptual design of a nuclear satellite power station which delivers 5 GWe net power to earth by microwave transmission. The system contains 26 modules each consisting of a reactor, fuel processing plant, Brayton PCU, space radiator, and nuclear shield. A high-temperature, gas-cooled, pebble-bed plutonium breeder concept was selected which is resupplied with fertile U-238. Sections of this core are periodically replaced and the spent fuel is chemically processed, the radioactive wastes separated, and stored for eventual space disposal. Fresh fuel pellets, formed from the U-238 and the bred plutonium, are recycled back to the reactor. The hot (1317 C) helium gas exiting the reactor serves as the working fluid in a 30%-efficient Brayton PCU. (Author)

A79-10035 The status of alcohol fuels utilization technology for highway transportation. E E Ecklund (US Department of Energy, Washington, D C), A J Parker, Jr, T J Timbario, and P. W McCallum (Mueller Associates, Inc., Baltimore, Md.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 226-232. 37 refs

The paper attempts to provide a 1977 picture of utilization technology readiness of automotive alcohol fuels (methanol and methanol/gasoline blends and ethanol and ethanol/gasoline blends) in anticipation of future demand. The utilization potential of alcohol fuels is discussed in terms of (1) exhaust emissions, (2) performance and fuel economy, (3) vehicle driveability, (4) engine/vehicle design changes, (5) other environmental, health, and safety considerations, and (6) fuels characterization. B J

A79-10036 Energy from biomass through hydrolysis of wood. B Guha and A L Titchener (Auckland University, Auckland, New Zealand) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 233-238. 12 refs. Research supported by the New Zealand Energy Research and Development Committee.

An effective method for converting biological material to liquid fuel is the production of ethanol by hydrolysis of cellulose and

fermentation of the resulting sugar. The conversion of wood cellulose to sugar is best achieved through dilute sulfuric acid hydrolysis process. The hydrolysis of wood is described by a two step consecutive reactions, of saccharification and decomposition. The first order reaction kinetics of both of these reactions have been established. Experiments with wood chips show the presence of considerable resistance to diffusion of sugar and the nature of wood growth. An optimization analysis for maximum yield of sugar in a percolator reactor, used for hydrolysis reaction is presented. The analysis show possible improvements in performance of such reactors, with a proper choice of process parameters of temperature, liquid flow rate and total percolation time. A new plant design concept incorporating some new process innovations has been presented. (Author)

A79-10037 The Garrett Energy Research biomass gasification process. R D Mikesell, D C Hoang, and D E Garrett (Garrett Energy Research and Engineering Co., Inc., Ojai, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 239-244. 5 refs.

A multiple hearth furnace is used for the gasification of biomass materials. Drying, pyrolysis, steam/char gasification, and combustion steps are carried out, each on its own hearth. Partially dry biomass feed is contacted on the top hearth of the furnace with hot flue gas from the combustion stage. The steam contained in the flue gas leaving the top hearth is condensed in the jacket of a vacuum predryer. The nearly dry feed material on the top hearth is dropped onto the pyrolysis hearth where it is pyrolyzed in the absence of oxygen at about 750 C. The pyrolysis gas is passed through a condenser which removes the steam and tar. Some of the pyrolytic carbon is steam-gasified at about 850 C in an external lift tube, while the remainder is burned on the combustion hearth. The ash drops onto the ash cooling hearth where it exchanges heat with the incoming combustion air. (Author)

A79-10039 Closed Cycle Gas Turbine power generation opportunities. W H Wilkinson and W T Hanna (Battelle Columbus Laboratories, Columbus, Ohio). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 278-284. 11 refs.

A screening comparison of bottomed Closed Cycle Gas Turbine (CCGT) alternatives is made using both thermal efficiency and heat transfer size requirements as criteria. Insights into trade-off opportunities are developed. Ultimate recommendations of preferred CCGT systems are made based on predictions of cost of electricity derived from data contained in the Energy Conversion Alternatives Study (ECAS) and applied to these unique cases. Atmospheric fluidized-bed combustion systems using these preferred systems show promise of producing electricity at significantly increased coal use efficiency without increase in the cost of electricity. (Author)

A79-10040 A new power cycle that combines power generation with energy storage. J Dayan, S Lynn, and A S Foss (California, University, Berkeley, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 285-291. Research supported by the U S Department of Energy.

A novel power cycle concept of high efficiency is being developed that utilizes the reversible chemical reaction $\text{SO}_3 \text{SO}_2(+)$ $1/2 \text{O}_2$ and combines power generation with energy storage. The process is most suitable for utilization in the central receiver of a solar power plant, but may be adapted to other sources of high-temperature thermal energy as well. During the day, liquid SO_3

is vaporized at 40 atm and heated to a temperature in excess of 800 C in receiver tubes that contain a catalyst for the reaction. The hot gases are expanded to about 2 atm through a gas turbine, then interchange heat with the reactor feed, and are finally cooled to near-ambient temperature by an appropriate coolant. A mixture of SO_2 and unreacted SO_3 condenses and the remaining sulfur oxides and oxygen are compressed to 40 atm for storage. Recombination of SO_2 and O_2 provides the heat to drive the turbine at night. Overall work/heat efficiency can approach 50%. (Author)

A79-10041 Advanced industrial gas turbine cooling and high pressure compressor technology. B T Brown, J K Schweitzer (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.), and J W Fairbanks (U S Department of Energy, Div of Power Systems, Washington, D C). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 292-299. 5 refs.

The paper describes a study which is part of a Department of Energy sponsored program to develop the component technology base required for improved industrial/utility gas turbine conversion efficiency. Specific goals of the study are to demonstrate the turbine cooling and high pressure compressor technologies required to achieve thermal efficiencies of 34-36% simple cycle and 45-48% in combined cycle operation, while reducing the number of compressor and turbine parts 80% over state-of-the-art units. Heat transfer cascade testing of the first stage turbine wafer airfoil cooling designs has exceeded design goals (815 C maximum metal temperature at 1371 C CET). B J

A79-10042 Coal-fired gas turbine power cycles with steam injection. W Fraize (Mitre Corp., Bedford, Mass.) and C Kinney (U S Department of Energy, Div of Power Systems, Washington, D C). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 300-308. 17 refs.

Two proposed coal-fired gas turbine power cycles using steam injection have been studied via a parametric cycle analysis. The steam-injected cycles are configured to achieve the following direct and environmentally acceptable use of coal as a fuel, no contact between hostile combustion products and the turbine expander, high efficiency without need for a bottoming cycle, and modest operating temperatures compatible with current gas turbine technology. The parametric analysis considers a typical range for pressure ratio (8, 12, 16), turbine inlet temperature (1500, 1750, 2000 F), steam injection rate, and turbine blade cooling flows, and shows the steam-injected cycles to be a significant improvement over the baseline configuration. A small (50 MW) conventional steam plant using fluidized bed combustion and wet cooling towers. The water use benefits and associated water treatment costs for the steam-injected cycles are also examined. (Author)

A79-10043 Oil recovery from a Utah tar sand deposit by in situ combustion. L A Johnson, L J Fahy, M W Thornton, L J Romanowski, Jr., and L C Marchant (U S Department of Energy, Laramie Energy Research Center, Laramie, Wyo.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 310-317. 19 refs.

A79-10044 Prerrefining true in situ shale oil. P L Cottingham (U S Department of Energy, Laramie Energy Research Center, Laramie, Wyo.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 318-321.

Crude shale oil from true in situ retorting of shale near Rock Springs, Wyoming was hydrotreated at 1500 psig pressure and 800 F

to produce a liquid product from which 98 percent of the sulfur and nitrogen had been removed. The product was distilled to yield 36.7 volume percent of the feed as gasoline containing 24 parts per million nitrogen and 51.0 percent as Nos. 1 through 4 diesel fuels with 160-400 ppm nitrogen. All diesel fuels qualified as low-sulfur, high-cetane diesel fuels. Hydrotreating the crude at 2200 psig produced a total liquid product with only 53 ppm nitrogen and less than 100 ppm sulfur after 888 hours operation. This experiment continued through 1668 hours onstream, the final products are being analyzed. (Author)

A79-10045 Jet fuels from shale oil - A near term technology. B. M. Harney, J. Ramsey, and R. Hildebrand (U.S. Department of Energy, Washington, D.C.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 322-328. 11 refs.

The paper reviews the production of shale oil by surface and in situ retorting technology. Past and present day programs on shale oil refining to obtain transportation fuels are discussed with emphasis on jet fuel production. Tables characterizing aircraft turbine fuels and the properties of dewatered Paraho shale oil are presented. B. J.

A79-10046 Colorado's oil-shale resource for vertical modified in-situ processes. J. W. Smith, L. G. Trudell (U.S. Department of Energy, Laramie Energy Research Center, Laramie, Wyo.), and T. N. Beard. In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 329-335. 18 refs.

A79-10047 Comparison of shale oils from different sources produced by controlled-state retort. J. J. Duvall and T. C. Bartke (U.S. Department of Energy, Laramie Energy Research Center, Laramie, Wyo.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 336-341. 13 refs.

Six oil shales from five different sources (including Colorado, Utah, Michigan, and Morocco) and of varying richness have been retorted in the controlled state retort using the same retorting conditions. The oils produced have been analyzed for boiling-point composition, elemental content, and physical properties. The gases produced have been analyzed for composition. The results of the analyses show differences in oil and gas composition related to shale richness and shale source. These differences include the relationship of boiling-point composition to shale grade and shale source, physical properties to shale grade and shale source, product gas composition to shale grade and shale source, and elemental analysis of the oil to the shale source. (Author)

A79-10048 Permeability enhancement using explosive techniques. W. J. Carter (California, University, Los Alamos, N. Mex.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 350-354. 9 refs.

In situ georesource recovery techniques generally involve the creation or enhancement of permeability within the bed to allow a uniform and predictable flow of fluid. This paper considers a method of computer prediction of fracture patterns, void distributions, particle size distributions, and path permeabilities resulting from explosive loading. The method requires stepwise solution of the nonlinear equations of compressible flow, with the initial and boundary conditions defined by the detonation properties of the explosive, and the material wave propagation and dynamic fracture constitutive relations determined by high strain rate mechanical tests of the resource bed material. B. J.

A79-10049 Design considerations for an in situ gasification test of eastern bituminous coals. L. D. Strickland, J. W. Martin,

and A. J. Liberatore (U.S. Department of Energy, Morgantown Energy Research Center, Morgantown, W. Va.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 355-365. 9 refs.

A79-10050 Underground thermal generation of hydrocarbons from dry, southwestern coals. N. E. Vanderborgh and G. R. B. Elliott (California, University, Los Alamos, N. Mex.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 366-372. 7 refs.

The LASL underground coal conversion concept produces intermediate-BTU fuel gas for nearby industries such as 'minemouth' electric power plants, plus major byproducts in the form of liquid and gaseous hydrocarbons for feedstocks to chemical plants, e.g., substitute natural gas (SNG) producers. The concept involves controlling the water influx and drying the coal, generating hydrocarbons, by pyrolysis and finally gasifying the residual char with O₂/CO₂ or air/CO₂ mixtures to produce industrial fuel gases. Underground conversion can be frustrated by uncontrolled water in the coal bed. Moisture can (1) prevent combustion, (2) preclude fuel gas formation by lowering reaction zone temperatures and creating kinetic problems, (3) ruin product gas quality by dropping temperatures into a thermodynamically unsatisfactory regime, (4) degrade an initially satisfactory fuel gas by consuming carbon monoxide, (5) waste large amounts of heat, and (6) isolate reaction zones so that the processing will bypass blocks of coal. Large amounts of electric power (or other) production along with vast supplies of hydrocarbon fuels are produced by this process. (Author)

A79-10051 Electrochemical engines for power generation and load-leveling at sites for underground coal conversion. G. R. B. Elliott and N. E. Vanderborgh (California, University, Los Alamos, N. Mex.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 373-379.

The integration of fuel generation by underground processing of coal with commercial consumption of the fuel at the mine site offers highly efficient utilization of energy. Commercial versions of Li/I₂ electrochemical engines to be used in one way of integration are postulated, described and evaluated on the basis of laboratory and theoretical studies. These engines are shown to be valuable for electric power generation and storage in connection with underground coal conversion (UCC) in arid land such as northwestern New Mexico. Such engines, combined with UCC, could convert roughly 26% of the coal energy to electric power while recovering about 22% of the energy as pyrolysis hydrocarbons. The engines also provide load leveling so that peak power generators would be unnecessary. (Author)

A79-10052 Status of the DOE underground coal conversion program. A. P. Sikri and E. L. Burwell (U.S. Department of Energy, Washington, D.C.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 380-387. 16 refs.

This paper presents the status and plans of the Department of Energy (DOE) underground coal conversion program. The four major field projects have been presented. The relationship of the program within the DOE structure and goals is described. The various elements which affect the program are discussed. These include process economics, paths to commercialization, potential environmental, economic, and resource base advantages over mining plus surface gasification, and supporting research. The current field tests have shown that subbituminous coals of the Rockies can be gasified underground with production rates of 10.2 M-mol/day with gas quality of 115-140 MJ/k-mol with air and 2.0 M-mol/day with gas quality of 210-265 MJ/k-mol with steam-oxygen. It is expected that

A79-10053

the Western Low-Btu and Medium-Btu Gas processes could be ready for commercialization by the mid-1980's (Author)

A79-10053 Instrumentation development for in situ coal gasification D A Northrop and L C Bartel (Sandia Laboratories, Albuquerque, N Mex) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif , August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa , Society of Automotive Engineers, Inc , 1978, p 388-394 10 refs Research supported by the US Department of Energy

Seven instrumentation techniques were designed, fielded, and evaluated on the Hanna II in situ coal gasification experiment conducted in 1975-76 Diagnostic techniques (thermal, in-seam gas sampling and pressure, and overburden tilt and displacement) were used to obtain data for process characterization Remote monitoring techniques (electrical, passive acoustic, and induced seismic) are being developed to provide a real-time map of the in situ process to be used for process control Assessments of these techniques clearly demonstrate the value of thermal instrumentation and analysis and the feasibility of electrical remote monitoring techniques (Author)

A79-10054 Operation of the Ft Lewis, Washington Solvent Refined Coal /SRC/ Pilot Plant in the SRC I and SRC II processing modes R D Moschitto (Pittsburg and Midway Coal Mining Co , Dupont, Wash) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif , August 20 25, 1978, Proceedings Volume 1 Warrendale, Pa , Society of Automotive Engineers, Inc , 1978, p 395-401

The operating history of a Solvent Refined Coal (SRC) Pilot Plant from start up through March 1978 is discussed The Solvent Refined Coal Process SRC I (solid fuel product) and SRC II (liquid fuel product) operating modes for converting high-sulfur, high-ash bituminous coals into low-sulfur, ash-free boiler fuels have been successfully demonstrated Extended periods of operation with both operating modes have been achieved and substantial quantities of both the solid (more than 3500 tons) and liquid (nearly 6000 barrels or 954 cu m) fuels have been produced A large scale burning test of the solid fuel product has been successfully concluded, and a similar test using the distillate fuel product is planned A comprehensive study of the effects of operating variables on product yield distributions has been helpful in identifying the most favorable operating conditions in both modes of operation (Author)

A79-10055 Coal conversion by flash hydrolysis and hydrogasification C L Oberg, L P Combs, and J Silverman (Rockwell International Corp , Rocketdyne Div , Canoga Park, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif , August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa , Society of Automotive Engineers, Inc , 1978, p 402-408 Contracts No EX 76-C-01-2044, No EX-77-C-01-2518

Results are described from two programs directed toward development of high-mass flux, short-residence time reactors for conversion of coal into high-value gases and liquids For either liquefaction or gasification, pulverized coal is rapidly and thoroughly mixed with preheated hydrogen and allowed to react for periods ranging from a few milliseconds to a few seconds In the liquefaction case, the reaction is subsequently quenched rapidly Successful reactor tests have been carried out at nominal coal flowrates of 1/4- and 1-ton/hour with caking bituminous coals Up to 1500 pounds of coal has been processed in single test with test durations up to 1 hour Favorable quality liquids and gases have been produced with overall conversions consistent with the requirements of a commercial plant Results from liquefaction tests with western Kentucky bituminous coals and gasification tests with bituminous and sub-bituminous coals will be described (Author)

A79-10056 H-coal products for direct application to power generation, P H Kydd (Hydrocarbon Research, Inc , Research and Development Center, Lawrenceville, NJ) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego,

Calif , August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa , Society of Automotive Engineers, Inc , 1978, p 409-413 12 refs Research supported by the US Department of Energy

The basic aspects of the H-coal process are outlined with reference to the types of fuel which may be made available Attention is given to the coal liquefaction process, solid-liquid separation, and hydrogen supplies H-coal product fractions and gas turbine fuel specifications are listed Heteroatom removal procedures are noted and the NO(x) problem is discussed in terms of NO(x) emissions associated with the conversion of fuel bound nitrogen to NO(x) SCS

A79-10057 Synthane - A process for the gasification of caking and noncaking coals A J Weiss (CE Lummus Co , Bloomfield, NJ) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif , August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa , Society of Automotive Engineers, Inc , 1978, p 414-421 11 refs

The paper discusses the synthane process of producing pipeline-quality gas from caking and noncaking coals The process basically consists of coal preparation (crushing, drying, screening), feeding, pretreatment, gasification, gas cooling, and char processing Operating data from a pilot plant are presented for two types of coal Problem areas are identified as the coal feed system, gasification, the entrainment of fines, and char disposal SCS

A79-10058 Process development for the Westinghouse advanced fluidized-bed coal gasification system L A Salvador, P Cherish, P J Margaritis, and L K Rath (Westinghouse Electric Corp , Advanced Coal Conversion Dept , Madison, Pa) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif , August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa , Society of Automotive Engineers, Inc , 1978, p 422-430 7 refs

Westinghouse Electric Corporation has developed an advanced fluidized bed coal gasification process for low-Btu gas The major emphasis on the program has been the operation of the 14,000 kg/d (15 t/d) process development unit (PDU) which contains the main subsystems of the gasification process, the devolatilizer, which decakes and devolatilizes the coal, and the gasifier which consumes the char produced in the devolatilizer and agglomerates the ash The feasibility of the devolatilizer was demonstrated in 1976 with a variety of coals including highly caking eastern bituminous coals During 1977 and 1978, the feasibility of the gasifier reactor was demonstrated in a series of highly successful tests run for a cumulative time of 1500 hours at design conditions of nominally 1038 C (1900 F) and 1550 kPa (225 psig) Techniques for routine operation of the reactor were established, and stable, controlled combustion, gasification, and agglomeration were achieved with a number of char and coal feedstocks fed directly to the unit without devolatilization or pretreatment (Author)

A79-10059 Gasification of coal liquefaction residues A M Robin and W G Schlinger (Texaco, Inc , Montebello Research Laboratory, El Monte, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif , August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa , Society of Automotive Engineers, Inc , 1978, p 431-437 7 refs Research supported by the Electric Power Research Institute, Contract No EX 76-C-01-2247

Methods for the gasification of high-ash-coal liquefaction residues are considered and a pilot plant process flow diagram is presented Particular attention is given to the feed preparation system, gasifier operation, the removal of molten slag, char recovery, and water recycling procedures Six coal liquefaction processes are listed noting the capacity, plant type, and plant location of each Primary physical and chemical properties of twelve residues are presented Preliminary and extended evaluations are made for pilot plant test runs SCS

A79-10060 Exxon Donor Solvent coal liquefaction process development W R Epperly and J W Taunton (Exxon Research and Engineering Co., Florham Park, N.J.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 450-456 6 refs

The paper surveys the Exxon Donor Solvent coal liquefaction process noting liquefaction, distillation, solvent hydrogenation, steam reforming, and flexicoking. The status of pilot unit operations is considered with reference to the units, operating history, longest run duration, and coals processed. Engineering design and product utilization studies are reviewed. SCS

A79-10061 Exploratory research in coal conversion I Wender and S Friedman (U.S. Department of Energy, Pittsburgh Energy Research Center, Pittsburgh, Pa.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 457-462 30 refs

Coal conversion studies are reviewed noting the mechanism of hydrogen transfer from donor molecules in coal liquefaction, the liquefaction of coal with CO and water, and the utilization of disposable catalysts in liquefaction. The basic characteristics of supercritical gas extraction are outlined. Methods for coal cleaning are reviewed with reference to precombustion chemical desulfurization. Prospects for using slurries of finely divided coal mixed with fuel oil or diesel fuel are suggested. SCS

A79-10062 Coal liquefaction - Status and new directions S B Alpert and R H Wolk (Electric Power Research Institute, Palo Alto, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 463-468

The development status of coal liquefaction processes is discussed noting the H-Coal, Exxon Donor Solvent, and Gulf SRC-II methods. Studies of coal and its liquid products, interactions among coal, solvent, hydrogen, and reaction products, and of the effect of mineral matter on reaction kinetics are described. Prospects for lowering the costs of liquid fuels are outlined along with the investment costs for coal liquefaction. The development of operating plant units is considered in terms of pumps, diagnostic equipment, and valves and valve materials. SCS

A79-10063 Theoretical studies of coal pyrolysis in an entrained bed flow reactor H Reidelbach and J Algermissen (Stuttgart, Universität, Stuttgart, West Germany) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 469-475 Deutsche Forschungsgemeinschaft Contract No. A1-104/6

The theoretical investigation of the devolatilization of coal in an entrained-bed flow reactor included the simulation of the heat transfer processes (thermal convection and radiation) and the simulation of the chemical decomposition reactions using a simplified kinetic scheme describing the primary pyrolysis reactions. Three important thermodynamic parameters were identified: reactor wall temperature, preheat temperature of the carrier gas, and mass flow ratio coal-to-gas. The particle size is very important for the heating process. The influence of the particle size distribution of pulverized coal and possible advantages of using size graded coals are discussed. Preliminary results indicating the influence of radiation and the effects of the addition of a solid heat carrier on the pyrolysis process are presented. This approach toward theoretical optimization studies shows promising results in spite of the rather simple physical models used. (Author)

A79-10064 Novel technology for conversion of methanol and synthesis gas to hydrocarbons C H Lechthaler, J J Wise, P B Weisz, and A J Silvestri (Mobil Research and Development Corp.,

Paulsboro and Princeton, N.J.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 476-481 10 refs

This paper reviews the chemistry of methanol conversion to high-octane gasoline, summarizes the early development work, and describes more recent studies in which the process was demonstrated in a 4 barrel-per-day fluid-bed pilot plant. The results obtained in this pilot plant have been excellent both in terms of unit operability and gasoline yield and quality. Related work on methanol conversion to light olefins and direct conversion of synthesis gas to gasoline is also briefly described. (Author)

A79-10065 New processes for the recovery of resource materials from coal combustion wastes F G Sealey, W J McDowell, and V A DeCarlo (Oak Ridge National Laboratory, Oak Ridge, Tenn.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 487-493 10 refs Contract No. W7504-eng-26

Laboratory-scale tests of methods for the recovery of aluminum and other metal values from fly ash have included reported processes such as lime-sinter, lime-soda-sinter, and the obvious direct acid leach methods, as well as two new combination sinter-dilute acid leach methods. In the first, fly ash is sintered with a NaCl-Na₂CO₃ mixture at 1000 C followed by successive leaches with water and 1 N HNO₃ or H₂SO₄. In the second, fly ash is sintered with a CaSO₄-CaCO₃ mixture at 1400 C, after which the sinter-cake is pugged with 36 N H₂SO₄ and then diluted to 4 N for a second leaching period. Both of these new methods are capable of recovering greater than 95% of the aluminum, of yielding a pure Al₂O₃ product if a solvent extraction circuit is included, and providing for product option flexibility in that Fe, Ti, Mn, U, and Th can also be recovered. (Author)

A79-10066 Fluidized-bed combustion of low-quality fuels J S Mei, U Grimm, and J S Halow (U.S. Department of Energy, Morgantown Energy and Research Center, Morgantown, W. Va.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 494-499 7 refs

The Morgantown Energy Research Center of the U.S. Department of Energy is currently evaluating the application of fluidized-bed combustion to utilize low quality fuels including anthracite refuse, subbituminous coal, lignite and lignite washery refuse. During the combustion tests, carbon combustion efficiencies from 70 to 90 percent were achieved. Calcium in the ash of subbituminous and lignite fuels was found to be effective in sulfur capture allowing low sorbent additions to meet EPA SO₂ limits. Anthracite refuse required higher sorbent addition rates than all fuels tested. NO_x limits were easily met. Several fuel specific operating problems and solutions to these problems were identified during the tests. (Author)

A79-10067 A review of the PFBC combined cycle and its influence on gas turbine design parameters A J Morrow (Preece, Cardew and Rider, Consulting Engineers, Brighton, Sussex, England) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 507-515

Present-day conventional combined cycle plants are primarily designed around simple cycle gas turbine standard frames. The present paper considers the validity of this approach to the pressurized fluidized bed combustion combined cycle (PFBC) and attempts to determine whether there is a need for a more fundamental approach to system design in which the gas turbine pressure ratio is an unrestricted variable. The results reveal a possible range of optimum pressure ratios, but indicate a need for wider examination of the pressure effects on PFBC design and capital costs. B J

A79-10068 Conceptual design and cost estimate 600 MWe coal fired fluidized-bed combined cycle power plant D A Huber and R M Costello (Burns and Roe Industrial Services Corp., Paramus, NJ) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 516-522 8 refs Contract No EX-76-C-01-2371

A79-10069 Factors limiting limestone utilization efficiency in fluidized-bed combustors I Johnson, J Shearer, R Snyder, and G J Vogel (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 523-528 13 refs Research sponsored by the US Department of Energy and US Environmental Protection Agency

The factors which determine the quantity of limestone needed to obtain acceptable SO₂ emission levels in the flue gas from fluidized bed combustors have been reviewed. The most important factors are the mole ratio of calcium (in the stone) to sulfur (in the coal) in the feed, the gas phase residence time, the temperature, and the type of limestone. Both calcitic and dolomitic limestones have been studied since they behave differently in FBCs. The differences between atmospheric-pressure and pressurized FBCs in relation to limestone utilization are discussed. Differences in the average pore size of calcined limestones is the major cause of the differences in limestone-SO₂ reactivities in FBCs (Author)

A79-10070 Solids mixing and fluidization characteristics in a tube filled bed S G Weiner, L P Golan, and D C Cherrington (Exxon Research and Engineering Co., Florham Park, NJ) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 529-539 8 refs

A two-dimensional flow visualization unit was used to study solids mixing and fluidization characteristics in tube bundles immersed in limestone beds. The effects of tube size and spacing on fluidization performance were studied for various configurations of two-inch, four-inch, and six-inch tubes. A practical upper limit of fluidization velocity (approximately 12 ft/sec) was defined for tube bundles of two-diameter and three-diameter spacing. Results indicate that tube to wall spacing of at least one tube diameter is necessary to avoid restricting the circulation of the bed material. Vertical and horizontal solids mixing was primarily a function of fluidization velocity and was relatively unaffected by tube size and spacing. B J

A79-10071 Circulating-bed boiler concepts for steam and power generation D L Kearns, W C Yang, R A Newby, J R Hamm, and D H Archer (Westinghouse Research and Development Center, Pittsburgh, Pa.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 540-547 33 refs

Circulating-bed boiler concepts offer the potential for extending fluidized-bed combustion technology. Fluidized bed boiler concepts combine combustion, heat transfer, and pollution control into a single vessel. Circulating-bed concepts incorporate the same process features while reducing process limitations and increasing operating flexibility. Areas of concern addressed by circulating bed concepts include start up, turn down, materials corrosion/deposition, and coal feed. Circulating bed boiler concepts are reviewed and concept development is discussed. (Author)

A79-10072 Aspects of pulsating combustion G T Reader (Royal Naval Engineering College, Plymouth, England) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers,

Inc., 1978, p 548-557 25 refs Research supported by the University of Bradford and Science Research Council

An attempt was made to perform an integrated experimental and theoretical investigation of a pulse combustion system burning a gaseous methane fuel at a nominal operating frequency of 40 Hz. Instantaneous pressures, temperatures and gas emissivities were obtained experimentally together with air and fuel consumption rates. In addition, a mathematical model of a pulse combustor was developed which takes account of combustion dynamics, heat release rates, and reignition and system boundary conditions. B J

A79-10073 Preliminary controller evaluation for the MERC/CTIU using a mathematical process model A Ray, V H Sumaria, and D A Berkowitz (Mitre Corp., Bedford, Mass.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 558-563 8 refs

A nonlinear process model of the Morgantown Energy Research Center Component Test and Integration Unit (CTIU) was formulated in state space form. It is suitable for application to analytical controller design. Based on a physical understanding of the fluidized-bed process and experience in conventional steam electric power plant control, a controller was designed and coupled to the process model. Eigenvalues of the linearized model were determined, and controller parameters varied to improve dynamic response of the system. Typical results of closed loop simulation of operating disturbances likely to occur in the real plant are presented. This study is a first step in selecting a CTIU controller structure. The method is useful for evaluating and verifying performance of any proposed controller structure. Effect of modifications to feedforward and feedback functions can be readily determined. (Author)

A79-10074 Alternatives for coal based power generation - An international overview R C Forrester, III (Oak Ridge National Laboratory, Oak Ridge, Tenn.), R Johnston, and M Teper (IEA Coal Research, London, England) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 564-573 9 refs

The Working Party on Coal Technology of the International Energy Agency was set up to evaluate the economic aspects of world coal utilization over the next several decades. This paper describes a technical evaluation, performed by the Working Party, of near-term alternative base load power generation processes which utilize coal. Four such alternative processes are described: (1) atmospheric fluidized bed boiler with steam cycle, (2) pressurized fluidized bed boiler with combined cycle, (3) integrated gasification/combined cycle (supercharged boiler), and (4) integrated gasification/combined cycle (exhaust boiler). The relative advantage of each of these technologies over the conventional pulverized fuel system is discussed. B J

A79-10075 Computer aided optimization of integrated coal gasification combined cycle power plants S Adibhatla and D C Leigh (Kentucky, University, Lexington, Ky.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 574-580 8 refs Research supported by the University of Kentucky

A79-10076 Pressurized fluidized-bed combustion/component test and integration unit preliminary design report W F Podolski (Argonne National Laboratory, Argonne, Ill.) and R W Crawford In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 609-616

The paper describes the recently completed preliminary design of the Pressurized Fluidized Bed Combustion/Component Test and Integration Unit (PFBC/CTIU). The major objectives of the CTIU

will be (1) to test and evaluate components, instrumentation, sampling techniques, control concepts and techniques, and construction materials proposed for PFBC systems, and (2) to investigate alternative PFBC concepts. Consideration is given here to the basic design philosophy of the PFBC/CTIU and to such aspects of it as combustor design, solids feed materials handling, hot gas cleanup, and CTIU instrumentation and control B J

A79-10077 Low Btu gas from the IGT ash-agglomeration gasification process A Rehmat, M K Vora, and W A Sandstrom (Institute of Gas Technology, Chicago, Ill.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 622-627 5 refs Contract No EX-76-C-01 2336

The Institute of Gas Technology (IGT) currently operates a single-stage fluidized-bed gasification pilot plant which produces low-Btu gas. A prime objective has been to achieve up to 95% carbon conversion through selective removal of high-ash-bearing material. This paper presents ash-agglomeration test results which show conclusively that raw subbituminous and bituminous coals can be successfully gasified to produce low Btu gas. The process can achieve 90% carbon conversions B J

A79-10078 The LASH /laser-ash/ particulate fragmentation removal concept for coal fired turbine power plants. T E Botts and J R Powell (Brookhaven National Laboratory, Upton, N.Y.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 628-634 15 refs

A novel method of high temperature particulate control for coal-fired gas turbines is to trap large (larger than 10 microns) coal ash particulates using conventional means and fragmenting remaining particulates to sizes below that where unacceptable turbine erosion occurs (5 microns) with pulsed CO₂ lasers. A 1000 MW(e) combined cycle plant based on this concept is projected to operate at thermal efficiencies of about 40 percent. This plant needs 1.6 percent of its gross electrical output to drive the laser system. All technology employed is within the present day state of the art, making this an attractive method for efficient electrical generation with coal. The laser-ash fragmentation system (LASH) for the conceptual plant has been costed at 33 million dollars. Conventional, low temperature emissions control may be used on the low pressure outlet from the turbine (Author)

A79-10079 Heat exchanger designs for coal-fired fluidized beds V Zakkay (New York University, Westbury, N.Y.) and G Miller (New York University, New York, N.Y.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 635-641 Contract No EF-76-C-01-2256.

A79-10080 * User experience with on-road electric vehicles in the USA and Canada J J Sandberg and K Leschly (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 644-654

Approximately 3000 on road electric passenger cars and delivery vans are now in use in the USA and Canada. The owners and operators of almost one-third of these vehicles have been surveyed directly in an attempt to determine the suitability of commercially sold electric vehicles for real on-road jobs. This paper is primarily concerned with the analysis of the engineering aspects of the user experience with electric vehicles, i.e., mileage and application, failure modes and rates, energy economy, maintenance requirements, life cycle costs, and vehicle performance characteristics. It is concluded that existing electric vehicles can perform satisfactorily in applica-

tions that have limited performance requirements, particularly in terms of range (Author)

A79-10081 A critical review and evaluation of published electric-vehicle performance data. R F McAlevy, III (Stevens Institute of Technology, Hoboken, N.J.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 655-661 9 refs

E V published performance characteristics were successfully correlated with 'naturally occurring' parameters that emerged from a vehicle mass and energy balance. Since the gravimetric-energy-content of batteries is less than 1/100 that of petroleum, the E V mass-fraction dedicated to energy-storage must be much greater than it is for petroleum-fueled vehicles. Thus, E V's must be built to value range at the (necessary) expense of competing values (e.g., energy-utilization, 'crashworthiness', etc.). Data from 68 E V's were plotted to show how (1) increasing battery mass-fraction increases vehicle total-mass to payload-mass ratio, (2) vehicle energy-utilization decreases with decreasing payload mass-fraction (in response to increasing battery mass-fraction) and, (3) the design range reaches an upper limit as battery mass fraction is increased (Author)

A79-10082 Pulse characteristics of sodium sulfur cells for electric vehicle propulsion M Mikkor, R W Minck, and L E Unnewehr (Ford Motor Co., Dearborn, Mich.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 662-665

Sodium-sulfur cells have been tested under steady and pulse load conditions at 350 C. The power and energy delivered during the pulses are found to be a function of the state of charge of the battery, decreasing sharply as the cell approaches the fully discharged state. Peak power densities in excess of one watt per square centimeter of ceramic electrolyte surface have been achieved for periods as long as 15 seconds. These peak values exceed extrapolated steady state data. The Na/S cell is extremely efficient in accepting pulse charging. The superior regeneration characteristics are due to the presence of discharge products near the ceramic electrolyte-graphite felt electrode interface. These characteristics are especially useful for electric vehicle propulsion (Author)

A79-10083 Nickel zinc vs silver zinc battery - A comparative study of baseline characteristics A Himy (U.S. Navy, Naval Ship Engineering Center, Washington, D.C.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 668-671

An attempt is made to describe the baseline characteristics and minimum requirements for nickel zinc batteries. A table is presented in which the nickel zinc battery is compared with the silver zinc battery in terms of such items as separator characteristics, cost of manufacture, life, and cycles. It is found that the commonality of these two types of batteries in many critical and performance-related areas such as zinc electrode and separator shows that any improvement in one system will be automatically reflected in the other, whether in life cycle, technology, or cost B J

A79-10084 * Rapid, efficient charging of lead-acid and nickel-zinc traction cells J J Smithrick (NASA, Lewis Research Center, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 672-676 6 refs NASA supported research, Contract No EC-77 A 31 1011

Lead-acid and nickel-zinc traction cells were rapidly and efficiently charged using a high rate taped dc charge (HRTDC) method which could possibly be used for on the road service recharge of electric vehicles. The HRTDC method takes advantage of initial high cell charge acceptance and uses cell gassing rate and

temperature as an indicator of charging efficiency. On the average, 300 amp-hour nickel-zinc traction cells were given a HRTDC to 78% of rated amp-hour capacity within 53 minutes at an amp-hour efficiency of 92% and an energy efficiency of 52%. Three-hundred amp-hour lead-acid traction cells were charged to 69% of rated amp-hour capacity within 46 minutes at an amp-hour efficiency of 91% with an energy efficiency of 64%. B J

A79-10085 Evaluation of methods for analyzing silver-zinc cells. D P Hafen (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 677-684.

Various methods of analyzing silver-zinc cells have been evaluated by application of the test methods to a failure-analysis program for large primary silver-zinc cells. The analysis methods included physical examination, wet chemical methods, and instrumental chemical techniques. The analysis methods have been evaluated in terms of labor required, problems encountered, and in terms of usefulness, accuracy, and precision. Physical examination methods were chosen that provide an estimate of the general condition of the cell and point out any anomalies. The physical methods included examination with the naked eye, examination using the optical microscope and scanning electron microscope, thickness measurements, and interplate and intraplate resistance measurements. The wet, chemical methods tested were used to measure the plate capacities and to provide information on the chemical composition of the electrolyte. The instrumental methods applied and evaluated include infrared spectrophotometry, emission and atomic absorption spectroscopy, conductimetry, gas and liquid chromatography, X-ray diffraction and fluorescence, and thermogravimetric analysis. (Author)

A79-10086 Review of industrial participation in the ANL Lithium/iron sulfide battery development program. E C Gay, W E Miller, R F Malecha, and R C Elliott (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 690-696. 5 refs.

Lithium/iron sulfide batteries are being developed at Argonne National Laboratory (ANL) for use as power sources for electric vehicles and for stationary energy storage devices for load leveling. This paper describes the nature of industrial subcontracting participation in the ANL Battery Program and the progress that has been made in the development and fabrication of industrial cells. B J

A79-10087 High performance lithium/iron disulfide cells. E J Zeitner, Jr and J S Dunning (GM Research Laboratories, Warren, Mich.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 697-701. 7 refs.

Two compact Li-Si alloy/FeS₂ cells are described and their performance is discussed in terms of the requirements for electric vehicle propulsion. The highest specific energy achieved was 182.7 Wh/kg obtained at an average specific power of 8.35 W/kg. At higher specific power levels, relatively high internal resistance, combined with decreased utilization of the active material in the positive electrode, reduced the specific energy (e.g., 75.3 Wh/kg at 96.4 W/kg). Both cells achieved more than 250 deep discharge cycles and over 5000 hours of operation. One cell failed by a rapidly developed internal short caused by extrusion of active material from the positive electrode, while the other cell is still operating at high coulombic efficiency (exceeding 98%). (Author)

A79-10088 Lithium silicon - Iron sulfide load-leveling and electric vehicle batteries. L R McCoy, S Sudar, L A Hedy, and J C Hall (Rockwell International Corp., Atomics International Div.,

Canoga Park, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 702-708. 10 refs. Research supported by the U.S. Department of Energy, and Electric Power Research Institute.

High temperature lithium silicon-iron sulfide batteries are being developed at Atomics International for use in electric utility energy storage plants and in electric vehicles. Individual cells with a capacity of up to 2.5 kWh have been designed, built, and tested for the former application. Cells with capacities of approximately 150 Wh are being tested for electric vehicle batteries. Current research efforts are directed to the design and test of lightweight, low-cost electrode structures, the development of negative and positive electrodes with high rate discharge capabilities, and the identification of corrosion-resistant materials required for long life. Systems studies are being made to establish cost-effective means of providing the thermal and electrical controls for large battery plants. This paper will describe the progress made in these areas in the past year. (Author)

A79-10089 Advances in the development of lithium-aluminum/metal sulfide cells for electric-vehicle batteries. F J Martino, T D Kaun, H Shimotake, and E C Gay (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 709-716. 10 refs. Research supported by the U.S. Department of Energy.

A state-of-the-art Li/MSx cell has been developed at the Argonne National Laboratory. The favorable design features in these cells include overall compactness, evolution of an improved positive terminal-current collector connection, and the use of delicate ceramic-felt separators. The Li-Al/MSx cells using the compact design have shown significant specific energy and specific power improvements (100 Wh/kg at the 4-hr discharge rate, 120 W/kg at 50% discharge) over earlier cell designs. B J

A79-10090 Bipolar lithium/iron disulfide cells. T G Bradley (GM Research Laboratories, Warren, Mich.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 717-722. 6 refs.

The cycle life of bipolar lithium/iron disulfide cells was studied using small cells of the type Li-Al alloy/LiCl-KCl eutectic or LiF-LiCl-LiBr melt in BN cloth/FeS₂. Batteries containing two of these cells were tested to determine the effects of edge losses. The results of a cell test using LiCl-KCl eutectic showed a final capacity density of 0.43 kC/sq cm and a self-discharge rate of 0.09 mA/sq cm after 128 cycles and 8.55 Ms (2374 h) of operation. B J

A79-10091 Heat transfer in phosphoric acid fuel cell stacks. H C Maru, C Chi, D Patel, and D Burns (Energy Research Corp., Danbury, Conn.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 723-731. 17 refs. Contract No. EC-77-C-03-1404.

The electricity production in phosphoric acid fuel cells is accompanied by approximately equal amounts of heat generation. Removal of this heat can be accomplished by a suitable flow of feed gases or by using separate cooling loops. Advantages and disadvantages of different heat removal schemes are examined in this paper, and a unique approach is described that provides a simple but cost effective and reliable means of heat removal. (Author)

A79-10092 Advances in lower cost phosphoric acid fuel cells. W H Johnson, R D Coykendall, L M Handley, D L Maricle, and A P Mientek (United Technologies Corp., Power Systems Div., South Windsor, Conn.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978,

Proceedings Volume 1 Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 732-737 Contract No EY-76-C-03-1169

In 1976 the Department of Energy sponsored a phosphoric acid fuel cell technology program which made important contributions to the fuel cell power section and fuel processor technology of the 4.8-MW Demonstrator power plant scheduled to be operated in the Consolidated Edison utility network in 1979. This program was continued for 1977 and 1978 with the primary objective of identifying improvements in phosphoric acid cell technology and power plant design which, if developed, would permit construction of a power plant equivalent to the 4.8 MW Demonstrator, but lower in both manufacturing and operating cost. In addition, an effort was recently undertaken to provide technology improvements of the new ribbed substrate cell concept for the 40-kW on-site power plant development program. B J

A79-10093 Mechanically rechargeable, metal-air batteries for automotive propulsion J F Cooper (California, University, Livermore, Calif) and E L Littauer (Lockheed Missiles and Space Co., Inc., Palo Alto, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 738-744 21 refs Contract No W-7405-eng 48

A systems study is reported concerning the application of mechanically refuelable metal air batteries to electric vehicle propulsion. The batteries are refueled by the addition of anode plates and water, while the reaction product is withdrawn to be recycled at fixed industrial sites. Aluminum is most attractive for this application because of the large domestic industry expected in the 1980s. Battery performance is projected from reported cell data for a hardware designed for rapid addition of electrodes. The reaction product is processed in the battery to form a purified, dry powder of trihydrated alumina - a feedstock of the current aluminum industry. For a 30-kW peak battery weighing 220-250 kg, ranges of 500-750 km are estimated for a one-tonne vehicle. Costs of recycled aluminum and air-cathode modules comprise 85% of the total cost (approximately 5 cents/km) of battery ownership and operation. (Author)

A79-10094 Iron-air batteries for electric vehicles E S Buzzelli, C T Liu, and W A Bryant (Westinghouse Research and Development Center, Pittsburgh, Pa) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 745-749 5 refs Contract No EY-76-C-02-2949

The successful demonstration of the performance characteristics of both high-performance sintered iron and bifunctional air electrodes under the expected electric vehicle use conditions make the iron-air battery a viable candidate for electric vehicles. State-of-the-art electrode performance characteristics in 100 sq-cm cells have demonstrated both sustained performance and acceptable characteristics. Design and development work to evaluate the system in prototype size 400 sq-cm cells and modules still has to be carried out to demonstrate the expected performance and life characteristics of the system. When fully developed, the iron air battery system will have an energy content of 100 W hr/kg with 1000 cycles life. B J

A79-10095 Development and evaluation of a 600-kWh lithium-hydrogen peroxide reserve power system E L Littauer, W R Momyer, and E S Schaller (Lockheed Research Laboratories, Palo Alto, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 750-754. Research supported by the Boeing Aerospace Co and Lockheed Missiles and Space Co., Contract No F42600-76-C-1214

A lithium hydrogen peroxide flowing electrolyte power system was developed and tested to evaluate its capability of satisfying a

specific USAF extended duration mission. The 600-kWh system comprised five 14-cell, 34-V, 5.5-kW modules each with a design goal of 24-hour discharge capacity. The power modules were discharged sequentially. This paper describes the features of the lithium power modules and supporting equipment. The results of the test program are discussed and the performance achieved compared to the goals. (Author)

A79-10096 100MWh zinc-chlorine peak-shaving battery plants C J Warde, P C Symons, C C Whittlesey, and H A Catherino (Energy Development Associates, Madison Heights, Mich) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 755-763 7 refs. Research supported by the Gulf and Western Industries and Electric Power Research Institute

Three conceptual designs of a 100-MWh zinc chloride battery plant have been prepared for energy storage applications in the electric-utility industry. The three designs, designated Marks 2, 3, and 4, were analyzed in terms of cost, efficiency, land usage, safety, and environmental impact. All of the designs can meet the criteria for commercialization. Mark 4, based on the use of a 58 kWh battery module, was found to be optimal in the areas of performance, safety, and manufacturability, while comparing favorably in cost and reliability with Marks 2 and 3. B J

A79-10097 * Response of lead-acid batteries to chopper-controlled discharge R L Cataldo (NASA, Lewis Research Center, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 764-768

The results of tests on an electric vehicle battery, using a simulated electric vehicle chopper-speed controller, show energy output losses up to 25 percent compared to constant current discharges at the same average current of 100 A. However, an energy output increase of 22 percent is noticed at the 200 A average level and 44 percent increase at the 300 A level using pulse discharging. Because of these complex results, electric vehicle battery/speed controller interactions must be considered in vehicle design. (Author)

A79-10098 Performance of a Stirling engine powered heat activated heat pump W D C Richards and W L Auxer (General Electric Co., Space Div., King of Prussia, Pa) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 823-830

The paper updates the status of the development program for a heat activated heat pump (HAHP) which employs a natural gas fired Stirling engine to drive a Rankine cycle vapor compressor. The HAHP has the potential for reducing the amount of gas required for space heating. Particular emphasis is placed on a description of the hardware comprising the HAHP and presents the results of subsystem level testing, including the combustor, Stirling engine, compressor, and air handler packages. The impact of measured component performances on the system level performance predictions is discussed. B J

A79-10099 * A technical analysis for cogeneration systems with potential applications in twelve California industrial plants V C Moretti, H S Davis, and M L Slonski (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 851-859 Contract No NAS7 100

In a study sponsored by the State of California Energy Resources Conservation and Development Commission, 12 industrial plants in five utility districts were surveyed to assess the potential applications of the cogeneration of heat and electricity in California industry. Thermodynamic calculations were made for each plant in

determining the energy required to meet the existing electrical and steam demands. The present systems were then compared to conceptual cogeneration systems specified for each plant. Overall energy savings were determined for the cogeneration applications. Steam and gas turbine topping cycle systems were considered as well as bottoming cycle systems. Types of industries studied were pulp and paper, timber, cement, petroleum refining, enhanced oil recovery, foods processing, steel and glass. (Author)

A79-10100 **The external combustion steam injected gas turbine for cogeneration** M P Boyce, Y K Vyas, and W L Trevillion (Boyce Engineering International, Inc., Houston, Tex.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 1 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 860-865 Contract No EC-77-C 03-1574

A theoretical analysis is presented which shows the technical feasibility of an external combustion steam-injected gas turbine. The system can utilize any fuel from natural gas to solid fuels such as lignite or waste, without any significant deterioration in performance and reliability. The study included the concept of total utilization of energy by cogeneration and the utilization of low pressure steam for maximum power and efficiency. A cycle analysis which determined the most desirable pressure ratio for steam injection is discussed. In addition, criteria for selecting a gas turbine and modifications required to convert it to an external combustion steam-injected gas turbine are discussed. B J

A79-10101 * **Thermal energy storage for industrial waste heat recovery** H W Hoffman, R J Kedl (Oak Ridge National Laboratory, Oak Ridge, Tenn.), and R A Duscha (NASA, Lewis Research Center, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 910-916 NASA-supported research Contract No W-7405-eng-26

Thermal energy storage systems designed for energy conservation through the recovery, storage, and reuse of industrial process waste heat are reviewed. Consideration is given to systems developed for primary aluminum, cement, the food processing industry, paper and pulp, and primary iron and steel. Projected waste-heat recovery and energy savings are listed for each category. S C S

A79-10102 **High efficiency thermal energy storage system for utility applications** D L Vrabie and R N Quade (General Atomic Co., San Diego, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 917-922 15 refs

A concept of coupling a high-efficiency base loaded coal or nuclear power plant with a thermal energy storage scheme for efficient and low-cost intermediate and peaking power is presented. A portion of the power plant's thermal output is used directly to generate superheated steam for continuous operation of a conventional turbine-generator to produce base-load power. The remaining thermal output is used on a continuous basis to heat a conventional heat transfer salt (such as the eutectic composition of $K_2NO_3/NaNO_3/NaNO_2$), which is stored in a high-temperature (538 C) reservoir. During peak demand periods, the salt is circulated from the high-temperature reservoir to a low temperature reservoir through steam generators in order to provide peaking power from a conventional steam cycle plant. (Author)

A79-10103 * **High temperature thermal energy storage in moving sand** R H Turner and H I Awaya (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 923-927 Contract No EX-76-A-29-1060

Several high-temperature (to 500 C) heat-storage systems using sand as the storage medium are described. The advantages of sand as

a storage medium include low cost for sand, widespread availability, non-toxicity, non-degradation characteristics, easy containment, and safety. The systems considered include stationary sand with closely spaced tubes throughout the volume, the use of a fluidized bed, use of conveyor belt transporter, and the use of a blower rapid transport system. For a stationary sand bed, very close spacing of heat transfer tubes throughout the volume is required, manifesting as high power related system cost. The suggestion of moving sand past or around pipes is intended to reduce the power related costs at the penalty of added system complexity. Preliminary system cost estimates are offered. These rough calculations indicate that mobile sand heat storage systems cost less than the stationary sand approach. (Author)

A79-10104 **Recent advances in thermochemical energy storage and transport** T T Bramlette (Sandia Laboratories, Livermore, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 928-934 23 refs

The article presents a review of the thermochemical energy storage and transport program noting the major results obtained to date. Projects associated with thermal energy storage for solar and nonsolar utilities, energy transport for nuclear, fossil, and solar-energy systems, and heat-pump storage systems for solar heating and cooling are described. The development of large-scale components is outlined. Future work will include screening experiments to identify other salts, studies of reaction kinetics, corrosion testing, and the design of prototype-scale and laboratory-scale systems. S C S.

A79-10105 **A thermochemical energy storage system and heat pump** M T Howerton (Martin Marietta Aerospace, Denver, Colo.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 935-940 U.S. Department of Energy Contract No 76-C-03-1229

A thermochemical energy storage system is described which has all of the characteristics of a thermally-driven heat pump. The system utilizes a pair of reversible ammoniated salt reactions, one operates at an elevated temperature (350K to 600K) and the other operates at a near-ambient (or below) temperature. The chemical reaction kinetics of 7 selected reactions were measured in the laboratory. Four high-temperature reactions were each paired with a near-ambient temperature reaction in a complete bench-scale test apparatus. The reactions were found to be reversible and the process reproducible from cycle to cycle under operating conditions. An independent heat transfer study determined a quantitative correlation for 4 heat transfer parameters representing the steps of the heat transfer mechanism. An analytical model was constructed which incorporated the values of the heat of reaction and vapor pressure, the reaction kinetic data, and the 4 heat transfer parameters in order to interpret the experimental data. A reasonably good comparison was obtained between the experimental and analytical results. (Author)

A79-10106 * **NaOH-based high temperature heat-of-fusion thermal energy storage device** B M Cohen and R E Rice (Comstock and Wescott, Inc., Cambridge, Mass.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 941-947 Research supported by the U.S. Department of Energy, Contract No NAS3-20615

A material called Thermkeep, developed as a low-cost method for the storage of thermal energy for solar electric power generating systems is discussed. The storage device consists of an insulated cylinder containing Thermkeep in which coiled tubular heat exchangers are immersed. A one-tenth scale model of the design contains 25 heat-exchanger tubes and 1500 kg of Thermkeep. Its instrumentation includes thermocouples to measure internal Thermkeep temperatures, vessel surface, heated shroud surface, and

pressure gauges to indicate heat-exchanger pressure drops The test-circuit design is presented and experimental results are discussed
S C S

A79-10107 Form-stable, crystalline polymer pellets for thermal energy storage I O Salyer, R A Botham, G H Jenkins, and G L Ball, III (Monsanto Research Corp., Dayton, Ohio) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2

Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 948-962 12 refs

In a Department of Energy funded program, the potential utility of the crystalline-to-amorphous phase change in lightly crosslinked, form-stable, high crystallinity, high density polyethylene pellets as a thermal energy storage bed material was investigated, and its utility demonstrated High density polyethylene (HDPE) is a low cost material (less than 30 cents/lb), that is produced on a large scale in the United States (4 billion lb/year), and is unaffected by solar heat transfer media such as water and glycol HDPE's melting point of 130 C is in the center of the 120-140 C temperature range most suited for solar absorption air conditioning applications Also, HDPE has a high heat of fusion (50 cal/g) as is needed to provide efficient energy storage capability for heating and cooling buildings Large energy savings are projected for a scaled-up unit of this type coupled to a suitable solar energy collection unit (Author)

A79-10108 * Storage systems for solar thermal power J E Calogeras and L H Gordon (NASA, Lewis Research Center, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 970-976 11 refs

A major constraint to the evolution of solar thermal power systems is the need to provide continuous operation during periods of solar outage A number of high temperature thermal energy storage technologies which have the potential to meet this need are currently under development The development status is reviewed of some thermal energy storage technologies specifically oriented towards providing diurnal heat storage for solar central power systems and solar total energy systems These technologies include sensible heat storage in caverns and latent heat storage using both active and passive heat exchange processes In addition, selected thermal storage concepts which appear promising to a variety of advanced solar thermal system applications are discussed (Author)

A79-10109 Ejector augmentation of the air supply in a compressed air energy storage plant D R Otis, T T Ng (Wisconsin, University, Madison, Wis.), and F W Ahrens (Argonne National Laboratory, Argonne, Ill.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 977-983 31 refs

Research supported by the U S Department of Energy

Air ejectors can augment the air delivered from multiple cavern, constant volume CAES systems when operated in this way after the pressure in one cavern has dropped to the turbine operating pressure, additional air is pumped from it by an ejector using high pressure air from an adjoining cavern The ejector requires no additional energy input being powered by the availability normally thrown away as a throttling loss Using the CAES plant in Huntorf, West Germany, as a test case, calculations are presented for ejector efficiencies ranging from 5 to 100% of the ideal ejector performance for optimized configurations For Huntorf, the air supply can be increased by 28% with an ejector operating at half the efficiency (Author)

A79-10110 Laboratory evaluation of a composite flywheel energy storage system E L Lustenader, J S Hickey, W R Nial, A B Plunkett, E Richter, F G Turnbull (General Electric Co., Fairfield, Conn.), and G Chang (U S Department of Energy, Washington, D C) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings

Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 984-991 12 refs

This paper describes the laboratory evaluation of a composite flywheel energy storage system which was designed for a small battery/flywheel electric vehicle in the 3,000 lb class The basic concept which has been demonstrated and evaluated in the laboratory consists of a flywheel energy storage package operating from a DC power source The main components of the energy storage package are a composite flywheel directly coupled to a solid rotor inductor-type synchronous machine The motor/alternator/flywheel package is coupled directly to a load commutated inverter which allows power to pass in either direction, to or from the DC power source A hybrid controller was used to acquire test data, perform the necessary calculations, store intermediate results, and print out summary results Based on the results of these tests, it is concluded that a flywheel energy storage system can be designed for electric vehicle application wherein braking energy can be regeneratively stored in the flywheel (Author)

A79-10111 A method for the comparative economic assessment of storage systems H Davitian and R W Leigh (Brookhaven National Laboratory, Upton, N Y) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 998-1001 5 refs Contract No EY-76-C-02-0016

This paper outlines a method for the comparative economic evaluation of various energy storage devices in a given application The method is particularly useful in examining the economics of devices with short lifetimes and can be employed whenever a device lifetime can be expressed as a function of physical parameters which are related to the manner in which the device is used Given a detailed description of the pattern of use of the device in the application, the device lifetime can be calculated The economic consequences of changes in lifetime result from the dependence of the capital recovery factor on device lifetime It is shown how analyses can be made of changes in technical performance characteristics or changes in the pattern of use of the storage device to determine their effects upon the annual cost of energy storage and to determine minimum cost systems (Author)

A79-10112 Energy distribution and storage alternates with a centralized heat source R N Quade, D L Vrabie, and D D Peterman (General Atomic Co., San Diego, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1016-1021 10 refs

Consideration is given to energy distribution systems with a centralized heat source designed for the production of high-temperature heat and high pressure steam The systems described include a chemical energy system, a sensible heat molten salt system, and a direct steam producer The three systems are compared on the basis of required source temperature, heat available to user, end user equipment, and environmental impact Cost estimates are presented for each system and procedures for additional energy storage are identified S C S

A79-10113 * Lithium and potassium heat pipes for thermionic converters G Miskolczy (Thermo Electron Corp., Waltham, Mass.) and E Kroeger (NASA, Lewis Research Center, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1035-1039 5 refs Contract No NAS3-20270

A prototypic heat pipe system for an out-of-core thermionic reactor has been built and tested The emitter of the concentric thermionic converter consists of the condenser of a tungsten heat pipe utilizing a lithium working fluid The evaporator section of the emitter heat pipe is radiation heated to simulate the thermal input from the nuclear reactor The emitter heat pipe thermal transport is matched to the thermionic converter input requirement The

collector heat pipe of niobium, 1%-zirconium alloy uses potassium as the working fluid. The thermionic collector is coupled to the heat pipe by a tapered conical joint designed to minimize the temperature drop. The area ratio of the evaporator to condenser is 16:1, which increases the radiation area. The composite wick structure consists of seven arteries and cylindrical wraps. The collector heat flux matches the design requirements of the thermionic converter. (Author)

A79-10114 **Liquid metal heat pipes for the central solar receiver** W. Bienert and D. Wolf (Dynatherm Corp., Cockeysville, Md.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2, Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1040-1049, 5 refs.

The feasibility of a heat pipe central solar receiver gas turbine plant has been studied. The conceptual system design consists of a semi-cylindrical cavity receiver and a gas-turbine generator mounted at the top of a reinforced tower located at the southern end of a heliostat field. Heat pipes are utilized to transform the concentrated solar flux within the receiver to flux levels compatible with heat transfer to the gaseous working medium of a Brayton cycle conversion system. The peak transport requirement is 13 T/KW and the highest evaporator flux is 0.34 MW/sq. m. Tests were conducted at conditions typifying operation in a central solar receiver, including anticipated heat pipe orientations and with transient heat input. Subscale tests allowed numerous wick configurations to be tested and also substantiated theoretical performance models. The most successful wick configuration consisted of a series of parallel tent arteries for axial liquid transport and bias cut screen tubes for circumferential liquid distribution. (Author)

A79-10115 **Cost effective solar collectors using heat pipes.** D. M. Ernst and G. Y. Eastman (Thermacore, Inc., Leola, Pa.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2, Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1050-1055.

System requirements are established for heat pipes to be used with vacuum insulated tubular collectors. Heat pipes are designed and developed. Candidate heat pipe envelope materials and working fluids are investigated. Freeze resistant water heat pipes and units with non-freezing fluids are tested. Water compatible steel heat pipes are tested. Stagnation operation is investigated. Heat pipe-to-system interface geometries are explored analytically and experimentally. Test results for electrically and solar heated collectors are reported. (Author)

A79-10117 **Analysis and application of the heat pipe heat exchanger** T. H. Sun and R. C. Prager (Hughes Aircraft Co., Torrance, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2, Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1060-1065, 11 refs.

Heat pipe heat exchangers offer many advantages over more conventional heat exchangers, particularly for gas-to-gas application. Proper application of these devices depends on the conditions imposed by the process from which waste heat is to be recovered, and some of the more common constraints are analyzed. The overall operation of heat pipe heat exchangers is best studied using effectiveness-NTU calculations, and the operation of heat pipes within the heat exchanger is characterized as two film coefficients in series. Success in designing an energy recovery system is dependent not only upon how much energy is recovered, but how effectively the recovered energy is utilized. Some typical options available to the system designer are discussed. (Author)

A79-10118 **Geothermal preheating in fossil-fired steam power plants** H. E. Khalifa, R. DiPippo, and J. Kestin (Brown University, Providence, R.I.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25,

1978, Proceedings Volume 2, Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1068-1073, 10 refs. Contract No. EY-76-S-02-4051.

In this paper a thermodynamic analysis of a hybrid fossil geothermal power plant in which the low-grade geothermal energy is used for preheating the feedwater in a fossil-fired steam power plant is presented. By restricting the geofluid to sensible heat addition, the entropy production in this process can be reduced. This results in an overall improvement in the utilization of the two energy sources. The performance of the hybrid system is studied in terms of suitably defined figures of merit. These include criteria for the choice of the appropriate hybrid utilization strategy, given the finite nature of geothermal and fossil resources. The paper also addresses the question of optimum bleed conditions in a cycle comprising both geothermal and regenerative feedwater heating. (Author)

A79-10119 **Performance of a 10 MW geothermal energy conversion test facility** W. O. Jacobson (San Diego Gas and Electric Co., San Diego, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2, Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1074-1076.

The performance of San Diego Gas & Electric's Geothermal Loop Facility has been generally good. Comparison of initial flash/binary conversion cycle selection criteria to performance data has led to renewed interest in a flash cycle. Brine system performance has been generally successful but hampered by scale accumulation. Improved scale removal and control techniques are being evaluated. Geothermal steam and condensate systems have shown good steady state performance, but performance is adversely affected by upsets or oscillations. Operation of the binary system, originally designed for isobutane, with water as the working fluid has been off design, but no performance problems are expected if design conditions are approached. (Author)

A79-10120 **Geothermal power from salt domes** S. J. Altschuler (Dow Chemical Co., Midland, Mich.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2, Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1082-1088, 10 refs.

A deep geothermal energy scheme is described in which a long, double pipe heat exchanger is embedded in a salt dome. The plasticity of the hot salt should allow the well to be installed by sinking a weighted pipe rather than conventional methods. If successful, this method could be a major regional source of energy, despite relatively slow conduction heat transfer. Capital costs are estimated to be comparable to other alternate energy sources. (Author)

A79-10121 **Optimum design conditions for a power plant at a vapor dominated geothermal resource, Pacific Gas and Electric's The Geysers Power Plant Unit 16** J. Pietruszkiewicz (Pacific Gas and Electric Co., San Francisco, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2, Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1089-1094.

A79-10122 **Fossil superheating in geothermal steam power plants** R. DiPippo, H. E. Khalifa, R. J. Correia, and J. Kestin (Brown University, Providence, R.I.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2, Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1095-1101, 18 refs. Research supported by the U.S. Department of Energy.

This paper reports the results of thermodynamic studies of geothermal steam power systems incorporating fossil-fired superheaters. One- and two-stage systems are covered. Realistic assumptions have been included to account for losses that may be incurred in actual plants. The systems are evaluated on the basis of a number of appropriate figures of merit. It is found that fossil superheat hybrid geothermal power plants offer a thermodynamic advantage.

over individual fossil and geothermal plants for a wide range of operating conditions, and deserve consideration whenever fossil and geothermal energy resources are found in reasonable proximity

(Author)

A79-10123 Heat exchanger design for geothermal power plants B W Dambly (J Hilbert Anderson, Inc., York, Pa) In *Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2* Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 1102-1108 6 refs

This paper describes the development of a unique and proprietary method of shell-and-tube heat exchanger construction Designed specifically for use in a pilot hydrothermal geothermal power plant the units described here will utilize geothermal brine to heat, boil, and super-heat isobutane in an organic Rankine cycle power process This design provides true counterflow configuration by eliminating the conventional cross baffles normally associated with such equipment Spacing and support are provided by deformed short tubes shaped to fit within each cluster of seven tubes These spacers are held in place by the clamping action of a strap around each cluster The exchanger tube bundle is made up of an integration of such support clusters both along its length, and laterally across the tube bank By providing an optimum ratio of surface area-to-pressure drop, efficiency of heat exchange is effectively increased and pumping power is significantly reduced

(Author)

A79-10124 Hydrocarbon working fluid and operating conditions selection for the conventional geothermal binary cycle K Z Iqbal, H H West, and K E Starling (Oklahoma, University, Norman, Okla) In *Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2* Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 1114-1120 6 refs Research supported by the University of Oklahoma and U.S. Department of Energy

The subject of selecting working fluid and process operating conditions for the geothermal binary power cycle is addressed herein To examine a wide variety of potential working fluids, a fluid screening procedure was developed The first phase of the three phase screening procedure permits a quick evaluation, with potential working fluids identified for more detailed analysis The second phase screening procedure requires more thermophysical property data for the potential working fluid in order to evaluate a series of cycle parameters The final phase of the screening procedure requires evaluation with the aid of a power cycle simulation program complete with rigorous thermodynamics, process, and economic estimation routines The working fluids compared in detail herein include isobutane, isopentane, cis-2-butene, R-11, R-114 and an equimolar mixture of isobutane and isopentane It is concluded that the range of working fluids considered by the industry to date has been too limited

(Author)

A79-10125 Effect of noncondensable gases on geothermal power generation G P Hajela and B Katz (Rockwell International Corp., Atomic International Div., Canoga Park, Calif) In *Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2* Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 1121-1128 16 refs

Two geothermal power generation cycles - direct-flash steam and steam binary cycles - are compared, on the basis of total cost of major equipment, for a power plant of 10-MWe net output, using a brine containing noncondensable (NC) gases The concentration of the NC gases was varied over a wide range The effect of the NC gases on the cost and efficiency of both cycles is discussed Both cycles are optimized with respect to the given parameter, and the cost of major components is estimated Over the entire range of NC gas concentrations, the direct flash steam cycle was found to be more economical

(Author)

A79-10126 Hydrogen production from high temperature electrolysis and fusion reactor V D Dang, M Steinberg, J Fillo, H

S Isaacs, O Lazareth, J R Powell, and F J Salzano (Brookhaven National Laboratory, Upton, N.Y) In *Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2* Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 1142-1149 17 refs Research sponsored by the U.S. Department of Energy

Production of hydrogen from high temperature electrolysis of steam coupled with a fusion reactor is studied The process includes three major components the fusion reactor, the high temperature electrolyzer and the power conversion cycle each of which are discussed in the paper Detailed process design and analysis of the system is examined A parametric study on the effect of process efficiency is presented

(Author)

A79-10127 Engineering and bench-scale studies of the sulfur-iodine cycle at General Atomic J D de Graaf, K H McCorkle, J H Norman, R Sharp, G B Webb (General Atomic Co., San Diego, Calif), and T Ohno (Idemitsu Kosan Co., Ltd., Tokyo, Japan) In *Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2* Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 1150-1157 7 refs Contract No EY-76-C-03 0167

The progress made on process engineering and bench scale investigations of a sulfur-iodine thermochemical water-splitting cycle is presented A second-generation process engineering flowsheet is under development The results of this new flowsheeting effort not only represent a reiteration in the process engineering, but also reflect the progress made in the laboratory, at present approximately 60% of the flowsheet is complete It is expected that the thermal efficiency of the process will be 45% or higher In 1977, bench scale investigations of the sulfur iodine cycle were initiated with the objective of verifying the practical chemical feasibility of the cycle One of three subunits, which perform the main solution reaction, has been built and the first experimental run has been performed The other subunits are planned to be ready for testing by 1979, and operation of the integrated unit is expected late in 1979

(Author)

A79-10128 A copper oxide-copper sulfate water-splitting cycle S E Foh, J D Schreiber, and J R Dafler (Institute of Gas Technology, Chicago, Ill) In *Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2* Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 1158-1163 12 refs Research supported by the Gas Research Institute, Contract No EC 77 C 02-4434

A hybrid copper oxide-copper sulfate thermochemical water-splitting cycle has been demonstrated in the laboratory with recycled materials The optimum configuration and operating conditions for the electrolytic hydrogen producing step have not yet been defined A conceptual flow sheet was developed for this cycle and a load line efficiency of about 37% calculated This figure is the result of a single iteration on the original base case flow sheet and compares well with the values calculated for other processes at this stage of development An iterative optimization of process conditions would improve efficiency The data required to perform an economic analysis are not yet available and the electrolysis step must be more fully defined Relatively few corrosive materials and few gas phase separations are attributes of Cycle H 5 which suggests that hydrogen costs would be improved significantly over similar processes analyzed to date

(Author)

A79-10129 New energy from an old source - Hydrogen from falling water D G Johnson, W J D Escher, and J B Pangborn (Institute of Gas Technology, Chicago, Ill) In *Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2* Warrendale, Pa, Society of Automotive Engineers, Inc., 1978, p 1164-1169 7 refs

A method for developing small-capacity falling-water resources for hydrogen production is presented Consideration is given to the characteristics of the resource base, the economic feasibility of

hydrogen production, storage, and transport, and hydrogen product roles. It is felt that on a small scale, falling-water hydrogen may partially replace steam-reformed natural gas. S C S

A79-10130 Some problems and benefits from the hydrogen fueled spark ignition engine. H C Watson and E E Milkins (Melbourne, University, Melbourne, Australia) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1170-1177. 13 refs. Research supported by the Shell Australia, Ford Motor Co., and Repco Research.

Induction ignition or back-flashing associated with H₂ engines is shown to be caused by deposit ignition or residual gas ignition. Results from single cylinder engine tests show that operation free of induction ignition is possible at all mixtures and compression ratios up to knock and beyond. Test with a typical automotive engine gave thermal efficiencies on average nearly twice that for gasoline. Specific NO_x emissions were always less than with gasoline (1/200 to 1/3), but the maximum torque range could not be explored because pyrolysed carbon from the lubricant caused induction ignition which could not be eliminated. (Author)

A79-10131 Utility fuel cells for biomass fuel. O Lindstrom, T Nilsson, M Bursell, C Hornell, G Karlsson, C Sylwan, and B Ahgren (Kungl Tekniska Hogskolan, Stockholm, Sweden) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2.

Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1178-1184. 15 refs. Research supported by the National Swedish Board for Energy Source Development, Styrelsen for Teknisk Utveckling, and Trygger's Foundation for Scientific Research.

The fuel cell alternative is attractive because of the high reactivity of biomass in pyrolysis/gasification processes and the outstanding environmental qualities of the fuel cell. The system comprises a fuel processor for conversion of biomass and peat to hydrogen, and alkaline fuel cells. The fuel processor uses a modified steam iron process. A conceptual 100 MW plant is using so-called FC 041 2.5 MW generator units. Fuel cell cathodes consist of nickel screens embedded in PTFE bonded silver catalysts and give 1 kA/sq m in the range -0.11 to -0.21 V vs Hg/HgO. Anodes with skeleton nickel from AlNiTiMo alloys on nickel matrices operate at 1 kA/sq m at -0.87 V. The pseudoresistivity of the cathodes is inversely proportional to the 0.7th power of the oxygen partial pressure. (Author)

A79-10132 Progress report on hydrogen production and utilization for community and automotive power. J H Ruckman, R E Billings, R L Woolley, B C Campbell, L D Hadden, and V R Anderson (Billings Energy Corp., Provo, Utah) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2.

Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1185-1190. 6 refs.

Each of a number of future energy sources can be used to obtain hydrogen which can be easily and safely stored and transported. Hydrogen can be substituted for almost every combustible fuel with only moderate changes in equipment. Hydrogen can be transported in pipelines more cheaply and with less energy losses than electricity through wires. A description is given of a number of projects which have been undertaken to demonstrate the utility of hydrogen. The Hydrogen Homestead is the first step of multiphase project moving toward implementation of hydrogen energy. The 'Homestead' is a private dwelling in which natural gas appliances have been converted for hydrogen operation. Another project considered involves the development of a small scale, low cost electrolyzer suitable to operate at remote sites and interface with energy sources. G R

A79-10133 Assessment of the potential of generating power from aqueous saline solutions by means of Osmo-Hydro Power systems. M D Fraser, S Loeb, and G D Mehta (InterTechnology/Solar Corp., Warrenton, Va.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1202-1207. 10 refs. Contract No EG-77-C-05-5560.

The basic principle of Osmo-Hydro Power (OHP) is to generate a pressurized flow from water which permeates by pressure-retarded osmosis through a semipermeable membrane into a more concentrated salt solution and to discharge this flow through a hydraulic turbine. Calculations of performance and cost were made with a comprehensive model for OHP systems using estimated performance and costs for an experimental glass hollow fiber membrane and a du Pont-type aromatic polyamide fiber. A 1-MW system using glass membranes would operate at about 1,900 psi. A solar evaporation pond would be used to evaporate the waste brine to recycle the salt in the form of a slurry containing 50% solids. The cost of electricity produced is about \$0.39/kWh and the required capital investment about \$10,000/kW. (Author)

A79-10134 Economic optimization of the coal-fired MHD Steam Power Plant. J N Chapman, L W Crawford, and J B Dicks (Tennessee, University, Tullahoma, Tenn.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1230-1236. Contract No EX-76-C-01-1760.

A computer based model of the MHD/Steam Power Plant is used to optimize the plant with regard to combustor temperature, combustor pressure and magnetic field strength. Cost of electricity is used as the measure of merit for the optimization. The results indicate that the combustor pressure should be 5 atmospheres for coal prices projected around 1990. The magnetic field and air preheat temperatures should be selected at the upper limit of the interval considered. Sensitivity of results to coal prices, seed flow rates and combustor heat loss is examined. (Author)

A79-10135 Reducing combustion air temperature variations in magnetohydrodynamic/steam power plants. J D Aspnes (New Hampshire, University, Durham, N.H.), D A Pierre (Montana State University, Bozeman, Mont.), and T C. Robles (Tennessee Technological University, Cookeville, Tenn.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1236-1241. 6 refs. Research supported by the University of New Hampshire and Montana State University, Contract No EF-77-C-01-2524.

A dynamic computer model of a magnetohydrodynamic (MHD)/steam power plant is used to evaluate methods for reducing temperature variations in preheated combustion air. The effectiveness of a heat capacitor in smoothing short-term temperature ripple caused by regenerative air preheater switching is discussed. In addition, the results of utilizing a control loop specifically to reduce long-term fluctuations in preheated air temperature are given. Representative computer simulations showing the effects of specific overall plant control configurations are included. (Author)

A79-10136 Considerations for MHD power generation development. R V Shanklin (US Department of Energy, Div of Magnetohydrodynamics, Washington, D.C.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1242-1248. 12 refs.

Magnetohydrodynamic generation (MHD) is a method of direct electromechanical power conversion based on the interaction of conducting fluids with magnetic fields. The Energy Conversion Alternative Study which included a comparative economic analysis of several advanced electric power system concepts completed during

1975-76 shows that MHD is economically viable. The characteristics of an open cycle MHD/steam system are considered along with questions regarding the historical development of the concept of MHD power generation. A new chapter in the history of the national program was opened in September 1975 with the formation of the MHD Division of DOE (then ERDA). The overall objective of the MHD program is the demonstration in the 1990's of an electrical, utility-sized MHD/steam power plant, utilizing coal as fuel in a process that is economically attractive and environmentally acceptable. Accomplishments in critical areas are discussed. G R

A79-10137 A proposed 40 MWe MHD pilot plant. S. Way. In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1249-1256. 8 refs.

The proposed plant would put out 40 MW of DC power from the MHD generator (39.2 MW of AC power), and have a thermal rating of 182.87 MW. Total net station electrical output, including the steam turbo generator, is about 76 MW. A two stage combustor is used with a slagging vortex gasifier first stage. The generator channel proposed is of hot wall design, slightly under 7 m long, with 5.8 tesla field. Air preheat is 1360 K, to give a top temperature 2700 K. A radiant direct fired recuperator would be used. Fuel assumed is a Western Pennsylvania bituminous. Seeding is by 0.7% (weight) potassium, put in as dry carbonate. This plant might be upgraded to 50/90 MW for use as a transition MHD steam power installation.

(Author)

A79-10138 Thermal modeling of coal-fired MHD plant components. R. E. Powe (Mississippi State University, Mississippi State, Miss.). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1257-1266. 9 refs. Contract No. EX-76-C-01-2246.

A facility for simulating the gas stream environment in any of the steam plant components of a coal fired MHD power plant is described. Equilibrium calculations are employed to determine gas stream chemistry at various temperatures, and a thermal model is developed for predicting the longitudinal temperature profile in the gas stream. In this model, heat transfer to the wall is considered to be by both radiation and convection, and developing temperature and velocity profiles are considered. The wall is assumed to be coated with a slag layer which is partly solid and partly flowing liquid. Performance predictions of the system under a variety of conditions are given. The thermal model should have general application to a variety of coal combustion applications.

(Author)

A79-10139 Controlling NOx from a coal-fired MHD process. S. S. Strom, J. N. Chapman, J. W. Muehlhauser, and J. H. Lanier (Tennessee University, Tullahoma, Tenn.). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1267-1273. 9 refs. Contract No. EX-76-C-01-1760.

A direct coal-fired Magnetohydrodynamics process requires combustion temperatures that are conducive to environmentally unacceptable NOx levels. Equilibrium values in excess of 10,000 ppm can be expected. System studies performed at The University of Tennessee Space Institute (UTSI) have shown that when operating at stoichiometric ratios of 0.85 NOx can be controlled. An experimental program using an existing UTSI test facility has shown that less than 100 ppm NOx can be achieved when coal is combusted with oxygen using a stoichiometric ratio of 0.85 and a residence time of 1.3 seconds. These tests have shown that under MHD conditions conclusions concerning NOx, drawn from gas or liquid fuels can be applied to coal.

(Author)

A79-10140 A superconducting dipole magnet system for the MHD facility at Univ of Tennessee Space Institute. S.-T. Wang, L. R. Turner, R. C. Niemann, L. Genens, and M. S. Srinivasan

(Argonne National Laboratory, Argonne, Ill.). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1274-1278.

A superconducting dipole magnet system for use in the MHD facility at the University of Tennessee Space Institute (UTSI) has been designed by Argonne National Laboratory. The system consists of the magnet and its cryostat, a helium liquefier/refrigeration facility, a helium gas handling system, apparatus for cryogenic transfer and storage and an integrated control system including computer data acquisition system, power supply, magnet operation and safety protection. (Author)

A79-10141 Progress in the testing of materials and design concepts for directly-fired MHD air heater service. D. P. Saari, R. R. Smyth, and L. R. White (Flu/Dyne Engineering Corp., Minneapolis, Minn.). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1279-1282. 5 refs. Contract No. ET-78-C-01-3005.

Materials evaluation and heater operability testing as part of a continuing program of MHD air heater development work has resulted in identification of a candidate material for MHD air heater service and demonstration of the feasibility of stable operation of an MHD air heater. A five meter high cored brick matrix has been operated for 750 hours with seed and slag, showing acceptable materials performance and controllable solids deposition and removal. (Author)

A79-10142 Design studies and trade-off analyses for a superconducting magnet/MHD power generator system. J. N. Chapman, J. F. Martin, J. W. Muehlhauser, C. K. Petersen, Y. C. L. Wu, and J. B. Dicks (Tennessee University, Tullahoma, Tenn.). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1283-1288. 5 refs. Contract No. EX-76-C-01-1760.

The considered system is to be used in a facility which is designed for the development of coal fired MHD systems. The facility, as presently planned, will provide a mixture of oxygen and nitrogen preheated by a heater to simulate oxygen enriched air. Four principal equations bearing on the selection of a physical configuration for the magnet are investigated. An analysis indicates that a superconducting magnet having an overall length of 5 M (3.1 M effective length) with a warm bore having an entrance diameter of 6M or larger and capable of supporting the channel loading, a peak magnetic field of 6 Tesla and a warm bore taper that matches MHD Generator taper for the 27.8 Kg/sec mass flow case provides the best choice for experimental utility in the facility. G R

A79-10144 Fusion-Fission Energy Systems. S. L. Bogart (U.S. Department of Energy, Washington, D.C.). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1322-1326. 11 refs.

On the path to the achievement of the goal to produce useful energy from pure fusion, there may be an opportunity to employ fusion as a key element of a Fusion-Fission Energy System. Such an energy system could consist of five or more symbiotic thermal power reactors and the fuel producing 'Hybrid Reactor'. The Hybrid Reactor would contain a pure fusion neutron source surrounded by a fertile blanket. Hybrid fusion-fission reactors could provide fuel to currently installed and planned fission reactors until pure fusion systems could be developed and commercialized. The potential advantages of Fusion-Fission Energy Systems are considered along with Fusion-Fission Energy Systems concepts and the current Fusion-Fission Energy Systems program. G R

A79-10145

A79-10145 **Doublet III design and construction** J R Gilleland (General Atomic Co, San Diego, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1327-1330

The Doublet III device is the world's largest operating fusion research device. Engineering tests were successfully initiated last February. Within the next two years, the machine will generate a reactor-like plasma. Details of program objectives, machine construction, and initial results will be discussed. (Author)

A79-10146 **Demonstration and commercial prototype tokamak reactors** D W Kearney (General Atomic Co, San Diego, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1331-1336 17 refs

Tokamak confinement and technology is briefly reviewed with emphasis on plasma power density and energy transport scaling as well as technology needs in such areas as materials, magnets, and blanket/shield systems. Selected design parameters of certain demonstration (GA Doublet DPR, ORNL DPR, MIT/PPL HFCTR, and FINTOR-D) and commercial prototype (UWMAK-III, EURATOM, University of Wisconsin NUMAK, and GA Doublet Prototype) reactors are presented, and blanket designs and remote maintenance considerations are briefly discussed. B J

A79-10147 **The Mirror Fusion Test Facility /MFTF/** K I Thomassen (California, University, Livermore, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1337-1342

The MFTF, begun at Lawrence Livermore Laboratory in FY78 and to be completed at the end of FY81 gives the mirror program the flexibility to explore mirror confinement principles at a significant scale and advances the technology of large reactor-like devices. This paper reviews mirror fusion concepts, discusses the objectives of MFTF, and gives a brief description of the facility. The role of MFTF for future research and the implications for reactor like devices to follow MFTF are also considered. B J

A79-10148 **Mirror fusion reactors** G A Carlson and R W Moir (California, University, Livermore, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1343-1352 5 refs Contract No W-7405-eng-48

Conceptual design studies of fusion reactors based on the three current mirror confinement concepts have been carried out: the standard mirror, the tandem mirror, and the field-reversed mirror. Recent studies of the standard mirror have emphasized its potential as a fusion-fission hybrid reactor, designed to produce fissile fuel for fission reactors. In the present study a large commercial hybrid based on standard mirror confinement, and also a small pilot plant hybrid have been designed. Tandem mirror designs include a commercial 1000 MWe fusion power plant and a nearer term tandem mirror hybrid. Field-reversed mirror designs include a multicell commercial reactor producing 75 MWe and a single cell pilot plant. (Author)

A79-10149 **Overview of inertial confinement fusion reactor designs** J Hovingh (California, University, Livermore, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1353-1361 31 refs Contract No W 7405 eng 48

Inertial confinement consists of compressing a tiny pellet of deuterium-tritium to very high densities and temperature using intense beams of photons or particles. This paper reviews various aspects of inertial confinement, including energy deposition from beam-pellet interactions and microexplosions, energy deposition in

the first wall and blanket, and the effects of energy deposition time on temperature and stress. Consideration is also given to first wall material selection considerations for inertially confined fusion reactors, and some conceptual designs for laser fusion systems are discussed. B J

A79-10150 **CO2-laser fusion** E E Stark, Jr (California, University, Los Alamos, N Mex) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1362-1365 8 refs Research sponsored by the U S Department of Energy

The basic concept of laser fusion is described, with a set of requirements on the laser system. Systems and applications concepts are presented and discussed. The CO2 laser's characteristics and advantages for laser fusion are described. Finally, technological issues in the development of CO2 laser systems for fusion applications are discussed. (Author)

A79-10151 **Compact fusion reactors using controlled imploding liners** R L Burton (Jaycor, Alexandria, Va) and P J Turchi (U S Navy, Naval Research Laboratory, Washington, D C) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1372-1376 Research supported by the U S Department of Energy and U S Navy

In the LINUS approach to thermonuclear fusion, the stabilized implosion of a liquid rotating first wall or liner of lead-lithium alloy is used to heat a D-T plasma by adiabatic compression. The imploded liner is sufficiently thick at peak compression to absorb the fusion neutrons and protect the solid portions of the reactor. The repetition rate of the controlled implosion plasma compression event and the flow rate of the liner material through the reactor are adjusted to maintain a liner temperature suitable for operating a steam-electric plant. It is shown that Q, the ratio of nuclear energy produced per pulse to the energy supplied to implode the liner, is on the order of unity for economical reactor-size LINUS systems. The reactor size is calculated for a power output of 700MW(e) at a pulse rate of 1 Hz. Prototype controlled liner implosion systems are also described. (Author)

A79-10152 **The fast power cycle for fusion reactors** J Powell, J Fillo, and H Makowitz (Brookhaven National Laboratory, Upton, NY) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1377-1382 6 refs Research sponsored by the U S Department of Energy

The unique, deep penetration capability of 14 MeV neutrons produced in DT fusion reactions allows the generation of very high temperature working fluid temperatures in a thermal power cycle. In the FAST (Fusion Augmented Steam Turbine) power cycle, steam is directly superheated by the high temperature ceramic refractory interior of the blanket, after being generated by heat extracted from the relatively cool blanket structure. The steam is then passed to a high temperature gas turbine for power generation. Cycle studies have been carried out for a range of turbine inlet temperatures (870 to 1650 C), number of reheats, turbine mechanical efficiency, recuperator effectiveness, and system pressure losses. (Author)

A79-10153 **A calculation of linear magnetic liner fusion reactor performance** M J Schaffer, R F Bourque, C-L Hsieh, R E Waltz, and T Yamagishi (General Atomic Co, San Diego, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1383-1388 12 refs Research supported by the Electric Power Research Institute

The fusion reactor performance of an open field line, linear, magnetically confined plasma column compressed radially by a rotating liquid metal liner is analyzed and calculated. Models for liner

dynamics and plasma confinement are derived from the results of specialized one-dimensional computer calculations. It is shown that this plasma and liner combination is mutually self-consistent and is capable of fusion power production at reasonable net efficiencies

(Author)

A79-10154 Energy conversion in the long run W R Martini (Washington, University, Richland, Wash) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1390-1399 52 refs

Energy converters for supplying mechanical power, electrical power, and the heating and cooling of buildings are evaluated to determine what efficiency improvements are possible. It is projected that the following long-term improvements are possible: (1) engines - 100%, (2) fuel use by cogeneration - 100-300%, (3) electricity generation - 50-100%, (4) building heating - 500%, and (5) building cooling - 300%. In addition, converters of energy from free sources are compared and rated by the cost of collection. B J

A79-10155 Can solar energy contribute significantly to the solution of the world's energy famine? C E Backus (Arizona State University, Tempe, Ariz) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1406-1411

The paper briefly reviews the historical development of solar energy technology and discusses the status of solar energy in the United States and other industrialized nations, with reference to such applications as domestic hot water, the heating and cooling of buildings, and electric generation. The potential role of solar energy in developing countries is also considered. It is noted that solar energy will not be a panacea for the energy problems of the world, but that it can make an important contribution to solving these problems. B J

A79-10156 Analysis and design of an 18-ton solar-powered heating and cooling system F R Biancardi and G Melikian (United Technologies Research Center, East Hartford, Conn) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1459-1464 Research sponsored by the US Department of Energy

Currently underway is a program to design, develop and test a prototype solar-powered Rankine-cycle heating and cooling system for use in multifamily or light commercial applications. The performance characteristics and the preliminary design of the prototype system are described in this paper along with the results of optimization and integration studies of system components and controls to maximize seasonal coefficient of performance. A cooling COP of 0.60 to 0.95 along with a heating COP, based on fuel consumption, of 1.3 to 2.5 is predicted. (Author)

A79-10157 Combined cycle gas turbine for an automobile application E R Earnest (Hydragon Corp, Lake Park, Fla) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1465-1473 13 refs

A combined cycle gas turbine-organic fluid Rankine automobile engine is discussed. A unique design, designated 'IBR' (Integrated Brayton-Rankine) engine couples the two cycles thermodynamically and mechanically in such a way as to result in the single Brayton turbine functioning as a free power turbine under most operating conditions. Several unconventional cycle modifiers are used to improve part load efficiency and reduce exhaust emissions without resorting to variable flow path geometry. An 82kw (110hp) all metal IBR engine based on near-term state-of-the-art component efficiencies in a 3500 lb vehicle is predicted to provide 18% better than average fuel economy than an equivalent Otto cycle powered vehicle. (Author)

A79-10159 Preliminary design of the solar total energy-large scale experiment at Shenandoah, Georgia A J Poche, S A Haas (General Electric Co, Space Div, King of Prussia, Pa), and R W Hunke (Sandia Laboratories, Albuquerque, N Mex) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1508-1513 Contract No EG-77-C-04-3985

A preliminary design study is described for the Solar Total Energy System (STES) for the US Department of Energy's Large Scale Experiment at Shenandoah, Georgia. The STES will supply electric power, process steam, and hot water for heating and air conditioning of a 42,000-sq-ft building. In addition to the preliminary design, the study includes experiment site layout, definition of site-specific system requirements, and development of preliminary plans for the operating phase. B J

A79-10160 Conceptual design of the Fort Hood Solar Total Energy-Large Scale Experiment D L Black (Westinghouse Electric Corp, Advanced Energy Systems Div, Pittsburgh, Pa) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1514-1521 Contract No EG-77-C-04-3988

Studies leading to the selection of a conceptual design are described for a Solar Total Energy System applied to five buildings within the 87,000 barracks complex located on the US Army base at Fort Hood, Texas. The plant is required to produce 200-500 kW(e) for electrical load peaking and supply greater than 60 percent of the thermal load. Numerous cycle arrangements and their effect on efficiency were studied and a computer program was developed to calculate solar utilization. Energy displacement and life cycle costs were analyzed. Supplementary studies included an evaluation of available solar collector designs, energy storage concepts, turbine and air conditioner comparisons, health and safety considerations and environmental effects. Operational, development, and procurement plans were also completed. (Author)

A79-10161 * JPL - Small Power Systems Applications Project R R Ferber, A T Marriott, and V Truscello (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1522-1527 Contract No EX-76-A-29-1060

The Small Power Systems Applications (SPSA) Project has been established to develop and commercialize small solar thermal power plants. The technologies of interest include all distributed and central receiver technologies which are potentially economically viable in power plant sizes of one to 10 MWe. The paper presents an overview of the SPSA Project and briefly discusses electric utility involvement in the Project. B.J.

A79-10162 * Enhanced solar energy options using earth-orbiting mirrors W P Gilbreath, K W Billman (NASA, Ames Research Center, Moffett Field, Calif), and S W Bowen (Beam Engineering, Inc, Sunnyvale, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1528-1534 11 refs

A system of orbiting space reflectors is described, analyzed, and shown to economically provide nearly continuous insolation to preselected ground sites, producing benefits hitherto lacking in conventional solar farms and leading to large reductions in energy costs for such installations. Free-flying planar mirrors of about 1 sq km are shown to be optimum and can be made at under 10 g/sq m of surface, thus minimizing material needs and space transportation costs. Models are developed for both the design of such mirrors and for the analysis of expected ground insolation as a function of orbital parameters, time, and site location. Various applications (agricul-

tural, solar-electric production, weather enhancement, etc) are described (Author)

A79-10163 * Performance and economic risk evaluation of dispersed solar thermal power systems by Monte Carlo simulation R Manvi and T Fujita (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1535-1540 8 refs

A preliminary comparative evaluation of dispersed solar thermal power plants utilizing advanced technologies available in 1985-2000 time frame is under way at JPL. The solar power plants of 50 KWe to 10 MWe size are equipped with two axis tracking parabolic dish concentrator systems operating at temperatures in excess of 1000 F. The energy conversion schemes under consideration include advanced steam, open and closed cycle gas turbines, stirling, and combined cycle. The energy storage systems include advanced batteries, liquid metal, and chemical. This paper outlines a simple methodology for a probabilistic assessment of such systems. Sources of uncertainty in the development of advanced systems are identified, and a computer Monte Carlo simulation is exercised to permit an analysis of the tradeoffs of the risk of failure versus the potential for large gains. Frequency distribution of energy cost for several alternatives are presented (Author)

A79-10164 Design, construction, and testing of a Fixed Mirror Solar Concentrator field J R Schuster, J L Russell, Jr, and G H Eggers (General Atomic Co, San Diego, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1541-1547 Research supported by the US Department of Energy

The Fixed Mirror Solar Concentrator (FMSC) uses a fixed mirror circular trough that produces a sharp line focus regardless of sun position. The heat receiver, which employs a compound parabolic (Winston) secondary concentrator, is moved in a circular arc to track the focal line. With secondary concentration the FMSC has a theoretical upper concentration limit of 206 suns, and the secondary concentrator makes possible the design of a practical FMSC for the efficient generation of steam under modern steam plant operating conditions. FMSC modules of precast concrete and glass mirrors to supply a 260-sq-m collector field to Sandia Laboratories for the Solar Total Energy Demonstration Facility have been fabricated. B J

A79-10165 * Thermal performance trade-offs for point focusing solar collectors L Wen (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1548-1553 11 refs

Solar thermal conversion performance is assessed in this paper for representative point focusing distributed systems. Trade-off comparisons are made in terms of concentrator quality, solar receiver operating temperature, and power conversion efficiency. Normalized system performance is presented on a unit concentrator area basis for integrated annual electric energy production (Author)

A79-10166 Measurement of heat loss from a heat receiver assembly of a Fixed Mirror Solar Concentrator W E Walker, J J Housman, and J L Russell (General Atomic Co, San Diego, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1554-1562 Research supported by the Electric Power Research Institute

An experimental measurements program was performed on a heat receiver of the type currently used by the Fixed Mirror Solar

Concentrator (FMSC) at the Sandia Solar Total Energy Test Facility. The program (1) defined a balanced data sampling matrix for the variables of temperature, wind condition, material property, and configuration, (2) designed and constructed electrically heated thermal mock ups of the heat receiver, a wind tunnel, and a data collection system, (3) collected performance data and performed evaluation experiments to determine end effects, instrument stability and accuracy, and approach to equilibrium, (4) compared the results with predictions of solar receiver heat loss computer models and with preliminary loss data available from the Sandia program (Author)

A79-10167 * Effects of pointing errors on receiver performance for parabolic dish solar concentrators R O Hughes (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1563-1569 6 refs Research sponsored by the US Department of Energy, Contract No NAS7-100

The effects of dynamic (moving) pointing errors on the performance of solar thermal receivers is investigated. Only point focusing types of solar collectors are considered. The key element in the study is the analytical derivation of the intercept factor that relates pointing errors to captured energy at the receiver. A detailed example using typical parameter values is modeled on the digital computer and demonstrates the theory and the dynamic nature of the problem (Author)

A79-10168 Transient energy removal in cylindrical parabolic collector systems N E Wijesundera (University of Sri Lanka, Peradeniya, Sri Lanka) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1570-1574 8 refs

This paper describes two heat transfer models for the transient energy removal in cylindrical parabolic collectors. The models are used to study the transient behaviour of cylindrical parabolic collectors and their respective accuracies of prediction are compared. A single design parameter, namely, the collector time constant is used to characterise the transient behaviour. The dependence of this time constant on other collector design variables is studied using the heat transfer models referred to above (Author)

A79-10169 * Ultralow-mass solar-array designs for Halley's comet rendezvous mission E N Costogno (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) and G Rayl (General Electric Co, Philadelphia, Pa) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1575-1581 Contract No NAS7-100

This paper describes the conceptual design study results of photovoltaic arrays capable of powering a Halley's comet rendezvous mission. This mission would be Shuttle-launched, employ a unique form of propulsion (ion drive) which requires high power levels for operation, and operate at distances between 0.6 and 4.5 AU. These requirements make it necessary to develop arrays with extremely high power-to-mass ratio (200 W/kg). In addition, the dual requirements of providing ion thruster power as well as housekeeping power leads to the development of unique methods for mode switching. Both planar and variable concentrator-enhanced array concepts using ultrathin (50 micron) high-efficiency (up to 12.5%) silicon solar cells coupled with thin (75 micron) plastic encapsulants are considered. In order to satisfy the Shuttle launch environment it was necessary to provide novel methods of both storing and deploying these arrays (Author)

A79-10170 * The application of photovoltaic roof shingles to residential and commercial buildings N F Shepard, Jr (General Electric Co, Philadelphia, Pa) and L E Sanchez (California Institute of Technology, Jet Propulsion Laboratory, Pasadena,

Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1582-1587 6 refs

The recent development of a shingle-type solar-cell module makes it possible to incorporate easily photovoltaic power generation into the sloping roofs of residential or commercial buildings. These modules, which use a closely packed array of nineteen 53-mm-diameter circular solar cells, are capable of producing 101 watts/sq m of module area under standard operating conditions. This module performance is achievable by the use of solar cells with an average efficiency of 13.3 percent at 1 kW/sq m air-mass-1.5 insolation and at a cell temperature of 28 C. When these modules are mounted on a sloping south-facing roof which is insulated on the rear surface, the annual energy generated at the maximum power operating point will vary from 255.6 to 137.3 kWh/sq m of module area depending on the site location, with Albuquerque, NM, and Seattle, WA, representing the highest and lowest values of the thirteen sites considered.

(Author)

A79-10171 Cost minimization of photovoltaic power supplies S A Rosenberg (Bell Northern Research, Ltd., Ottawa, Canada) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1588-1592 7 refs

This paper describes a design procedure for minimizing the cost of self-contained photovoltaic power supplies by optimum selection of the solar array/battery mix. The procedure takes into account variations in the relative and absolute costs of solar arrays and batteries, as well as local insolation data. General expressions are established to represent seasonal variations in solar-cell output based on local monthly insolation data. Functions are then derived for determining the cost of solar cells and batteries in dollars per average watt output. The minimum-cost system is then determined by differentiation. It is shown that total cost savings over present techniques can be 30% or more depending on latitude and solar-cell/battery cost ratio.

(Author)

A79-10172 Photovoltaic concentrating array R L Donovan and S Broadbent (Martin Marietta Aerospace, Denver, Colo.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1593-1599 US Department of Energy Contract No 05-4564A

A photovoltaic concentrating array (PCA) for terrestrial application is described. The PCA uses point-focusing acrylic Fresnel lenses to concentrate sunlight on high intensity solar cells. The objective of the PCA development was to obtain economical photovoltaic power generation by replacing relatively high-priced solar cells with lower-cost lenses. The PCA operates at a concentration of 40, tracks the sun in two axes, and is passively cooled. An inherent advantage of concentrating systems over flat arrays is that they can afford high-cost high-performance cells since the cost impact of the cells becomes secondary to total system cost. This performance advantage manifests tremendous cost leverage since it reduces the field size required to provide a given power output.

(Author)

A79-10173* Comparative evaluation of distributed-collector solar thermal electric power plants T Fujita, N El Gabalawi, G G Herrera (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), and R S Caputo In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1600-1607 17 refs Contract No EX-76-A-29-1060

Distributed collector solar thermal electric power plants are compared by projecting power plant economics of selected systems to the 1990-2000 timeframe. The approach taken is to evaluate the performance of the selected systems under the same weather conditions. Capital and operational costs are estimated for each

system. Energy costs are calculated for different plant sizes based on the plant performance and the corresponding capital and maintenance costs. Optimum systems are then determined as the systems with the minimum energy costs for a given load factor. The optimum system is comprised of the best combination of subsystems which give the minimum energy cost for every plant size. Sensitivity analysis is done around the optimum point for various plant parameters.

(Author)

A79-10174 Hybrid air to water solar collector design J L Loth (West Virginia University, Morgantown, W Va.) and G M Palmer In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1608-1613 Contract No EG-77-G-04-4087

A large, inexpensive, lightweight grooved Foamglas solar collector assembly has been designed and installed at WVU. Six different collector construction techniques are applied. The six types are connected in parallel to allow independent thermal performance testing. An automated data logger collects performance data from all six types of collectors simultaneously and at preselected intervals. All collectors discharge the hot air to a single header. The air is then ducted through a blower, several electric heater elements and then through three 'A' coils. Water is pumped through these air conditioning evaporator 'A' coils to obtain domestic hot water heating. The test objectives are to determine the most cost effective area ratio between the solar collectors and that of the 'A' coils, and the total hybrid system thermal performance.

(Author)

A79-10175 Central solar heat stations and the Studsvik Demonstration Plant P Margen and R Roseen (Studsvik Energiteknik AB, Nykoping, Sweden) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1614-1619

A reduced-scale demonstration central solar heat plant is discussed which has been designed for northern climates where little solar heating occurs during winter and involves storage of excess summer heat for use during winter. A pit type warm-water magazine for hot-water storage and a plastic piping system for hot-water distribution are described. Salient features of the demonstration plant's solar collectors, heat storage magazine, consumer needs, and measurement procedures are briefly highlighted. Ways to obtain a high heat storage capacity and to achieve optimum operation of the central solar heat plant are examined, including the use of a heat pump.

F G M

A79-10176 Liquid desiccant solar air conditioner and energy storage system H I Robison (South Carolina University, Conway, S C) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1620-1622 7 refs

A liquid desiccant air conditioning system has been designed and is being constructed for testing. The absorbate chosen is water, the absorbent is triethylene glycol. Shallow-well water removes sensible heat. Direct solar radiation reactivates the dilute sorbent solution as it flows down corrugated trickle collectors. Insolation is used for mass transfer, and very little energy is lost to the ambient air stream as sensible heat. Parasitic losses are small as no blower is necessary in the regenerator and heat exchangers recover sensible heat absorbed by the glycol. A small, concentrated solution, flywheel storage system makes continuous operation possible.

(Author)

A79-10177 Thermosyphon solar water heating system under Brazilian conditions A F Orlando, D Magnoli, and L Goldstein, Jr (Centro de Tecnologia Promon, Rio de Janeiro, Brazil) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1628-1633 Research supported by Promon Engenharia, S A

A double-loop thermosyphon solar water heater has been developed, and its performance measured. The collectors are of the double-glazing flat plate type with a roll-bond aluminum absorber employing low-cost materials. The working fluid (corrosion inhibited water) flows in a closed loop consisting of the collectors and a shell-and-tube heat exchanger. Cold water is heated in the secondary loop of the heat exchanger and stored in a hot water tank located below the collector level, thus improving architectural aspects of the solar water-heating system for domestic use. Larger thermosyphon systems (possibly up to 20 sq m of collecting surface) may find applications in regions of Brazil with limited energy supply. The heat-exchanger design is found to be critical to the technical and economic performance of the system; the thermostatic valve must be properly selected in order to optimize cost and technical performance. Estimates of production costs were developed for Brazilian conditions. (Author)

A79-10178 Heat pipe central solar receiver gas turbine plant. G. Carli and R. J. Zoschak (Foster Wheeler Development Corp., Livingston, N.J.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1634-1640. 7 refs. Research sponsored by the U.S. Department of Energy.

A conceptual design for a 10-MWe heat pipe central-receiver gas-turbine power plant has been developed. The heat-pipe central solar receiver uses heat pipes to transform the concentrated high solar heat flux at the receiver into a lower heat flux compatible with gas heat-transfer systems. Several Brayton cycles were studied to determine which cycles and operating conditions are technically and economically most viable for a central-receiver power plant. An open gas cycle with an inlet turbine temperature of 815 C (1500 F) was selected. The turbine-generator and receiver are located at the top of a reinforced tower, with a north field of two-axis tracking heliostats. The system can be adapted for operation as a hybrid plant, providing a higher level of availability and a dependable generating capacity, which are important considerations from the utility point of view. The predicted cycle efficiency is 33 to 38 percent, and the overall solar-to-electric efficiency is 20 to 22.5 percent. (Author)

A79-10179 Simulation of solar powered Rankine cycle systems. R. K. Rout, B. Fortunato, and S. M. Divakaruni (Cincinnati, University, Cincinnati, Ohio). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1641-1649. 21 refs.

A parabolic cylindrical focusing collector is used as the boiler in a conventional Rankine-cycle system. The heat input to the solar-powered Rankine-cycle system is simulated over a period of time by utilizing the insolation data in the Transient Simulation computer program at different geographic locations. The power generation is accomplished by converting the expansive work of the working fluid in the turbine by means of an electrical generator. Both steam and organic fluids are studied to compare the power outputs from the complete solar-powered Rankine-cycle system simulation. Independent parametric studies are performed on the focusing collector and on the Rankine cycle, and the values of the parameters which generated the maximum efficiency are used in the subsequent simulation of the system. Finally, cost analysis of the system is done using data available in the literature and is compared with other power-generating systems. (Author)

A79-10180 The fossil fuel cost of solar heating. P. R. Payne and D. W. Doyle (Payne, Inc., Annapolis, Md.). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1650-1656. 12 refs. Contract No. EG-77-G-04-4138.

The fossil-fuel investment required to build and install a solar heating or cooling system is estimated in terms of the average energy needed to fabricate various raw materials and products as well as the energy assignable to labor. It is found that, in general, the energy

investment for a flat plate fluid-heating collector system is about 1.9 million Btu/sq ft and that the payback time for this is 10.4 yr, assuming an average collector efficiency of 0.35 and neglecting maintenance costs. It is suggested that this energy payback time is unacceptable since not much fossil fuel is saved and that less energy intensive materials be employed. Some low energy solutions are discussed, including concrete solar collectors, concrete-block air heaters, and clay and ceramic collectors. It is concluded that the energy cost for a ceramic collector produced with the aid of a closed-circuit furnace is around 4000 Btu/sq ft, which is low enough for solar collectors to be used to power the collector manufacturing facility. F. G. M.

A79-10181 Compartmental model for agricultural conversion of solar energy into fixed biomass. M. Sanai (Arya Mehr University of Technology, Teheran, Iran). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1657-1661. 8 refs.

Results obtained from a computerized 11-compartment model of the agricultural conversion of solar energy into fixed biomass are compared with measurements determined for alfalfa plantations, and the results suggest that the model can indicate the balance and interrelation of all the parameters involved. The results facilitate prediction of the biomass energy yield per unit farm area, the efficiency of photosynthetic conversion, and the overall efficiency, and characterize variation in ecosystem parameters caused by modification of operation schemes. Each compartment in the described model represents one of the main parameters of the system; the relations are characterized by regression-type differential equations. M. L.

A79-10182 Operating experience at the DOE/Sandia mid-temperature Solar Systems Test Facility. J. A. Leonard (Sandia Laboratories, Albuquerque, N. Mex.). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1662-1667. 8 refs. Research supported by the U.S. Department of Energy.

A79-10183 A theoretical method for the prediction of monthly mean solar radiation parameters. H. Daneshyar (Arya Mehr University of Technology, Teheran, Iran). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1668-1675. 8 refs.

Comparison of the existing experimental data for the monthly mean direct, diffuse and total solar radiation with the predictions obtained by a theoretical method has indicated that the mean monthly solar radiation parameters can be computed to a very good degree of accuracy. The basic assumption in the theoretical method is that both direct and diffuse solar radiation are primarily functions of solar zenith angle and cloud cover. The proposed theoretical method has been used to compute the monthly mean direct, diffuse and total solar radiation on horizontal, sun tracking and tilted surfaces at 34 locations in Iran and the computed results are presented in tables. The two input parameters used in the computations were the location latitude angle and the mean monthly total hours of sunshine for the 34 locations in the last ten years. (Author)

A79-10185 Selenide isotope generator for the Galileo mission. C. J. Goebel and T. E. Hamme (Teledyne Energy Systems, Timonium, Md.). In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2. Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p. 1685-1692.

A significantly improved thermoelectric generator has been developed by private industry under Department of Energy (DOE) sponsorship to provide electric power for NASA's Galileo Mission in

1982 Nominal power requirements for Galileo will be about 450 watts at beginning of life (BOL) and this will be furnished by two selenide isotope generators (SIG) each powered by a multi-hundred watt (MHW) radioisotopic heat source. A ground demonstration system (GDS) of a nominal 100 w(e) will be in operation by June of 1978. The GDS features a selenide ring module around a shortened MHW-dimensioned electrical heat source, newly developed axially grooved heat pipes on a disk-shaped radiator, and other innovations which will allow a full sized generator's weight to be held at about 90 lbs. Work is continuing towards achieving further improvements in areas of safety, performance, and weight. (Author)

A79-10186 * **Cooling radioisotope thermoelectric generators in the Shuttle** R M Norman (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1693-1698 Contract No NAS7-100

Radioisotope thermoelectric generators (RTG) to be used on future spacecraft and launched by the Shuttle must be cooled from the time they are installed and enclosed until the spacecraft is deployed from the Shuttle. A special Cooling Kit maintains their temperature well below critical by circulating water through the coils soldered to them and through a heat exchanger that boils water and externally discharges the resulting steam. The RTG Cooling Kit, including its support frame, if fully charged with about 64 kg of evaporation water, will increase the Shuttle launch mass by about 200 kg. (Author)

A79-10187 * **The application of solar thermoelectric generators in near-sun missions** V Raag, L Hankins (Synal Corp., Sunnyvale, Calif.), M Swerdlow, and R Ivanoff (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2

Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1699-1706 7 refs Contract No NAS7-100

Future planetary near-sun missions, such as those studied for low-altitude Mercury Orbiters, introduce challenges in the selection of appropriate power sources. Study results have shown that conventional silicon solar array technology is not adequate to produce power because of expected temperatures which range from -90 C to +285 C in about 40 to 50 minutes for 16 sun eclipses/day. The solar thermoelectric generator (STG), which requires relatively high temperatures, is being considered as a replacement power source. The complete STG consists of a solar concentrator and multiple thermopiles, each containing numerous thermocouples and thermal insulation material. Articulation of the STG design configurations is required at 0.45 AU to acquire maximum incident radiation and at 0.3 AU to reduce the higher incident radiation. STG thermal input to the spacecraft as it orbits Mercury (including sun eclipses) is insignificant. (Author)

A79-10188 **Copper/water axially-grooved heat pipes for RTG applications** N Strazza (Teledyne Energy Systems, Timonium, Md.), P J Brennan, and N H Nguyen (B & K Engineering, Inc., Towson, Md.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1707-1711 Contract No EX 76-C 01-3077

The use of heat pipes for enhancing the overall heat-rejection capability of the radiative fins of a radioisotope thermoelectric generator (RTG) offers significant weight savings for these systems. Copper/water heat pipes are best suited for these applications because of the associated operating temperature range and materials compatibility considerations, but long term materials compatibility is a problem particularly when temperatures exceed 150 C. This paper discusses copper/water RTG heat pipe experience and describes the development of oxide-coated axially-grooved copper/water heat

pipes which have demonstrated more than 8000 hours of continuous operation at 225 C with no gas generation attributable to chemical incompatibility. The chemical oxide coating is described as well as the life test results. Thermal performance of the axially-grooved heat pipes which were optimized for the Department of Energy sponsored selenide isotope generator (SIG) is presented. (Author)

A79-10190 **Brayton Isotope Power System - The versatile dynamic power converter** R D Gable and J E McCormick (A1Research Manufacturing Company of Arizona, Phoenix, Ariz.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1717-1720

The Brayton Isotope Power System (BIPS) is being developed to provide 1.3 kilowatts of electric power (kWe) for space use with mission durations in excess of five years and a reliability greater than 0.95. These design goals will be achieved initially utilizing superalloy hot-end components operating at a turbine inlet temperature of 760 C or lower. With proper refractory metal component development, these goals ultimately will be achieved at a turbine inlet temperature of 871 C, which will result in a significant reduction in total system weight. This discussion presents a comparison of system performance and the rationale for employing the BIPS as a low temperature as well as a high temperature dynamic power system using the same rotating machinery. In addition, the versatility of the BIPS is shown by examining the cycle efficiency (temperature) and power growth capabilities of the system. (Author)

A79-10191 **Melting multifoil insulation for KIPS emergency cooling** D K Darooka and V R Loughheed (Teledyne Energy Systems, Timonium, Md.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 2 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1721-1727

An emergency cooling system (ECS) for the kilowatt isotope power system is described. The multifoil insulation system used by ECS consists of 60 layers of 1 mil pure aluminum foils separated by micron-size zirconia particles. If loss of coolant occurs, the insulation system can dump all the heat into the environment and thus maintain heat source assembly temperature within upper and lower limits. The performance was studied by use of a computer code based on a described analytical model, and the results indicating suitable performance are found to be in reasonable agreement with results obtained from reported scale-model tests and full scale electrical heat source assembly multifoil meltdown tests. M L

A79-10192 **A computer and experimental simulation of Stirling cycle machines** D M Berchowitz and C J Rallis (Witwatersrand, University, Johannesburg, Republic of South Africa) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 10001 01-44) Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1730-1738 11 refs

The computer simulation of Stirling cycle machines developed by Urieli et al (1977) is evaluated against experimental results and ideal analyses. The experimental results were obtained from a rig which was designed to simulate the thermodynamic conditions present in real machines. For this particular rig the simulation consistently underpredicts the overall heat engine requirements by approximately 13%. The ideal analyses used in the comparison are the Schmidt analysis and a form of second order ideal pseudo Stirling analysis (Finkelstein's adiabatic analysis). (Author)

A79-10196 **The Pseudo Stirling cycle - A suitable performance criterion** G T Reader (Royal Naval Engineering College, Plymouth, England) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1763-1770 9 refs

Stirling engines are usually defined as devices which operate on a closed regenerative thermodynamic cycle with the expansion and

compression processes being ideally isothermal. However the ideal isothermal Stirling cycle does not yield usable information in terms of either predicted performance indications or performance criteria against which engine performance may be judged. Although more comprehensive analyses may allow machine design optimisation they do not provide performance criteria as these may only emanate from ideal cycle calculations. Since the isothermal cycle is deficient a new ideal cycle is required. One such cycle, recently postulated, is the so-called Pseudo-Stirling cycle and this has been rigorously investigated and found to be most promising. Perhaps the most significant finding from the theoretical data obtained is that maximum obtainable thermal efficiencies are independent of working fluid type (Author)

A79-10200 **Balanced compounding of Stirling machines**
 T Finkelstein (TCA Stirling Engine Research and Development Co., Beverly Hills, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1791-1797 9 refs

The results of a preliminary investigation using the Schmidt isothermal theory coupled with vector representation of cyclic quantities is presented. It is shown that using the principle of balanced compounding it is possible to combine double acting pistons in a Stirling engine so that the compression work is internally balanced by the expansion work. In consequence, the forces transmitted through the reciprocating links to the output shaft of a conventional machine can be reduced considerably and overall efficiency may therefore be higher. As an attractive alternative, one can also eliminate the mechanical output shaft and construct efficient self-starting and self-actuating free piston machines. Schematic diagrams of new configurations with one, two and four cylinders are presented. It is also shown that balanced compounding may be used for a free piston heat pump or a refrigerator. An example of such a design with only two moving parts is shown (Author)

A79-10201 **Influence of cyclic wall-to-gas heat transfer in the cylinder of the valved hot-gas engine** K P Lee and J L Smith, Jr (MIT, Cambridge, Mass.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1798-1804 8 refs

The valved hot gas engine (VHGE), first reported at the 1973 IECEC, is a closed regenerative, reciprocating Brayton cycle engine using helium as the working gas. Preliminary analysis shows that this engine is competitive with the Stirling engine in terms of low pollution, high efficiency, and power density. The low efficiencies of the first one cylinder engine have been under investigation since 1972. Tests and analyses show that cyclic heat transfer between the gas and the cylinder causes the major loss rather than piston ring leakage as first suspected. Engine efficiency could approach the expected 47% by further reduction of cyclic heat transfer in both the expander and the compressor (Author)

A79-10202 **Conversion of a standard single cylinder IC engine into a 'gamma' configuration air charged Stirling engine** G Rice (Reading, University, Reading, Berks., England) and J F Buckingham. In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1805-1811 9 refs

A Villiers Mark 10,99cc Single Cylinder Four Stroke Engine has been converted into a gamma configuration Stirling engine. The engine has been run using air at charge pressures of up to 6.6 bar. Instrumentation has enabled cyclic variation pressure-volume plots to be obtained. Various internal temperature measurements have been recorded. The test results are compared with theoretical predictions and an empirical relationship with respect to internal leakage has been obtained. A value of regenerator effectiveness is also derived (Author)

A79-10203 * **Design of a preprototype Stirling Laboratory Research Engine** F W Hoehn and A R McDougal (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1812-1819 5 refs Contract No NAS7 100

A description is given for the design and fabrication of a first generation, preprototype Stirling Laboratory Research Engine. The engine represents the first step in providing a research tool to be used to support the development of a broad range of analytical modeling and experimental efforts, and to evaluate new approaches to the design of components for Stirling engines. The test engine is a horizontally-opposed, two-piston, single-acting machine with a dual crankshaft drive mechanism. The preprototype engine is rated at 10 kW and was designed for maximum modularity. The long term objective of the project is to provide a proven design of a standardized test engine, which can be commercially produced, for national research on Stirling cycle machines (Author)

A79-10204 **The matching of a free piston Stirling engine coupled with a free piston linear compressor for a heat pump application** T J Marusak and W S Chiu (General Electric Co., Space Div., King of Prussia, Pa.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1820-1825

In connection with the development of a heat activated heat pump, a free piston Stirling engine, driving a free piston linear refrigerant compressor was selected for the prototype heat activated heat pump system prime mover/load configuration. The proper matching of a prime mover and a load is a design problem common to most power plant system analyses. The performance and the dynamic characteristics of the free piston Stirling engine/free piston compressor are sensitive to many design parameters. This sensitivity is a critical design concern since the free piston compressor load spring rate varies appreciably as a function of the ambient temperature. A linearized spring/mass dynamic model is used as a tool to assess the parametric tradeoffs during the early engine design phase. Later, the results of this first order approach for describing the component dynamics are verified with the aid of a thermodynamic analysis G R

A79-10205 **A free-piston Stirling engine for small solar power plants** G Prast and A K de Jonge (Philips' Gloeilampenfabrieken, Philips Research Laboratories, Eindhoven, Netherlands) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1826-1829

After a discussion of the requirements needed in a heat engine for a small solar thermal power plant a description is given of a free-piston Stirling engine, which might fulfil these requirements. The theory for the movements of the piston and displacer in the free-piston engine are given, and with a qualitative description it is shown how the machine has to be designed to reach the frequency wanted and that complete automatic operation between zero and full load is possible. Some preliminary results of a laboratory model are given (Author)

A79-10206 **A Stirling engine heat pump system** M L Hermans and G A A Asselman (Philips' Gloeilampenfabrieken, Philips Research Laboratories, Eindhoven, Netherlands) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1830-1833 5 refs

Results of theoretical and experimental work on a Stirling driven air-to-water Rankine heat pump are presented in this paper. The maximum heating capacity, consisting of the waste heat in the cooling water of the gas-fired engine and the heat produced by the

heat pump, is 23 kW Capacity control is by continuous speed modulation between 750 and 3000 rpm Calculations based on the experiments show a seasonal performance factor of 1.42 for a 1973 Hamburg house A second system consisting of a Stirling engine, a generator and a Rankine heat pump will be described too In this unit the speed is controlled discontinuously (750-1500-3000 rpm) by the electric generator, which is coupled to the mains A version of the latter system will be installed in summer 1978 in two semi-detached private houses (Author)

A79-10207 Conceptual design of a variable displacement Stirling engine for automotive propulsion R J Meijer and A P J Michels (Philips' Gloeilampenfabrieken, Philips Research Laboratories, Eindhoven, Netherlands) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1834-1840 9 refs

The first results of a fuel consumption study are given, in which the Stirling engine and automobile are treated as one system Controlling the shaft power of the Stirling engine by varying the stroke of its pistons makes it possible to eliminate the torque converter and automatic transmission A clutch and direct drive are used throughout the whole CVS speed range The Philips computer program is used to optimize the engine for highest efficiency at a part load point Constraints at low speeds and maximum power output are added A layout of a transversely mounted engine is made, frontwheel driving a 3500 lb automobile, using only existing technology and experience The accessories of the 4-215 and the 4-98 engines were scaled to fit this application Using Ford Motor Company simulation programs, a diesel fuel economy of 40 MPG is predicted for the Metro-Highway cycle This high economy further enhances the favorable emission characteristics of the engine (Author)

A79-10208 Mechanical efficiency of the Stirling cycle machine with rhombic drive A J Organ (King's College, London, England) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1841-1852 12 refs

Procedures are given for calculating the bearing loads and estimating the overall mechanical efficiency of Stirling-cycle machines with rhombic drive The simplifying assumptions are listed and the rhombic drive mechanism is considered with reference to expressions for axial displacements of the displacer and power piston, coefficients of friction for composite materials, the problem of interface, and buffer or crank-case pressure Loads in connecting rods, on main bearings, and crank pin loads are described Sample calculations are presented for the General Motors' PD-46 Stirling engine SCS

A79-10210 Development of a 1 kW/e/ isotope fueled Stirling cycle power system R L Wiley (General Electric Co, Fairfield, Conn) and D Lehrfeld (North American Philips Co, Inc, Philips Laboratories Div, Briardiff Manor, N Y) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1858-1864 Contract No EX-76-C-16-3084

The development of a 1 kW(e) Stirling Isotope Power System (SIPS) is underway This paper reports upon the design, construction, and predicted performance of SIPS The basic elements of the system are a 3900 watt plutonium (238) dioxide heat source, a Stirling cycle thermal converter driving twin alternators, controls, waste heat rejection loop, insulation, and auxiliary and emergency cooling subsystems for the heat source The SIPS is designed to deliver more than 1 kW(e) at 100 Vdc with an overall system efficiency approaching 30% It is designed to operate continuously and unattended for periods of six months with only routine maintenance between operation periods (Author)

A79-10211 Potential of the Stirling engine for stationary power applications in the 500-2000 HP range L C Hoagland (Amtech, Inc, Newton, Mass) and W H Percival In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1865-1871 17 refs Contract No EC-77-C-05-5392

The application of Stirling engines for stationary power applications in the 500-2000 hp range is assessed It is found that stationary Stirling engines can operate with an efficiency equal to that of comparable sized diesel engines while yielding lower levels of exhaust emissions and noise Stirling engines may be fired with solid fuels or low-grade fuels such as residual oil, crop residues, and waste materials For large stationary engines, the multicylinder, double-acting engine is the most suitable in terms of cost effectiveness Primary areas of technical concern are identified as piston rod seals, piston ring life, heater head cost and life, and air preheater cost and life SCS

A79-10212 Status of free-piston Stirling engine/linear alternator power conversion system development S J Piller (Mechanical Technology, Inc, Latham, N Y) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1872-1877

The development of a kW free-piston Stirling engine/linear alternator power conversion system is discussed in terms of the second phase of testing Attention is given to (1) engine/alternator system testing to demonstrator system feasibility, (2) the demonstrator preliminary design which defines concepts for system arrangement, analyzes components and their interactions, and establishes an optimal design, (3) a conceptual design of a 2 kWe free-piston Stirling engine space power system, and (4) the demonstrator final design SCS

A79-10213 The Department of Energy's thermionic energy conversion program O S Merrill (U.S. Department of Energy, Power Systems Div, Washington, D C) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1880-1886

The thermionic energy conversion program developed by the Department of Energy is outlined with reference to the near-term, mid-term, and long-term goals The two phases of the near-term program include the selection and development of the thermionic power modules The activities of the central station power plant application are identified as thermionic and materials research, power module evaluation, module development, and retrofit demonstration The estimated annual costs through 1987 are given and the fiscal year 1978 program is reviewed SCS

A79-10214 Thermionic power plant design point selection - The economic impact G O Fitzpatrick and E J Britt (Rasor Associates, Inc, Sunnyvale, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 1887-1892 5 refs Research supported by the U.S. Department of Energy

The paper discusses variations in thermionic heat exchanger (THX) design on overall power-plant efficiency, capital cost, and electricity cost A comparison is made between THX and reference steam systems A computer program developed to calculate the performance and cost of a THX is described along with the basic THX thermionic power plant design A block diagram of power plant performance and costs is presented with reference to an expression for overall system efficiency Results are presented in terms of THX operating point impact on efficiency, efficiency as a function of bypass heat, and capital cost as a function of design point THX and several other systems are compared on the basis of efficiency and costs SCS

A79-10215 Characteristics of combustion-heated thermionic diodes F N Huffman, B Gunther, and G Miskolczy (Thermo Electron Corp., Waltham, Mass.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1898-1903 7 refs Contract No EY 76 C 02 3056

Flame heated thermionic converters require protection from the combustion environment Ceramic and alloy materials are being evaluated for this purpose Silicon carbide and Inconel 671 have appeared most satisfactory in combustion atmosphere tests Experiments with variable spaced converters have identified L605 as a promising emitter material Flame-heated diodes using Inconel 671 have provided a power density of one W/sq cm at an emitter temperature of 1500 K The design and performance of such thermionic diodes are described (Author)

A79-10216 * A summary of USSR thermionic energy conversion activity N S Rasor (Rasor Associates, Inc., Sunnysvale, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1904-1908 20 refs Research supported by the U S Department of Energy and NASA

The paper surveys the research and development associated with thermionic energy conversion in the USSR Consideration is given to the basic physics of the thermionic converter, the development of thermionic nuclear reactors including the three TOPAZ models, radioisotope heated generators, and the thermionic topping of fossil-fueled electric-power plants Comparisons are made between U S and USSR capabilities in thermionic energy conversion and potential cooperative programs are noted S C S

A79-10217 * NASA's thermionic technology program L B Holcomb (NASA, Washington, D C) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1909-1916 21 refs

Since the termination of the NASA-AEC in core thermionic power program in 1973, NASA has maintained a modest thermionic technology program The current program emphasis on out-of-core thermionics allows greater flexibility in materials and geometrics previously prohibited by reactor nucleonics This out-of-core approach has allowed NASA's program to make significant technology contributions since 1973 This program currently aims at four areas (1) thermionic power systems analysis, (2) converters, (3) insulators, and (4) heat pipes Objectives, requirements, status and plans are presented for each area (Author)

A79-10219 Commercial applications of thermionic conversion using a fusion reactor energy source - A preliminary assessment T G Frank and L A Booth (California, University, Los Alamos, N Mex.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1924-1928 10 refs Research sponsored by the U S Department of Energy

A preliminary assessment of using thermionic conversion as a topping cycle for fusion reactors is presented Because of mitigation of restrictive temperature limitations for fusion-reactor blankets, fusion reactors may offer significant advantages, compared to fission reactors and fossil-fuel energy sources, for utilizing thermionic topping cycles A system with a thermionic topping cycle and a conventional steam-turbine generator that utilizes the heat rejected by the thermionic converters is presented for illustration This system consists of conceptual laser fusion reactors with high temperature radiating reactor blankets serving as heat sources for the thermionic topping cycle For the example analyzed, net conversion efficiencies of combined thermionic and steam turbine cycles are high, exceeding 50% for some values of the operating parameters,

and the cost of producing low voltage direct current for electrochemical processing is low (Author)

A79-10220 * Prospects of thermionic power systems K Shimada (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1929-1935 11 refs Contract No NAS7 100

Potential thermionic power systems for space or terrestrial applications are described so that the development goals can be clearly identified The thermionic power systems considered are a space nuclear power system, a fossil fuel thermionic topping steam power system, a solar thermionic topping steam power system, and advanced systems Attention is given to a discussion of the current status of technology development in thermionic converters and associated elements in power systems Future prospects of thermionic power systems are also discussed It is concluded that thermionic conversion has a great potential for a variety of applications S D

A79-10221 Selenide thermoelectric converter technology J D Hinderman, E F Hampl, Jr., R B Ericson, W C Mitchell, R S Reylek, and D A Wald (3 M Pioneering Laboratory, St Paul, Minn.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1938-1945 5 refs Contract No EY-76-C-02-2331

The potential of selenide thermoelectric materials to offer a significant performance advantage over state-of-the-art thermoelectrics has been discussed in recent years This paper describes recent advances in materials technology, including a characterization of the operating environmental requirements for a long-life thermoelectric generator The reference design for the converter section of a 156-couple ground demonstration system (GDS) is presented which was fabricated and placed on test at the end of 1977 A description of module development and component characterization leading up to the GDS design will also be presented (Author)

A79-10222 * Selenide technology evaluation program at JPL G Stapfer and L Garvey (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1946-1951 Contracts No AT(04-3) 959, No NAS7-100

Results are presented for experimental and analytical investigations of the overall performance of a selenide radioisotope thermoelectric generator intended to provide the electrical power for interplanetary spaceprobes such as the Galileo mission to Jupiter The discussion focuses on technology areas of concern, electrical properties of the selenide thermoelectric materials used, and thermal conductivity of these materials for superior performance It is shown that the selenide thermoelectric materials offer the advantage of high conversion efficiency The long life requirement on the power system for the Galileo mission necessitates proper design, known fabrication techniques, and reproducible assembly techniques in order to ensure stability of the thermoelectric properties However, the thermophysical properties sublimation and creep - of the p-material remains an area of considerable concern S D

A79-10223 * Analytical predictions of selenide RTG power degradation E L Noon, G Stapfer (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), and V Raag (Synical Corp., Sunnysvale, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1952-1957 Contracts No AT(04 3)-959, No NAS7-100

A mathematical model for the performance and degradation analysis of an RTG using the newly developed selenide thermoelectric materials has been developed at JPL. The computerized model is quite comprehensive and enables the accurate detailing of the electrical and thermal effects that take place within the thermocouple under any desired set of operation conditions, including heat input, ambient temperature and load conditions. The paper discusses the logic flow of the computer model and presents the time and temperature dependent results for various degradation mechanisms and rates as they have been established to date (Author)

A79-10224 **Suppression of vaporization in copper-silver-selenide thermoelectric materials** J Chin and N B Elsner In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1958-1962 Contract No E(04-3)-167 ERDA Project 60

Suppression of vaporization in P-type copper-silver selenide, (Cu,Ag)₂Se, was attempted by applying coatings and by mechanical barriers. The difficulties encountered with this material are associated with its very high thermal expansion and change in stoichiometry. Coatings which were both chemically inert and reactive with selenium were examined and include both crystalline and glassy coatings. Vaporization rates for inert and glassy coatings were 1/5 the rates of uncoated control samples. Reactive coatings reduced 850 C isothermal weight loss rates to 1/10 that of uncoated controls. Theoretical and experimental studies have been performed on bonded elements containing both glass sleeves and coatings. Results obtained with this concept have shown the greatest promise for minimizing 900 C vaporization degradation (Author)

A79-10225 * **Modified silicon-germanium alloys with improved performance** R K Pisharody (Synical Corp., Sunnyvale, Calif.) and L P Garvey (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1963-1968 7 refs Contract No NAS7-100

This paper discusses the results of a program on the modification of silicon-germanium alloys by means of small extraneous material additions in order to improve their figures-of-merit. A review of the properties that constitute the figure-of-merit indicates that it is the relatively high thermal conductivity of silicon-germanium alloys that is responsible for their low values of figure-of-merit. The intent of the effort discussed in this paper is therefore the reduction of the thermal conductivity of silicon-germanium alloys by minor alloy additions and/or changes in the basic structure of the material. Because Group III and V elements are compatible with silicon and germanium, the present effort in modifying silicon-germanium alloys has concentrated on additions of gallium phosphide. A significant reduction in thermal conductivity, approximately 40 to 50 percent, has been demonstrated while the electrical properties are only slightly affected as a result. The figure of merit of the resultant material is enhanced over that of silicon-germanium alloys and when fully optimized is potentially better than that of any other presently available thermoelectric material (Author)

A79-10226 **Recent terrestrial and undersea applications of radioisotope thermoelectric generators (RTGs)** F E Rosell, Jr (Defense Systems Management College, Fort Belvoir, Va.) and J F Vogt (U.S. Navy, Naval Nuclear Power Unit, Port Hueneme, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1969-1977

A79-10227 **Militarized thermoelectric power sources** G Guazzoni, A Herchakowski, and J Angello (U.S. Army, Electronics Technology and Devices Laboratory, Fort Monmouth, NJ.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1978-1983 5 refs

Thermoelectric power sources are being developed to provide multifuel, silent, maintenance free tactical power generators for forward area applications. Recent technology improvements, state of development, and performance characteristics of the 100 Watt and 500-Watt Thermoelectric Power Sources are presented (Author)

A79-10228 **High reliability contacts for miniature thermoelectric converters** M Lanxner, I Shai (Atomic Energy Commission, Nuclear Research Centre, Beersheba, Israel), A Brandstetter, and G Yekutieli (Weizmann Institute of Science, Rehovot, Israel) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1984-1988 10 refs

The stringent reliability requirements on biomedical power sources impose highest possible standards of quality and long term stability on the metal-semiconductor contacts of implantable radioisotope thermoelectric generators (RTG's). We have successfully used a technique of local heat pulses, bonding p and n type bismuth telluride thermoelements to palladium electrodes and resulting in contact resistivities as low as 10 to the -6th power ohm-sq cm. Details on the technique and results in terms of metallurgical interfaces, resistance profiles, contact strength and aging characteristics are presented (Author)

A79-10229 **Solar furnace type high power density thermoelectric generator** A Brandstetter, G Yekutieli (Weizmann Institute of Science, Rehovot, Israel), M Lanxner, and I Shai (Atomic Energy Commission, Nuclear Research Centre, Beersheba, Israel) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1989-1995 15 refs

The performance of a solar-powered thermoelectric generator based on an earlier described high power density thermopile concept is reported. In this generator the wedge-shaped electrodes bridging between the thin p and n type thermoelements are arranged in a cylindrical configuration forming a central cavity in which solar radiation is trapped like in a solar furnace. The device has a nominal electrical output of 10 Watt at 5 percent thermal efficiency and has so far been tested with solar radiation from a Fresnel lens, on an automatic sun-tracker, supplying about 100 Watt thermal input. Results of thermoelectric characteristics and performance measurements are presented, with particular emphasis on contact resistance effects and stability. Very good agreement is found with predicted performance in relation to the triangular electrode thermopile concept (Author)

A79-10230 **Nitinol heat engines for economical conversion of low grade thermal energy** J S Cory (Cory Laboratories, Escondido, Calif.) and J L McNichols (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 1998-2004 10 refs

Results of an investigation of Nitinol heat engine thermodynamic cycle performance are presented. The analysis is based upon extensive equation of state measurements and an irreversible thermodynamics algorithm formulated to account for internal friction (hysteresis) losses. Theoretical maximum efficiency for a Nitinol heat engine is shown to differ from Carnot by about 1%, showing conclusively that second law efficiency is not a limiting factor for application of Nitinol heat engines to low-grade thermal energy

A79-10231

conversion Performance is determined for present Nitinol material and is shown to be critically dependent on thermodynamic cycle selection Efficiency for various practical cycles ranges to greater than 80% of Carnot, and specific work to greater than 2000 J/kgm/cycles (Author)

A79-10231 Research on the sodium heat engine T K Hunt, N Weber, and T Cole (Ford Motor Co, Dearborn, Mich) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2011-2017 7 refs

The sodium heat engine (SHE) is a new device for direct thermoelectric energy conversion It uses the ionically conducting ceramic, beta-double prime alumina, to form a high-temperature concentration cell for elemental sodium The vapor pressure (activity) gradient across the cell is maintained by a high temperature heat source (at 600-1000 C) on one side of a beta-double-prime alumina membrane and a low temperature condenser (at 100-200 C) on the other side Theoretical analysis of the SHE shows that under quasi-reversible conditions the efficiency should be more than 90% of Carnot efficiency For typical operating conditions of $T_2 = 800$ C ($T_2 =$ inner-section temperature), $T_1 = 100$ C ($T_1 =$ outer-section temperature) a specific power output of 0.7 watt/sq cm has been achieved in test electrodes If certain design criteria involving parasitic heat losses can be met, the SHE should achieve overall thermal efficiency in the range of 20-40% at a power output of 1 watt/sq cm (Author)

A79-10232 Quasi-equilibrium Air Standard heat balanced cycle analysis E L Keating, R F Blaser, and A A Pouring (U S Naval Academy, Annapolis, Md) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20 25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2018-2026 8 refs Navy supported research

The Air Standard model of the cycle for the Naval Academy Heat Balanced Engine (NAHBE) has been investigated analytically The 'ideal' thermodynamic or heat balanced cycle was studied parametrically to determine the influence of changes in geometry and heat input on predicted indicated engine performance Values for the cycle state points as well as mean effective pressure and thermal efficiency were obtained from the analysis as a function of variations in compression ratio and heat input Comparisons are given with compatible Air Standard Otto and Diesel cycles Results obtained for quasi-equilibrium indicate that for equal compression ratios and total heat input the heat balanced cycle yields lower peak pressures than the Otto cycle and with optimum geometry yields higher thermal efficiency than the Otto cycle Equilibrium reduces to the classic dual cycle (Author)

A79-10233 Army facility energy conservation J R Hoffman (U S Army, Corps of Engineers, Washington, D C) and H D Musselman (U S Army, Facilities Engineering Support Agency, Fort Belvoir, Va) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20 25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2039-2042

The Army installation is similar to a small city with a population of 30,000 to 40,000 people The Army's approach to energy conservation, energy management and control, and the use of alternate energy sources is on an installation wide or city wide basis, i.e., energy master planning The first step in energy master planning is to perform an energy audit to determine when, where and how energy is consumed This data is used to determine benefits that can be derived from energy conservation ideas, changes in building design criteria and base operation changes that will conserve energy (Author)

A79-10234 * Design and operating experience on the U S Department of Energy Experimental Mod-O 100 kW Wind Turbine J C Glasgow and A G Birchenough (NASA, Lewis Research

Center, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2052-2059 5 refs

The Mod-O 100 kW Experimental Wind Turbine was designed and fabricated by NASA, as part of the Federal Wind Energy Program, to assess technology requirements and engineering problems of large wind turbines The machine became operational in October 1975 and has demonstrated successful operation in all of its design modes During the course of its operations the machine has generated a wealth of experimental data and has served as a prototype developmental test bed for the Mod-OA operational wind turbines which are currently used on utility networks This paper describes the mechanical and control systems as they evolved in operational tests and describes some of the experience with various systems in the downwind rotor configuration (Author)

A79-10235 * DOE/NASA Mod-OA wind turbine performance T R Richards and H E Neustadter (NASA, Lewis Research Center, Cleveland, Ohio) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2060-2063 11 refs

The NASA Lewis Research Center has designed, built, and is operating a 200-kW wind turbine (designated the Mod-OA-1) at Clayton, New Mexico This paper compares the measured power-vs-speed performance of the Mod-OA 1 with predictions made using the PROP code It is found that the actual performance closely matches predictions B J

A79-10236 On-line control of a large horizontal axis wind energy conversion system and its performance in a turbulent wind environment J M Kos (United Technologies Corp, Hamilton Standard Div, Windsor Locks, Conn) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20 25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2064-2073

This paper describes a closed loop, shaft torque control for controlling the power of a large (2 megawatt), variable pitch, horizontal axis wind turbine, driving a synchronous generator connected to a large power system (on line operation) A control mode is presented which provides a stable, responsive control system by sensing shaft torque and rotor rotational speed Dynamic performance results from a digital simulation of the system operating on-line in a turbulent wind environment are presented The results show the dramatic improvement in on-line system performance that can be achieved with the responsive shaft torque control described in this paper The responsive control significantly attenuates both blade loads and electrical power fluctuations due to wind turbulence and will go far toward maximizing the on-line operating hours of the wind energy conversion system (Author)

A79-10237 Advanced wind furnace systems for residential and agricultural heating and electrical supply applications J G McGowan (Massachusetts, University, Amherst, Mass) and P H Sarkisian (Carrier Corp, Syracuse, NY) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3 Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2074-2081 22 refs Research supported by the U S Department of Energy

This paper summarizes the results of an analytical performance and economic evaluation of three advanced wind furnace heating systems The work represents an extension of previous work on wind powered heating systems and extends this wind energy application to the supply of electricity as well as space and hot water energy loads for rural residences and farms Details of the proposed systems and the analytical modeling of the overall system and subcomponents are presented as well as typical system energy and economic performance (Author)

A79-10238 Experimental demonstration of the Diffuser Augmented Wind Turbine concept B L Gilbert and K M Foreman (Grumman Aerospace Corp, Research Dept, Bethpage, N Y) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2082-2089 6 refs Contract No EY-76 C 2-2616

The Diffuser Augmented Wind Turbine (DAWT) is one of the advanced concepts being investigated to improve the economics of wind energy conversion systems (WECS) Very compact diffusers using boundary layer control have been examined experimentally Small scale model testing with screens and centerbodies to simulate a real turbine was used to choose a baseline diffuser configuration This design is a conical, 60-deg included angle diffuser with an area ratio of 2.78 controlled by two tangential injection slots The configuration also has been tested at ten times greater physical size and up to 3.5 times greater wind speed using screens and a real turbine This first generation, nonoptimized DAWT configuration should provide about four times the power of a conventional WECS with the same turbine efficiency, diameter, and wind at optimum turbine disk loading (Author)

A79-10239 Torque ripple in a vertical axis wind turbine R C Reuter, Jr and M H Worstell (Sandia Laboratories, Albuquerque, N Mex) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2090-2098 9 refs Research supported by the U S Department of Energy

Torque ripple is a name given to time variations in torque which are propagated through the drive train of wind energy conversion systems This paper covers an analytical and experimental investigation of torque ripple in a Darrieus vertical axis wind turbine An analytical model of the turbine is described and numerical results from a solution to the equations of this model are compared to experimental results obtained from the existing DOE/Sandia 17 meter vertical axis wind turbine Discussions on the sources of torque ripple, theoretical and experimental correlation, and means of suppressing its magnitude are included (Author)

A79-10240 Toroidal Accelerator Rotor Platforms for wind energy conversion A L Weisbrich (Kaman Aerospace Corp, Bloomfield, Conn) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2099-2107 10 refs Presented is a Toroidal Accelerator Rotor Platform (TARP) design for Wind Energy Conversion Systems (WECS) application A TARP WECS is analyzed for performance and economic viability using both experimental results and analytical approaches Results indicate a TARP WECS to have unusual promise and potential for meeting the diverse prerequisites for a WECS to become a viable energy system alternative These are reduced energy cost, applicability and interface adaptability to a broad range of uses, environments and structures, as well as aesthetic design with minimal environmental impact One of TARP's principal design features include adaptation of its support structure for multipurpose use to conventional base structures which greatly aids its economic viability (Author)

A79-10241 * SIMWEST - A simulation model for wind energy storage systems R W Edsinger, A W Warren (Boeing Computer Services, Inc, Seattle, Wash), L H Gordon (NASA, Lewis Research Center, Cleveland, Ohio), and G C Chang (U S Department of Energy, Washington, DC) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2108-2114 This paper describes a comprehensive and efficient computer program for the modeling of wind energy systems with storage The

level of detail of SIMWEST (Simulation Model for Wind Energy Storage) is consistent with evaluating the economic feasibility as well as the general performance of wind energy systems with energy storage options The software package consists of two basic programs and a library of system, environmental, and control components The first program is a precompiler which allows the library components to be put together in building block form The second program performs the technoeconomic system analysis with the required input/output, and the integration of system dynamics An example of the application of the SIMWEST program to a current 100 kW wind energy storage system is given (Author)

A79-10242 Nickel-cadmium battery reconditioning and long term performance in geosynchronous orbit spacecraft R H Sparks and D Rusta (TRW Defense and Space Systems Group, Redondo Beach, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2116-2120 9 refs Present geosynchronous orbit spacecraft systems are designed to operate for five to ten years Future systems are planned for 12 years of service and beyond There is, therefore, strong encouragement to find new operational methods that will extend nickel cadmium battery service life This paper summarizes progress made toward achieving the stated objective and other work directed toward improvement of the specific energies of the nickel cadmium and nickel-hydrogen battery systems Studies and tests indicate that 10 to 15 year life requirements can be met at an 80 percent depth of discharge The work has focused on (1) application of deep discharge reconditioning techniques, (2) use of electrochemically impregnated nickel electrodes, and (3) reduction of average battery temperatures (Author)

A79-10243 * Ultra-thin silicon solar cells for high performance panel applications C F Gay (Spectrolab, Inc, Sylmar, Calif) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2121-2124 6 refs NASA-sponsored research Solar cells have been fabricated which achieved the highest power to mass ratios and radiation stability yet reported for silicon devices The thinnest cells (0.4 mm) had initial efficiencies in excess of 2 watts per gram (AMO) and 17 watts per gram after an irradiation of 1×10 to the 15th equivalent 1 MeV electrons per square centimeter The cells have been successfully interconnected by welding and filtered using a FEP bonded, ceria-doped microsheet of six mil thickness Handling losses during cell manufacture and panel assembly may be minimized through the use of an integral reinforcing perimeter or ribs which remove almost all restrictions on cell thickness and area Such a cell is typically composed of a main section which can be as thin as 0.015 mm and is supported at the edge by a thicker border (0.20 mm) of silicon (Author)

A79-10245 Development and testing of the ULP solar array H von Bassewitz and K Schneider (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif, August 20-25, 1978, Proceedings Volume 3

Warrendale, Pa, Society of Automotive Engineers, Inc, 1978, p 2131-2142 The described flatpack ultralightweight panel is intended for triaxially stabilized spacecraft with sun-oriented solar arrays and a power requirement of 1 to 10 kW The array consists of modular panels composed of a rigid carbon-fiber frame with a pretensioned solar-cell blanket Objectives of the development program for this solar array are surveyed, and the test procedure - in particular, the sinusoidal vibration test, the acoustic noise test, deployment testing, and thermal cycling - is described Performance and design characteristics are reported M L

A79-10246 Catalytic gasification predevelopment research N C Nahas and J E Gallagher, Jr (Exxon Research and Engineering Co, Florham Park, NJ) In Intersociety Energy

A79-10247

Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3
Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 2143-2147 Contract No E(49 18) 2369

Significant progress has been made in the predevelopment research phase of catalytic coal gasification for the production of substitute natural gas (SNG). The potassium catalyst and the processing sequence permit the direct reaction of steam and coal to form methane and carbon dioxide, a reaction which is thermally neutral and does not require oxygen for heat balance or downstream methanation of synthesis gas. A model of the reaction kinetics has been developed and a preferred approach has been identified to recover about 90 percent of the potassium catalyst for reuse.

(Author)

A79-10247 Catalytic coal gasification exploratory research program K E Woodcock (U S Department of Energy, Div of Coal Conversion, Washington, D C) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3
Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 2148-2152 13 refs

Catalytic coal gasification research programs are surveyed, and favorable effects of catalysis on rate, gas composition, and reduction of the free swelling index are examined. Economic feasibility is considered, and it is suggested that catalytic coal gasification may offer significant economic incentives over alternate approaches. Bench scale experiments with coal feed rates up to 10-20 pounds per hour are described.

M L

A79-10248 LAG-Process, some results of utilization in transport and mechanical engineering L A Gussak (Akademiya Nauk SSSR, Institut Khimicheskoi Fiziki, Moscow, USSR) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3
Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 2153-2163 20 refs

Fuel burning processes involving systems of energy conversion provide mankind with a wide spectrum of methods of heating, transporting, producing, lighting, etc. Useful as they are, these processes possess some properties: narrow flammability and combustion limits, low speed and incompleteness of combustion, corrosive aggressiveness and biological toxicity that limit the possibility of raising the utilization efficiency of our energy resources. The purpose of this paper is to contribute to the technology required to limit these negative effects. Results of our investigations of combustion processes are described. These investigations have led to the discovery of the high chemical activity of products of incomplete combustion of fuel-air mixtures. This has established a basis for a novel process - the avalanche activation of combustion (LAG-Process). It has been used both for cyclic combustion in gasoline carbureted and injection-fueled internal combustion engines and for stationary burning of gas in furnaces for thermal and technological metal-heating. Some test results of these devices are also described.

(Author)

A79-10249 Electric power from laser fusion - The HY-LIFE concept M Monsler, J Maniscalco, J Blink, J Hovingh, W Meier, and P Walker (California, University, Livermore, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3
Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 2164-2169 11 refs Contract No W 7405-eng 48

A high yield lithium injection fusion energy chamber is described which can conceptually be operated with pulsed yields of several thousand megajoules a few times a second, using less than one percent of the gross thermal power to circulate the lithium. Because a one meter thick blanket of lithium protects the structure, no first wall replacement is envisioned for the life of the power plant. The induced radioactivity is reduced by an order of magnitude over solid blanket concepts. The design calls for the use of common ferritic steels and a power density approaching that of a LWR, promising

shortened development times over other fusion concepts and reactor vessel costs comparable to a LMFBR.

(Author)

A79-10250 The laser fusion scientific feasibility experiment T J Gilmartin, R O Godwin, and J F Holzrichter (California, University, Livermore, Calif.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3
Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 2170-2172 Contract No W-7405-eng-48

The Nova project will provide a 200-300 terawatts (TW) laser and target irradiation facility for advanced laser fusion experiments. The goal is to prove the scientific feasibility of laser fusion by demonstrating high-energy-gain microexplosions. The laser system design utilizes the most advanced solid state laser technology, which is optimized to achieve the highest performance. The target systems represent a significant advance in laser fusion technology.

(Author)

A79-10251 Economic methodology for solar power-generating systems A S Roy In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3
Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 2175-2179 14 refs Contract No W 7405-eng-26

A generalized methodology is developed for comparative assessments of various design concepts of solar power systems. The formulated relationships are based on both identified reference frames equally applicable to any solar power system and on explicit relationships between equipment costs and fundamental system parameters that relate to physical properties and design concepts. No arbitrary cost assumptions are made, however, major cost-determining factors are identified and correlated. All solar systems and subsystems are compared on an equal basis, that is, 'normalization' is built in. Synergetic effects between the subsystems of a plant are identified, and the assessment of the relative merits of various possible improvements is facilitated. As the area related subsystems cost several times more than the conversion subsystems, analysis shows that efforts for improving conversion efficiencies are justified even at considerable expense. High-temperature materials especially are expected to play an important role in this respect.

(Author)

A79-10252 Wave energy conversion in a random sea M E McCormick (U S Naval Academy, Annapolis, Md.) In Intersociety Energy Conversion Engineering Conference, 13th, San Diego, Calif., August 20-25, 1978, Proceedings Volume 3
Warrendale, Pa., Society of Automotive Engineers, Inc., 1978, p 2186-2193 15 refs

The wind wave power delivered to several hypothetical wave energy converters is predicted using the Pierson-Moskowitz wave spectrum. Two general types of converters are considered. First, the half-plane type which is dependent on wave direction, but not normally dependent on wave frequency. The second type is the omni-directional which is independent of wave direction but normally frequency dependent. Results of the analyses are then applied to several specific devices.

(Author)

A79-10253 # A thermodynamic study of heating with geothermal energy G M Reistad (Oregon State University, Corvallis, Ore.), B Yao (Ford Motor Co., Power Train and Chassis Div., Dearborn, Mich.), and M Gunderson (AirResearch Manufacturing Company of California, Torrance, Calif.) (*American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27 Dec 2, 1977, Paper 77-WA/Ener-1.*) ASME, Transactions, Journal of Engineering for Power, vol 100, Oct 1978, p 503-510

The study provides information useful for determining when and for what systems a detailed thermodynamic study of heating with geothermal energy should be conducted. More specifically, the information provided concerns the thermodynamic evaluation of a number of systems for using geothermal energy which exists at a definite geothermal-resource temperature, T(R), to supply heating at a desired temperature, T(H). The discussion is limited to the thermodynamic performance of several conventional systems, the

common direct heating geothermal system, and two geothermal systems utilizing heat pumps. The formulation of the thermodynamics for each system is described along with optimal results for each system at various T(R) and T(H). It is shown that no single system is superior to the others, but rather certain systems have better performance for specific ranges of T(R) and T(H), while in other ranges different systems are superior. S D

A79-10257 # Development of gas turbine performance seeking logic. D Jordan (Connecticut, University, Storrs, Conn.) and G J Michael (United Technologies Research Center, East Hartford, Conn.) (*American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-13*) ASME, Transactions, Journal of Engineering for Power, vol 100, Oct 1978, p 571-575, Discussion, p 575. NSF Grant No SER 76-05002

Adaptive control logic has been defined for static performance optimization of variable geometry gas turbine engines. The control logic is directed toward (1) in-flight minimization of thrust specific fuel consumption, (2) test-stand automatic trimming, and (3) generation of optimum control schedules. The algorithm was evaluated by application to a nonlinear digital dynamic simulation of the F100/F401 turbofan engine throughout a range of representative flight conditions. Engine component degradations as well as mistrimmed control schedules were introduced to assess algorithm performance. Results indicate that the performance seeking algorithm offers promise for steady state performance optimization for in-flight, test-stand, and set point design optimization applications. (Author)

A79-10269 # Evaluation program for new industrial gas turbine materials. C Just and C J Franklin (Sulzer Brothers, Ltd., Zurich, Switzerland) (*American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-145*) ASME, Transactions, Journal of Engineering for Power, vol 100, Oct 1978, p 704-710. 11 refs

An evaluation system is described which minimizes the time and cost of testing many candidate materials for industrial gas turbines, along with the risk related to the introduction of a new material into service. The data required for materials evaluation comprise strength properties as a function of temperature, corrosion resistance, suitability of protective coatings, metallographic and fractographic data, physical properties, production and testing methods, machining and bonding techniques, and costs and availability. The discussion focuses on important properties for modern industrial gas turbines, thermal fatigue, matrix coating interactions, and general evaluation procedure. S D

A79-10278 # Vortex sheet analysis of the Giromill. R E Wilson (Oregon State University, Corvallis, Ore.) ASME, Transactions, Journal of Fluids Engineering, vol 100, Sept 1978, p 340-342. 12 refs. Contract No EY-76-S 06-2227

A two-dimensional analysis of the performance and flowfield of the Giromill is presented. The Giromill is a vertical-axis wind turbine with straight blades that are articulated to produce maximum energy extraction from the wind. It is found that the power coefficient and windwise force coefficient for the Giromill have the same limit as obtained for the horizontal axis wind turbine. A cross-wind force is also obtained with this type of wind turbine. The cross-wind force is of second order and decreases with tip speed. Streamlines and velocity profiles are illustrated for several loading conditions. (Author)

A79-10398 * Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity. L Tobias, E A Palmer (NASA, Ames Research Center, Moffett Field, Calif.), and P J O'Brien (FAA, National Aviation Facilities Experimental Center, Atlantic City, N.J.) (*Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass., May 1-4, 1978, Paper 780523*) 13 p. 6 refs

Fuel-conservative procedures have been investigated using real-time air traffic control simulations linked to two piloted simulators. The fuel-conservative procedures studied were profile descents and two types of landing approaches. The investigation determined the effect of these procedures on the ATC system and terminal area capacity. It examined the mixing of aircraft executing fuel-conservative approaches with those executing conventional approaches. The results indicate a systems fuel savings for the landing approaches under all tested conditions except at, or near, maximum system capacity. Also, there is a fuel savings and reduced controller workload for the profile descent procedures. (Author)

A79-10403 Filon panels - A technical report. J E Whitridge (Vistron Corp., Filon Div., Hawthorne, Calif.) *Sunworld*, vol 2, Feb 1978, p 18-22

All Filon panels are manufactured with acrylic-fortified polyester resin reinforced with fiberglass and contain UV light absorbers to reduce color degradation. But it is generally agreed that Tedlar-clad Filon panels are best suited for solar applications. The Tedlar surface provides additional UV protection as well as protection from surface degradation, and its matte finish tends to reduce reflectivity. This paper presents preliminary experimental data on the properties of Tedlar clad Filon panels for use as solar collector covers. Consideration is given to optical properties (transmittance and reflectance), spectral characteristics, and to the problems associated with heat distortion, open aqueous collectors, fastening, hail, and wind loads. B J

A79-10419 * Organic geochemical studies on kerogen precursors in recently deposited algal mats and oozes. R P Philp, M Calvin, S Brown, and E Yang (California, University, Berkeley, Calif.) *Chemical Geology*, vol 22, 1978, p 207-231. 38 refs. Research supported by A L Day Fund and ERDA, Grant No NGL-05-003-003

The same kerogen-like residue from the algal mats and oozes at Laguna Mormona, Baja California, is examined following degradation by saponification, alkaline KMnO4 oxidation, and HBr treatment. For comparison, pyrolytic degradation is performed for the residue and five others, two of which are obtained from algal mats at Baffin Bay, Texas. Major conclusions are that (1) Saponification of a residue specimen from the algal-ooze residue results in minor amounts of components bonded to it as esters, (2) Alkaline KMnO4 oxidation reveals that the same residue consists of a cross linked aliphatic nucleus with additional components attached to it as esters, (3) the major products from pyrolysis of the residue include phytenes, pristenes, sterenes, and triterpenes, and (4) the HBr treatment yielded only one product, indicating the absence of a large number of ether-linkages readily cleaved by HBr. S D

A79-10452 # The propulsion of vehicles by a flywheel (La propulsion de véhicules par roue d'inertie). J Benoit (Institut National de la Recherche Scientifique Energie, Varennes, Quebec, Canada) In Urbanization and pollution, Symposium, Saint-Jovite, Quebec, Canada, May 29-31, 1977, Proceedings. Montreal, Association pour l'Assainissement de l'Air, 1977, p 1-11. In French

The use of flywheels to store energy and to power automobiles and buses is discussed. The basic inertial properties of flywheels are reviewed, the profiles of some commonly used flywheels are presented, and parameters of flywheels made from different materials are reported. The use of flywheels can reduce the size of a battery system required to power a car since the flywheel stores energy that would otherwise have to be stored in a battery system, advantages of combined systems are examined. Characteristics of the Oerlikon bus (which uses discontinuous external sources of electricity, not batteries), the Rabenhorst urban vehicle, and the kinetic-energy-wheel bus are reported. M L

A79-10475 Scaling up coal liquids. R Whitaker *EPRI Journal*, vol 3, Sept 1978, p 6-13

Electric utilities are vitally interested in coal liquefaction technology because many of them have major investments in oil-fired

A79-10511

generating plants that can economically work out their productive lives only on liquid fuels. Also, liquefaction processes have the built-in potential to remove such troublesome coal constituents as sulfur and nitrogen, thus yielding clean-burning fuels. It is, therefore, of vital importance that the new fuels will be available, when needed, as a price-competitive supply. Attention is given to the nature of coal liquids, three contemporary processes, development problems, and approaches for insuring the feasibility of a production of the coal-derived liquid fuels at the time when they are needed. G R

A79-10511 # Space platforms for building large space structures C J Goodwin (Grumman Aerospace Corp., Bethpage, N Y) *Astronautics and Aeronautics*, vol 16, Oct 1978, p 44-47

The paper considers a mid '80s beam builder space platform with a moving cherry picker that could build structures too large for a single Shuttle sortie, but smaller than solar power satellites. The platform could have solar arrays, radiators, space construction equipment, and docking provisions. It would be a free flyer, placed into a low earth orbit readily accessible to the Shuttle. Docked to the Shuttle, the platform would enlarge the construction workspace, and add power and cooling to handle more demanding payloads and extend the Shuttle's on-orbit duration. As a free flyer, it could support experiments, laboratories, observation instruments, and even habitation modules. B J

A79-10513 # Structures for solar power satellites R H Nansen and H di Ramio (Boeing Aerospace Co., Seattle, Wash) *Astronautics and Aeronautics*, vol 16, Oct 1978, p 55-59

The paper compares tapered tube and continuous-chord construction concepts for the baseline photovoltaic planar array of a solar power satellite. Both concepts appear to be feasible and could potentially be incorporated into an SPS design. The tapered tube has the advantage of less mass per SPS, higher manufacturing rate, easier structural-integrity verification, and more structural design flexibility. The continuous chord has the advantages of higher packaging density if manufactured in space, less joint slop, and lower machine complexity. B J

A79-10520 Instrumentation for in situ coal gasification II - Thermal and gas sampling diagnostic techniques P J Hommert, S G Beard, R P Reed, J A Beyeler, and D A Northrop (Sandia Laboratories, Albuquerque, N Mex) *In Situ*, vol 2, no 3, 1978, p 143-172 11 refs

Thermal and gas sampling instrumentation used in the Hanna II in situ coal gasification experiment is discussed, and details of the instrumentation hardware, data acquisition and validation procedures, and thermal data analyses are presented. Analysis of the thermal data provides descriptions of the location, size, and temperature of the reverse combustion linkage path, a thermal and spatial profile of the reaction front, and a method for improved process mapping. Long line gas sampling techniques are shown to be suitable for determining local in-seam gas compositions and pressures. Capabilities of a limited and a more extensive thermal array are described, and improvements in thermometry and gas sampling for the Hanna IV experiment are examined. M L

A79-10521 Engineering analysis of in situ liquefaction of coal D L Wise and D C Augenstein (Dynatech R/D Co., Cambridge, Mass) *In Situ*, vol 2, no 3, 1978, p 173-195 38 refs

In situ liquefaction of underground coal by hot aqueous alkaline extraction is discussed and is evaluated as an economic and practical alternative to deep shaft mining as well as in situ gasification. In the described process, hot alkali, pumped at high pressure down a borehole, passes through the coal bed (rendered permeable by fracturing) and reacts with coal to form a product mix which exits through a second borehole. Examination of material and energy balances and thermal effects suggests that this liquefaction concept has favorable features. M L

A79-10522 Combustion rates for oil shale carbonaceous residue L Dockter and T F Turner (U.S. Department of Energy, Laramie Energy Research Center, Laramie, Wyo) *In Situ*, vol 2, no 3, 1978, p 197-215 11 refs

The combustion rate of the residual carbon remaining in retorted oil shale core samples was studied, and the data seem to indicate an ash layer diffusion control mechanism. The combustion front penetration rate is proportional to the square root of time and increases linearly with the square root of the sweep gas oxygen concentration. Equations relating the residual carbon combustion rate to shale richness and the oxygen concentration in the sweep gas are presented. M L

A79-10523 Underground coal gasification research at the University of New Mexico H E Nuttall, E A Walters, and T M Niemczyk (New Mexico University, Albuquerque, N Mex) *In Situ*, vol 2, no 3, 1978, p 237-241 8 refs

A79-10658 Hybrid reactor based on laser-induced thermonuclear fusion L P Feoktistov, E N Avrorin, L F Varganova, A D Gadzhiev, V A Lykov, V Z Nechai, and L I Shibarshov (*Kvantovaya Elektronika /Moscow*), vol 5, Feb 1978, p 349-358) *Soviet Journal of Quantum Electronics*, vol 8, Feb 1978, p 201-206 23 refs Translation

The primary physical characteristics of a high-energy hybrid laser-fusion device are reviewed. Various target configurations are described including (1) solid spherical targets of DT ice compressed by a laser pulse, (2) targets made of thin shells of DT ice, and (3) targets of spherical glass or metal shells filled with DT gas under high pressure or with layers of DT ice. The vessel is discussed and the parts of the blanket are identified as the high-power fuel-containing zone, external and internal pressure vessels, and the tritium breeding zone. A conceptual reactor assembly is presented. S C S

A79-10778 # Second-generation integrated coal gasification/combined-cycle power systems N G Carlson, F L Robson, J S Westmoreland (United Technologies Corp., East Hartford, Conn), and W M Talbot (Pullman, Inc., Houston, Tex) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-14* 11 p 8 refs Members, \$150, nonmembers, \$300 Contract No. FY-76-C-01 2292

This paper discusses the second generation integrated coal gasification/combined-cycle power systems using, as a basis, the molten-salt gasifier. A brief description of the major equipment which forms the basis of the power plant, the analysis identifying the operating conditions for the integrated system, and a discussion of the overall power plant design are given. (Author)

A79-10788 # Powerplant integration - The application of current experience to future developments T W Brown and J E Talbot (British Aircraft Corp., Ltd., Commercial Aircraft Div., Filton, Bristol, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-113* 11 p 8 refs Members, \$150, nonmembers, \$300

The paper reviews the basic operation and function of the current Concorde powerplant and describes some advances in aerodynamic and control system philosophy for better performance with reduced weight and complexity. The discussion is limited to air intake design and powerplant control. With low risk aerodynamic modifications to provide enhanced performance, the current twin-celle unit can be improved to give overall characteristics at full scale within an acceptable margin of current proposals for so called advanced supersonic transport aircraft. In the future, any alternative proposals for a powerplant installation must show a significant margin in terms of theoretical/wind tunnel performance before it can be recognized as a viable alternative. S D

A79-10791 # Investigating combustion turbine burner performance with coal derived liquids having high fuel bound nitrogen P W Pillsbury (Westinghouse Electric Corp , Eddystone, Pa), A Cohn (Electric Power Research Institute, Palo Alto, Calif), P R Mulik (Westinghouse Electric Corp , Pittsburgh, Pa), and T R Stein (Mobil Oil Corp , Paulsboro, N.J) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-126* 12 p 21 refs Members, \$1 50, nonmembers, \$3 00 Research supported by the Electric Power Research Institute

Characteristics of coal-derived liquids proposed as turbine fuels are discussed relative to hydrogen and aromatic content, nitrogen content, and metal content Viscosity and health considerations of coal-derived liquids are highlighted Attention is given to combustor deposits and increase in combustor wall temperature Experience with fuel bound nitrogen is briefly outlined indicating that at high burner outlet temperatures, increases in fuel-bound nitrogen do not appear to cause proportionate increases in exhaust NO_x Coal-derived liquids are presently under consideration to replace petroleum distillates and natural gas as fuels for combined-cycle power plants S D

A79-10799 # Development of a compact gas turbine combustor to give extended life and acceptable exhaust emissions D McKnight (Rolls-Royce, Ltd , Industrial and Marine Div , Ansty, Warwick, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-146* 9 p Members, \$1 50, nonmembers, \$3 00

The paper describes the development history of the Olympus gas turbine combustor from the time that it was first applied to an industrial application in the early 1960s The design improvements made (1) to permit a change in fuel (from kerosene to diesel and/or natural gas), (2) a 60 percent increase in engine performance, and (3) to reduce emission levels are detailed, and the in service problems associated with these changes are also discussed The emphasis is placed upon improvements in combustor life and capability to produce smoke levels well below the visible threshold, and significant success is shown to have been achieved in these two factors The final sections of the paper are concerned with the latest on going development effort, which is primarily to produce a low emission combustor that can be retrofitted into today's engines (Author)

A79-10816 # Advanced turbofan engines for low fuel consumption W Sens (United Technologies Corp , Commercial Products Div , East Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-192* 12 p Members, \$1 50, nonmembers, \$3 00

A projection of jet fuel usage by the free world commercial fleet shows that the fuel used by new advanced turbofan engines developed from technology advances anticipated in the next six to eight years would become significant toward the end of this century assuming that the advanced turbofans start entering the fleet by approximately 1990 During the time period 1980 to the year 2000 approximately 90 percent of the total will be burned by engines in existence today, or new engines based on existing design technology Only about 10 percent would be used by advanced turbofan engines designed in the mideighties or later Means of improving the fuel consumption of current engines by as much as 5 percent are identified and attention is given to an advanced turbofan configuration which has the potential of providing a reduction in fuel consumption of 20 percent G R

A79-10818 # Making turbofan engines more energy efficient. M C Hemsworth and M A Zipkin (General Electric Co , Cincinnati, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-198* 13 p 10 refs Members, \$1 50, nonmembers, \$3 00

A review of transport aircraft gas turbine engine development and evolution during the past two decades is presented in terms of

energy consumption The interaction and effects of cycle pressure ratio, firing temperature, bypass ratio, and component efficiencies on installed fuel consumption are reviewed The possibilities for further substantial improvement in energy efficiency with improved operating economics and with improved environmental characteristics are identified and evaluated Parametric data are presented showing trade offs in the areas of efficiency and economics Environmental considerations are also discussed The balance of these factors in a cost effective advanced turbofan is discussed In conclusion, projections are made for the capability of an advanced turbofan engine compared with the goals established by NASA for their Energy Efficient Engine Program The characteristics of this more efficient, cost-effective power plant, that can be operational in the late 1980's are shown in relationship to current turbofan engines (Author)

A79-10824 * # Alternative aircraft fuels J P Longwell (MIT, Cambridge, Mass) and J Grobman (NASA, Lewis Research Center, Cleveland, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 21 p* 11 refs

In connection with the anticipated impossibility to provide on a long-term basis liquid fuels derived from petroleum, an investigation has been conducted with the objective to assess the suitability of jet fuels made from oil shale and coal and to develop a data base which will allow optimization of future fuel characteristics, taking energy efficiency of manufacture and the tradeoffs in aircraft and engine design into account The properties of future aviation fuels are examined and proposed solutions to problems of alternative fuels are discussed Attention is given to the refining of jet fuel to current specifications, the control of fuel thermal stability, and combustor technology for use of broad specification fuels The first solution is to continue to develop the necessary technology at the refinery to produce specification jet fuels regardless of the crude source G R

A79-10897 Proposals for power conditioning systems of high power communication satellites K Graszynski (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Cologne, West Germany) In *Power Electronics Specialists Conference* Palo Alto, Calif , June 14-16, 1977, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 254-260 8 refs

Several power conditioning concepts for a high power communication satellite are described The concepts include (1) regulated ac voltage, (2) resonant current converter, and (3) square-wave alternating current and voltage It is shown that an ac system with regulated sinusoidal main-bus voltage is flexible and suited for high power applications On the other hand, decentralized resonant current systems may be better suited to some special applications due to their high efficiency B J

A79-10898 Thyristor controlled rectifier inverting at unity power factor S B Dewan and J R Sylvester (Toronto, University, Toronto, Canada) In *Power Electronics Specialists Conference*, Palo Alto, Calif , June 14-16, 1977, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 262 267

Conventionally, variable voltage dc power is converted to three phase 60 Hertz with three phase controlled rectifier operating in the inverting region and the input power factor varies with the magnitude of the dc voltage This paper describes a modified controlled rectifier system which maintains the line power factor to almost unity independent of the magnitude of the dc voltage Both conventional and modified schemes are analyzed and the expressions for power factor are derived Also the above circuits are compared for slip energy recovery in one and two quadrant wound rotor slip energy recovery systems (Author)

A79-10902 Advancements in the design of solar array to battery charge current regulators M C Glass (Lockheed Missiles and Space Co , Inc , Sunnyvale, Calif) In *Power Electronics Specialists Conference*, Palo Alto, Calif , June 14 16, 1977, Record

New York, Institute of Electrical and Electronics Engineers, Inc., 1977, p 346-350

A spacecraft power system is described which uses a solar array as power source and a storage battery. Through the application of power electronics the system is optimized in two stages, the final version of which uses an analog maximum power tracker. The power maximization concept is developed and a circuit design is presented. The maximum power tracker circuit has been breadboarded, and some test results are included. (Author)

A79-11121 Fusion power with particle beams G Yonas (Sandia Laboratories, Albuquerque, N Mex.) *Scientific American*, vol 239, Nov 1978, p 50-61

Certain difficulties regarding the implementation of the magnetic confinement approach to fusion power related to the required long confinement times of seconds or minutes, can be avoided by making use of an inertial method. In the inertial approach the fuel is heated as it is compressed to an extreme density (typically 1,000 times the normal density of the solid fuel). Under these conditions the fuel reacts so rapidly that the burning is actually a small explosion. Since the compressed fuel is restrained by its own inertia, it burns before it flies apart (in less than a billionth of a second). A description is given of an experimental electron-beam fusion accelerator in which the required conditions are to be provided by concentrating 36 electron beams on a deuterium-tritium fuel pellet. Attention is given to the disadvantages of a use of lasers for fusion applications, an employment of X rays and gamma rays, a number of high-energy electron-beam accelerators, the utilization of the 'self-pinching' effect, switching problems, the magnetically insulated transmission line, and details of the implosion process.

G R

A79-11146 Materials problems and opportunities in coal conversion systems J Stringer (Electric Power Research Institute, Palo Alto, Calif.) (*U.S. Department of Energy, Electric Power Research Institute, American Gas Association and National Coal Association, Energy Technology Conference, 5th, Washington, D C., Feb 27-Mar 1, 1978*) *SAMPE Quarterly*, vol 10, Oct 1978, p 45-53 13 refs

In many of the advanced coal conversion systems now being developed, the materials of construction will be exposed to very severe conditions. It is probable that the ability of materials to withstand these conditions will ultimately determine the success or failure of the new technologies. A number of specific examples are discussed, and four systems are analyzed in more detail: heat exchangers in fluidized bed combustors, gas turbines in combined cycle systems, low-pressure steam turbines, and superheaters in pulverized coal boilers. In each of these cases the problem is in part the deterioration of materials in contact with the environment, but the solution to the problem requires the close integration of materials development and design engineering. (Author)

A79-11147 Specular mirrors for solar energy application H Taketani (McDonnell Douglas Astronautics Co., St Louis, Mo) and W M Arden (Sheldahl, Inc., Northfield, Minn.) *SAMPE Quarterly*, vol 10, Oct 1978, p 54-63

The reflectance efficiency of heliostat mirror surfaces is a critical parameter in the central tower concept for conversion of solar energy. Reflectance efficiency was measured on silver coated surfaces and on second-surface mirrors of float and sheet glass for comparison in a solar heliostat. Abrasion tests were conducted to determine the effect of impingement of sand particles on the reflectance of the heliostat mirror. Washing studies were performed to identify the most effective solution and cleansing procedure for the heliostat surfaces. (Author)

A79-11150 Ceramic components for vehicular gas turbines (Keramische Bauteile für Fahrzeug-Gasturbinen) P Walzer (Volkswagenwerk AG, Wolfsburg, West Germany) *Motortechnische Zeit-*

schrift, vol 39, Oct 1978, p 465-468 7 refs. In German. Research supported by the Bundesministerium für Forschung und Technologie.

The paper describes the present status of component development in the German high temperature ceramic research program. Ceramic materials are silicon nitride and silicon carbide in different fabrication processes. Combustors and stator vanes have survived in short time tests at gas temperatures as high as 1650 K. In developing the rotor different concepts are being investigated. One concept is a metal-ceramic hybrid rotor, a second concept is a rotor machined from a hot pressed billet and a third concept is a pressed multi-density rotor. Experimental rotors have attained circumferential speeds of 283 m/s at gas temperatures of 1350 K. The recuperator is being developed as a bonded structure of performed ceramic plates. (Author)

A79-11195 # Application of composite materials in the solar energy domain (Utilisation des matériaux composites dans le domaine de l'énergie solaire) G Chiron (Saint Gobain Industries, Neuilly-sur Seine, Hauts-de-Seine, France) *Verre Textile, Plastiques Renforcés*, vol 16, June 1978, p 9-14. In French.

The basic procedure for solar energy collection and conversion is outlined with reference to the thermal energy available in France at different times of the year. It is noted that many difficulties usually associated with glass collectors may be alleviated by cells made of translucent composite materials. These cells are less fragile than glass, light-weight, and may be easily molded into the desired component shapes. Various types of collection systems are described including the classic water-based collectors and Trombe walls. The installation of solar energy systems in houses is discussed. S C S

A79-11216 Roll-out solar arrays - Candidate power sources for future space missions J Rath (Telefunken AG, Wedel, West Germany) *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct 1-8, 1978, Paper 78-39* 22 p 5 refs

The development of solar arrays for future space missions is reviewed and the requirements for solar array power sources for such missions are discussed. Emphasis is placed on roll-out arrays, with application to future Shuttle missions. Attention is also given to cost and materials considerations, and development strategies and test philosophies for future power arrays. B J

A79-11217 Radioisotope powered free-piston Stirling engine for space applications A K Jakubowski (Virginia Polytechnic Institute and State University, Blacksburg, Va.) *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct 1-8, 1978, Paper 78-42* 13 p 5 refs

The paper presents a preliminary conceptual design of a 2 kw(e) autonomous power system consisting of a radioisotopic heat source, free-piston Stirling engine, reciprocating induction generator and a space radiator. The proposed design features a direct thermal interfacing of the Pu 238 heat source with the Stirling engine head, low heat losses during normal operation, and provides an auxiliary/emergency cooling system in the case of the engine failure or stopping. The Stirling engine is of the free-displacer, free-piston type invented by Beale and uses helium as the working fluid. The engine piston is integrated with the armature of a simple linear alternator which is used for electric generation. Waste heat is rejected by a four-finned space radiator sized for a geosynchronous orbit. Specific power and efficiency of the Stirling isotope power system are compared with the present and predicted performance of other power conversion systems suitable for the same power range.

(Author)

A79-11218 * Evolution of space power systems R F Freitag (NASA, Office of Space Transportation Systems, Washington, D C) and W A Kisko (NASA, Office of Space Transportation Systems, USAF, Washington, D C) *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct 1-8, 1978, Paper 78-43* 14 p 11 refs

NASA planning for large power systems (tens to hundreds of kilowatts) in space for the next decade is summarized Applications requiring large amounts of power, the selection of solar photovoltaic as the primary power conversion approach, and the power technology base are explained Large power systems, beginning with a Space Shuttle/Spacelab power augmentation kit and an orbitally stored Power Module, are described (Author)

A79-11287 The utilization of European space techniques for energy production Y Demerliac and M Toussaint (EURO-SPACE, Paris, France) *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct 1-8, 1978, Paper 78-190* 16 p

A brief review of Europe's energy crisis is presented, and attention is given to possible space-based solutions to energy problems, including satellite solar power stations and the disposal of nuclear-power-plant wastes in space, and space manufacturing and processing It is noted that terrestrial energy solutions should be closely coordinated with possible space-based solutions B J

A79-11288 On-orbit fabrication and assembly of large space structural subsystems J F Garibotti, A J Cwiertny, Jr, and R Johnson, Jr (McDonnell Douglas Astronautics Co, Huntington Beach, Calif) *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct 1-8, 1978, Paper 78-192* 14 p 8 refs

Future large space systems are examined with respect to on-orbit fabrication, and the role, design, and testing of generic structures are considered The feasibility of on-orbit fabrication of a selected generic structure, a tetrahedral truss, is indicated, and preliminary planning for integration of a beam machine and associated fabrication equipment with the Orbiter is reported The development of large structural subsystems and their evaluation are discussed M L

A79-11298 New design verification aspects of large flexible solar arrays K J Zimmermann (Aerospace Engineering Office, Zurich, Switzerland) *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct 1-8, 1978, Paper 78-217* 11 p 7 refs

The proposed design verification approach for studying large flexible solar arrays (1) starts testing at component level and follows the hardware assembly tree, (2) makes intensive use of structural optimization methods for the update of the mathematical model based on the test results, and (3) might reduce design verification cost while improving the accuracy in the analytical prediction The verification approach is examined with respect to a study which analyzes, tests, and updates the mathematical model of a flexible blanket section of the CTS solar array Characteristics and uses of large flexible solar arrays are considered M L

A79-11356 Solar energy and the 'Common Heritage of Mankind' S B Rosenfield (New England School of Law, Boston, Mass) *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct 1-8, 1978, Paper 78-SL-45* 25 p 47 refs

The legal implications of the phrase, the 'Common Heritage of Mankind', which is referred to in all treaties relating to outer space, are discussed The effects of the 'Common Heritage' concept on the development of solar energy are considered with attention to the burdens and limitations which could be imposed by this doctrine on solar energy transmitted from outer space It is concluded that there is probably nothing in the 'Common Heritage' doctrine which would make it directly applicable to the use of solar energy in outer space or to the development of solar energy in outer space for use on earth The consequences of the incorporation of the 'Common Heritage'

concept into the moon treaty are analyzed, and the relevance of the concept to the use of the geostationary orbit is examined M L

A79-11368 # Some aspects of aircraft jet engine fuels (Niektóre zagadnienia paliw do lotniczych silników turbinowych) R Bekiesinski (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland) *Technika Lotnicza i Astronautyczna*, vol 33, Sept 1978, p 11, 12 5 refs In Polish

The paper reviews technologies for improving the thermal stability of jet fuels, with reference to the overheating of fuel tanks in supersonic aircraft Consideration is given to the development of a new jet fuel with high thermal stability by the Polish petroleum industry B J

A79-11448 # There is a lot of energy in digester gas . use it G M Wesner (Culp/Wesner/Culp, El Dorado Hills, Calif) and W N Clarke, Sr *California Water Pollution Control Association, Bulletin*, vol 15, July 1978, p 70-79 7 refs US Environmental Protection Agency Contract No 68-03-2186

Information on the potential for on-site use of anaerobic digester gas in municipal wastewater treatment plants is presented, and experience in on site use in the U S is reviewed Gas production data, process design criteria, and cost estimates for gas cleaning and storage and on-site electricity generation are presented Energy requirements for activated-sludge treatment are compared with the energy available from anaerobic digestion M L

A79-11542 * # Effect of inlet temperature on the performance of a catalytic reactor D N Anderson (NASA, Lewis Research Center, Cleveland, Ohio) *US Environmental Protection Agency, Workshop on Catalytic Combustion, 3rd, Asheville, N C, Oct 3, 4, 1978, Paper 21* p 17 refs Contract No EC 77 A-31-1040

A 12-cm-diameter by 15-cm-long catalytic reactor was tested with No 2 diesel fuel in a combustion test rig at inlet temperatures of 700, 800, 900, and 1000 K Other test conditions included pressures of 300,000 and 600,000 Pa, reference velocities of 10, 15, and 20 m/s, and adiabatic combustion temperatures in the range from 1100 to 1400 K The combustion efficiency was calculated from measurements of carbon monoxide and unburned hydrocarbon emissions Nitrogen oxide emissions and reactor pressure drop were also measured At a reference velocity of 10 m/s, the CO and unburned hydrocarbons emissions and, therefore, the combustion efficiency were independent of inlet temperature At an inlet temperature of 1000 K, they were independent of reference velocity Nitrogen oxides emissions resulted from conversion of the small amount of fuel bound nitrogen in the fuel Up to 90% conversion was observed with no apparent effect of any of the test variables For typical gas-turbine operating conditions, all three pollutants were below levels which would permit the most stringent proposed automotive emissions standards to be met (Author)

A79-11546 * # An improved method for analysis of hydroxide and carbonate in alkaline electrolytes containing zinc M A Reid (NASA, Lewis Research Center, Cleveland, Ohio) *Electrochemical Society, Meeting, 154th, Pittsburgh, Pa, Oct 15-20, 1978, Paper 13* p 9 refs

A simplified method for titration of carbonate and hydroxide in alkaline battery electrolyte is presented involving a saturated KSCN solution as a complexing agent for zinc Both hydroxide and carbonate can be determined in one titration, and the complexing reagent is readily prepared Since the pH at the end point is shifted from 8.3 to 7.980, m cresol purple or phenol red are used as indicators rather than phenolphthalein Bromocresol green is recommended for determination of the second end point of a pH of 4.3 to 4.4 (Author)

A79-11558 # Solar power satellite developments. P E Glaser (Arthur D Little, Inc., Cambridge, Mass) *American Astronautical Society and Deutsche Gesellschaft für Luft- und Raumfahrt*,

Goddard Memorial Symposium, 16th, Washington, D C, Mar 8-10, 1978, AAS Paper 78-Q22 30 p 26 refs

The terrestrial solar energy conversion methods capable of generating power continuously are reviewed and the rationale for solar energy conversion in geosynchronous orbit is outlined. The principles of the concept of solar power satellites (SPS) are presented and the technology options for converting solar energy in space, transmitting microwave power, and converting it on earth into electricity, are summarized. The development of the design concept of the SPS, based on solar thermal and photovoltaic conversion, is examined and salient characteristics are provided. The details of microwave power generation, beam transmission, and conversion to DC at the receiving antenna on earth are discussed. The requirements for a space transportation system, orbital construction and assembly, maintenance and operations are reviewed. The environmental impacts of SPS operation, such as stratospheric emission by space vehicles and atmospheric attenuation and scattering, ionospheric interactions, and biological effects of the microwave beam are highlighted. Economic and social issues are considered and the potential contribution of the SPS to meet future energy demands is projected. (Author)

A79-11572 # Energy conservation aircraft design and operational procedures. P. Poisson-Quinton (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *(NATO, AGARD, Lecture Series on Energy Conservation in Aircraft Propulsion, Munich, West Germany, Oct 26, 27, 1978)* ONERA, TP no 1978 107, 1978 48 p 90 refs

The paper reviews studies associated with improved fuel efficiency. Several aircraft design concepts are described including (1) increases in aerodynamic efficiency through decreased friction drag, parasitic drag, and drag due to lift, (2) structural efficiency and the implementation of composite materials, (3) active control technology, (4) the optimization of airframe engine integration, and (5) VTOL and STOL concepts. Consideration is also given to operational procedures associated with flight management, terminal area operations, and the influence of environmental noise constraints on fuel economy. SCS

A79-11599 * # Characteristics and combustion of future hydrocarbon fuels. R. A. Rudey and J. S. Grobman (NASA, Lewis Research Center, Cleveland, Ohio) *(NATO, AGARD, Lecture Series on Energy Conservation in Aircraft Propulsion, Munich, West Germany, Oct 26, 27, 1978, Paper 25 p 19 refs)*

Dwindling supply of high-quality crude is beginning to manifest itself in the form of crude oils containing higher percentages of aromatic compounds, sulfur, nitrogen, and trace constituents. In the present paper, problems which have arisen with regard to the hydrogen content in jet fuels derived from these crude oil sources are discussed, with particular reference to the effects of varying the fuel properties on the combustion and thermal stability characteristics of a fuel. The importance of knowing how severe the effects of variations in hydrogen content, fuel-bound nitrogen content, and boiling range are on such combustion phenomena as soot and carbon formation, emissions, and ignition is pointed out. V.P.

A79-11600 * # Impact of future fuel properties on aircraft engines and fuel systems. R. A. Rudey and J. S. Grobman (NASA, Lewis Research Center, Cleveland, Ohio) *(NATO, AGARD, Lecture Series on Energy Conservation in Aircraft Propulsion, 96th, Munich, West Germany, Oct 26, 27, 1978, Paper 32 p 20 refs)*

From current projections of the availability of high-quality petroleum crude oils, it is becoming increasingly apparent that the specifications for hydrocarbon jet fuels may have to be modified. The problems that are most likely to be encountered as a result of these modifications relate to engine performance, component durability and maintenance, and aircraft fuel-system performance. The effect on engine performance will be associated with changes in specific fuel consumption, ignition at relight limits, at exhaust emissions. Durability and maintenance will be affected by increases in combustor liner temperatures, carbon deposition, gum formation

in fuel nozzles, and erosion and corrosion of turbine blades and vanes. Aircraft fuel-system performance will be affected by increased deposits in fuel system heat exchangers and changes in the pumpability and flowability of the fuel. The severity of the potential problems is described in terms of the fuel characteristics most likely to change in the future. Recent data that evaluate the ability of current-technology aircraft to accept fuel specification changes are presented, and selected technological advances that can reduce the severity of the problems are described and discussed. (Author)

A79-11675 Disposal of industrial wastes by combustion. Present state-of-the-art. Volume 3. Research supported by the American Motors Corp., Cannon Mills Co., Carpenter Steel Co., et al. New York, American Society of Mechanical Engineers, 1977 70 p 21 refs \$15

Five systems for disposing of industrial wastes by combustion are described. Three of the systems - two for oil wastes and one for paper manufacture wastes - use fluidized bed combustion, and the characteristics and advantages of this process are considered. The advantages of a thermal regeneration air purification system (TRAPS) used by a food manufacturer and of a watergrate system used by the city of Philadelphia are examined. The watergrate incinerator method uses a liquid surface as a grate on which the oil wastes are burned. M.L.

A79-11776 Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings. Symposium sponsored by the Electrochemical Society. Edited by J. D. E. McIntyre (Bell Telephone Laboratories, Inc., Murray Hill, N.J.), S. Srinivasan (Brookhaven National Laboratory, Upton, N.Y.), and F. G. Will (General Electric Co., Schenectady, N.Y.) Princeton, N.J., Electrochemical Society, Inc. (ECS, Proceedings, Volume 77-6), 1977 1046 p \$20

The topics considered are related to photoelectrochemical energy conversion, electrocatalysis, hydrogen production and storage, fuel cells, and batteries. Attention is given to semiconductor electrodes for conversion and storage of solar energy, the role of semiconductor properties in photoelectrolysis, semiconductor liquid junction solar cells, theoretical models of chemisorption on metal surfaces, recent advances in the understanding of electrocatalysis and its relation to surface chemistry, the effects of traces of platinum in sodium tungsten bronze electrodes, hydrogen production in a solar-hydrogen economy, solid polymer electrolyte electrochemical cells, advanced electrolysis in alkaline solution, model predictions for the stability of ternary metallic hydrides, basic physical and chemical processes for storage of heat, new alloy systems for hydrogen storage, recent advances in electrocatalysis and their implications for fuel cells, ERDA fuel cell programs, recent advances in battery materials, thermal efficiencies of battery systems, and calcium/iron sulfide secondary cells. G.R.

A79-11777 Semiconductor electrodes for conversion and storage of solar energy. H. Gerischer (Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Fritz-Haber-Institut, Berlin, West Germany). In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1977, p 8-29 41 refs

It has been found that the conversion of light into chemical energy occurs in the photosynthetic system by means of electrochemical reactions. This insight should provide an incentive for electrochemists to investigate the possibility to develop a similar system for the use and storage of solar energy. The question is in this connection discussed whether photosynthesis can serve as a model for electrochemical devices. An analysis of the photosynthetic apparatus of the plant shows that a number of difficulties would have to be overcome. There seems to be little chance to develop a technical analog to photosynthesis on the basis of membrane devices. A more promising approach may be the use of micelles for the separation of the products. The serious problem here, however, is to extract the products from the interior of the micelles without

initiating the reverse reaction Electrochemical alternatives to the approach employed by nature are discussed Attention is given to electron transfer reactions at illuminated semiconductor electrodes, the photoelectrolysis of water, the regenerative photoelectrochemical cell, and the characteristics of the stability problem G R

A79-11780 **Role of semiconductor properties in photoelectrolysis** M A Butler and D S Ginley (Sandia Laboratories, Albuquerque, N Mex) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa , May 9-12, 1977, Proceedings Princeton, N J , Electrochemical Society, Inc , 1977, p 54-68 31 refs Contract No AT(29-1)-789

The eventual utility of any electrode envisaged for practical use in the photoelectrolysis of water will depend on three criteria the stability of the material in the rather harsh photoelectrochemical environment, a good quantum efficiency and bandgap such that there is an optimal use of the solar spectrum, and the system should operate with high net conversion efficiencies at zero or small external bias Two models are presented here which provide guidance in fulfilling the latter two criteria The semiconductor electrolyte interface is described in terms of a Schottky barrier model which quantitatively describes the photoresponse and indicates the relationship of various physical parameters such as conductivity, carrier mobility and nature of the optical transition to conversion efficiency The ability to operate without a bias is directly related to the semiconductor electron affinity (Author)

A79-11781 **Iron oxide semiconductor electrodes in photo-assisted electrolysis of water** L-S R Yeh and N Hackerman (Rice University, Houston, Tex) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa , May 9-12, 1977, Proceedings Princeton, N J , Electrochemical Society, Inc , 1977, p 69-76 22 refs Research supported by the Robert A Welch Foundation

The preparation of polycrystalline n-type iron oxide electrodes by heating of iron samples in air is reported The behavior of these electrodes in aqueous solutions of different pH values in the presence and absence of illumination is shown The photocurrent response of these electrodes to all wavelengths in the visible region is seen Photoassisted electrolysis of water occurs at these wavelengths resulting in the evolution of oxygen bubbles at the iron oxide electrodes with no noticeable corrosion problems in pH 4.0 acetate buffer to 5.5 M KOH solutions (Author)

A79-11783 **Semiconductor liquid junction solar cells - Efficiency, electrochemical stability, and surface preparation** B Miller and A Heller (Bell Telephone Laboratories, Inc , Murray Hill, NJ) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa , May 9-12, 1977, Proceedings Princeton, N J , Electrochemical Society, Inc , 1977, p 91-104 31 refs

A review is presented of investigations which have been conducted to find examples of regenerative semiconductor liquid junction cells with respectable solar conversion efficiencies and a promise of stability An outline is provided of directions for reducing the cost of the semiconductor member of the cell Attention is also given to studies which have been carried out to obtain information regarding the controlling parameters Two beam optical techniques for examining the surface condition of semiconductors are considered and the application of rotating disk methodology to the analysis of the electrochemical stability of the semiconductor-liquid junction is discussed Electrochemical stability refers to the result of the competition between the desired regenerative path and the photocorrosion of the surface G R

A79-11784 **n-CdS/n-GaAs photoanode** S Wagner and J L Shay (Bell Telephone Laboratories, Inc , Holmdel, NJ) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa , May 9-12, 1977, Proceedings Princeton, N J , Electrochemical Society, Inc , 1977, p 105-109 9 refs

Incorporated in an electrochemical solar cell, the n-CdS/n-GaAs heterodiode acts like two photodiodes in series It raises output voltage, and efficiency, over those achievable with a simple n-CdS anode (Author)

A79-11785 **Polycrystalline CdSe-based photo-electrochemical cells** J Manassen, G Hodes, and D Cahen (Weizmann Institute of Science, Rehovot, Israel) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa , May 9-12, 1977, Proceedings Princeton, N J , Electrochemical Society, Inc , 1977, p 110-118 7 refs

A79-11793 **Study of the interaction of H₂O and O₂ with the surface of TiO₂ by electron stimulated desorption and Auger and characteristic loss spectroscopies** M L Knotek (Sandia Laboratories, Albuquerque, N Mex) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa , May 9-12, 1977, Proceedings Princeton, N J , Electrochemical Society, Inc , 1977, p 234-246 21 refs Contract No AT(29-1) 789

A79-11795 **The anodic oxidation of ethyleneglycol at platinum, gold and Pt/Au-alloys in alkaline solution** W Hauffe, J Heitbaum, and W Vielstich (Bonn, Universitat, Bonn, West Germany) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa , May 9-12, 1977, Proceedings Princeton, N J , Electrochemical Society, Inc , 1977, p 308-320 10 refs

The anodic oxidation of ethylene glycol (EG) has been investigated both under the aspect of electrocatalysis and in relation to its application in fuel cells In order to study the electrocatalysis of EG electrode, gold and platinum were chosen as electrode materials Current potential diagrams show the rather different behavior of Pt, Au and Pt/Au alloys While oxalate is the main reaction product, glycol aldehyde, glyoxal, glycolate and glyoxalate have been found as intermediates or by products by MS, chemical analysis and electrochemically using ring-disk electrodes The kinetics of the process is determined by a 1-electron reaction on platinum, the desorption of an intermediate being the rds, as follows from the reaction orders measured In addition to the fundamental investigations, a rechargeable EG/air fuel cell for use at ambient temperatures has been developed The high energy density (100-120 Wh/kg), the long operating life time and the low costs are features for the practical application (Author)

A79-11796 **Hydrogen production in a solar-hydrogen economy** J O Bockris (South Australia, Flinders University, Adelaide, Australia) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa , May 9-12, 1977, Proceedings Princeton, N J , Electrochemical Society, Inc , 1977, p 338-353 28 refs

The prospects and costs of different approaches to hydrogen production on a commercial scale are examined Features of new electrochemical processes are examined, and application of the theory of photochemical hydrogen production to determine the relationships of electrical parameters is described Characteristics and economics of four stable photoelectrolytic cells involving new cathodes or stable CdS in solution are reported It is suggested that high costs preclude the use of chemical processes for large scale hydrogen generation M L

A79-11798 **Advanced electrolysis in alkaline solution** A J Appleby and G Crepy (Compagnie Generale d'Electricite, Centre de Recherches, Marcoussis, Essonne, France) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa , May 9-12, 1977, Proceedings Princeton, N J , Electrochemical Society, Inc , 1977, p 382-395 22 refs

It is shown that improvements in present industrial pressure electrolyzers might lead to high efficiency electrolysis at high current density (approximately 0.4 A/sq cm) and moderate temperature Nonnoble metal catalyzed electrodes and thin stable separators could

be used to obtain approximately 1.55 V (including IR drop) at 0.4 A and 120-130 C. Requirements for future advanced electrolyzers are reviewed, and economic costs are considered. Topics examined include the constraints associated with pressure electrolysis, approaches to lower operating potentials, reductions of overpotential, oxygen and hydrogen evolution, and the effect of electrode surface area. M L

A79-11799 Electrochemical-ellipsometric studies of oxide films formed on nickel during oxygen evolution P W T Lu and S Srinivasan (Brookhaven National Laboratory, Upton, NY) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, NJ, Electrochemical Society, Inc, 1977, p 396-413 34 refs ERDA-sponsored research

A79-11801 Electrocatalysis, charge-transfer and the states of H adsorption in the hydrogen evolution reaction B E Conway (Ottawa University, Ottawa, Canada) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, NJ, Electrochemical Society, Inc, 1977, p 441-455 41 refs

A79-11802 Model predictions for the stability of ternary metallic hydrides A R Miedema, K H J Buschow, and H H van Mal (Philips' Gloeilampenfabrieken, Philips Research Laboratories, Eindhoven, Netherlands) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, NJ, Electrochemical Society, Inc, 1977, p 456-469 35 refs

A model for predicting the stability of ternary metallic compounds prepared from intermetallic compounds of two transition metals is presented, and the rule of reversed stability - the more stable the starting intermetallic compound, the less stable the ternary hydride - is discussed. The model predicts the enthalpy of formation of a ternary hydride from values for the heats of formation of the corresponding binary hydrides and binary compounds. Experimental data are examined with respect to the change in hydride stability for AB₅ compounds when the metal A is varied, the tendency to form hydrides as a function of the intermetallic compound composition for a given binary transition-element system, and the prediction of the occurrence of stable ternary hydrides. M L

A79-11803 Hydrogen storage by LaNi₅ - Fundamentals and applications T B Flanagan and S Tanaka (Vermont University, Burlington, Vt) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, NJ, Electrochemical Society, Inc, 1977, p 470-481 36 refs NSF-supported research

Despite its relatively high cost, the intermetallic compound LaNi₅ has attracted great interest as a hydrogen storer because of several very desirable features. It is easily activated forming small particles which readily absorb and desorb hydrogen even at very low temperatures. This activity towards hydrogen is not destroyed by traces of gaseous contaminants. It absorbs up to 6 hydrogen atoms per formula unit of LaNi₅ and the equilibrium pressure over the hydrogen-saturated intermetallic compound and the hydride phase is convenient for energy utilization, e.g., 1.5 atm at 300 K. Recently obtained thermodynamic and kinetic data for both the unactivated and activated compound are discussed. The understanding of hydrogen absorption and desorption by this intermetallic compound may be useful for the 'tailor-making' of other, less expensive and lighter, intermetallic compounds which may be otherwise as suitable for hydrogen storage as LaNi₅. (Author)

A79-11804 Absorption of hydrogen by the intermetallics NdNi₅ and LaNi₄Cu and a correlation of cell volumes and desorption pressures D M Gruen, M H Mendelsohn, and I Sheft (Argonne National Laboratory, Argonne, Ill) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, NJ, Electrochemical Society, Inc, 1977, p 482-488 16 refs

A79-11805 Basic physical and chemical processes for storage of heat G Alefeld (Munich, Technische Universität,

Garching, West Germany) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, NJ, Electrochemical Society, Inc, 1977, p 489-496 16 refs

Methods of storing heat are discussed with attention to the concept of specific heat, the latent heat of phase transition, chemical reactions, and heterogeneous vaporization. Several methods of heat transport are briefly surveyed. The use of heat storage devices by power stations, households, heating stations, and vehicles is examined. M L

A79-11806 New alloy systems for hydrogen storage C M Adkins and E J Taylor (Virginia University, Charlottesville, Va) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, NJ, Electrochemical Society, Inc, 1977, p 497-504 13 refs Contract No E(40-1)-4952

The reported investigation is related to the objective to develop alloys which would form hydrides with a maximum amount of available hydrogen per unit weight and unit volume at room temperature. It was found that in accordance with the predictions of the Engel-Brewer theory the Ti₂M phase was formed. M in this case denotes a mixture of Fe and one of either Co, Ni, or Cu. The considered alloys formed TiH₂ and TiM and an undetermined constituent upon hydriding and extraction at room temperature. Since Ti₂M was stable to about 750 C the available hydrogen at room temperature was mostly from the TiM phase. No improvements in the hydriding characteristics of Ti₂M as compared to TiFe were observed at room temperature. The one sample that was hydridated and extracted at 400 C showed no unexpected peaks. The extraction remains consisted of TiM, TiH₂, Ti₂M, and Ti. G R

A79-11807 Recent advances in electrocatalysis and their implications for fuel cells W Vielstich (Bonn, Universität, Bonn, West Germany) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, NJ, Electrochemical Society, Inc, 1977, p 505-518 17 refs

The anodic oxidation of ethylene glycol, used in an alkaline glycol air battery, is discussed with attention to the effects of Pb-, Bi-, Pd-, and Ru-doping of Pt electrodes. Initiation of CHO-compound electrolysis is found to occur frequently at the carbon-hydrogen bond of the alpha carbon. Doping additives that improve Raney nickel or silver electrode lifetimes in alkaline fuel cells are reported. The ability of phthalocyanine to improve electrolysis in acid media is discussed. M L

A79-11808 On the mechanism of the electrocatalytic oxygen reduction with particular regard to metal chelates H Behret, H Binder, W Clauberg, and G Sandstede (Battelle Institut, Frankfurt am Main, West Germany) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, NJ, Electrochemical Society, Inc, 1977, p 519-536 44 refs

Oxygen reduction by platinum, gold, silver, and carbon electrodes coated by a metal chelate (e.g. Co-dibenzotetraazaannulene) is studied. The individual characteristics of the uncoated electrodes are suppressed by the coating. A reaction scheme for oxygen reduction is considered, and values for the rate constants of individual reaction steps are presented. A mechanism is proposed for describing the observed change in the rate-determining step of reactions shifting from acid to alkaline solutions. M L

A79-11809 O₂ reduction kinetics in concentrated acids J McHardy (EIC Corp, Newton, Mass) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, NJ, Electrochemical Society, Inc, 1977, p 537-545 8 refs

The exchange current density for O₂ reduction in 85% H₃PO₄ is three orders of magnitude smaller than in 1M HClO₄. To explore the reasons for this difference, O₂ reduction kinetics in H₃PO₄, H₂SO₄, and HClO₄ have been compared as a function of acid concentration. Tests were performed on Pt-black at 90 C in a pressurized system.

The rate of O₂ reduction was found to increase uniformly with H₂O activity in each of the three acids. The apparent reaction order for H₂O was 1 in H₃PO₄, 2 in H₂SO₄, and approximately 9 in HClO₄. This trend may be related to the effects of adsorbed anions on the orientation of H₂O dipoles in the electric double layer. In H₃PO₄ at fuel cell temperatures, the kinetic effect of H₂O activity is just offset by its thermodynamic effect on the reversible potential. As a result, no advantage is to be expected from lowering the present H₃PO₄ concentrations in fuel cells (Author)

A79-11810 Fuel cell electrocatalysis - Where have we failed A P Fickett (Electric Power Research Institute, Palo Alto, Calif.) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc., 1977, p 546-558 11 refs

Progress made in phosphoric acid fuel cell technology is summarized, and reasons for the comparative lack of progress in the field despite major research efforts are considered. Developments in cathode, anode, and cell components during the period 1967-1977 are described. Opportunities for future electrocatalysis research are discussed with emphasis on the elucidation and improvement of the kinetics of the oxygen reduction mechanism, development of a CO tolerant anode at 190 C without an overvoltage or life penalty, and retardation of platinum 'sintering' (surface area reduction). Some requirements for a practical system are surveyed M L

A79-11811 Migrational polarization in high-current density molten salt electrochemical devices J Braunstein and C E Vallet (Oak Ridge National Laboratory, Oak Ridge, Tenn.) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc., 1977, p 559-571 15 refs ERDA-supported research

Electrochemical flux equations based on the thermodynamics of irreversible processes have been derived in terms of experimental transport coefficients for binary molten salt mixtures analogous to those proposed for high temperature batteries and fuel cells. The equations and some numerical solutions indicate steady state composition gradients of significant magnitude. The effects of migrational separation must be considered along with other melt properties in the characterization of electrode behavior, melt composition, operating temperatures and differences of phase stability, wettability and other physicochemical properties at positive and negative electrodes of high current density devices with mixed electrolytes (Author)

A79-11812 Growth of refractory oxide layers by electrochemical vapor deposition /EVD/ at elevated temperatures A O Isenberg (Westinghouse Electric Corp., Pittsburgh, Pa.) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc., 1977, p 572-583 11 refs Research supported by the U.S. Department of the Interior, Westinghouse Electric Corp., and ERDA

The necessity of fabricating gas-tight refractory oxide layers for high temperature, solid electrolyte fuel cells led to the development of a vapor deposition process in which the solid reaction product separates the reacting gaseous species and film growth takes place under the condition that the reaction product exhibits some electronic as well as ionic conductivity. The process resembles the operation of an internally shorted galvanic concentration cell, where the activity gradient of vapor species across the oxide layer is the driving force for film growth. Basic and practical aspects of growing dense layers of stabilized zirconia, ceria, alumina and mixed refractory oxides are discussed (Author)

A79-11813 Electrochemical characteristics of ZrO₂-Y₂O₃ solid electrolytes for fuel cells H S Isaacs, P G Russell, and L J Olmer (Brookhaven National Laboratory, Upton, N.Y.) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings

Princeton, N.J., Electrochemical Society, Inc., 1977, p 584-592 11 refs ERDA-sponsored research

A79-11814 ERDA fuel cell programs L R Lawrence, Jr (U.S. Department of Energy, Div of Conservation, Research and Technology, Washington, D.C.) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc., 1977, p 593-606

Program objectives for first and second generation fuel cells are discussed. Advantages of fuel cell systems include siting flexibility, modularity, and multifuel capability, and oil savings resulting from the use of fuel cells are considered. A demonstration first-generation 4.8-MW fuel cell power system has been prepared, and ERDA research interests such as utility demonstrations, fuels utilization, and systems development are surveyed M L

A79-11815 The state-of-the-art of hydrogen-air phosphoric acid electrolyte fuel cells H R Kunz (United Technologies Corp., Power Systems Div., South Windsor, Conn.) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc., 1977, p 607-620 26 refs

The use of phosphoric acid fuel cell stacks in conjunction with fossil fuel powerplants which produce a hydrogen-rich gas is considered. Characteristics of the electrolyte fuel cells are discussed with attention to the activity of platinum for oxygen reduction and for hydrogen oxidation. Decay mechanisms are surveyed. The phosphoric acid cell operates at approximately 190 C, performance is unaffected by CO₂ in the fuel, but CO causes anode poisoning M L

A79-11816 Analysis of electrolyte shunt currents in fuel cell powerplants M Katz (United Technologies Corp., Power Systems Div., South Windsor, Conn.) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc., 1977, p 621-633

A general mathematical model is presented for calculating the shunt currents and effective operating potentials of the materials in multicell stacks which have electrolyte interconnections between the individual fuel cells. The analysis takes into account the electrochemical polarizations that occur at the positive and negative ends of each shunt path. Numerical results are presented for an acid electrolyte fuel cell stack design (Author)

A79-11817 Molten carbonate fuel cell systems - Status and potential J P Ackerman (Argonne National Laboratory, Argonne, Ill.) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc., 1977, p 634-643 9 refs

Characteristics, applications, and developmental requirements of molten carbonate fuel cell systems are discussed. The cell oxidizes carbon monoxide and produces heat at a temperature of approximately 925 K. Cell performance is being studied with respect to composition and utilization of both fuel and oxidant as well as temperature, pressure, and the effect of gas contaminants such as H₂S. Cell life, performance goals, and costs are considered M L

A79-11818 Effects of sintering on porous fuel cell electrodes K Kinoshita (Argonne National Laboratory, Argonne, Ill.) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa., May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc., 1977, p 644-655 24 refs

High surface area (small particle) electrocatalysts are not thermodynamically stable and consequently sintering of porous electrodes occurs in the fuel cell environment. The present paper reviews the effect of sintering on the morphology and electrochemical performance of porous electrodes used in the H₃PO₄, KOH and molten carbonate fuel cells. Measurements of the surface area

loss of supported and unsupported electrocatalysts in fuel cell environments is discussed by considering the various proposed sintering mechanisms (Author)

A79-11819 Partial processes and transport parameters in molten carbonate fuel cell operation J R Selman (Institute of Gas Technology, Illinois Institute of Technology, Chicago, Ill), H C Maru, V Sampath, and L G Marianowski (Institute of Gas Technology, Chicago, Ill) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc 1977, p 656-681 26 refs ERDA-supported research

The partial processes (electrode kinetics, ionic and dissolved-gas transport, heat effects, current and potential distribution) involved in the operation of the molten-carbonate fuel cell are reviewed Transport property data available in the literature are critically evaluated from the point of view of optimal electrolyte composition Porous electrode models are used to assess the relative importance of electrode-kinetic and mass-transfer rate limitations Essential data which remain to be evaluated are pointed out (Author)

A79-11820 Thin film high temperature solid electrolyte fuel cells A O Iseberg (Westinghouse Electric Corp, Pittsburgh, Pa) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc, 1977, p 682-691 6 refs Research supported by the U.S. Department of the Interior and Westinghouse Electric Corp

High temperature solid electrolyte fuel cells which are fabricated without the use of noble metals, can operate at a current density of over 500 mA/sq cm when electrically interconnected in stacks The complex structure of interconnected fuel cells demands matching materials properties of five stack components with respect to thermal expansion, non reactivity and thermodynamic stability Performance of interconnected cells and state-of-the-art preparation techniques are reviewed The life of cell stacks is limited mainly due to mechanical failure of the cell interconnection New interconnection materials and better film deposition processes are needed in order to increase stack life (Author)

A79-11821 Preparation and ionic conductivity of H3O⁺/beta alumina G C Farrington, J L Duffy, M W Breiter, and W L Roth (General Electric Co, Schenectady, N Y) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc, 1977, p 692-700 8 refs Research supported by the Electric Power Research Institute

The preparation, stability, and conductivity of H3O⁺ beta alumina, a potential solid H⁺-conducting electrolyte for fuel-cell application, are discussed Ion exchange of Na⁺ beta alumina in concentrated H2SO4 at 295 C is the most satisfactory method of preparation of H3O⁺ beta alumina The structure of H3O⁺ beta alumina is stable from 20 to 700 C, above which it irreversibly decomposes Between 200 and 300 C, H3O⁺ beta alumina undergoes a partial and reversible dehydration, forming H⁺-H3O⁺ beta alumina The ionic conductivity of H3O⁺ beta alumina is 7 x 10 to the -11th power per ohm cm at 20 C From 20 to 200 C, it increases in an Arrhenius relationship with an activation energy of 18 kcal/mole Partial dehydration between 200 and 300 C results in a decrease of conductivity which has not yet been fully characterized (Author)

A79-11822 Thermodynamic and kinetic considerations on zinc-halogen batteries F G Will and H S Spacil (General Electric Co, Schenectady, N Y) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc, 1977, p 713-723 7 refs

Rechargeable zinc halogen batteries exhibit a number of inherent advantages that let them appear as possible candidates for

applications in electric vehicles and utility load leveling Some fundamental thermodynamic and kinetic features of zinc-chlorine and zinc-bromine batteries are described Relationships establishing the dependence of energy efficiency and specific energy on specific power are presented and the effect of major parameters on these relationships is examined (Author)

A79-11823 The zinc electrode in sealed alkaline cells J McBreen (GM Research Laboratories, Warren, Mich) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc, 1977, p 724-731 14 refs

It is found that increasing the amount of metallic zinc in the negative electrodes of sealed Zn/NiOOH cells improves the capacity maintenance during cycling and the initial oxygen recombination rate on the zinc electrode Although the amount of hydrogen evolved in cells increases with increasing Zn reserve, the hydrogen is not a problem if there is an adequate, ZnO reserve in the negative electrodes at the end of charge Contamination of the Zn electrode by the positive electrode-active materials - Ni(OH)2 and Co(OH)2 - does not present any problems in sealed cells M L

A79-11824 * Factors affecting the open-circuit voltage and electrode kinetics of some iron/titanium/redox flow cells M A Reid and R F Gahn (NASA, Lewis Research Center, Cleveland, Ohio) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc, 1977, p 732-749 10 refs Contract No E(49-28)-1002

The effect of acid concentration on the performance of the iron/titanium redox flow cell was studied When the acidity was increased, open-circuit voltages decreased on the titanium side but load voltages increased due to decreased polarization The best load voltage occurs when there is high acidity on the titanium side coupled with low acidity on the iron side, but such cells show voltage losses with repeated cycling because of the diffusion of acid through the membrane No membrane tested has been found capable of maintaining the differences in acidity Chelating agents show some promise in reducing polarization at the Ti electrode and thus improving energy efficiency M L

A79-11830 Electrochemical determinations of the chemical potential and diffusivity of sodium in Na_x/TaS₂ at 300 K A S Nagelberg and W L Worrell (Pennsylvania, University, Philadelphia, Pa) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc, 1977, p 847-860 33 refs ARPA-supported research

One major impediment in the development of secondary alkali metal battery systems with high energy density is the lack of suitable electrode materials Dichalcogenides of the Group IV and V transition metals intercalated with lithium or sodium offer exciting possibilities as novel electrodes Electrochemical cell techniques have been used to measure the variation of the chemical potential and diffusivity of sodium with composition x in Na_xTaS₂ where x varies from 0 to 1.0 The measured cell voltage at 300 K is a linear function of sodium content The chemical diffusivities of sodium where a broad range of nonstoichiometry exists as in the system Li/TiS₂ (Author)

A79-11832 Electrochemistry of lithium/metal sulfide and calcium/metal sulfide cells using molten salt electrolytes R K Steunenberg and M F Roche (Argonne National Laboratory, Argonne, Ill) In Symposium on Electrode Materials and Processes for Energy Conversion and Storage, Philadelphia, Pa, May 9-12, 1977, Proceedings Princeton, N.J., Electrochemical Society, Inc, 1977, p 869-889 47 refs ERDA-sponsored research

The electrochemical properties of lithium/LiCl-KCl/metal sulfide and calcium/LiCl-KCl-CaCl₂/metal sulfide cells are described

These cells, which operate at about 700 K, employ intermetallic compounds (rather than elemental lithium or calcium) as their negative electrodes, the positive electrodes are usually iron sulfides, but a variety of other transition metal sulfides have also been tested in lithium cells. The cells with the highest power characteristics are based on the LiAl/FeS₂ couple. This couple appears to be limited only by ohmic losses. However, a statistical model is required to account for the variation in cell polarization with utilization of the electrodes. Results of a variety of metallographic and cyclic voltammetry studies are also described. (Author)

A79-11835 Calcium/iron sulfide secondary cells. S. K. Preto, L. E. Ross, A. E. Martin, and M. F. Roche (Argonne National Laboratory, Argonne, Ill.) In *Symposium on Electrode Materials and Processes for Energy Conversion and Storage*, Philadelphia, Pa., May 9-12, 1977, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 914-924. 11 refs. ERDA-sponsored research.

Studies of calcium intermetallic compounds for use as negative electrodes in molten-salt calcium/iron sulfide cells are described. The binary intermetallics of Ca with Al, Mg, and Si did not have acceptable performance characteristics, but the ternary Ca-Mg-Si intermetallic performed satisfactorily in cell tests. These calcium cells are being developed for stationary-energy-storage and electric-vehicle applications. (Author)

A79-11837 Batteries for transportation and load-leveling applications. A. R. Landgrebe (U.S. Department of Energy, Washington, D.C.) In *Symposium on Electrode Materials and Processes for Energy Conversion and Storage*, Philadelphia, Pa., May 9-12, 1977, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 937-949. 20 refs.

Secondary storage battery systems under consideration for automotive propulsion applications are examined. Performance requirements are described, and lead-acid, nickel-iron, nickel-zinc, zinc-chlorine, iron-air, lithium metal sulfide, and sodium sulfur batteries are discussed. It is suggested that the last two systems are good candidates for electric vehicles. The effect of battery characteristics on electric car design is considered. M. L.

A79-11838 The secondary lithium electrode in non-aqueous electrolytes - Some problems, some solutions. S. B. Brummer, T. W. Dampier, V. R. Koch, and R. D. Rauh (EIC Corp., Newton, Mass.) In *Symposium on Electrode Materials and Processes for Energy Conversion and Storage*, Philadelphia, Pa., May 9-12, 1977, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 975-984. 15 refs. NSF Grant No. AER-75-03779, Contract No. EY-76-C-02 2520.

Studies of Li cycling on Ni substrates have been carried out in propylene carbonate, methyl acetate and tetrahydrofuran. In general, LiAsF₆ gives higher cycling efficiencies than LiClO₄. With LiAsF₆ solutions, treating the electrolyte with alumina and preelectrolysis markedly increase the cycling efficiency. In the case of THF, 1 M LiAsF₆, storage of the electrolyte at 71 C leads to further improvements. Efficiencies in all samples deteriorate with repeated cycling. The drop is gradual, however, with LiClO₄-containing electrolytes, and with aged THF, 1 M LiAsF₆. It is postulated that the rate of occlusion of the Ni substrate, and therefore the rate of efficiency deterioration, depends on the characteristics of the films formed on Li by reaction with components of the electrolyte solution. (Author)

A79-11841 A practical electrochemical transport equation for non-dilute solutions. A. S. Roy. In *Symposium on Electrode Materials and Processes for Energy Conversion and Storage*, Philadelphia, Pa., May 9-12, 1977, Proceedings. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 1009-1022. 10 refs.

Operation of most electrochemical energy storage systems involves electrochemical transport in concentrated solutions or fused

salts. Analysis of the transport behavior of the species in the liquid is useful for the purpose of optimizing the system. A practical transport model based on gradients of concentrations and electric field is formulated and a method for obtaining all the necessary transport coefficients is outlined for isothermal and isobaric conditions. For n-component systems, (n-2)-squared diffusivities and (n-1) mobilities are experimentally obtainable. No activity data are required. The transport equation gives directly a flux expression with respect to stationary axes with no need of any inversion procedure. (Author)

A79-11871 A numerical solar radiation model based on standard meteorological observations. M. A. Atwater and J. T. Ball (Center for the Environment and Man, Inc., Hartford, Conn.) *Solar Energy*, vol. 21, no. 3, 1978, p. 163-170. 17 refs. NSF Grants No. ATM-76-09581, No. AER-75-14536.

The described solar radiation model, based on standard weather observations, extends the model presented by Atwater and Brown (1974) by revising the method used to compute the optical path length. Equations for computing the direct flux of solar radiation are presented, and verification of the model by comparison with other models and by comparison with observations is discussed. Hourly values of solar radiation, both total and direct fluxes, were computed at 50 stations located throughout the U.S. for a two-year period (1971-1972), and examples of significant average monthly mesoscale variations of total daily solar radiation in seven regions are reported. It is suggested that the model can compute radiation at about 300 U.S. stations and at stations for which cloud observations are available. M. L.

A79-11872 Asymptotic behaviour as a guide to the long term performance of solar water heating systems. B. J. Brinkworth (University College, Cardiff, Wales) *Solar Energy*, vol. 21, no. 3, 1978, p. 171-175. 10 refs.

It is found that the asymptotic behavior of a solar water heating system, as the storage mass becomes infinitely large, is a good predictor of long-term performance. Predictions are compared with those indicated by full computer modeling and by long-term tests involving a single-glazed nonselective collector supplying a fully mixed preheat store. It is suggested that predictions from the described procedure can be obtained rapidly and easily. M. L.

A79-11873 Perspectives on utility central station photovoltaic applications. E. A. DeMeo and P. B. Bos (Electric Power Research Institute, Palo Alto, Calif.) *Solar Energy*, vol. 21, no. 3, 1978, p. 171-192. 27 refs.

An array design parameter defined to include array-area-related costs, overall power plant efficiency, and average available insolation is used to compare a number of generic power plant conceptual designs which utilize solar photovoltaic conversion devices. The analysis indicates that flat-plate approaches without concentration or tracking have good prospects for commercial viability if device conversion efficiencies near 10% can be combined with installed device costs under \$20/cu m and device lifetimes exceeding 20 years. Thin-film approaches are considered to have this potential. Very high efficiency devices coupled with concentrations in excess of about 100:1 represent a viable alternative if sufficiently high conversion efficiencies (25% or more) can be achieved. M. L.

A79-11874 The measurement of optical properties of selective surfaces using a solar calorimeter. H. Willrath and R. B. Gammon (New South Wales Institute of Technology, Broadway, Australia) *Solar Energy*, vol. 21, no. 3, 1978, p. 193-199.

An instrument has been constructed to measure the solar absorptivity and IR emissivity of surfaces using calorimetric methods to determine their selectivity and hence their possible use in solar energy devices. Absorptivity and total hemispherical emissivity can be calculated as a function of temperature by measuring respectively, the rate at which a thermally isolated sample in an evacuated chamber increases in temperature when exposed to real or simulated

sunlight, and the rate at which it cools when shaded. These parameters can be used to compare the relative efficiencies of different surfaces at various operating temperatures (Author)

A79-11875 Computation of IR sky temperature and comparison with surface temperature M A Atwater and J T Ball (Center for the Environment and Man, Inc., Hartford, Conn) *Solar Energy*, vol 21, no 3, 1978, p 211-216 11 refs NSF Grants No AER-75-14536, No ATM-76-09581, Contract No NOAA-2-35353

The effects of atmospheric IR radiation must be accounted for in energy budget computations of solar collectors. IR radiation is often parameterized by determining an equivalent sky temperature dependent on surface temperature. Hourly values of IR radiation were computed at eleven stations in the United States in 1971 and 1972 and the equivalent sky temperature obtained. The model used for these computations was verified by comparison with special observations in the Lake Ontario region taken during the International Field Year of the Great Lakes (IFYGL) in 1972. Differences between surface temperature and sky temperature ranged between 5 and 20 C and are a complex function of season (specifically of cloudiness, humidity, and surface temperature) and geographical location (Author)

A79-11876 Theoretical upper limit to the conversion efficiency of solar energy J E Parrott (University of Wales Institute of Science and Technology, Cardiff, Wales) *Solar Energy*, vol 21, no 3, 1978, p 227-229 6 refs

A79-11877 An approximate equation for predicting the solar transmittance of transparent honeycombs K G T Hollands (Waterloo, University, Waterloo, Ontario, Canada), K N Marshall (Arneson Products, Inc., Corte Madera, Calif.), and R K Wedel (Lockheed Research Laboratories, Palo Alto, Calif) *Solar Energy*, vol 21, no 3, 1978, p 231-236 10 refs Contract No E(04-03)-1256

An approximate equation is presented for predicting the solar transmittance of transparent honeycombs. The method accounts for scattering which occurs in such honeycombs by introducing diffuse components for both the reflectivity and transmissivity of the honeycomb wall. Required inputs to the equation are the optical properties of the honeycomb wall material, averaged over the solar spectrum. Methods of determining these properties are described. Although strictly applicable to a square-celled honeycomb, the equation should be approximately valid for hexagonal honeycombs as well. The equation is compared to the measured transmittance of a hexagonal-celled Lexan honeycomb with good results (Author)

A79-11878 Solar pond stability experiments J P Leshuk, R J Zaworski (Oregon State University, Corvallis, Ore), D L Styris, and O K Harling (Battelle Pacific Northwest Laboratories, Richland, Wash) *Solar Energy*, vol 21, no 3, 1978, p 237-244 13 refs Contract No AT(45-1)-1830

The paper describes a year-long experimental study of the long-term stability of salinity gradients necessary for the proper operation of nonconvecting salt pond solar collector/storage systems. In this preliminary study, the only failure mode detected in the thermohaline layers was a steady growth of the bottom and top uniform mixing layers during irradiation and subsequent cooling. The rate of instability growth can be controlled by increasing initial salinity gradients and utilizing natural diffusion. Maximum bottom temperatures of 76 C and stable temperature gradients ranging from 150-300 C were obtained. Difficulties in modeling the system are noted M L

A79-11879 Effect of surface curvature on measurement of the absorptance properties of solar coatings R B Petit (Sandia Laboratories, Albuquerque, N Mex) *Solar Energy*, vol 21, no 3, 1978, p 247, 248 6 refs Research supported by the US Department of Energy

A79-11880 Annual available radiation for fixed and tracking collectors W C Dickinson (California, University, Livermore, Calif) *Solar Energy*, vol 21, no 3, 1978, p 249-251 Contract No W-7405-eng-48

A79-11955 * Optimum antireflection coating for Antireflection-coated Metal-Oxide-Semiconductor (AMOS) solar cells Y C M Yeh, F P Ernest, and R J Stirn (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In *Optical polarimetry Instrumentation and applications*, Proceedings of the Seminar, San Diego, Calif, August 23, 24, 1977 Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1977, p 97-103 10 refs Contract No NAS7 100

Consideration is given to the design of a single-layer optimum antireflection coating for AMOS (antireflection-coated metal oxide-semiconductor) solar cells to match the entire sunlight spectrum. The energy conversion efficiency is maximized by maximizing the open circuit voltage and the short-circuit current. The former is maximized by oxidation techniques and the latter is maximized by the light-coupling into the solar cell. With reference to the effective index of refraction as obtained by ellipsometry, examples of optimum antireflection coatings for 60-Au-Au-GaAs solar cells are presented SCS

A79-11965 Optics applied to solar energy conversion, Proceedings of the Seminar, San Diego, Calif, August 23, 24, 1977 Seminar sponsored by the Society of Photo-Optical Instrumentation Engineers. Edited by R Winston (Chicago, University, Chicago, Ill) and A I Mlavsky (Mobil-Tyco Energy Corp., Cambridge, Mass) Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings Volume 114), 1977 100 p \$28

Advances in photovoltaic and thermal solar energy conversion are reviewed. Essential breakthroughs in the optical concentration of radiant energy are discussed, with special emphasis on optical technology pertinent to solar energy. Topics of interest include recent progress in thin film polycrystalline solar cells based on cadmium sulfide and on indium phosphide, options for solar thermal conversion, and nonimaging solar concentrators SD

A79-11966 Recent progress in thin film polycrystalline solar cells based on cadmium sulfide J D Meakin (Delaware, University, Newark, Del) In *Optics applied to solar energy conversion*, Proceedings of the Seminar, San Diego, Calif, August 23, 24, 1977 Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1977, p 2-6 23 refs NSF Grant No AER-72-03478, Contract No E(49-18)-2538

Recent developments in thin film polycrystalline cells based on CdS/Cu₂S have established this cell as a major contender for large scale terrestrial application. Conversion efficiencies for CdS/Cu₂S now exceed 8%, with firm reason to believe that 10% is achievable. A modified cell using (CdZn)S is expected to be capable of about 15% conversion efficiency (Author)

A79-11967 Photovoltaic effects in II-VI heterojunctions R H Bube (Stanford University, Stanford, Calif) In *Optics applied to solar energy conversion*, Proceedings of the Seminar, San Diego, Calif, August 23, 24, 1977 Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1977, p 7-13 14 refs NSF-ERDA-supported research

Photovoltaic effects have been investigated in II-VI heterojunctions prepared by close-space vapor transport, vacuum evaporation, spray pyrolysis and sputtering. Solar efficiencies of about 8% have been measured for the following systems: (1) n-Cds film deposited on single crystal p-CdTe by vacuum evaporation, (2) n-ZnCdS film deposited on single crystal p-CdTe by spray pyrolysis, and (3) n-Indium-Tin Oxide film deposited on single crystal p-CdTe by sputtering in an inert atmosphere. Open-circuit voltages greater than 0.8 V have been measured in heterojunctions of type (2) and (3), as well as in CdTe p-n homojunctions produced by ion implantation (Author)

A79-11968 High efficiency solar cells based on indium phosphide J L Shay, S Wagner (Bell Telephone Laboratories, Inc., Holmdel, N.J.), K J Bachmann, and E Buehler (Bell Telephone Laboratories, Inc., Murray Hill, N.J.) In *Optics applied to solar energy conversion*, Proceedings of the Seminar, San Diego, Calif,

August 23, 24, 1977

Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p 16 19 10 refs

The paper reports on crystal InP-CdS solar cells having AM2 efficiencies of 15 percent and polycrystalline thin-film cells having AM2 efficiencies of 5.7 percent. Basic studies of the interface reveal that the thin-film efficiency is presently limited at least in part by the quality of the InP within the grains, and not exclusively by interface phenomena intrinsic to a polycrystalline cell. (Author)

A79-11969

Options for solar thermal conversion F Kreith, G F Lameiro, and K C Brown (Solar Energy Research Institute, Golden, Colo.) In Optics applied to solar energy conversion, Proceedings of the Seminar, San Diego, Calif., August 23, 24, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p 22-34 14 refs

A methodology is proposed which could provide the kind of information necessary to evaluate the advantages and disadvantages of the high-temperature and the intermediate-low temperature options for solar thermal conversion. Attention is given to generic types of solar collectors which exist to meet the demand, and to some available information which categorizes these solar collectors. Generic solar collector performance is discussed in terms of thermal conversion efficiency, defined as the ratio of the useful energy delivered by the collector to the incident total available solar energy at the aperture of the collector. An illustrative example is presented for the matching of a concentrator system to a specific task. S D

A79-11970

A vacuum solar thermal collector with optimal concentration J D Garrison (San Diego State University, San Diego, Calif.) In Optics applied to solar energy conversion, Proceedings of the Seminar, San Diego, Calif., August 23, 24, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p 35-42 6 refs

The paper describes the steps of optimal design for a fixed vacuum solar thermal collector (all glass tubular construction) intended to maximize the collected heat energy and to minimize losses and cost. The first step selects the operating temperature near 200 C or below. The next step chooses fixed (nontracking) collector. Further steps deal with maximizing radiation collection while minimizing losses and cost. The side walls and bottom of the collector tube are coated with a front surface mirror which concentrates radiation arriving within the acceptance angle onto an internal absorbing tube coated with a selective absorber. The solar collector will consist of an array of these collector tubes. The vacuum enclosure must have a convex glass window to transmit the solar radiation to the absorbing surface. Computational results indicating the performance expected for an array of these collector tubes are presented. It is shown that this performance is near optimum and is superior to that obtained by current fixed collector models. S D

A79-11971

Optical evaluation techniques for reflecting solar concentrators B L Butler and R B Pettit (Sandia Laboratories, Albuquerque, N Mex.) In Optics applied to solar energy conversion, Proceedings of the Seminar, San Diego, Calif., August 23, 24, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p 43-49 6 refs

Mirrors in reflecting solar concentrators attenuate and spread reflected beams, and aberration due to surface contour distortions misdirects the reflected rays. The paper shows how an automated laser ray trace allows fast and accurate evaluation of optical surface contours. The use of a mathematical instead of a physical reference surface makes this tool extremely versatile. It is also shown how a bidirectional reflectometer can measure scattering profiles down to 0.2 mrad and provides solar averaged data for use in solar concentrators. These techniques can be used for providing commercial product specifications, for process quality control, and for obtaining data on optimization of a material or process. Furthermore, these techniques can be used to study how concentrator properties change with time. A data format is presented for collector design, quality control and/or concentrator specification. S D

A79-11972

Five MW solar thermal test facility heliostat focus and alignment system L P Oldham (Martin-Marietta Aerospace, Denver, Colo.) In Optics applied to solar energy conversion; Proceedings of the Seminar, San Diego, Calif., August 23, 24, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p 52-59. Research supported by the U.S. Department of Energy.

A unique system has been developed to focus and align the nearly 8000 mirrors for the nation's first Central Receiver Solar Thermal Test Facility, located at Albuquerque, New Mexico. The computer-controlled system utilizes a laser light source which is scanned over a 61-in-diam collimating mirror to simulate a collimated solar beam. The collimator and laser source are mounted on a microprocessor controlled precision pointing mount with 0.1 milliradian pointing accuracy. Control of the system is achieved through a vehicle-mounted terminal plugged directly into the control electronics of the heliostat undergoing alignment. The simulated solar beam is reflected from the heliostat mirror and imaged onto a retroreflective target screen. The screen is observed by an integrating video system over the period of a complete laser scan. Alignment is achieved through computer simulation of the sun/heliostat/receiver geometry for a selectable time and day of the year. The paper gives an overview of the Solar Thermal Test Facility and a detailed description of the focus and alignment system. (Author)

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A79-11973

Nonimaging solar concentrators W W Schertz (Argonne National Laboratory, Argonne, Ill.) In Optics applied to solar energy conversion, Proceedings of the Seminar, San Diego, Calif., August 23, 24, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p 60-66 5 refs. ERDA-supported research.

Nonimaging concentrators with maximum light concentration permitted by physical principles are described. Concentrators with and without parabolic side walls are considered. Heating and cooling applications can best be achieved by a 1.5x (concentration ratio) stationary concentrating collector operating in a manner similar to a flat plate. The higher concentration ratio (5x) collectors appear to be competitive in performance to EW focusing parabolic troughs for temperatures in the range 200-300 C, do not require tracking systems, and can effectively utilize all of the circumsolar and 20% of the diffuse radiation. This makes them a prime candidate as the collector for total energy systems in which the thermal energy is first used to power a turbine for power generation, and the waste heat from the turbine is used for space heating or cooling. S D.

A79-11974 *

Comparison of the solar concentrating properties of truncated hexagonal, pyramidal and circular cones D G Burkhard, D L Shealy, and G L Strobel (Georgia University, Athens, Ga.) In Optics applied to solar energy conversion, Proceedings of the Seminar, San Diego, Calif., August 23, 24, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p 67-94. Contract No NAS8-32149.

The concentrating properties of specularly reflecting pyramids, hexagons and circular cones are examined. The concentration factor is determined as a function of the coefficient of reflection and the shape and orientation of the incident sunlight. Reflector designs allowing multiple reflections for both normal and oblique incidence are considered. (Author)

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A79-11976

Large, lightweight, replicated mirrors W Talbert (Talbert Reflectors, Oakland, Calif.) In Advances in replicated and plastic optics, Proceedings of the Seminar, San Diego, Calif., August 23, 24, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p 7-17.

Replication of large scale optical quality mirrors has been demonstrated to be feasible for the first time in recent development work. This paper traces the stages of the development process from conceptual considerations on large lightweight mirrors through pilot production of flight simulator mirrors. Applications include flight simulator displays, visual and TV projection systems, solar energy

collectors, IR laser systems, millimeter and submillimeter radio reflectors (Author)

A79-12037 Optics in adverse environments, Proceedings of the Seminar, San Diego, Calif., August 25, 26, 1977 Seminar sponsored by the Society of Photo Optical Instrumentation Engineers Edited by E Bernal (Honeywell Corporate Material Sciences Center, Minneapolis, Minn.) and H V Winsor (Defense Advanced Research Projects Agency, Arlington, Va.) Bellingham, Wash., Society of Photo Optical Instrumentation Engineers (SPIE Proceedings Volume 121), 1978 188 p \$34

Papers are presented on mechanisms of laser damage to optical components, rain erosion mechanisms of optical materials, and infrared optics in airborne environments Optics in space and underwater applications is outlined with reference to radiation effects, underwater optical communications receivers, and a free-electron laser Consideration is given to optics for energy generation noting beam transport optics for laser fusion and the optical design of components for a 100-kJ CO₂ laser Sources of optical distortions in high energy laser systems are identified and rain erosion resistant antireflective coatings for infrared windows are described S C S

A79-12045 Predicted performance of heliostats for ERDA's 10 MWe power plant P Leary and J D Hankins (Sandia Laboratories, Livermore, Calif.) In Optics in adverse environments, Proceedings of the Seminar, San Diego, Calif., August 25, 26, 1977 Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1978, p 98 105

A79-12062 Frequency doubling of a solar pumped Nd YAG laser J D Barry and C J Kennedy (USAF, Space Laser Communication Program Office, Los Angeles, Calif.) In Advances in laser engineering, Proceedings of the Seminar, San Diego, Calif., August 25, 26, 1977 Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p 82-87 13 refs

Optical restrictions on the design of a solar pumped laser are related to the collection of the sunlight and the required opto-mechanical assembly to provide end pumping of a small Nd YAG laser rod Solar pumping influences affect the laser operation Simultaneous mode-locking and frequency-doubling are additional complications (Author)

A79-12114 Coal desulfurization Chemical and physical methods, Proceedings of the Symposium, New Orleans, La., March 23, 1977 Symposium sponsored by the American Chemical Society Edited by T D Wheelock (Iowa State University of Science and Technology, Ames, Iowa) Washington, D C., American Chemical Society (ACS Symposium Series, No 64), 1977 340 p \$25

The occurrence of sulfur in coal and the determination of sulfur are considered along with the physical methods for removing sulfur from coal, the extraction of sulfur from coal by reaction and leaching, and the removal of sulfur by pyrolysis, hydrodesulfurization, and other gas-solid reactions Attention is given to coal microstructure and pyrite distribution, a chemical comminution process for liberating the mineral matter from coal, the use of the flotation process for the desulfurization of coal, a comparison of coal beneficiation methods, pyrite removal from coal, the magnetic desulfurization of some Illinois basin coals, the applicability of the Meyers process for the desulfurization of U S coal, the oxidative desulfurization of coal, a hydrothermal coal process, and coal desulfurization by low temperature chlorinolysis G R

A79-12115 An overview of coal preparation J A Cavalario and A W Deurbrouck (US Bureau of Mines, Coal Preparation and Analysis Laboratory, Pittsburgh, Pa.) In Coal desulfurization Chemical and physical methods, Proceedings of the Symposium, New Orleans, La., March 23, 1977 Washington, D C., American Chemical Society, 1977, p 35-57 11 refs

In the U S today coal preparation practices are directed toward maximizing Btu recovery, 3 shift-per day operation of preparation plants, fine-size coal washing, closed water circuits, and reducing sulfur in the final product Sulfur in coal occurs in three forms, including organic sulfur, sulfate, and pyritic sulfur Organic sulfur, which is an integral part of the coal matrix and which generally cannot be removed by direct physical separation, comprises 30-70% of the total sulfur of most coals The sulfate is normally an oxidation product which is water soluble and, therefore, readily removed during coal cleaning Sulfate sulfur content is usually less than 0.05% Pyritic sulfur in the form of mineral pyrite occurs in coal as discrete and sometimes microscopic particles The pyritic sulfur content of a coal generally can be reduced significantly by size reduction and subsequent specific gravity separation Attention is given to the control of sulfur oxide emissions from stationary combustion sources, the result of sulfur reduction potential studies, and the effects of the beneficiation of coal reserves G R

A79-12116 Desulfurization of coals by high-intensity high-gradient magnetic separation - Conceptual process design and cost estimation C J Lin and Y A Liu (Auburn University, Auburn, Ala.) In Coal desulfurization Chemical and physical methods, Proceedings of the Symposium, New Orleans, La., March 23, 1977 Washington, D C., American Chemical Society, 1977, p 121-139 36 refs Research supported by the Gulf Oil Foundation and Auburn University, NSF Grants No G1 38701, No AER-76-09300

A79-12117 Applicability of the Meyers process for desulfurization of U S coal - A survey of 35 coals J W Hamersma, M L Kraft, and R A Meyers (TRW Systems and Energy, Redondo Beach, Calif.) In Coal desulfurization Chemical and physical methods, Proceedings of the Symposium, New Orleans, La., March 23, 1977 Washington, D C., American Chemical Society, 1977, p 143-152 10 refs

The Meyers process is a new chemical leaching process which allows many coal-fired power plants and industrial sources to meet federal and state sulfur oxide emission standards without the use of flue gas cleaning A regenerable aqueous ferric sulfate leaching unit is used to chemically convert and remove the pyritic sulfur content of the coal as elemental sulfur and iron sulfate Although only pyritic sulfur is removed (organic sulfur remains), the Meyers process has wide applicability for converting U S coal reserves to a sulfur level consistent with present and proposed governmental sulfur oxide emission standards Thirty-five mines from the major coal basins were investigated in the considered study Attention is given to pyritic sulfur removal from coal, pyritic sulfur partition by float-sink separation from the same coals, the effect of the Meyers process on the trace element content of the treated coals, and the applicability of the Meyers process for meeting air pollution control standards G R

A79-12118 Coal desulfurization test plant status - July 1977 L J van Nice, M J Santy, E P Koutsoukos, R A Orsini, and R A Meyers (TRW Systems and Energy, Redondo Beach, Calif.) In Coal desulfurization Chemical and physical methods, Proceedings of the Symposium, New Orleans, La., March 23, 1977 Washington, D C., American Chemical Society, 1977, p 153-163

In connection with the development of the Meyers process, an 8-metric ton/day process test plant was built for chemical desulfurization of coal utilizing ferric sulfate leach solution It was found that the density of aqueous ferric sulfate leach solution, as utilized in the Meyers process, is ideal for accomplishing a practical gravity separation of coal for specific gravities between 1.2 and 1.4 The new test plant is a highly flexible facility capable of testing the numerous alternate processing modes of potential interest in the Meyers process A process based on the oxidation of coal pyrite with ferric sulfate is considered The leaching reaction is highly selective to pyrite with 60% of the pyritic sulfur converted to sulfate sulfur and 40% to elemental sulfur G R

A79-12119 * Coal desulfurization by low-temperature chlorinolysis G C Hsu, J J Kalvinskas, P S Ganguli, and G R Gavalas (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In Coal desulfurization Chemical and physical methods, Proceedings of the Symposium, New Orleans, La, March 23, 1977 Washington, D C, American Chemical Society, 1977, p 206-217 18 refs Contract No NAS7-100

Among the three principal methods for precombustion desulfurization of coal, which include physical depyriting, chemical desulfurization, and coal conversion to low-sulfur liquid and gaseous fuels, the potential of chemical methods looks promising in terms of both total sulfur removal and processing cost. The principal chemical methods for coal desulfurization involve treatment with either oxidizing agents or basic media at elevated temperature and pressure. A description is given of some recent experimental results which show the feasibility of removing sulfur, particularly organic sulfur, from high-sulfur coals by a simple method of low-temperature chlorinolysis followed by hydrolysis and dechlorination. The chemical feasibility of sulfur removal by chlorinolysis rather than the detailed engineering process is emphasized. G R

A79-12120 Desulfurization and sulfidation of coal and coal char G J W Kor (United States Steel Research Laboratory, Monroeville, Pa) In Coal desulfurization Chemical and physical methods, Proceedings of the Symposium, New Orleans, La, March 23, 1977 Washington, D C, American Chemical Society, 1977, p 221-247 13 refs

A79-12121 Fluid-bed carbonization/desulfurization of Illinois coal by the Clean Coke Process - PDU studies N S Boodman, T F Johnson, and K C Krupinski (United States Steel Research Laboratory, Monroeville, Pa) In Coal desulfurization Chemical and physical methods, Proceedings of the Symposium, New Orleans, La, March 23, 1977 Washington, D C, American Chemical Society, 1977, p 248-266 Contract No E(49-18)-1220

The Clean Coke Process combines both fluid-bed carbonization and hydrogenation/liquefaction to convert high-sulfur coal to low-sulfur metallurgical coke, chemical feedstocks, and to a lesser extent, liquid and gaseous fuels. Run-of-mine coal is beneficiated and classified by conventional means and split into two feed portions, including a sized fraction suited for fluid-bed processing and a fines fraction suited for high pressure hydrogenation. A description is presented of the results obtained from sustained operation of a carbonization process development unit (PDU). The results confirm and extend the data obtained previously in bench studies. All tests were run with Illinois No. 6 seam coal containing 2-2.5% sulfur after preparation. From this were produced chars containing, generally, 0.6-0.7% sulfur. Char containing as little as 0.2% sulfur was produced under the more severe reaction conditions. Reaction conditions investigated for their effect on char sulfur content included residence time, temperature, pressure, and H₂S concentration in the fluidizing gas. G R

A79-12186 # A problem of optimizing the setting angle of sun-battery panels of concave shape (Ob odnoi zadache optimizatsii uglov ustanovki panelei solnechnoi batarei vypukloi formy) S V Rzhevskii, O N Tokareva, N Z Shor, and G N Iun TsAGI, *Uchenye Zapiski*, vol 8, no 3, 1977, p 165-169. In Russian

The minimax problem of determining the optimal angle of solar-panel setting on a satellite with allowance for the possible positions of the orbit with respect to the sun is analyzed. The solution of the problem by Shor's (1972) method of steepest descents involving space dilatation is demonstrated. V P

A79-12241 Calculation of wake effects in wind turbine parks P J H Bultjes (Centrale Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Nijverheidsorganisatie, Apeldoorn, Netherlands) and J Smit (Netherlands Energy Research Foundation, Petten, Netherlands) *Wind Engineering*, vol 2, no 3, 1978, p 135-145

Considering the problem of the mutual spacing and pattern in which wind turbines have to be placed in order to get an optimal (from an aerodynamic and economical point of view) energy output on a restricted area, wake measurements have been carried out in a wind tunnel of a turning model of a Darrieus rotor. Using these wake results calculations considering interacting wakes of different turbines have been performed using the computer code 'winds'. For small parks with up to 20 turbines an optimum energy output seems to be gained at a mutual distance of about 5 wing diameters, for larger parks above 60 turbines this value is about 9 diameters. In the case of larger parks a row pattern is preferable to a regular pattern. (Author)

A79-12242 The influence of blade camber on the output of vertical-axis wind turbines J V Healy (Belfast, Queen's University, Belfast, Northern Ireland) *Wind Engineering*, vol 2, no 3, 1978, p 146-155

This study represents an extension to cambered airfoils of a previous work on symmetric ones. The model used is the multiple-streamtube one and the airfoils have Gottingen profiles - the only ones for which sufficient data is available. It is found that airfoils with high lift can abstract more than the optimum amount of energy from each streamtube. This high lift can be generated by using camber or by presetting symmetric profiles at some initial angle of incidence. In general, the closer the airfoil is to symmetric, the more satisfactory its power output. Cambering or presetting the angle of incidence seems a likely way to avoid excessive turbine speeds. (Author)

A79-12243 A comparison of the Weibull and Rayleigh distributions for estimating wind power potential J P Hennessey, Jr (Oregon State University, Corvallis, Ore) *Wind Engineering*, vol 2, no 3, 1978, p 156-164 14 refs

For potential wind power sites where the Weibull model of the wind speed distribution is applicable, some general guidance is provided which will help investigators decide (1) whether or not the Rayleigh distribution will be a satisfactory approximation to the Weibull, (2) which sites are the most productive and reliable for an aerogenerator of a specific size, and (3) which size of aerogenerator should be used given the wind speed characteristics of a certain site. (Author)

A79-12244 Performance prediction methods for horizontal axis wind turbines D J Milborrow (Central Electricity Generating Board Research Laboratories, Leatherhead, Surrey, England) *Wind Engineering*, vol 2, no 3, 1978, p 165-175 11 refs

A method of assessing the performance characteristics of horizontal-axis wind turbines has been developed, using the airfoil theory which is applied to axial flow fans. The capabilities of the method are compared with those of the propeller theory normally used for windmill performance assessment. Weaknesses in the propeller theory are identified, and it is concluded that the fan analysis technique has certain advantages and lends itself to further refinement. Both theories have been applied to a particular windmill design for which field measurements are available (the LT Co aerogenerator at Aldborough). Fan theory predicts rather higher peak performance in agreement with LT Co observations that design performance has been exceeded. (Author)

A79-12264 # Nitinol thermodynamic state surfaces J S Cory (Cory Laboratories, Inc., Escondido, Calif) *Journal of Energy*, vol 2, Sept Oct 1978, p 257, 258 5 refs Contract No EC-77 X 01-4111

An empirical data correlation for the thermodynamics of the alloy Nitinol is presented and used to specify the necessary and sufficient state variables and to provide a quantitative description of all possible thermodynamic paths together with the work associated with each of these paths. The applied procedure involves the replacement of the single-state surfaces of reversible materials with two infinite sets of state surfaces which completely fill a bounded volume in state space. Nitinol is of interest because Joule effect heat

engines which use this shape memory alloy as the working material are considered to be a potentially cheap means of converting low temperature heat energy into shaft power M L

A79-12265 # Electric automobiles - Yes E Stuhlinger (Alabama, University, Huntsville, Ala) *Journal of Energy*, vol 2, Sept-Oct 1978, p 279-288 Contract No EC 77-X 01 3559

Growing shortage of petroleum threatens the lifeline of conventional automobiles and makes the search for alternate transportation systems mandatory. Among several possible substitutes, the electric automobile appears promising as a short-distance commuter car (COMCAR). Its lack of pollution would be an additional advantage. A systematic user test and demonstration project was undertaken to analyze the performance capability of a commercially available electric automobile. The project included a six month driving program by volunteer test drivers who used the car for daily trips to and from work. Although the performance of the test vehicle was only about half as good as can be expected with an electric commuter car specifically designed for its purpose, the reaction of volunteer test drivers in the COMCAR project was positive. Experience and data obtained in this project led to recommendations for further steps toward the development and introduction of large numbers of electric commuter cars for urban transportation.

(Author)

A79-12266 # Direct energy converters - Efficiency and cost estimates for two electrostatic concepts M A Hoffman (California, University, Davis, Calif) *Journal of Energy*, vol 2, Sept-Oct 1978, p 293-302 15 refs Contract No W 7405 eng 48

This study is concerned with two specific types of electrostatic direct energy converters for direct recovery of a large fraction of the plasma ion energy from magnetic-mirror type fusion reactors. Simplified equations are presented for each of the important loss mechanisms in both single stage direct converters and multistage 'venetian blind' type direct converters. These equations can be used to estimate the efficiency and electric power output of the direct converter subsystem. Scaling relations for the cost of each major component in the direct converter subsystem are also given, these include the vacuum tank, direct converter (DC) modules, the DC power conditioning equipment, cryogenic vacuum pumping system, and the thermal bottoming plant. Examples of cost effectiveness studies for two specific reference direct converter designs are presented in terms of the specific capital costs (i.e., the capital cost per unit of electric power produced) for the direct converter subsystem. These examples show that relaxation of the requirement for small charge exchange losses can significantly reduce the specific capital costs of the direct converter subsystem.

(Author)

A79-12267 # Technology and development requirements of the solar power satellite R L Kline (Grumman Aerospace Corp., Bethpage, N Y) *Journal of Energy*, vol 2, Sept-Oct 1978, p 303-308 11 refs

This paper discusses three major technology and development issues (energy conversion, microwave power transmission system and ground receiver, and construction) which must be addressed to achieve solar power satellite (SPS) operational capability. The technology and development issues center about economical operation of the SPS and identify requirements for such a program from the near term to the mid-1980's. For each of the issues, current status is described and critical considerations which must be addressed are identified. Hardwares under development and their evolution/utilization are also described. A timetable for an SPS program, together with a key technology and development step, the power technology module (PTM), are detailed. Based on the identified requirements, a three-step technology and development program, consisting of a ground technology phase, a Shuttle sortie mission phase, and a PTM phase, is recommended.

(Author)

A79-12268 # An aperture-augmented prototype power satellite. K E Drexler and B R Sperber *Journal of Energy*, vol 2, Sept-Oct 1978, p 318, 319

The paper considers a proposed subscale prototype for testing the technically risky parameters of the microwave power transmission system at their full scale values while greatly relaxing other parameters to reduce total system cost. The prototype would include a microwave optical element used to augment the transmitting aperture area. The prototype is modeled as a power generating and transmitting system with mass proportional to power output and with a reflector (or lens) with mass proportional to area, and an expression for the minimum weight is obtained. M L

A79-12270 The ion fly-wheel effect on the electro-thermal instability in non-equilibrium MHD Hall disc generators V Thiagarajan (New York, State University, Buffalo, N Y) *Energy Conversion*, vol 18, no 2, 1978, p 53-56 5 refs

The electrothermal instability in a nonequilibrium plasma used in a MHD generator is treated in an approximately collisionless time scale. It is shown that when a charge separation field exists, some energy is transferred from the electrons to the ions during the process of restoration of the charge neutrality, and part of this energy can be stored in the azimuthal translational mode of the ions (i.e., the 'ion flywheel'). The energy will be transferred to the neutrals by ion-neutral collisions, and there will be a gain in the critical Hall parameter, since the energy causing the instability is now reduced. The process is especially applicable in a nonequilibrium MHD Hall disk generator operating with flow symmetry, and approximate calculations predict that the critical Hall parameter can be raised from two to three by virtue of the ion flywheel effect. M L

A79-12271 Solar thermal energy storage using heat of dilution - Analysis of heat generation in multistage mixing column T Tanaka, K Sakuta, M Kamimoto, T Tani, S Sawata, and T Horigome (Ministry of International Trade and Industry, Electro technical Laboratory, Tokyo, Japan) *Energy Conversion*, vol 18, no 2, 1978, p 57-65

Heat recovery obtained after storage of solar energy in the form of heat of dilution is studied by analyzing the mixing of two liquids (H2SO4 and H2O) in two multistage mixing column systems. The thermal analysis shows that heat at various temperatures can be produced by heat of dilution in a manner useful for various energy supply systems. Enthalpy balances are examined, and advantages of heat-of-dilution systems, advantages including ease of heat transfer and reaction control - are considered. M L

A79-12272 Analysis of a direct coupling d c motor and a photovoltaic converter J Bany (Tel Aviv University, Tel Aviv, Israel) *Energy Conversion*, vol 18, no 2, 1978, p 73-79

The performance characteristics of specific dc motors (separate, series, and shunt excitation) supplied from a specific solar cell array were analyzed and tested. Speed, torque, and control features are plotted. It is found that the performance of a dc motor fed by a photovoltaic converter is usually inferior to the performance of a motor with a constant voltage supply, although the former has the feature of self limiting starting current. Factors affecting operation are considered. M L

A79-12273 Solar thermal electric power systems - Manufacturing cost estimation and systems optimization W S Duff and W W Shaner (Colorado State University, Fort Collins, Colo) *Energy Conversion*, vol 18, no 2, 1978, p 81-93 9 refs

A79-12274 Magnetohydrodynamic/steam power plant modeling and control J D Aspnos (Alaska, University, Fairbanks, Alaska) and D A Pierre (Montana State University, Bozeman, Mont) *Energy Conversion*, vol 18, no 2, 1978, p 101-113 13 refs Contract No E(49-18)-1811

A dynamic power-flow simulation of an overall magnetohydrodynamic (MHD)/steam electrical power generating plant is developed. Time domain solutions to the set of system equations are given. Several control configurations are applied to the system and their effects on system dynamic response are presented. The overall

combined-cycle system model utilizes an input-output characterization of the Combustor/Nozzle/Channel/Diffuser. This characterization is developed from polynomial approximations of data resulting from the solutions of energy balance, state, and continuity equations for the combustor and the quasi one-dimensional MHD equations for the nozzle, channel and diffuser. The boiler and turbine valve model has turbine valve area and power available to generate steam as inputs, and throttle pressure, power to the turbines, and boiler and stack losses as outputs. Regenerative air preheater cycling is also modeled, and the effect of cycling on plant output is given.

(Author)

A79-12275 Aeroelastic wind energy converter G Ahmadi (Pahlavi University, Shiraz, Iran) *Energy Conversion*, vol 18, no 2, 1978, p 115-120 18 refs. Research supported by the Pahlavi University.

The principle of aeroelastic wind energy conversion is introduced and an H-section model which works on the basis of torsional aeroelastic instability is described. A mathematical formulation for the prediction of the power coefficient of such wind machines is presented. A small model is constructed and tested in a wind tunnel. Although the efficiency of the model was very low, the system has the advantage of being capable of conversion of energy at very low wind speed. Furthermore, this wind energy converter is relatively simple and economical.

(Author)

A79-12324 * Feasibility of rocket propellant production on Mars R L Ash, W L Dowler, and G Varsi (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *Acta Astronautica*, vol 5, Sept 1978, p 705-724 48 refs. Contract No NAS7 100.

In situ production of rocket propellant to reduce landed mass requirements for Mars return missions has been investigated. The analysis has shown that a system which utilizes atmospheric carbon dioxide and soil moisture to produce liquid methane oxygen propellant requires a landed mass which is less than half the mass of the ascent vehicle it produces.

(Author)

A79-12325 Transient attitude dynamics of satellites with deploying flexible appendages K W Lips and V J Modi (British Columbia, University, Vancouver, Canada) (*International Astronautical Federation, International Astronautical Congress, 28th, Prague, Czechoslovakia, Sept 25-Oct 1, 1977*) *Acta Astronautica*, vol 5, Oct 1978, p 797-815 23 refs. National Research Council of Canada Grant No A 2181.

A general formulation is presented for librational dynamics of satellites with an arbitrary number, types, and orientation of deploying flexible appendages. The generalized force term is incorporated, making the formulation applicable to a wide variety of situations where aerodynamic forces, solar radiation, earth's magnetic field, etc., become significant. In particular, the case of a beam-type flexible appendage deploying from a satellite in an arbitrary orbit is considered. The corresponding nonlinear nonautonomous equations for in plane and out of plane vibrations are derived, allowing for the variation of mass density and flexural rigidity along the length with time dependent deployment velocity and spin rate. Next, attention is focused on the linearized analysis of the in plane vibrational equation using the assumed-mode method and its substantiation through numerical integration. Finally, results for both steady-state and transient attitude behavior for a representative gravity-gradient configuration for a range of initial conditions and system parameters are given which show the combined effect of flexibility and deployment on the dynamics of the system to be substantial.

(Author)

A79-12340 # The need for materials recycling M E Henstock (Nottingham University, Nottingham, England) In *Reclamation and recycling of metals*. London, Institution of Metallurgists, 1977, p 48 12 refs.

Factors involved in determining the cost benefits of metal recycling programs are discussed. It is concluded that a specific

program must be evaluated in terms of factors such as energy, employment, litter, extension of resource life, and reduced pollution from primary production. 'Open loop recycling', which uses the waste from one process as a raw material for another process, is considered, and the economics of metal recovery is described. M L.

A79-12376 National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings. Conference sponsored by the Western Michigan University. Edited by H D Behm (Western Michigan University, Kalamazoo, Mich.) Kalamazoo, Mich, Western Michigan University, 1977 154 p \$10 00.

The papers in this volume present technological and operational approaches to the problem of increasing fuel economy in general aviation. Topics discussed include the controversy of regulation versus technological improvements, alternative aviation turbine fuels, automotive engines for aircraft, energy conservation in general aviation piston-powered aircraft, economy in flight operations, and efficiency through angle-of attack monitoring. P T H.

A79-12378 * # Alternative aviation turbine fuels J Grobman (NASA, Lewis Research Center, Advanced Technology Section, Cleveland, Ohio) In *National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings*. Kalamazoo, Mich, Western Michigan University, 1977, p 40-59 11 refs.

The efficient utilization of fossil fuels by future jet aircraft may necessitate the broadening of current aviation turbine fuel specifications. The most significant changes in specifications would be an increased aromatics content and a higher final boiling point in order to minimize refinery energy consumption and costs. These changes would increase the freezing point and might lower the thermal stability of the fuel and could cause increased pollutant emissions, increased smoke and carbon formation, increased combustor liner temperatures and poorer ignition characteristics. This paper discusses the effects that broadened specification fuels may have on present-day jet aircraft and engine components and the technology required to use fuels with broadened specifications. (Author)

A79-12379 # Automotive engines - A viable alternative for aircraft J T Camden (Lear Avia Corp, Lincoln, Neb.) In *National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings*. Kalamazoo, Mich, Western Michigan University, 1977, p 77-80.

It has already been demonstrated that automotive engines can be adapted for aircraft use. The Model 'T' and 'A' engines which powered early aircraft in the US attest to that. Now the feasibility of a use of modern automotive engines and modern technology in aviation is being investigated. It is found that current passenger car engines adapted for aircraft use can provide a low cost, quiet, and above all fuel efficient alternative to present air-cooled aircraft engines. Continued development work by the many companies and individuals now engaged in this activity will produce the data and experience needed to provide convincing proof regarding the practicality of automotive conversions. G R.

A79-12380 # Turbine engines in light aircraft E Lays (Williams Research Corp, Walled Lake, Mich.) In *National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings*. Kalamazoo, Mich, Western Michigan University, 1977, p 83-91.

Some of the aircraft used by company executives have as many as 19 seats which are rarely used because it's seldom that 19 businessmen are going to the same place, at the same time. Much of the fuel consumed by business jets could, therefore, be saved by using smaller aircraft with smaller engines. Suitable engines and aircraft models which would satisfy company transportation objectives more economically are discussed. Attention is also given to the use of one-man crews for business aircraft, the advantages of high-altitude flying capabilities, the desirability to design a small

business jet from the outset to be compatible in approach speed with an airliner to reduce the fuel consumption of the airliner by eliminating the need for special maneuvering operations, and fuel savings possible by the use of the general aviation airport G R

A79-12381 # Energy conservation in general aviation and operation and maintenance of Avco Lycoming piston engines J A Doblin (Avco Corp., Avco Lycoming Williamsport Div., Williamsport, Pa.) In National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich., October 10, 11, 1977, Proceedings Kalamazoo, Mich., Western Michigan University, 1977, p 92, 93

The author emphasizes certain points on more fuel-efficient flying with general aviation piston engines. It is mentioned that proper leaning at cruise makes the engines smooth, protects engine mounts and accessories from vibration and possible failure. Leaning at cruise extends the range. It is pointed out that switching to automotive fuel is not recommended. P T H

A79-12383 # Economy in flight operations G A McKinzie (United Air Lines, Inc., Chicago, Ill.) In National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich., October 10, 11, 1977, Proceedings Kalamazoo, Mich., Western Michigan University, 1977, p 128 133

A strategy for fuel conservation in general aviation is outlined, the main points of which are (1) reduction of burnout rate, (2) reduction of excess weight, and (3) general measures such as schedule adjustments and improved flight planning. The author suggests fuel burnout monitoring, loading for minimum drag, elimination of unnecessary 'tankering', and careful monitoring of the fueling operations. P T H

A79-12384 # Flying angle of attack D E Lange (Teledyne Avionics, Charlottesville, Va.) In National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich., October 10, 11, 1977, Proceedings Kalamazoo, Mich., Western Michigan University, 1977, p 134 143

The possibilities for angle of attack reference in economic operation of turbojet aircraft are discussed. A chart is given showing the relationship between basic angle of attack, Mach number, calibrated airspeed, and true airspeed for different pressure altitudes and different gross weights for the Falcon 10 aircraft. Angle of attack cruise schedules for this airplane are given. An angle of attack sensor and indicator system is briefly described, the proper use of which, it is claimed, will result in approximate maximum fuel economy. P T H

A79-12471 * # High efficiency low cost solar cell power I Bekey (NASA, Washington, D C, Aerospace Corp., El Segundo, Calif.) and W Blocker (Aerospace Corp., El Segundo, Calif.) *Aeronautics and Aeronautics*, vol 16, Nov 1978, p 32-38 12 refs

A concept for generating high-efficiency, low cost, solar-cell power is outlined with reference to solar cell parameters, optical concentrators, and thermal control procedures. A design for a 12.5-kw power module for space operation is discussed noting the optical system, spectrum splitter, light conversion system, cell cooling, power conditioner, and tracking mechanism. It is found that for an unconcentrated array, efficiency approaches 60% when ten or more bandgaps are used. For a 12-band system, a computer program distributed bandgaps for maximum efficiency and equal cell currents. Rigid materials and thin films have been proposed for optical components and prisms, gratings, and dichroic mirrors have been recommended for spectrum splitting. Various radiator concepts are noted including that of Weatherston and Smith (1960) and Hedgepeth and Knapp (1978). The concept may be suitable for the Solar Power Satellite. S C S

A79-12507 * # Detection of internal defects in a liquid natural gas tank by use of infrared thermography A G Kantsios (NASA, Langley Research Center, Hampton, Va.) *Biennial Infrared Information Exchange, 4th, St Louis, Mo., Aug 22-24, 1978, Paper 20 p*

The use of an infrared scanning technique to detect defects in the secondary barrier of a liquid natural gas tank is described. The method works by detecting leak-caused temperature differences as low as 0.2 K, but can provide only an approximate idea of the extent of the defect. The nondestructive method was tested in a study of a LNG tank already at its location in a ship, the secondary barrier was located inside the tank wall. Defective areas indicated by the infrared radiometric measurements were confirmed by other probe techniques and by physical examination. M L

A79-12529 # Current problems in the development and production of small gas turbine engines (Aktualni otázky vyvoje a vyroby malych turbinovych motoru) A Malek *Zpravodaj VZLU*, no 3, 1978, p 123 127 5 refs In Czech

A multifaceted approach is taken to the problem of developing small gas turbine engines. Consideration is given to the utilization of experimental flight data in the preliminary design stage, and to the necessity for improved fabrication technology, construction materials, and structural designs. It is noted that fuel consumption of small gas turbines will, in the future, remain the most essential economic parameter. B J

A79-12551 # Molten-carbonate CO2 concentrator Preliminary experiments O Abdel-Salam and J Winnick (Missouri Columbia, University, Columbia, Mo.) *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, San Diego, Calif., July 10-13, 1978, Paper 78-ENAs-2* 7 p 7 refs Members, \$1 50, nonmembers, \$3 00

This paper discusses preliminary experiments of a molten carbonate CO2 concentrator. These experiments have been carried out in three generations of devices in the current program. The results of these experiments show the concentrator to be feasible. The efficiencies are not yet as high as those found with the aqueous carbonate cells, but may improve as design and operating experience evolve. (Author)

A79-12556 # Low-grade thermal energy-conversion Joule effect heat engines W S Ginnell, J L McNichols (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.), and J S Cory *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, San Diego, Calif., July 10-13, 1978, Paper 78-ENAs-7* 13 p 19 refs Members, \$1 50, nonmembers, \$3 00

Low grade thermal energy conversion is discussed with attention to energy sources, heat engines, and potential Joule engine applications. Nitinol heat engine concepts are discussed, and the Nitinol equation-of state surfaces and transition characteristics are indicated. Bottoming cycles are considered, the untapped low-temperature water energy sources are estimated, the heat-transfer limitation of gas phase heat engines is examined, and solid-state heat engines are surveyed. (Author)

A79-12569 # Liquid metal heat pipe performance in the presence of a transverse magnetic field H J Fivel (McDonnell Douglas Astronautics Co., St Louis, Mo.) *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, San Diego, Calif., July 10-13, 1978, Paper 78-ENAs-20* 11 p 5 refs Members, \$1 50, nonmembers, \$3 00 Contract No EY 76-C 02-2802

A study was undertaken to explore experimentally the performance of a liquid metal heat pipe in the presence of a magnetic field and to compare test results with a theoretical analysis. Two 1.59-cm-O D sodium-filled heat pipes with composite wicks were designed, fabricated, and tested at magnetic field strengths up to 2 Tesla. Both heat pipes showed no apparent change in power throughput when tested in a magnetic field as compared to tests without the magnetic field, operating with over 500 w net input power to the evaporator section. Measured operation was also compared with theoretical predictions of the wicking limit, taking into account MHD effects on the liquid phase pressure drop. The present analysis shows the performance of the composite wick design to be much less sensitive to transverse magnetic fields than is

indicated by earlier literature references for heat pipe designs employing grooves or annular wicks (Author)

A79-12579 # Thermal energy storage heat exchanger design R A Haslett, R L Kosson, A A Ferrara, and J G Roukis (Grumman Aerospace Corp., Bethpage, N Y) *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, San Diego, Calif., July 10-13, 1978, Paper 78-ENAs 30 10 p* Members, \$1 50, nonmembers, \$3 00

Thermal energy storage (TES) is one method for utilities to store energy during low electrical usage periods for later use to meet peak demands. The size of the storage system can be minimized by utilizing the large latent heat capacity of salt eutectics that melt at the high temperatures (300 to 1000 F, 149 to 538 C) encountered in utility Rankine cycles. A modified tube and shell heat exchanger design was developed with the salt on the shell side and the steam or feedwater in the tubes. This TES system is shown to be less expensive than increasing plant size to provide peaking loads.

(Author)

A79-12683 'Local' breakdown criterion in highly ionized gas flow Iu A Nikuev (Akademia Nauk SSSR, Nauchno Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 16, Jan-Feb 1978, p 54-58) *High Temperature*, vol 16, no 1, July 1978, p 42-46 23 refs Translation

Liubimov (1973) has proposed a semiempirical criterial expression for breakdown in an ionized gas flow, the physical meaning of which is that breakdown will occur when the energy imparted to an electron over the mean free path exceeds the ionization energy of a given gas. In the present paper, a modification of Liubimov's criterion, termed the local breakdown criterion, is analyzed and shown to provide better agreement with experimental data on electrical discharges between two cold electrodes in a streaming ionized gas in the presence of an external magnetic field. V P

A79-12691 Stability of combustion in the combustion chamber of an MHD generator A I Bystryi, R V Ganefel'd, G V Davydovskii, Ia S Zhuludov, and M M Nekhamin (Akademia Nauk Ukrainsoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR) (*Teplofizika Vysokikh Temperatur*, vol 16, Jan-Feb 1978, p 143-147) *High Temperature*, vol 16, no 1, July 1978, p 111-115 8 refs Translation

The possibility was studied of obtaining stable combustion in a chamber with a thermal power between 10 and 20 MW under conditions of premixing natural gas with oxygen-enriched air. The working temperature of the combustion products was between 2800 and 2900 K, the chamber efficiency was 97 to 98 percent, the dwell time was 15 msec, and the pressure pulsations were 1 to 3 percent of the total pressure. The influence of the excess air ratio on combustion stability was studied. It is shown that the tendency to instability decreases with increasing percentage of oxygen enrichment and the associated increase in combustion rate. V P

A79-12692 U-25B MHD unit for carrying out investigations under the conditions of strong electric and magnetic fields V A Kirillin, A E Sheindlin, V I Maksimenko, S A Pashkov, D S Pinkhasik, S I Pishchikov, N P Privalov, V D Semenov, V S Sidorov, and Iu D Sokirko (Akademia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 16, Jan-Feb 1978, p 148-159) *High Temperature*, vol 16, no 1, July 1978, p 115-124 5 refs Translation

The MHD electrical power generating system described in the present paper was developed for use in a Soviet-USA research program to be conducted during 1978 through 1982 to study such aspects of MHD electric power plants as long-term operation of circuit elements at high electric potentials, optimal designing of MHD elements for operation at electric fields as high as 35 kV/m, high current densities, and high Hall voltages, the characteristics of superconducting magnetic systems capable of inducing magnetic

fields in excess of 5 tesla, etc. The block diagram of the generator and the design of the principal elements and subsystems are discussed. V P

A79-12693 Channel No 1 of the MHD generator of a U-25B unit for carrying out investigations in strong electric and magnetic fields A V Karpukhin, V I Maksimenko, S A Pashkov, V D Semenov, and Iu N Sokolov (Akademia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 16, Jan-Feb 1978, p 160-167) *High Temperature*, vol 16, no 1, July 1978, p 125-131 8 refs Translation

The MHD channel discussed uses the combustion products of natural gas and 60-wt% oxygen-enriched air as the working medium, with additional injection of cold air in front of the combustion chamber, and alkali metal additions in the form of aqueous solutions of potassium or cesium salts in amounts of up to 1.5 mol%. The maximum stagnation pressure at the channel inlet is 3.5 atm abs, the stagnation temperature at the inlet is 2750 K at 40% O₂-enrichment, and 3000 K at 60% O₂-enrichment, the stagnation pressure at the outlet is 0.8 to 1.0 atm abs, depending on the mode of exhaust-fan operation and the amount of air inflow behind the diffuser. The design of the MHD channel is illustrated, and its characteristic features are discussed. V P

A79-12694 A collisional plasma rotating between two cylinders V Thiagarajan and V K Rohatgi (Bhabha Atomic Research Centre, Bombay, India) (*Teplofizika Vysokikh Temperatur*, vol 16, Jan-Feb 1978, p 168-177) *High Temperature*, vol 16, no 1, July 1978, p 132-139 9 refs Translation

In the present paper, the two-fluid MHD equations are applied to the analysis of an argon plasma which rotates between two coaxial cylindrical electrodes in crossed electric and magnetic fields. The plasma is generated by a diffuse discharge, i.e., under conditions where charge transfer occurs over the entire gap. The steady velocity and density distributions at a pressure of 33 mm Hg are obtained from a numerical solution of the dimensionless equations. It is shown that the centrifugal force is negligible, whereas the Coriolis force and the electron pressure gradient should be taken into consideration. In the case of an inward directed radial current, gas motion may reverse in the gap. V P

A79-12708 Combustion of porous particles A M Golovin and V R Pesochin (*Fizika Goreniia i Vzryva*, vol 14, Jan-Feb 1978, p 11-18) *Combustion, Explosion, and Shock Waves*, vol 14, no 1, July 1978, p 7-13 20 refs Translation

A theoretical investigation in the quasi-steady approximation of the combustion of carbon particles at high temperature (up to 2500 K) and high pressure is performed. Consideration is given to changes in pore size, degree of porosity and the character of the reaction surface, the effects of convective transfer in the pores on burning rate are also examined. It is found that surface reactivity is negligibly small compared to reactivity inside the pores. B J

A79-12725 * Selling solar energy as a cash crop L W Brantley (NASA, Marshall Space Flight Center, Huntsville, Ala) *Agricultural Engineering*, vol 59, Mar 1978, p 12-16

The paper considers solar energy equipment which, besides supplying energy for farmstead needs, would convert excess energy to a transportable form to sell to a power company. It is suggested that a concentrating two-axis tracking spheroidal collector would cost as little as \$5/sq ft if mass produced. The proposed system uses 7854 sq ft of collector area (set in about one acre of land), and the cost payback is estimated. M L

A79-12821 Test and development of ceramic combustors, stators, nose cones, and rotor tip shrouds D L Hartsock, R R Baker, P H Havstad, and J H Buechel (Ford Motor Co., Dearborn, Mich) In *Ceramics for high performance applications - II*, Proceedings of the Fifth Army Materials Technology Conference, Newport,

R I , March 21-25, 1977 Chestnut Hill, Mass ,
Brook Hill Publishing Co , 1978, p 291, 293-315 ARPA Army-
ERDA-supported research

This paper describes the evolutionary stages of design and process changes which occurred in the development of ceramic stators for Ford's Model 820 Ceramic Gas Turbine Engine. In the ultimate design, the outer shroud and vanes were injection molded in one shot to form a monolithic silicon nitride stator which achieved a density of 2.7 gm/cc after nitriding. One such stator met the performance target goal of operating successfully for 175 hours of steady state testing in a ceramic structures test rig at 1930 F. 'Best lifes to date' are also reported for several other stationary ceramic components which are used in the hot gas path flow of Ford's Model 820 engine (Author)

A79-12823 Reliability and durability of ceramic regenerators for gas turbine applications C J Rahnke and J K Vallance (Ford Motor Co , Dearborn, Mich) In Ceramics for high performance applications - II, Proceedings of the Fifth Army Materials Technology Conference, Newport, R I , March 21-25, 1977

Chestnut Hill, Mass , Brook Hill Publishing Co , 1978, p 335-347 ARPA-Army-ERDA-supported research

High thermal stresses and chemical attack limited the early lithium silicate regenerators used in gas turbine engines to a B10 life of 600 hours. This paper presents the results of an engineering program that was initiated in 1973 to develop a regenerator that is capable of a B10 life of 10,000 hours. Since then, over 100,000 core-hours of gas turbine engine testing have been accumulated on new materials and regenerator design concepts. Two materials, aluminum silicate and magnesium aluminum silicate continue to show promise of achieving the program objective. An aluminum silicate core has now accumulated over 6935 hours and shows little evidence of chemical attack damage (Author)

A79-12826 Ceramic heat exchanger - Applications and developments A Pietsch (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz) and K Styhr (AiResearch Casting Co , Torrance, Calif) In Ceramics for high performance applications - II, Proceedings of the Fifth Army Materials Technology Conference, Newport, R I , March 21-25, 1977 Chestnut Hill, Mass , Brook Hill Publishing Co , 1978, p 385-395

The potential for using ceramic heat exchangers to recover waste heat in selected industrial processes and in the direct combustion of coal is discussed. The paper also describes results recently achieved on two experimental programs which are evaluating silicon carbide tubes in heat exchanger applications (Author)

A79-12830 Designing and testing Si3N4 turbine components at Mercedes-Benz J Heckel, J Heuer, W Raeuchle, and E Tank (Daimler-Benz AG, Stuttgart, West Germany) In Ceramics for high performance applications - II, Proceedings of the Fifth Army Materials Technology Conference, Newport, R I , March 21-25, 1977

Chestnut Hill, Mass , Brook Hill Publishing Co , 1978, p 445-479 6 refs Research supported by the Bundesministerium fur Forschung und Technologie and Daimler-Benz AG

The suitability of a ceramic recuperator and a ceramic turbine wheel for use in a high-temperature gas-turbine system to provide motion to automobiles is studied. The recuperator design utilized an internally headered counterflow matrix with plate-fins. The recuperator was made from reaction-bonded silicon nitride, and thermal stress, pressure load stress, and performance tests of the recuperator are reported. Additional testing of the matrix material is described, and the use of chemical vapor deposition Si3N4 to improve resistance to oxidation is explained. Application of the duodenity concept to turbine wheel development is considered M L

A79-12831 Development of ceramic parts for a truck gas turbine at MTU W H Peschel, W Siebmans, and K Trappmann (Motoren- und Turbinen-Union Munchen GmbH, Munich, West Germany) In Ceramics for high performance applications - II, Proceedings of the Fifth Army Materials Technology Conference,

Newport, R I , March 21-25, 1977 Chestnut Hill, Mass , Brook Hill Publishing Co , 1978, p 481-502 5 refs Research supported by the Bundesministerium fur Forschung und Technologie and Motoren- und Turbinen-Union Munchen

Based on requirements to be met by hot section components of an advanced truck gas turbine, ceramic parts (flame tube, turbine inlet nose cone, turbine nozzle and a metal disk/ceramic blades turbine wheel) have been designed and tested at MTU Munich. Description of parts design includes optimization studies and a survey over calculated stress distributions due to temperature gradients, gas and attachment forces at different gas turbine operating conditions. Presentation of test results concentrates on flame tube and turbine wheel testing. Flame tubes of various shapes, made from different materials have successfully been tested. In turbine wheel development the attachment of ceramic blades to the metallic disk has extensively been investigated. Turbine blade spin test results are in good agreement with calculation results, burst speeds obtained are well above the aerodynamically necessary speeds (Author)

A79-12832 Development of multi-density silicon nitride turbine rotors P Walzer, M Langer, and J Siebels (Volkswagenwerk AG, Wolfsburg, West Germany) In Ceramics for high performance applications - II, Proceedings of the Fifth Army Materials Technology Conference, Newport, R I , March 21-25, 1977

Chestnut Hill, Mass , Brook Hill Publishing Co , 1978, p 503-514 Research sponsored by the Bundesministerium fur Forschung und Technologie

The Volkswagenwerk AG is developing a ceramic turbine rotor consisting of a hot pressed silicon nitride hub and a reaction sintered silicon nitride blade ring. Three different fabrication concepts are being investigated. At room temperature, prototype rotors have attained circumferential speeds up to 385 m/s. Simplified blade rings have survived gas temperature changes of 500 K/s. At temperatures above 1300 K, oxidation may reduce the strength of a ceramic component (Author)

A79-12849 Preliminary design of a subscale ceramic helical-rotor expander P B Mohr (California, University, Livermore, Calif) In Ceramics for high performance applications - II, Proceedings of the Fifth Army Materials Technology Conference, Newport, R I , March 21-25, 1977 Chestnut Hill, Mass , Brook Hill Publishing Co , 1978, p 861-875 12 refs Contract No W-7405-eng-48

Design concepts for a prototype small-scale (125 mm rotor diameter) ceramic helical-rotor expander are discussed. The proposed expander, which would operate at temperatures in excess of 1350 C, is a variant of the Lysholm concept helical rotor expander and consists of two helically fluted intermeshing rotors operating within a close-fitting case. During operation, a measured quantity of working fluid at high temperature and pressure is admitted to a confined space within the flutes (lobes) of the rotors where, by expanding, the fluid exerts a turning effort on the rotors in the direction of increased expansion. No combustion occurs within the expander. Component design and testing procedures are discussed M L

A79-12850 * Ceramics for the advanced automotive gas turbine engine - A look at a single shaft design S M Nosek (NASA, Lewis Research Center, Cleveland, Ohio) In Ceramics for high performance applications - II, Proceedings of the Fifth Army Materials Technology Conference, Newport, R I , March 21-25, 1977 Chestnut Hill, Mass , Brook Hill Publishing Co , 1978, p 959-972

A single shaft regenerative design with a single-stage radial turbine is analyzed in terms of achievable fuel economy for the cases of both limited and unlimited turbine tip speed and regenerator inlet temperature. The 100 hp engine for a 3500 lb automobile is designed to use gasoline. Fuel economy data and operating parameters are presented for different values of turbine inlet temperatures, and turbine stress estimates and ceramic design stress estimates are discussed M L

A79-12851 * **Ceramic applications in the advanced Stirling automotive engine** W A Tomazic and J E Carrelli (NASA, Lewis Research Center, Cleveland, Ohio) In *Ceramics for high performance applications - II*, Proceedings of the Fifth Army Materials Technology Conference, Newport, R I, March 21-25, 1977

Chestnut Hill, Mass., Brook Hill Publishing Co., 1978, p 973 987

The requirements of the ideal Stirling cycle, as well as basic types of practical engines are described. Advantages, disadvantages, and problem areas of these Stirling engines are discussed. The potential for ceramic components is also considered. Currently ceramics are used in only two areas, the air preheater and insulating tiles between the burner and the heater head. For the advanced Stirling engine to achieve high efficiency and low cost, the principal components are expected to be made from ceramic materials, including the heater head, air preheater, regenerator, the burner and the power piston. Supporting research and technology programs for ceramic component development are briefly described. (Author)

A79-12873 **Catalysis in coal conversion** J A Cusumano, R A Dalla Betta, and R B Levy (Catalytica Associates, Inc., Santa Clara, Calif.) New York, Academic Press, Inc., 1978, 283 p 925 refs \$21

Advances in catalysis are discussed, advances in related disciplines are surveyed, and coal liquefaction and gasification processes are reviewed. Synthesis of liquid fuels from carbon monoxide hydrogen mixtures are considered. Topics include petroleum products and refining, upgrading of liquid products from the Coalcon process, conversion of solvent refined coal to low sulfur low-nitrogen boiler fuel, catalytic hydrocracking of coal or lignite to low-sulfur low-nitrogen liquid boiler fuels, water gas shift and methanation catalysis in the synthesis of substitute natural gas, catalytic gasification of coal or lignite to synthesis gas and substitute natural gas, and synthesis of fuels and selected feedstocks from carbon monoxide and hydrogen. M L

A79-12957 # **Dynamic model of an industrial plant manufacturing a variety of products (Dinamicheskaya model' mnogoproduktovogo proizvodstvennogo ob'ekta)** M M Rafikov and T K Sirazetdinov *Aviatsionnaya Tekhnika*, vol 21, no 2, 1978, p 74-82. In Russian

A mathematical model, consisting of a system of differential and algebraic equations and inequalities, is proposed for an industrial plant. The production process is treated in terms of three different but related factors: the resources and means of production, materials and power consumption, and the labor force. Each of these factors is analyzed, and equations describing the development and status of each factor are derived. The interaction of the three factors is examined, and the conditions reflecting the constraints on production are formulated. The application of the model is illustrated by an example. V P

A79-12977 **Alternative hydrocarbon fuels. Combustion and chemical kinetics**, SQUID Workshop, Loyola College, Columbia, Md., September 7-9, 1977, Technical Papers. Workshop sponsored by the U.S. Navy, U.S. Air Force, and U.S. Department of Energy, Project SQUID. Edited by C T Bowman (Stanford University, Stanford, Calif.) and J Birkeland (U.S. Department of Energy, Washington, D.C.) New York, American Institute of Aeronautics and Astronautics, Inc. (Progress in Aeronautics and Astronautics Volume 62), 1978, 476 p. Members, \$20; nonmembers, \$35.

The considered topics are related to alternative fuel availability and anticipated combustion problems, critical processes in the combustion of alternative fuels, pyrolysis and oxidation kinetics of alternative fuels, pollutant emissions considerations for alternative fuel combustion, and questions of alternative fuels policy and technology. Attention is given to alternative fuels and combustion problems, future fuels in gas turbine engines, alternative fuels for reciprocating internal combustion engines, the use of alternative fuels in stationary combustors, alternative fuels in gas turbine combustors, combustion and chemical kinetics problems in internal combustion

engines, the combustion of droplets and sprays of some alternative fuels, flame emissivities in the case of a use of alternative fuels, the pyrolysis and oxidation of aromatic compounds, the combustion chemistry of chain hydrocarbons, liquid-phase reactions of vaporizing hydrocarbon fuels, the role of aromatics in soot formation, the kinetics of nitric oxide formation in combustion and emission control techniques for alternative fuel combustion. G R

A79-12978 * **Alternative fuels and combustion problems** J P Longwell (MIT, Cambridge, Mass.) In *Alternative hydrocarbon fuels. Combustion and chemical kinetics*, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 3-18, Discussion, p 18-20. 7 refs.

Questions concerning the supply and use of liquid fuels, particularly in the transportation sector are considered, taking into account the need of the 1990-2000 time period and expected changes to the year 2025. For the time period under consideration, the world-wide availability of oil will be the primary driving force for change. The 'gap' between supply and demand is expected to be felt between 1980 and 1997. A major response to the onset of the 'gap' in the U.S. is production of liquids from oil shale and coal. During the 1990-2000 period, production of these liquids is expected to be small relative to total demand (2-10%). Rapid growth is possible, so that by 2025 half of the liquid hydrocarbons might come from these sources. Shifts in relative magnitude of the various liquid hydrocarbon uses will force reexamination of combustion system performance, particularly in the transportation area and home heating. G R

A79-12979 # **Future fuels in gas turbine engines** W S Blazowski (Exxon Research and Engineering Co., Linden, N.J.) and L Maggitti (U.S. Naval Air Propulsion Test Center, Trenton, N.J.) In *Alternative hydrocarbon fuels. Combustion and chemical kinetics*, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 21-72, Discussion, p 72, 73. 92 refs.

A review is conducted of potential combustion problems associated with the utilization of future fuels in gas turbine engines, and prospects for coping with these difficulties are considered. Increased cost and reduced availability of jet fuels, along with the potential future depletion of world-wide petroleum resources, has created an interest in the feasibility of obtaining jet fuel from nonpetroleum resources. Crude oils from coal, oil shale, and tar sands, alone or in mixtures with petroleum crudes, are likely possibilities. Because of basic chemical differences in these crudes, and processing economics, future fuels may have properties that are different from those of current fuels. Programs are necessary to provide the information base for future specifications. The end objective is to optimize the factors of availability, cost, aircraft performance, and safety. G R

A79-12980 * **Alternative fuels for reciprocating internal combustion engines** N E Gallopoulos (GM Research Laboratories, Warren, Mich.) In *Alternative hydrocarbon fuels. Combustion and chemical kinetics*, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 74-112, Discussion, p 112-115. 56 refs.

By the year 2000 world petroleum demand will have outstripped supply. These circumstances compel the search for fuels not derived from petroleum, which usually are referred to as alternative fuels. Results of several investigations have shown that hydrogen-fueled Otto cycle engines are efficient because of hydrogen's high flame speed and because they can operate at very lean equivalence ratios. However, the low volumetric energy density of hydrogen makes its storage on vehicles a difficult problem to solve, particularly for passenger cars and other small vehicles. Compared to hydrocarbon fuels, ammonia combustion in normally aspirated Otto cycle engines yields very low efficiency and power. There are also ignition

A79-12981

problems. Because of their similarity with current petroleum derived fuels, many of the organic alternative fuels present fewer technical challenges than inorganic fuels. The greatest challenge presented by the organic alternative fuels for the near future is related to the technology and the economics of converting various natural resources to organic automotive fuels. G R

A79-12981 # Use of alternative fuels in stationary combustors M P Heap (Energy and Environmental Research Corp., Irvine, Calif.) In Alternative hydrocarbon fuels Combustion and chemical kinetics, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 116-131, Discussion, p 131-133 18 refs

A review is presented of the information available to date on the use of alternative fuels in stationary combustors. Attention is given to coal-derived fuel gases, methyl alcohol as a fuel for package boilers, coal or shale derived liquid fuels, and the influence of water in fuel oil emulsions on boiler efficiency and pollutant efficiency. It is found that major concerns associated with the use of alternative fuels are the impact upon combustor operation and the pollutant emission potential. Combustor operation is mainly a mechanical problem, and improvements in combustor design can be applied as readily to conventional fuels as alternate fuels. Two properties of the alternate fuels which are likely to be used in boilers and furnaces that might provide problems for their utilization in the future are their relatively high nitrogen contents and their low hydrogen-to-carbon ratios. These properties will tend to increase the potential for the formation of two pollutants, nitrogen oxides and carbonaceous particulates. G R

A79-12982 # Ignition/stabilization/atomization - Alternative fuels in gas turbine combustors A H Lefebvre, A M Mellor, and J E Peters (Purdue University, West Lafayette, Ind.) In Alternative hydrocarbon fuels Combustion and chemical kinetics, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 137-158, Discussion, p 158, 159 25 refs. Research supported by the Ford Motor Co., Grant No DAAE07-76-C 0063

It is pointed out that fuel preparation, ignition, flame spreading, and flame stabilization are important considerations in the design of gas turbine engines. It is discussed how changes in the major properties of alternative fuels will affect atomization, ignition, flame spread, and lean blowoff in gas turbine burners. It is found that it is primarily the physical properties of the fuel which influence the performance parameters. Studies have shown that ignition is strongly dependent on fuel volatility and viscosity. A graph showing the influence of atomization quality on ignition limits is presented. For all fuels considered the atomization quality is found to be markedly inferior to that of normal kerosene, indicating that problems of ignition and lean blowoff will be more severe. The correlations predict that jet fuels derived from shale oils, tar sands, and coal syncrudes will pose more serious problems of atomization than similar petroleum-based fuels. G R

A79-12983 # Combustion of droplets and sprays of some alternative fuels J B Jordan and A Williams (Leeds University, Leeds, England) In Alternative hydrocarbon fuels Combustion and chemical kinetics, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 180-196, Discussion, p 196-198 8 refs. Research supported by the Science Research Council.

The paper describes a method of studying the rate of combustion of suspended single droplets of liquid fuels by means of continuously recording microbalance. The technique has been applied to a range of alternative liquid fuel combinations and to coal/oil mixtures. Experimental data are presented on the continuous variation of diameter and mass of burning droplets as a function of time for the various fuel combination burning in air at 850 C. The

results are analyzed in terms of D² rate constants and mass burning rate constants. The influence of fuel composition and, in particular, of the asphaltene content, coal content in the coal/oil mixtures, and the influence of water emulsification are analyzed. In addition, some data are given on ignition delay times. (Author)

A79-12984 # Flame emissivities - Alternative fuels A F Sarofim (MIT, Cambridge, Mass.) In Alternative hydrocarbon fuels Combustion and chemical kinetics, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 199-227, Discussion, p 227-229 72 refs

An understanding of radiative heat transfer from combustion products is needed for the prediction of thermal efficiency and heat flux distribution in furnaces and for the estimation of the thermal punishment of the confining walls in internal combustion engines and gas turbines. The emissivities of combustion products are considered, taking into account carbon dioxide, water vapor, the overlap correction factor, soot, carbonaceous particles, the emissivities of mixtures of solids and gases, furnaces fired with low- or intermediate Btu gas, the effect of H/C ratio on the nonluminous contribution to emissivity, the emissivity of coal combustion products, Diesel engines, and gas turbines. It is found that the expected shift from petroleum derived oils to coal derived liquids would have only a modest effect on the nonluminous contribution to radiation in a large scale combustor. The greatest potential impact of increases in radiation anticipated with increases in the C/H ratio of fuels is in the design of gas turbine combustors. G R

A79-12986 # Combustion chemistry of chain hydrocarbons F L Dryer and I Glassman (Princeton University, Princeton, N.J.) In Alternative hydrocarbon fuels Combustion and chemical kinetics, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 255-294, Discussion, p 294-306 53 refs. NSF Grant No AER-75 09538, Grant No AF-AFOSR-74 2604, Contract No EC-17 S 02-4272

A summary is provided of the available information from which realistic kinetic approximations for hydrocarbon chemistry can be formulated. Past and current efforts for developing models are discussed and suggestions are made regarding future experimental and analytical needs for improving approaches that approximate the true hydrocarbon combustion chemistry. The concept upon which the Edelman and Fortune model for hydrocarbon oxidation is developed provides an appropriate basis for combustion modeling. Correct modeling of carbon monoxide/hydrogen oxidation in detail can estimate both the major energy release step of alkyl hydrocarbon oxidation, and the radical intermediates (OH, O, H) necessary to predict the Zeldovich NO_x production and quenching of carbon monoxide. G R

A79-12987 # Liquid-phase reactions of vaporizing hydrocarbon fuels A Vranos In Alternative hydrocarbon fuels Combustion and chemical kinetics, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 307-327, Discussion, p 327-331 17 refs

It has been demonstrated in gas turbine combustors and in prototype residential oil burners that improved performance and lowered emissions result when fuel is vaporized prior to injection into the combustor. A description is presented of some new results from an exploratory study of the decomposition of surface vaporized fuel. Reaction products have been measured by direct sampling of the vaporizing fluid and at the exhaust of a simple vaporizer. Hydrocarbon and oxygenate measurements are used to provide insight into the extent of liquid- and vapor phase decomposition and the interactions between chemical and heat transfer processes. In order to understand the important physical processes, a single-component fuel, n-hexadecane (air saturated), is being studied initially. Hexadecane was selected as a study fuel because of its boiling point and simple molecular structure. G R

A79-12988 # **Role of aromatics in soot formation** J D Bittner and J B Howard (MIT, Cambridge, Mass.) In *Alternative hydrocarbon fuels Combustion and chemical kinetics*, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 335-356, Discussion, p 356-358 63 refs

Soot and polycyclic aromatic hydrocarbons (PAH) associated with incomplete combustion generally are recognized as potential pollution problems. Some of the PAH produced in flames and adsorbed on soot particles are known to be carcinogenic. The problems of soot formation in combustion systems will become increasingly important when conventional petroleum based fuels have to be supplemented by coal and coal-derived fuels. Because of their higher aromaticity, coal and liquid fuels derived from coal are much more prone to sooting. A brief review is presented concerning the effect of fuel type, specifically aromatic contents, on soot formation, taking into account the role of the aromatic nucleus in terms of possible mechanisms of soot formation. G R

A79-12989 # **Kinetics of nitric oxide formation in combustion** B S Haynes (New South Wales, University, Kensington, Australia) In *Alternative hydrocarbon fuels Combustion and chemical kinetics*, SQUID Workshop, Columbia Md., September 7-9, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 359-388, Discussion, p 388-394 49 refs. Research supported by the National Coal Research Advisory Committee

Three main processes leading to the formation of nitric oxide are related to the Zeldovich mechanism, a non Zeldovich pathway to the fixation of molecular nitrogen, and fuel NO derived from bound nitrogen introduced with fuel. A computer kinetic program has been used to model the considered chemical mechanism. There is no doubt that hydrocarbon species in the primary reaction zone react with NO and NH₃ to form HCN, and it would be expected that such processes occur also in the burnt gases whenever excess hydrocarbons persist beyond the flame front. The influence of the hydrocarbon species is investigated. It is found that a simple one-parameter reaction model based on a considered reaction scheme accounts for most features of experimentally observed nitrogen chemistry in the burnt gases of fuel rich ethylene-air flames at temperatures around 2000 K. G R

A79-12990 # **Emission control techniques for alternative fuel combustion** G B Martin (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Research Triangle Park, N.C.) In *Alternative hydrocarbon fuels Combustion and chemical kinetics*, SQUID Workshop, Columbia, Md., September 7-9, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 395-420, Discussion, p 420-422 27 refs

This paper summarizes the available information on the state-of-the-art emission control technology for use of conventional and alternative fuels in stationary combustion sources. The data on alternative fuels are very limited, and therefore experience with conventional fuels is used as the basis for postulating the effectiveness of combustion process modifications on the emissions from alternate fuels. It is concluded that the primary problem will be emissions of nitrogen oxides formed from chemically bound nitrogen in the fuel molecule. There is the potential for a problem with carbon particulate formation if low NO_x combustors are not designed with this in mind. Finally, based on promising results for heavy petroleum fuel oils and coal, it is concluded that burner and combustion process design modifications have a high probability of success for alternative fuels. (Author)

A79-13077 # **Impact of fuel availability and other cost trends on air carrier operations** J D Smith (United Air Lines, Inc., Chicago, Ill.) In *Radio Technical Commission for Aeronautics, Annual Assembly*, Washington, D.C., November 17-19, 1977, Pro-

ceedings Washington, D.C., Radio Technical Commission for Aeronautics, 1977, p 17-36

The paper reviews fuel-cost trends with reference to the airline and industry point of view. Consideration is given to questions of fuel supply, conservation, future fuel requirements, productivity, and equipment procurement. It is noted that the use of new technology and alternative fuels may be able to hold fuel-cost and other inflation factors to levels that will not price air travel out of the transportation market. B J

A79-13078 # **Impact of fuel availability and other cost trends on general aviation** J H Winant (National Business Aircraft Association, Inc., Washington, D.C.) In *Radio Technical Commission for Aeronautics, Annual Assembly*, Washington, D.C., November 17-19, 1977, Proceedings Washington, D.C., Radio Technical Commission for Aeronautics, 1977, p 37-41

The response of general aviation to the 'energy crisis' and to the need for the creation of a national energy policy is considered. It is emphasized that a national energy policy should stress the development of new energy sources as well as conservation. A bright future is forecast for general aviation, given a national policy which will aim for the elimination of government regulation, for intensified conservation, for the development of new petroleum sources, and for alternative fuel sources. B J

A79 13085 # **Pilot's view of the evolving air transport** H R Lahr (United Airlines, Inc., Chicago, Ill.) In *Radio Technical Commission for Aeronautics, Annual Assembly*, Washington, D.C., November 17-19, 1977, Proceedings Washington, D.C., Radio Technical Commission for Aeronautics, 1977, p 139-145

The pilot's role in conserving energy is described and attention is given to the impact of energy conservation efforts on evolving air transport. Some proposals for conserving fuel during various phases of the flight operation are discussed. B J

A79-13098 * # **Diminide thermionic energy conversion with lanthanum-hexaboride electrodes** E W Kroeger, V L Bair, and J F Morris (NASA, Lewis Research Center, Cleveland, Ohio) *Institute of Electrical and Electronics Engineers, International Conference on Plasma Science, Monterey, Calif., May 15-18, 1978, Paper 17* p 41 refs

This paper presents thermionic conversion data obtained from a variable-gap cesium diminide with a hot-pressed, sintered lanthanum-hexaboride emitter and an arc-melted lanthanum-hexaboride collector. Performance curves cover a range of temperatures: emitter 1500 to 1700 K, collector 750 to 1000 K, and cesium reservoir 370 to 510 K. Calculated values of emitter and collector work functions and barrier index are also given. (Author)

A79-13288 **Optimization of electrical and optical characteristics of silicon photocells used for photothermal concentrated solar radiation converters** M M Koltun and I P Gavrilova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, no 1, 1978, p 3-12.) *Applied Solar Energy*, vol 14, no 1, 1978, p 1-8 11 refs Translation

A79-13289 **Spectral characteristics of photoconverters with nonuniform defect distribution in the base** E B Vinogradova, T M Bolovner, S M Gorodetskiy, G M Grigor'eva, E V Zhidkova, A K Zaitseva, and L B Kreinin (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, no 1, 1978, p 13-17.) *Applied Solar Energy*, vol 14, no 1, 1978, p 9-12 9 refs Translation

The described procedure for analyzing the spectral distribution of the silicon photoconverter collection coefficients permits a qualitative estimation of the clumping of defects in the base region of the specimen. The long wave portion of the silicon photoconverter spectrum indicates the distribution of the recombined centers in the base regions adjacent to p-n junctions. The derivation of an

expression for the effective values of diffusion lengths is explained, and the analytic procedure can indicate operating conditions which do not cause the appearance of defect layers. Experimental results are presented. M L

A79-13290 Study of diffusion processes in low-temperature thermopiles V M Sokolova, L D Dudkin, L I Petrova, and N Kh Abrikosov (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, no 1, 1978, p 18-21) *Applied Solar Energy*, vol 14, no 1, 1978, p 13-16 Translation

The paper describes the kinetics of formation as well as the qualitative and quantitative chemical analysis of the composition of the reactive diffusion layer in a (Bi,Sb)2Te3-Co contact with respect to the hot junction of a low-temperature thermal battery. An expression is presented for the relation between the diffusion coefficient and the temperature. The results of the quantitative analysis of the diffusion layer are found to correspond to the phase equilibrium of the Ca-Sb-Te system. M L

A79-13291 General principles of multielement concentrating system design R A Zakhidov (Akademiya Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priboroostroeniia, Uzbek SSR) (*Geliotekhnika*, no 1, 1978, p 22-29) *Applied Solar Energy*, vol 14, no 1, 1978, p 17-23 13 refs Translation

Some aspects of a procedure for calculating characteristics of any arbitrary multielement solar energy concentration system are discussed. Topics include the ray vector field, the statistical brightness, the ray path, and reflection. The organization of the calculation model and the computer algorithm is indicated. M L

A79-13292 Facility with sectioned photoreceiver and laser radiator for determining solar radiation concentrator accuracy characteristics V I Krasilovskii, B V Tarnizhevskii, and E V Tver'ianovich (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, no 1, 1978, p 30-35) *Applied Solar Energy*, vol 14, no 1, 1978, p 24-28 7 refs Translation

A79-13293 Selection of method for calculating the parameters of wind and solar power station storage facilities R B Salieva (Tashkentskii Elektrotekhnicheskii Institut Sviazi, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 1, 1978, p 67-71) *Applied Solar Energy*, vol 14, no 1, 1978, p 55-58 5 refs Translation

The paper describes the kind of data required for application of the calendar method to determine reliable parameters for energy storage devices used at wind and solar installations. Results based on periodic observations are compared with results based on hourly observations. It is found that 20 years of periodic observations are sufficient for establishing reliable winter, spring, and fall patterns, while 10 years of periodic observations are sufficient for the summer pattern. M L

A79-13439 Development of energetic neutral beams to the megawatt power level for controlled thermonuclear research E Thompson (EURATOM and U K Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England) In Low-energy ion beams, 1977, International Conference, Salford, Lancs., England, September 5-8, 1977, Invited and Contributed Papers. Bristol, Institute of Physics, 1978, p 236-242 17 refs

Beams of neutral atoms with energies of 20-30 keV and powers of up to a few MW are finding wide application as a means of heating magnetically confined plasmas. Next generation experiments will require well collimated beams of several MW at energies of up to 80 keV (neutral H) or 160 keV (neutral D). The overall design requirements for such injectors and how the technical specification can simply be derived from the characteristics of the plasma to be heated are reviewed. It is shown how the technical specification can be met using electron capture by a beam of positive ions. The production of multiampere ion beams is discussed, together with

factors governing the maximum performance and overall electrical efficiency. (Author)

A79-13448 Heavy-ion beam inertial-confinement fusion R C Arnold (Argonne National Laboratory, Argonne, Ill.) *Nature*, vol 276, Nov 2, 1978, p 19-23 40 refs. Research supported by the U S Department of Energy

The paper reviews the status of inertial confinement fusion driven by heavy-ion accelerator systems. The main requirements on ion sources, preaccelerators, and storage rings are discussed. Bunching, transport, and beam focusing considerations are weighed. Beam propagation in the reaction chamber and energy deposition in targets are discussed. Principles of target structure and reactor concepts are outlined. P T H

A79-13574 Energy efficiency in the transport sector R K Koshal (Ohio University, Athens, Ohio) and K L Kool (Rio Grande College, Rio Grande, Ohio) *International Journal of Energy Research*, vol 2, Oct-Dec 1978, p 337-341 10 refs

Energy requirements for various modes of transportation are estimated by applying multiple regression techniques and using data for 1960-1970. Marginal energy requirements for additional ton mile and passenger mile are calculated, and the results are compared with values determined in two independent studies. The statistical analysis based on overall traffic patterns suggests that, in terms of energy, railroads are the most efficient mode for freight (water transport not considered) while buses are the most efficient mode for passenger transport. M L

A79-13575 The efficiencies of thermochemical energy transfer P O Carden and O M Williams (Australian National University, Canberra, Australia) *International Journal of Energy Research*, vol 2, Oct-Dec 1978, p 389-406 10 refs

A general thermodynamic study of the thermochemical energy transfer and work production processes is presented. Gaseous systems in which the effluent of each reactor is not separated into the reactant and product species, as well as liquid/gas systems in which the effluent separates spontaneously into liquid and gas phases are treated. The overall system efficiency is derived as the product of two efficiencies: the energy storage efficiency and the work recovery efficiency. Fundamental thermodynamic processes are examined from the view point of design and operation optimization of individual system components. In particular, it is shown that the available work from a thermochemical energy transfer system approaches the maximum value given by the Gibbs' free energy change when the temperature profile of the exothermic reactor is suitably tailored. The work of separation has formed the basis of the analysis of specific system components and has given a useful insight into the understanding of energy storage efficiency. Work recovery efficiencies are calculated for the ammonia/hydrogen-nitrogen system. (Author)

A79-13579 # Performance of a honeycomb type flat plate collector with serpentine tube A S Shinde and G K Sharma (Indian Institute of Technology, Bombay, India) In National Heat and Mass Transfer Conference, 4th, Roorkee, India, November 21-23, 1977, Proceedings. Meerut, India, Sarita Prakashan, 1978, p 47-52 7 refs

The efficiency of a solar collector can be improved by reducing the heat losses from the hot absorber plate to the cooler surrounding. The present study deals with the reduction of heat losses due to natural convection and radiation from the hot absorber plate to the surrounding using a honeycomb structure between the glass cover and absorber plate. The performance of different types of honeycomb structures and for the various values of honeycomb L/d ratios has been studied experimentally and the obtained results are discussed. (Author)

A79-13609 # Return flow solar air-heater J S Saini (Roorkee, University, Roorkee, India) and R K Suri (Bharat Heavy Electricals, Ltd, New Delhi, India) In National Heat and Mass Transfer Conference, 4th, Roorkee, India, November 21-23, 1977, Proceedings Meerut, India, Sarita Prakashan, 1978, p 709-719

Return-flow solar air heaters are discussed with reference to theoretical and experimental work. Mathematical models are presented for both single-flow and return-flow solar air heaters and the numerical values of the normalized exit temperatures are compared. Experimental data are also given. These data show higher efficiencies for the return-flow configuration. This is attributed to the continuous absorption by the fluid while traversing the two limbs and lower losses. Procedures for converting a single-flow configuration into a return-flow configuration are noted. S C S

A79-13611 # Rate of desorption in a solar regenerator P Gandhidasan, V Sriramulu, and M C Gupta (Indian Institute of Technology, Madras, India) In National Heat and Mass Transfer Conference, 4th, Roorkee, India, November 21-23, 1977, Proceedings Meerut, India, Sarita Prakashan, 1978, p 837-844 12 refs

Chemical dehumidification of air using absorbent solutions is an important industrial process, and solar energy can be utilized for regenerating the absorbent solution. Different methods are in vogue for regenerating the solution. A simple and efficient method is described in this paper. The weak absorbent solution flows down a flat plate collector as a thin film and the water evaporating from the liquid surface is removed by a laminar air stream. The solution and air stream are cocurrent to each other. The paper discusses the heat and mass transfer processes occurring in the regenerator. (Author)

A79-13619 German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 (Deutsches Sonnenforum, 1st, Hamburg, West Germany, September 26-28, 1977, Tagungsberichte Volume 2) Forum sponsored by the Deutsche Gesellschaft für Sonnenenergie. Edited by U Bossel. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977. 603 p. \$23.54. In German and English.

Consideration is given to such topics as solar collection techniques, collector testing, control units for solar energy systems, photoelectric conversion, solar power plants, and selective absorbing surfaces. Nonconventional energy sources such as wind energy, wave energy, and hydrogen-based energy are also considered. B J

A79-13620 Solar radiation simulation by means of solar simulator for the indoor testing of solar collectors (Nachbildung der terrestrischen Solarstrahlung für Indoor-Solarkollektortests mit Hilfe eines Sonnensimulators) W Ley (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Cologne, West Germany). In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 3-14. In German.

DFVLR has constructed a solar simulator for the continuous indoor monitoring of the thermal performance of solar collectors. Solar radiation is simulated with regard to spectral distribution, uniformity, intensity, collimation angle, azimuth, and elevation angle. The optical system design for the simulator is described (diagrams are presented) and attention is given to the basic characteristics of the facility. B J

A79-13622 Results of measurements of solar radiation on surfaces of different orientations (Messergebnisse über die Sonneneinstrahlung auf unterschiedlich orientierte Flächen) D Holz (Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung, Institut für Bauphysik, Holzkirchen, West Germany). In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 27-37. In German.

A measuring device is described by means of which it is possible to determine in a simple way the duration of certain intensity intervals of solar radiation (e.g. intervals of 100 kcal/sq m-h each). In the open air test area of Holzkirchen, the irradiation of differently oriented surfaces was registered with five devices of this kind during a year's time and was statistically analysed for a horizontal surface and four vertical surfaces oriented according to the four main directions of the sky. (Author)

A79-13623 Measurement of radiation intensity by means of a pyrheliometer (Messung der Strahlungsleistung mit einem Pyrheliometer) Z Kopac (Paderborn, Gesamthochschule, Paderborn, West Germany). In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 39-46. In German.

The paper briefly considers the use of a simple home-made pyrheliometer for measuring insolation intensity. The principles involved in measuring solar radiation levels are discussed along with the design principles of a simple pyrheliometer. Some typical results obtained with the instrument are presented. B J

A79-13624 Irradiances on inclined surfaces (Bestrahlungsstärken auf geneigten Flächen) J Krochmann (Berlin, Technische Universität, Berlin, West Germany). In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 47-58. 11 refs. In German.

Irradiances on inclined surfaces from sun, sky and earth albedo are calculated for clear and overcast sky conditions. It is assumed that the radiance distribution of the sky is equivalent to the luminance distribution. The 'average' irradiance is determined on the basis of the sunshine probability. The yearly radiation exposure of three 'optimal' inclined surfaces is calculated. (Author)

A79-13625 The use of a sort of slide rule for the quick determination of solar irradiation of surfaces and through double glazing of arbitrary orientation and different inclination (Schnelle Bestimmung des Strahlungsempfangs auf Flächen und durch Doppelverglasungen beliebiger Orientierung und verschiedener Neigungen mit einer Art Rechenscheibe) H Freymuth (Institut für Tageslicht-Technik, Stuttgart, West Germany). In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 59-68. 15 refs. In German. Research supported by the Forschungsgemeinschaft Bauen und Wohnen.

A set of stereographic diagrams has been developed for studying insolation conditions. By superposing two such diagrams, the user is able to determine quickly and with sufficient accuracy the insolation intensity per hour of surfaces of arbitrary orientation and different inclinations, regardless of the time of year and either for clear or cloudy sky conditions. B J

A79-13626 Sun-position diagrams using examples from Flensburg to Mittenwald (Sonnenstand-Diagramme mit Beispielen von Flensburg bis Mittenwald) G Rupprecht, A Stork, and F Werthas (Neumarkt, Sternwarte, Neumarkt, West Germany). In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 69-82. 6 refs. In German.

Diagrams of sun position in the course of the day have been devised for purposes of solar energy collection. A diagram devised for Germany is considered as an example. Recommendations are presented on determining optimum tilts of solar collectors and estimating the sunshine hours of a given dwelling. B J

A79-13627 Testing the efficiency of solar collectors (Wirksamkeitsgradtests von Solarkollektoren) H Reiss (Brown, Boveri et Cie AG, Heidelberg, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft fur Sonnenenergie, 1977, p 85-94 7 refs In German

An alternative method to the NBS-procedure for testing the efficiency of flat-plate solar collectors is presented Combined indoor/outdoor measurements lead to an independent determination of the heat losses and of the collector's optical response to incident radiation The results show less scattering than is obtained following the NBS-procedure The test method described here is, because of a reduced number of required outdoor measurements, more suitable for Central European weather conditions (Author)

A79-13628 Dynamic behaviour of light-weight solar collectors (Dynamisches Verhalten leichter Sonnenwärmekollektoren) M-L Liwerski and H W Scheel (H W Scheel, Berlin, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft fur Sonnenenergie, 1977, p 95-104 In German

The performance of a solar collector is highly sensitive to its response to variations of insolation of flow rate The dynamic response has been evaluated from measured temperature curves Heat capacity has been determined experimentally and analytically A very low heat capacity and a high conversion factor are mandatory for a high overall efficiency under the climatic conditions of Northern Germany (Author)

A79-13629 Electronic components in solar technology (Elektronische Komponenten in der Solartechnik) F Bankewitz In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft fur Sonnenenergie, 1977, p 107-115 In German

Consideration is given to switching and control electronics for solar energy installations A theoretical analysis of various switching methods is presented and problems of overall control are discussed The particular example of a nonlinear two-point controller for a solar collector system is examined, with consideration given to its operational parameters, efficiency, and cost Block diagrams of various systems are presented B J

A79-13630 Control of solar energy systems, heat storage, and heat utilization (Regelung von Sonnenenergieanlagen, Wärmespeicherung, Wärmenutzung) G Rettich (Danfoss GmbH, Offenbach, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft fur Sonnenenergie, 1977, p 117-130 In German

The paper reviews various aspects of the application of automatic control to solar heating systems Consideration is given to the choice of reference values for determining the best type of control, to the choice of control (modulated or on-off), and to the determination of safety factors for solar collector cycles Particular attention is given to control of the heat-storage and heat-utilization regimes of the solar system B J

A79-13631 Simple high-accuracy diode temperature-difference control circuit (Einfache Dioden-Temperaturdifferenz-Regelrichtung hoher Genauigkeit) W August and H Weik (Lubeck, Fachhochschule, Lubeck, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft fur Sonnenenergie, 1977, p 131-140 5 refs In German

It is recommended that semiconductor diodes be used as temperature sensors in the temperature control units of solar heating systems because of their excellent properties high linearity of the

temperature coefficient (2 mV/K per Si-diode), negligible interference in parallel systems, and high working temperature (up to 130 C) This paper describes a temperature control unit which employs six Si-diodes in series as temperature sensors The resolution of this unit is found to be better than 1 % B J

A79-13632 The Arbonia control concept - Does flow regulation in the solar system cycle make sense (Das Regelkonzept von Arbonia - Ist eine Mengenregulierung im Solarkreislauf sinnvoll) E Ulli (Arbonia AG, Arbon, Switzerland) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft fur Sonnenenergie, 1977, p 141-148 In German

The paper considers aspects of heat-carrying fluid regulation in the Arbonia Multisol solar heating system It is shown that, for steady state operation of the system, heat flows in the collectors and heat exchanger are in equilibrium A reduction in the volume of heat carrying fluid circulating in the system leads to a drop in the energy gain B J

A79-13633 Solar heating and safety techniques (Sonnenheizungen und Sicherheitstechnik) H Wenzel (Technischer Überwachungsverein Bayern, Munich, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft fur Sonnenenergie, 1977, p 151-162 11 refs In German

Consideration is given to methods of protecting solar heating systems against frost, overheating, and overpressures Safety-design norms for such systems are described which highlight the following features (1) the intrinsic reliability of the system, (2) a biodegradable heat-carrying fluid, and (3) the possibility of having the system installed by local technicians and fitters B J

A79-13634 Safety requirements for solar heating systems - Practical considerations (Sicherheitstechnische Anforderungen an Sonnenheizungsanlagen - Gesichtspunkte aus der Praxis) K Breuer (Zentralverband Sanitär- Heizungs- und Klimatechnik, St Augustin, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft fur Sonnenenergie, 1977, p 163-172 In German

Boundary conditions for solar-heating safety are examined with reference to the following system features thermal stability, the general properties of the heat-carrying fluid, chemical stability and biodegradability of this fluid, and cost factors Measures for preventing overheating and dangerous overpressures in solar systems are discussed and specific safety techniques are outlined Solar-technology law (or the absence of it) is briefly discussed B J

A79-13635 Progress and trends in the development of terrestrial photoelectric conversion K. W Boer (Delaware, University, Newark, Del) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft fur Sonnenenergie, 1977, p 175-214 71 refs

This review paper describes the principles of operation of photovoltaic cells and surveys the use of different photovoltaic materials Consideration is given to the development of silicon cells (polycrystalline, amorphous, and nonconventional), CdS/Cu₂S cells, Schottky-barrier cells, and thin-film cells A technoeconomic analysis points to the probability of large-scale terrestrial utilization of solar cells to start sometime in the mid-1980s A number of tables describing the characteristics of such cells are presented B J

A79-13636 Activities in the field of solar cells in the Federal Republic of Germany (Aktivitäten auf dem Gebiet der photoelektrischen Solarzellen in der BRD) H R Losch (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Bereich fur Projekttragerschaften, Cologne, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich,

Deutsche Gesellschaft für Sonnenenergie, 1977, p 215-227. 10 refs
In German

The development of photovoltaic conversion technology in West Germany, both for space and terrestrial applications, is reviewed for a period extending from the early 1960s to the present. Attention is given to the historical background of CdS-cell and Si-cell development and to research programs at Stuttgart University and Varta, Kelkheim. The development of a large 10 x 10 cm polycrystalline silicon cell is also discussed. B J

A79-13637 **Cu₂S-CdS thin-film solar cells (Cu₂S-CdS Dunnschichtsolarezellen)** G H Hewig (Stuttgart, Universität, Stuttgart, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 229-243. 11 refs. In German

The paper reviews fabrication technology for Cu₂S-CdS thin-film solar cells, discusses methods for their diagnostics and life testing, and considers questions of cost relating to such cells. Consideration is given to a pilot line for Cu₂S-CdS cells with a production rate of 1 sq-m of cells per month. These cells have an area of 7 x 7 cm and show efficiencies of 4-5%. B J

A79-13638 **Practical applications of silicon solar cells in appliances and installations (Praktische Anwendung von Silizium-Solarzellen in Gebrauchsgeräten und Anlagen)** P Kipp (Ferranti GmbH, Munich, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 245-256. 8 refs. In German

The design and operational characteristics of solar generators based on silicon solar cells are briefly reviewed. A number of terrestrial applications of small-scale and medium-scale silicon solar generators are surveyed, including their use as power sources for radio beacons, mobile TV receivers, clocks, and on mountain expeditions. B J

A79-13639 **Solar electric power supplies - Design and layout (Solarelektrische Energieversorgungen - Aufbau und Auslegung)** H K Kothe (Varta AG, Kelkheim, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 257-279. 8 refs. In German

Large-scale terrestrial utilization of solar electric power will be feasible only when systems are designed which provide continuous current flow with minimum losses. For this purpose, the paper proposes a hybrid system consisting of solar generator, storage battery, and control circuitry. After a brief survey of the available components and circuitry, consideration is given to the selection and layout of an accumulator and solar generator for a continuous power supply system. Practical experience with such a system is described and appropriate block and circuit diagrams are presented. B J

A79-13640 **Solar power plants in the U.S.A. (Solarkraftanlagen in den USA)** R Köhne (Deutsche Forschungs- und Versuchsanstalt für Luft und Raumfahrt, Institut für Technische Physik, Stuttgart, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 283-295. In German

The paper considers two different solar power plant concepts: (1) solar farms (distributed systems) with small outputs, and (2) solar tower plants (central receiver systems) with large outputs. Some solar farms in the U.S.A. are discussed, including the Solar Total Energy Test Facility at Sandia Laboratories, Albuquerque, the solar farm at Willard, New Mexico, and the solar water pump system at Northwestern Mutual/Battelle. The solar tower test installation at Sandia Laboratories, Albuquerque is also discussed. B J

A79-13641 **Development of solar thermal power plants (Entwicklungsarbeiten für solarthermische Kraftwerke)** H Hopmann (Messerschmitt-Bölkow-Blöhm GmbH, Munich, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 297-313. In German

Basic concepts of solar thermal energy utilization are surveyed, and solar power plant designs are characterized. Cost factors and the effect of size on cost efficiency are considered. A 10-kW prototype with fixed mirrors, a 50-kW solar farm with moving parabolic mirrors, and the design of some parabolic mirrors and central towers are characterized. The use of a gas turbine is considered. M L

A79-13642 **Small solar power plant with a Freon turbine (Ein Kleinsonnenkraftwerk mit Freonturbine)** H Gehrke (Dornier System GmbH, Friedrichshafen, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 315-323. In German

A project is presented which is aimed at developing and testing a prototype of a small solar power plant with an output of 10 kWe. Thermal energy collected by flat plate collectors and parabolic troughs is converted into mechanical and subsequently electrical energy by means of a Freon-Rankine-process. Preliminary functional tests of the plant proved to be successful. (Author)

A79-13643 **Experimental results and concepts of different solar concentrators (Messergebnisse und Konzeption verschiedener Solarkonzentratoren)** U Wobker (Entwicklungs und Forschungslabor, Lorrach, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 325-338. In German. Research supported by the Bundesministerium für Forschung und Technologie

Weakly concentrating and strongly concentrating parabolic solar collectors are described. Theoretical requirements for maximum working temperature and electrical output are considered, and the construction of a reflector by use of a vacuum to shape a reflecting film to the shape of the supporting structure is described. M L

A79-13644 **Solar thermal power stations (Solarthermische Kraftwerke)** M Simon (Maschinenfabrik Augsburg-Nürnberg AG, Munich, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 339-347. In German

A solar power station with 5-50 kW peak output is being constructed in Munich and is described. Vertical and horizontal cylindrical parabolic mirrors will be used to heat water in dark steel tubes to 200-300 C. Materials and device parameters are surveyed, and the use of the heat in conjunction with a described steam engine is explained. The future role of solar energy is considered. M L

A79-13645 **Sea water desalination by means of solar energy (Meerwasserentsalzung mit Solarenergie).** U Heidtmann (Süddeutsche Metallwerke GmbH, Nussloch, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2. Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p. 349-362. In German

The paper reviews several types of solar desalination techniques. Consideration is given to solar distillation plants of the greenhouse type, (2) high-capacity distillation plants with heat pipe collectors, and (3) multistage evaporation plants operating in conjunction with flat plate collectors. The feasibility of these different techniques is briefly discussed. B J

A79-13646 **Selective solar absorbers (Selektive Absorber).** J von Wienskowski (Leybold-Heraeus GmbH und Co., Hanau, West Germany) In German Solar Energy Forum, 1st, Hamburg, West

Germany, September 26-28, 1977, Proceedings Volume 2
Munich, Deutsche Gesellschaft für Sonnenenergie,
1977, p 365-374 9 refs In German

The physics of materials which selectively absorb certain wavelengths is discussed, and application of these materials as coatings in solar energy devices is examined. Absorber-reflector tandem layers, interference layers, and the temperature dependence of selectivity are considered. Coating technology is surveyed, and economic factors are characterized. M L

A79-13647 Selective coatings for aluminum and steel solar absorbers (Selektive Schichten für Solarabsorber aus Aluminium und Stahl) W Scherber and G Dietrich (Dornier System GmbH, Friedrichshafen, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 375-388 In German

Low and a high temperature selective coatings are presented. The low temperature coating has been developed for aluminum panels, the high temperature coating can be used up to 400 C on heat-resistant materials like steel or copper. Coatings with excellent optical values can be produced by low-cost electroplating techniques. The corrosion and temperature resistance are superior to that of previously known selective coatings. (Author)

A79-13648 Solaronyx - Selective coating for solar energy absorbers (SOLARONYX - Selektive Beschichtung für Sonnenenergie-Absorber) J Goebel (Harshaw Chemie GmbH, Wermelskirchen, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 389-397 In German

It is shown that the Solaronyx black-chrome electroplating technique can produce selective coatings for solar energy absorbers with absorption/emission ratios exceeding 10. Optimal absorption/emission ratios can be achieved with pretreatment of the substrate material and precise adherence to electroplating equipment specifications. Solaronyx coatings can be applied to such substrates as high-grade steel, carbon steel, aluminum, copper, and ABS plastics. The Solaronyx process is briefly described and attention is given to the impact of Solaronyx on energy costs and efficiency. B J

A79-13649 Reduction of the heat loss flux of collectors by infrared reflecting coatings on cover plates (Minderung des Wärmeverluststroms bei Kollektoren durch infrarot-reflektierende Schichten auf Abdeckungen) E Hussmann (Jenaer Glaswerk Schott and Gen., Mainz, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 399-412 In German

The ability of six cover-plate systems - two single-pane and four double-pane - to improve the efficiency of a solar flat-plate collector is studied. These systems transmit sunlight but reflect infrared light. Data are presented for an external temperature of 20 C and working temperatures of 50, 80, and 110 C, for three days in three different seasons, and for 0 and 50% cloud cover. The best heat gain was obtained with a double-pane cover plate both of whose inner pane surfaces reflect infrared light, the inner pane has been coated so that it no longer functions as a mirror. M L

A79-13650 Power extracted from the wind (Energie aus dem Wind) G Tetzlaff (Hannover, Technische Universität, Hannover, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 415-424 8 refs In German

The power output of wind turbines depends strongly on the local meteorological conditions. The current lack of adequate meteorological data, annual averages of wind velocity and gustiness, for designing wind powerplants is noted. Means of improving this situation are examined. V P

A79-13651 Low-cost concept for energy supply from the wind (Ein kostengünstiges Konzept zur Energieversorgung mit Wind). H-D Goslich (Ingenieurbüro Hans D Goslich, Hamburg, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 425-436 In German

After a number of years of practical experience with windmills (two-rotor Kw at Sylt, 11 Kw, 10 meter diameter and also smaller plants at Hamburg) two-blade, high rpm plants were designed with the rotor on the lee side of the tower, both in order to reduce the construction and maintenance cost and to increase the life of the windmill. The rotor blades are joined at the hub and rotate on a 'spherical radius' during periods of high wind velocity. Full power is produced during storm periods. The concept of large scale power generation is described along with cost comparisons. (Author)

A79-13652 Design of a low-energy house in Denmark heated by a combination of solar and wind energy T V Esbensen and F Strabo In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 437-447

The paper describes the project for a low-energy house constructed in Skive, Jutland, Denmark. With energy conservation arrangements such as well-insulated structures, mobile insulation of the windows, and heat recovery in the ventilating system, the heat requirement for space heating is calculated to 6000 kWh per year. The energy system consists of a 13 sq m flat-plate solar collector integrated into the roof structure, a wind rotor with a coated area of 25-sq m and a water storage tank with a capacity of 4 cu m. The storage tank is provided with a water brake driven by the wind rotor. This energy system supplies the house with 7200 kWh, which is 67% of the total heat requirement for space heating and hot water supply. (Author)

A79-13653 Vacation homes near the sea with solar and wind energy utilization - Research done at the Technical University of Hannover. Architectural considerations (Ferienhäuser an der See mit Sonnen- und Windenergienutzung - Studiearbeit an der TU Hannover Architekturabteilung) H Hagen In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 449-458 In German

The goal of this study was to consider the utilization of a combination of solar and wind energy for vacation homes, in order to achieve energy autonomy and yet to provide a minimum room temperature level, with 100% of the heating loads for short time periods being supplied even in the winter. This would increase the value of these homes. A main consideration was to develop an adequate architecture associated with solar and wind energy utilization. (Author)

A79-13654 Total energy systems (Totalenergieanlagen) H Seitz (Oldenburg, Fachhochschule, Oldenburg, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 459-470 In German

The possibility of local, complete and self sufficient energy supply systems for residences is investigated using the example of a family residence in the Oldenburg area, which is supplied with wind and solar power. Using wind data collected during a long period of time, consideration is given to the size of wind turbines and storage systems. From the small fluctuation of the energy available yearly, it is concluded that this renewable source has high reliability. Various systems constructed from solar collectors, wind turbines, and electric and heat storage systems are calculated. The frequency of charge and discharge operations of a storage system is examined. (Author)

A79-13655 Potential and technical utilization of renewable energy sources (Potential und technische Nutzbarkeit der regenerativen Energiequellen) M Meliss (Kernforschungsanlage

Julich GmbH, Julich, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 473-493 In German

The potential of utilizing geothermal energy, tidal energy, and several forms of solar energy is examined. Forms of solar energy considered include water circulation cycles, wind energy, wave energy, naturally stored solar heat, biological and chemical energy transformation, photoelectric energy transformation, and thermal energy transformation. Attention is directed to six means of producing energy, and their capabilities are indicated. M L

A79-13656 **Hydropower from a national point of view (Wasserenergie aus nationaler Sicht)** F G Rohde and W Nelihsen (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2

Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 495-500 6 refs In German

An essential assumption of present and future development concerning the welfare of man is the availability of energy and the optimal exploitation of all available sources, taking into account environmental protection. This report contains a description of current conditions as well as future development, up to 1985, of hydroelectric power. Although in the future one expects a reduction in the rate of development of large hydropower projects, new alternatives related to multipurpose projects exist. The authors report on the possibility of small hydropower projects. Alternatives of development are presented. (Author)

A79-13657 **Wave driven power generating system (Ein Seegang-getriebenes Energieerzeugungssystem)** H Kayser In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 501-514 9 refs In German

The paper deals with the design and principle of a hydroelectric wave power generator for minimum-motion buoys. The theory of the generator is based on the assumption that the water volume employed by the generator is negligible compared with the wave volume and that the downward motion of the buoy is the only one that is not constrained. The principal components of the generator are storage cells and ballast, water inlet and outlet, water cylinder, pumps for high-pressure water, high-pressure-water and turbine tank, and a hydrostorage. V P

A79-13658 **Problems, status, and prospects of a solar hydrogen economy (Problematik, Stand und Aussichten der Solar-Wasserstoff-Wirtschaft)** E Just (Braunschweig, Technische Universität, Braunschweig, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 517-549 29 refs In German

This introductory lecture explains the reasons for transition from high tension lines to high pressure pipe lines to connect cheaply very distant energy production and consumption sites. The properties of various gaseous energy carriers, e.g., CH₄ and H₂, are discussed. H₂ is found to be superior as universal energy carrier and raw material. Subsequently different methods of making H₂ gas from various primary energies are given, including biotechnical processes. Thereafter special advantageous applications of H₂ for industrial and domestic purposes, and the present status of construction of high pressure H₂ pipelines and the satisfactory experiences in Germany are reported. In conclusion the safety risks are treated. (Author)

A79-13659 **Hydrogen production by conventional and modified water electrolysis (Wasserstoffherzeugung mit konventionellen und modifizierten Wasserelektrolyseverfahren)** P Brennecke, H Ewe, and E Just (Braunschweig, Technische Universität, Braunschweig, West Germany) In German Solar Energy Forum, 1st,

Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2

Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 551-565 17 refs In German

On the basis of the fundamental understanding of the important anodic and cathodic electrode processes, the construction and operation of commercial water electrolyzers is explained. As further developments which use improved catalysts, novel electrode structures, and modified cell constructions, the compact Eloflux and Allis-Chalmers bipolar water electrolysis cells are presented. The most interesting methods in the emerging electrolysis technology are the solid polymer electrolyte (SPE), and high temperature steam-hydrogen electrolysis cells. (Author)

A79-13660 **On the thermal and thermo-electrolytical generation of hydrogen by solar energy** J Gretz (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 567-579 20 refs

Procedures for the generation of hydrogen by solar energy are presented, noting that electrolysis is the easiest and most cost-effective means for industrial hydrogen production. The characteristics of a 1-MW(e) heliostatic demonstration plant are discussed, including net power output, heliostat field characteristics, the steam cycle, tower dimensions, receiver capabilities, and the cooling water system. Consideration is given to the thermodynamics of water splitting including electrolysis, thermolysis, and thermochemical cycles. Various decomposition techniques are reported. S C S

A79-13661 **The wind as a potential energy source in future hydrogen technology (Der Wind als mögliche Energiequelle in der zukünftigen Wasserstofftechnologie)** P Kramer (Ingenieurbüro Kramer, Braunschweig, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 581-590 13 refs In German

As distinct from fossil fuels which represent both the source and carrier of energy in the power industry, hydrogen acts only as the carrier in the hydrogen industry. In the present paper, the question whether, and to what extent, wind energy could provide the primary energy in the hydrogen industry is studied from the viewpoint of technological feasibility, efficiency, economics, and environmental considerations. The results obtained with wind energy and electric energy as the energy carrier are compared. V P

A79-13662 **Generation of electrical energy from hydrogen and oxygen by means of fuel cells (Erzeugung elektrischer Energie aus Wasserstoff und Sauerstoff mittels Brennstoffzellen)** P Brennecke, H Ewe, and E Just (Braunschweig, Technische Universität, Braunschweig, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 591-601 9 refs In German

The authors describe the function of an alkaline H₂-O₂-fuel cell, the partition of the total reaction in an anodic and cathodic step, and the rate controlling mechanisms. By direct conversion of chemical into electrical energy, fuel cells are not limited by the Carnot factor prohibiting high conversion efficiency. Two developed technical fuel cells are described in detail: (1) an alkaline system operating at ambient temperatures, and avoiding the use of rare metal catalysts, (2) a fuel cell system operating with phosphoric acid as immobilized electrolyte at 150-190 C. (Author)

A79-13663 **Vehicle operation on fuels from solar energy (Fahrzeugbetrieb mit Kraftstoffen aus Sonnenenergie)** A König (Volkswagenwerk AG, Wolfsburg, West Germany) In German Solar Energy Forum, 1st, Hamburg, West Germany, September 26-28, 1977, Proceedings Volume 2 Munich, Deutsche Gesellschaft für Sonnenenergie, 1977, p 603-613 In German

A number of processes for the conversion of solar energy to an energy form suitable for use in vehicles has been described and evaluated with respect to efficiency and economy. The physical processes make relatively good use of the primary energy, but they are very uneconomic and they lead to fuels which do not fit into the current vehicle/fuel distribution system. The processes via the step 'biomass' offer better economy and more appropriate fuels. In any case, all fuels from solar energy are inferior to fuels from fossil sources. (Author)

A79-13833 # Current and potential uses of aerospace technology by the U S Department of the Interior. G A Thorley and C J Robinove (U S Geological Survey, Reston, Va.) *American Institute of Aeronautics and Astronautics and NASA, Conference on 'Smart' Sensors, Hampton, Va, Nov 14-16, 1978, AIAA Paper 78-1716* 8 p

A79-13853 # Solar One - A 10-megawatt solar thermal central receiver pilot plant project. R N Schweinberg (U S Department of Energy, El Monte, Calif) and J L Rasband (Southern California Edison Co., Rosemead, Calif.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1750* 4 p

Consideration is given to a 10 megawatt solar thermal power plant to be built in 1980-1981 using central receiver concepts of generating electricity from incident solar energy. The system will consist of a turbine-generator, cooling tower condenser, feed-water heaters and pumps, and a control room. The turbine will accept steam directly from the receiver or from the thermal storage facility. Condenser cooling will be accomplished by a wet evaporative cooling tower. The plant will be tested for a five-year period to establish the operating and maintenance characteristics of the facility. S C S

A79-13854 # Dynamic computer simulation of the DOE 10 MW solar thermal pilot plant. K L Zondervan, K F Steffan, and T J Connor (Aerospace Corp., El Segundo, Calif.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1752* 11 p. Research supported by the U S Department of Energy.

An approach to modeling for digital computer simulation of the five subsystems comprising the DOE's 10 MW Solar Thermal Pilot Plant to be located at Barstow, California, is discussed. Also presented are initial results of a simulation of the plant performance in response to the rapid passage of an ideal, short duration cloud directly over the site. Results indicate that the fundamental time constants of the Receiver (solar boiler), and likely controller response of that subsystem, will result in tightly controlled steam conditions. (Author)

A79-13855 # Alternative central receiver solar power plant using salt as a heat transfer and storage medium. T R Tracey and J E Myers (Martin Marietta Aerospace, Denver, Colo.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1753* 4 p

An alternative approach to solar thermal power plants, developed to reduce the cost of electricity relative to the first-generation water/steam systems, is discussed. The design uses a molten salt, a eutectic mixture of 60% sodium nitrate and 40% potassium nitrate, as the heat transfer and storage media. The system consists of nine heliostatic fields with 7711 heliostats in each. The heliostats direct the solar energy incident on them to one of four cavity apertures located at the top of a 158-m tower. Inside the cavities the flux is absorbed on panels cooled by molten salt. Salt flowrate is monitored and the hot salt is pumped to the steam generator or the storage system. The master control system is computerized and also provides data display and storage. The performance over first-generation systems is 30% and the performance improvement while operating from storage is 70%. S C S

A79-13856 # Flexed beams in central receiver heliostat drives. W H Raser (S C Plotkin and Associates, Los Angeles, Calif.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1755* 8 p

Horizontally flexed 'crossbow' beams in the form of large leaf springs are considered as a means for supporting and steering mirrors in central receiver systems. Their use reduces requirements for (1) heavy structural materials, (2) the number of tracking drives, (3) component machining precision and (4) land area. Although the exact amount depends upon the pointing accuracy and wind tolerance specifications, the economy in plant construction resulting from these changes could be over 25 percent. (Author)

A79-13857 # Passive solar heating and cooling. R Naismith (Atlantic Research Corp., Alexandria, Va.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1756* 5 p. 5 refs.

The paper discusses the passive solar energy concept which uses the building itself as a collector. Three types of gain may be used: direct gain where the energy is stored in a thermal mass, indirect gain where the solar energy goes directly into storage and is then released into the living space, and isolated gain where the solar energy is naturally transferred from a separate part of the structure into the living space. Various applications of passive solar energy systems are described including a Benedictine Monastery in New Mexico, an airport terminal in Aspen, Colorado, and a restaurant in Albuquerque, New Mexico. S C S

A79-13858 # Performance testing of a three ton solar absorption chiller. J M Froemming, B D Wood (Arizona State University, Tempe, Ariz.), and F P Mancini (Arizona Solar Energy Research Commission, Phoenix, Ariz.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1757* 11 p. 36 refs. Research supported by the Arizona Solar Energy Research Commission.

A test facility was designed and built to rate the performance of Arkla Industries WF36 residential size (3 ton) solar absorption refrigeration unit. This water cooled water chiller is designed to be driven by high performance flat plate or linear concentrating solar collectors. The test facility is capable of rating other comparable size heat driven water chillers. A steady state performance mapping of the absorption unit was completed and is in very good agreement with Arkla's published data and verifies the reliability of the test facility and the test procedure. Cold start up tests have also been performed to determine the system transients and their effect on the unit's performance. (Author)

A79-13859 # Evaluation of control options for solar climate control systems. J H Pejsa, K H Nguyen, and S A Wenzler (Honeywell Energy Resources Center, Minneapolis, Minn.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1758* 5 p

Improved control algorithms have been derived for three residential solar heating and cooling systems, with auxiliary backup fossil fuel systems. The combination of the variable solar energy source and the conventional constant fossil fuel heat source introduces control options that are interesting and often confounding. Performance of the three systems has been evaluated analytically, under various control options singly and in combination. The models and simulation software are part of the SUNSIM/DYNSIM computer package developed at the Honeywell Energy Resources Center. (Author)

A79-13860 # The ClearView Solar Collector system and associated one and two stage evaporative cooling - Interim results J F Peck, T L Thompson, H J Kessler, and C N Hodges (Arizona, University, Tucson, Ariz) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz , Nov 27-29, 1978, AIAA Paper 78-1759* 7 p

The ClearView Solar Collector is being developed in response to a need for a transparent, site-built, wall-mounted, hot air type solar collector. It uses dark venetian blinds or heat absorbing glass to absorb insolation, thus allowing windows to be placed wherever desired along the south wall. Both passive (natural energy flow) and active (fan-driven) forms have been devised. Heat is either stored in the mass of the home or in a rockbed. Summer cooling is accomplished either by ordinary evaporative cooling or by the more powerful two stage evaporative cooling. Auxiliary heating can be accomplished by simple low-cost devices that merely heat the daytime occupancy areas of the house during cloudy weather, or by more expensive devices that heat the entire home. Some forms may be retrofitted onto many existing homes. A 10 F temperature fluctuation in a double brick home (no wall insulation) using a retrofitted hybrid ClearView Solar Collector was recorded. Data on two-stage evaporative cooling taken during the summer of 1978 shows that typical daily output temperatures are between 65-72 F during both very hot and very humid weather conditions. (Author)

A79-13861 # Jet impingement solar air heater D R Rask, L J Mueller, and J H Pejsa (Honeywell Energy Resources Center, Minneapolis, Minn) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz , Nov 27-29, 1978, AIAA Paper 78-1760* 12 p

The development of a flat plate solar air heater based on a jet impingement concept as the absorber plate-to-air stream heat transfer mechanism is discussed. A prototype model has been evaluated to determine the effect of varying jet array parameters. These results are compared to a baseline parallel plate collector. An increased absorber plate-to-air stream heat transfer coefficient is observed to increase performance. The jet impingement concept increases the collector Y-intercept efficiency relative to the baseline parallel plate collector by about 13% and by 32% at a typical space heating. Recommendations are made for an optimum jet configuration, collector flow feed, and regarding construction materials. S C S

A79-13862 # The economic performance of passive solar heating - A preliminary analysis F Roach, S A Noll (California, University, Los Alamos, N Mex), and S Ben David (New Mexico, University, Albuquerque, N Mex) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz , Nov 27-29, 1978, AIAA Paper 78-1761* 11 p 8 refs

An analysis is made of the economic performance of passive solar heating systems. The analysis consists of (1) establishing the architectural design parameters for a standard house and solar energy system, (2) estimating the physical performance of the system at various locales, (3) developing costs for providing different solar fractions for each locale, (4) projecting the costs of providing conventional heat for each locale. It is found that the addition of night insulation to thermal mass storage walls increases the solar performance and the economic performance of passive systems. The relative economic competitiveness of passive solar thermal storage walls against conventional fuel alternatives is indicated. S C S

A79-13863 # Metal hydride solar heat pump and power system /HYCSOS/. R Gorman and P S Moritz (TRW, Inc., Energy Systems Div., McLean, Va) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz , Nov 27-29, 1978, AIAA Paper 78-1762* 7 p

The report presents the design, performance and cost of a solar powered metal hydride heat pump and power system for use on

a residence. The system design, which is limited by heat transfer, is optimized via an iterative computer program. The design process starts with optimizing the thermal transport properties of the hydride-bed heat exchanger, then traces temperatures and pressures through the operating cycles. The coefficient of performance (COP) of the overall system is then determined from the thermal losses due to cycling the hydride beds and due to the auxiliary power consumed by freon pumps and air moving fans. The system, using high temperature solar collector input at 210 to 280 F, provides heating with a COP of approximately 1.6 and cooling with a COP of approximately 0.6, and electrical power during spring and fall, all for a cost comparable to a solar absorption cooler. (Author)

A79-13864 # Photovoltaic overview M B Prince (US Department of Energy, Washington, D C) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz , Nov 27-29, 1978, AIAA Paper 78-1763* 4 p

The National Photovoltaic Program is outlined in terms of its major divisions and their activities. Economic analyses have been developed to characterize photovoltaic systems and policy and planning studies. The research and advance development section concentrates on developing selected thin-film cells and identifying potential new materials. Technology development is aimed at achieving large reductions in the cost of photovoltaic cells, arrays, and systems. The development and maintenance of a photovoltaic systems, analysis, and engineering capability is provided by the system definition and development section. Work is also aimed at applying photovoltaic systems to a wide range of uses and at establishing performance criteria and test standards. S C S

A79-13865 # Venture analysis of a proposed federal photovoltaic eight-year procurement plan D R Costello (Solar Energy Research Institute, Golden, Colo) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz , Nov 27-29, 1978, AIAA Paper 78-1766* 6 p 5 refs

The paper summarizes a venture analysis of a temporary federal subsidy for the purchase of photovoltaic energy systems by the private sector. The goal of the subsidy was to stimulate markets in order to reduce the price of photovoltaic systems. The study's objective was to determine if the marginal societal benefits of the subsidy (measured by changes in consumer surplus) justified the program's cost. The study used a mixture of analytical approaches and opinion gathering techniques. It was concluded that, under most future economic conditions, the subsidy would not be an effective mechanism to achieve the required photovoltaic system price reductions. The subsidy would yield useful market and performance information. (Author)

A79-13866 # Pennies a day Financing early deployment of photovoltaic utility applications through a user subsidy B Siegel (Aerospace Corp., El Segundo, Calif) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz , Nov 27-29, 1978, AIAA Paper 78-1767* 9 p 9 refs Contract No EY 76-C 03-1101

A preliminary analysis has been completed of the user subsidy required to permit photovoltaic systems to substitute for new coal plants or to replace existing oil plants in utility central station applications. It was found that relatively small increases in annual electric bills (\$10.25 a year for typical residential customers) would allow a significant national or regional deployment of photovoltaic systems over the 1986-2000 time period even if the cost of coal or oil does not increase any more rapidly than the annual rate of inflation. (Author)

A79-13867 * # NASA Lewis Research Center photovoltaic application experiments A Ratajczak, W Bifano, J Martz, and P O'Donnell (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics and Arizona Solar*

Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1768 9 p

The NASA Lewis Research Center has installed 16 geographically dispersed terrestrial photovoltaic systems as part of the DOE National Photovoltaic Program. Four additional experiments are in progress. Currently, operating systems are powering refrigerators, a highway warning sign, forest lookout towers, remote weather stations, a water chiller and insect survey traps. Experiments in progress include the world's first village power system, an air pollution monitor and seismic sensors. Under a separate activity, funded by the US Agency for International Development, a PV-powered water pump and grain grinder is being prepared for an African village. System descriptions and status are included in this report. (Author)

A79-13868 # Dispersed power systems and total energy V L Dugan (Sandia Laboratories, Albuquerque, N Mex.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1770* 4 p

Consideration is given to using cascaded energy systems to service dispersed loads. Such systems provide both mechanical/electrical energy and thermal energy to a load with which it is directly associated. This yields a higher cost for the input energy when compared to a noncascaded system. The selection of a particular collector for a given application is primarily based on the temperature of the application. SCS

A79-13869 * # Solar thermal power systems point-focusing distributed receiver /PFDR/ technology - A project description J W Lucas and E J Roschke (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1771* 14 p 8 refs. Research sponsored by the US Department of Energy, Contract No NAS7-100

The goal of the Project is to support the industrial development of PFDR technology that will provide favorable life-cycle costs per unit of electrical or thermal energy produced. The technology will be made available in the early 1980s for applications project experiments. PFDR systems utilize concentrator dishes to furnish energy to their own individual receivers and power conversion subsystems. Initial effort is with steam Rankine and gas Brayton cycles. Periodic assessments will be made to confirm or change the cycles initially selected. Subsystems will be designed, fabricated and tested together in modules as appropriate. This paper describes PFDR systems briefly, outlines the project goals and organization, discusses the plans and current status of the project, and lists the benefits of PFDR technology concepts. (Author)

A79-13870 # Future solar total energy markets for the US industrial sector L R Bush and P K Munjal (Aerospace Corp, El Segundo, Calif.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1773* 9 p. Research supported by the US Department of Energy

A computerized market penetration model has been developed to forecast commercialization of solar total energy systems in the US industrial sector. The model makes use of performance relationships developed through extensive computer simulation which define solar system economics and energy displacement by fuel type as functions of industrial application characteristics (thermal to-electric ratio, phasing, size), solar isolation and price of competing fuels. Results are presented for 140 industries, 50 states, and 7 time periods from 1985 through 2015. Aggregated national totals indicate that considerable fuel displacement can be achieved by 1990, and even earlier if government incentives are employed. (Author)

A79-13871 # Optimum selection of a wind turbine generator system J K Shultis, L A Poch, and N D Eckhoff (Kansas State University of Agriculture and Applied Science, Manhattan, Kan.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1774* 8 p 11 refs

A method is described for the selection of the optimum size (i.e., rated power and speed) for a wind turbine generating system (WTGS) such that, for given wind speed conditions and for given demand power requirements, the annual economic savings are maximized by using the WTGS compared to purchasing all power from a utility. No storage of excess generated electricity is considered and any demand in excess of that generated by the WTGS is assumed to be supplied by the utility grid. The economic saving realized with the optimum sized WTGS is examined for various problem variables such as the degree of variability in the wind speed and in the demand load throughout the day and from season to season. (Author)

A79-13872 # Design of a second generation concentrating tracking solar collector R W Miller and W D Antrim (American Science and Engineering, Inc, Cambridge, Mass.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78-1775* 10 p 16 refs. Contract No EM 78-C-04-4275

The design of a second generation concentrating tracking solar collector is described in detail. The prior work which led to this type of collector is summarized. The collector hardware, including parabolic reflectors, cylindrical blackbody type receiver, tracking system and enclosure are discussed in sufficient detail to establish critical design parameters. Emphasis is placed on the optical and thermal performance analysis of the collector which define the design configuration details. The result is a collector design capable of producing outlet fluid of high enough temperature to drive air conditioning equipment. Concentration ratio is 12 and predicted efficiency is 60% at fluid outlet temperature of 200 F. (Author)

A79 13873 # Preliminary design of solar total energy - Large scale experiment at Shenandoah, Georgia E H Ernst (General Electric Co, Valley Forge, Pa.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27-29, 1978, AIAA Paper 78 1776* 4 p. Contract No EG-77 C-04-3985

The design of the Solar Total Energy System large scale experiment at Shenandoah, Georgia, which supplies electric power, process steam, and hot water, is reported. The system is a cascaded total energy system having high-temperature paraboloidal dish collectors with a concentration ratio of 235 and a steam Rankine cycle power conversion subsystem. The solar controller subsystem has 192 7-m-diam parabolic dish collectors arranged in a repeating diamond pattern. The energy storage subsystem is based on the trickle oil concept providing a low-cost solid storage medium. The power conversion subsystem is a three-piece boiler configuration, and the thermal utilization subsystem consists of a 20 MMBtu capacity storage system, a 354-ton absorption chiller, and two cooling towers. The system is operated from a central control console. SCS

A79-13874 # A hybrid thermochemical hydrogen production cycle using solar energy process heat J R Dafler, S E Foh, and J D Schreiber (Institute of Gas Technology, Chicago, Ill.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz, Nov 27 29, 1978, AIAA Paper 78-1779* 7 p 37 refs

Thermochemical hydrogen production has been recommended as a means to provide a valuable chemical fuel without relying on the generation of electricity. Energy may be transmitted as hydrogen gas by high-pressure pipelines. Hydrogen not manufactured at high

pressure requires an initial compression to raise the gas to pipeline entry pressure. Increased thermochemical cycle efficiencies produce increased hydrogen per unit of process energy and per unit of plant investment. Solar concentration sources are expected to be capable of yielding near-isothermal heat at higher temperatures than nuclear fission reactors. The H-5 cycle, a hybrid thermoelectrochemical cycle using a small work input to electrolytically drive an otherwise unfavorable reaction, is described. S C S

A79-13876 # Liquid fuels from biomass. J L Kuester (Arizona State University, Tempe, Ariz.) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz., Nov 27-29, 1978, AIAA Paper 78-1781* 5 p. Research supported by the Arizona Solar Energy Research Commission, Contract No. EY-76-S-02 2982.

A project is described with the objective of converting cellulosic (biomass) and waste polymer materials to liquid fuel equivalents of current commercial products (kerosene, diesel fuel, high octane gasoline). A thermal conversion approach is utilized. Quality products have been produced with expected yields in the 20-100 gals fuel/ton feedstock depending on the type of feedstock processed. (Author)

A79-13899 Predicting the performance of passive solar-heated buildings. E Mazria (Matrix, Albuquerque, N Mex.), M S Baker (Oregon, University, Eugene, Ore.), and F C Wessling (New Mexico, University, Albuquerque, N Mex.) *Sunworld*, vol 2, May 1978, p 42-45.

The paper describes an analytical model used to predict the performance of thermal mass materials located in a solar heated space heated by a direct gain passive system. Three configurations of thermal storage mass are considered, and computer simulation results showing the relation between external and internal temperatures for the three configurations and for different materials are presented. The results indicate that passive solar heating systems can supply a significant portion of a building's winter space-heating requirements and can maintain relatively stable indoor air temperatures. M L

A79-13900 Saudi Arabia looks at the sun. A A M Sayigh (Riyadh, University, Riyadh, Saudi Arabia) *Sunworld*, vol 2, May 1978, p 46-49.

Solar distillation, passive cooling, greenhouse technology, combined solar and geothermal systems, and solar economics in Saudi Arabia are considered. The existence of three climatic regions—extremely arid, semiarid, and arid—is noted, and an equation used for solar intensity prediction is presented. Solar distillation is considered the most important solar application in Saudi Arabia, and research with single slope solar stills and with a multistage solar still is mentioned. The water required for agriculture could be reduced by the use of passive cooling and adobe greenhouses. In Saudi Arabia, solar water heating is cheaper than conventional methods while other solar applications are a little more expensive than existing means. M L

A79-13985 # Attenuating the transverse edge effect in MHD generators. A Yakhot (Negev, University, Beersheba, Israel) and A Levin (Technion Israel Institute of Technology, Haifa, Israel) *AIAA Journal*, vol 16, Nov 1978, p 1203-1205. Contract No. N00014-77-G 0034.

A specific inhomogeneity of the electric current, the so-called 'transverse edge effect', arises in the cross section of the channel of an MHD generator when, as a result of nonuniformity of the velocity in the direction of the magnetic field, a part of the current forms a closed loop over the boundary layers near nonconducting walls. The solution of a problem involving a rectangular channel with insulated walls and electrode-acting walls suggests that nonconducting baffles, parallel to the magnetic field and adjoining the insulated walls, be located in the electrode region of the generator. This is done so as to attenuate the shunting currents flowing along the boundary layers at

the insulated walls of the channel. An increase in the net current can be obtained by using small baffles. S D

A79-14054 # Space power technology - Current status and future development trends (Raumfahrtenergetik - Gegenwartiger Stand und zukünftige Entwicklungstendenzen). W Peschka (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt and Hermann-Oberth-Gesellschaft, Deutscher Luft- und Raumfahrtkongress, Darmstadt, West Germany, Sept 19-23, 1978, DGLR Paper 78-167* 31 p. 13 refs. In German.

The paper reviews different types of spacecraft primary power sources and power conversion systems. The following types of systems are considered: (1) solar photovoltaic power sources, (2) Brayton cycle (solar thermal) power systems, and (3) nuclear-reactor systems with radioisotope batteries and thermoelectric generators (i.e., the SNAP systems). Consideration is also given to different types of energy storage batteries (e.g., nickel-cadmium, silver-cadmium, and silver-zinc). Tables are presented giving detailed comparisons of the various power systems. B J

A79-14056 # Flexible roll-out solar generators - Energy sources for future high-power space missions (Flexible, rollbare Solargeneratoren - Energiequellen für zukünftige leistungsstarke Raumfahrtmissionen). J Rath (Telefunken AG, Wedel, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt and Hermann-Oberth-Gesellschaft, Deutscher Luft- und Raumfahrtkongress, Darmstadt, West Germany, Sept 19-23, 1978, DGLR Paper 78-165* 22 p. 5 refs. In German. Research supported by the Bundesministerium für Forschung und Technologie and European Space Agency.

The paper discusses the development of roll-out solar arrays for high-power (multi-kW or MW) space applications, with particular reference to the use of such arrays as power sources in Shuttle/Spacelab missions. The development of space power modules is described along with the use of roll-out arrays in satellite solar power stations. Cost considerations relating to the development of large arrays for the MW-power range are discussed, and particular attention is given to large single-crystal (5 x 5 cm) and polycrystalline (5 x 5 cm to 10 x 10 cm) silicon solar cells. B J

A79-14106 Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977. Conference sponsored by the AIChE, APCA, and Dayton Affiliate Societies Council. Edited by D G Nichols, E J Rolinski (USAF, Materials Laboratory, Wright Patterson AFB, Ohio), R A Servais (Dayton, University, Dayton, Ohio), L Theodore, and A J Buonocore (Entoleter, Inc., Hamden, Conn.) Dayton, Ohio, American Institute of Chemical Engineers, 1978. 607 p.

Consideration is given to such topics as energy conservation, waste disposal and utilization, methodology for the assessment of energy and environment, energy system studies, general air pollution control studies, coal preparation and cleaning, and alternate energy sources. Papers are also presented in such fields as regional energy/environment assessment studies, sulfur-dioxide control, particulate removal, water pollution control, health considerations in energy conversion, and social and economic energy/environment impact assessment. B J

A79-14107 Stabilization of power plant scrubbing slurries and fine coal refuse with the additive Calcilox C. Labovitz (Dravo Lime Co., Pittsburgh, Pa.) In *Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977*. Dayton, Ohio, American Institute of Chemical Engineers, 1978, p. 79-83.

Calcilox, when added to the scrubber thickener underflow at a percentage rate of the solid present, produces a stable material with the consistency of consolidated soils. Calcilox acts both chemically and mechanically to produce a relative impermeable landfill product. The speed and degree of stabilization increase with increasing

Calciox additive rate and increasing original solids-content of the FGD slurries The strength of the Calciox-treated sludges increases with increased solids content, increased curing time, and increased temperature The permeability of the stabilized sludge decreases with increased initial solids content and increased percent additives B J

A79-14108 Potential agricultural uses of fluidized bed combustion waste O L Bennett, W L Stout, J L Hern, and R C Sidle (U S Department of Agriculture and ERDA, Morgantown, W Va) In Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977

Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 84-89

The paper outlines a comprehensive research program to determine the potential uses of fluidized bed combustion (FBC) waste in agriculture Initial phases of the program consist of detailed chemical and physical evaluation of the waste material, followed by extensive greenhouse, environmental growth chamber, and field studies For the present, most of the research is confined to the Eastern United States, where most of the agriculturally important soils and surface mining spoils are acid and require large applications of limestone and complete fertilizer for plant growth Since FBC waste material contains calcium and magnesium oxides, it may have good potential for neutralizing soil acidity and supplying needed plant nutrients B J

A79-14109 A standard procedure of economic evaluation for energy-producing and pollution-abatement operations V W Uhl (U S Environmental Protection Agency, Research Triangle Park, N C) and A W Hawkins (Research Triangle Institute, Research Triangle Park, N C) In Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977

Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 103-108 1? refs

The proposed standard procedure of economic evaluation of energy-producing and environmental-control processes consists of two parts the description and the cost evaluation The descriptive part consists of seven headings (with parenthetical explanatory remarks) facility description, capacity rating, abstract of scope, performance specification, stage of development, degree of accuracy, and sensitivity The cost evaluation part includes assessments of capital investment, annual operating cost, profit and cash flow, and measures of economic feasibility B J

A79-14110 Advanced processes for generation of electric power Solvent refining of coal and combined cycle plants G N Reddy (Argonne National Laboratory, Argonne, Ill) In Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977

Dayton, Ohio, American Institute of Chemical Engineers 1978, p 161-166

An assessment of the status of technology of solvent refined coal (SRC) production and utilization and low Btu gasification/combined cycle power generation (LBC/CCPG) systems was made The assessment included an analysis of, among other things, the relative potential for commercial application, energy conversion efficiencies and economics The potential for commercial application of these two technologies was found to depend on certain institutional barriers and solution of a few technological problems Energy conversion efficiency for SRC production and utilization for generation of electricity was found to be comparable to conventional plants with flue gas desulfurization systems Energy conversion efficiency for combined cycle plants was found to be higher than that of conventional plants Cost of electricity generated by plants based on these two technologies was found to be higher at present but in the future it was projected to be comparable (Author)

A79-14111 State-of-the-art assessment of air pollution control technologies for various waste-as-fuel processes T W Devitt, C J Sawyer, and F D Hall (PEDCo Environmental, Inc., Cincinnati, Ohio) In Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977

Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 167-173 7 refs

The paper describes a research study whose goal is to develop prototype pilot scale air pollution control devices that can be tested and evaluated on various waste-as-fuel (WAF) processes to control potentially harmful emissions The duration of the study is 36 months and it is phased as follows (1) collection of data on known and potential air pollutants produced from WAF processes, (2) assessment of air pollution control technology for WAF processes, (3) development of conceptual designs of pilot-scale pollution control devices, (4) construction of such devices for the most significant problems associated with WAF processes, and (5) operation of the pilot-scale units to generate and analyze data B J

A79-14112 Energy consumption of environmental controls - Fossil fuel, steam electric generating industry B L Murphy, G F Hoffnagle, J R Mahoney, and J J Watson (Environmental Research and Technology, Inc., Lexington, Mass) In Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977

Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 174-179

Results are presented of a detailed study of environmental-control energy requirements for the fossil fuel, steam electric generating industry The study represents a significant improvement in estimates of energy use because it is based on real data from a large sample of power plants The final result of the study is that energy use for environmental control in this industry will be between 1% and 2% of total United States energy consumption by 1983 Consideration is also given to the relative importance of various regulatory areas and to control system options which lead to significant energy savings B J

A79-14113 Ambient air quality assessment of the Synthane coal gasification pilot plant, six month study /August 1976-January 1977/ R L Scott and R P Ladesic (U S Department of Energy, Pittsburgh Energy Research Center, Pittsburgh, Pa) In Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977

Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 200-205

The paper briefly describes the second phase results and conclusions relating to the ambient air monitoring program at the Synthane pilot plant in Allegheny County, Pennsylvania A description is given of the Synthane gasification process, and the nature of emissions and effluents is briefly discussed The site characteristics and the associated air monitoring system for the pilot plant are described B J

A79-14114 Pollution perspective for geothermal energy development R P Hartley (U S Environmental Protection Agency, Industrial Environmental Research Laboratory, Cincinnati, Ohio) In Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977

Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 243-248 11 refs

Hydrogen sulfide releases and wastewaters high in dissolved solids are the principal potential sources of pollution in the geothermal energy field Wastewater characteristics are relatively constant for a given reservoir, which is an advantage in designing treatment and disposal systems Two major control technology areas have evolved the treatment of noncondensable gases and the subsurface injection of wastewater The latter, if successful, will eliminate the need for wastewater treatment and assist in reservoir maintenance and subsidence control B J

A79-14115 Evaluation of the Ames, Iowa refuse derived fuel recovery system C C Wiles, D E Fiscus, R A Olexsey, A W Joensen, and J L Hall (U S Environmental Protection Agency, Cincinnati, Ohio) In Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977

Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 306-311

The City of Ames, Iowa has been commercially operating a system of materials and energy recovery from municipal solid waste since November 1975. The EPA implemented a three-year detailed evaluation of the Ames system, which began in February 1976. The major tasks of the EPA study were (1) environmental emission evaluation at the Ames Power Plant, (2) assessment of stoker boiler performance, (3) corrosion study in the stoker boiler, and (4) an economic evaluation and flow stream characterization at the solid waste process plant. This paper summarizes the results of the first year's evaluations and presents recommended plant modifications.

B J

A79-14116 * **Electricity from sunlight** C L Yaws, J W Miller (Lamar University, Beaumont, Tex.), R Lutwack, and G Hsu (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In *Energy and the environment*, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977. Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 329-334. 10 refs. ERDA-NASA-sponsored research.

The paper discusses a number of new unconventional processes proposed for the low-cost production of silicon for solar cells. Consideration is given to (1) the Battelle process (Zn/SiCl₄), (2) the Battelle process (SiI₄), (3) the Silane process, (4) the Motorola process (SiF₄/SiF₂), (5) the Westinghouse process (Na/SiCl₄), (6) the Dow Corning process (C/SiO₂), (7) the AeroChem process (SiCl₄/H atom), and the Stanford process (Na/SiF₄). Preliminary results indicate that the conventional process and the SiI₄ processes cannot meet the project goal of \$10/kg by 1986. Preliminary cost evaluation results for the Zn/SiCl₄ process are favorable.

B J

A79-14117 **Effects of weather and pollution on incident solar energy - Basic measurements leading to computer models** G M Lerfeld and V E Derr (NOAA, Environmental Research Laboratories, Boulder, Colo.) In *Energy and the environment*, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977. Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 335-338. Research sponsored by the U.S. Department of Energy.

A program of experimental measurements and analysis is being conducted to better define the roles played by the scattering and absorbing components in the atmosphere on the spectral transmission of solar radiation. These components include water vapor, stratospheric ozone, lithometeors, hydrometeors and the standard atmospheric gases. Simultaneous observations by a large backscatter lidar, solar spectral photometers, infrared radiometers, acoustic sounder, in situ particle samplers, and time-lapse sky cameras permit determination of each of the absorbing/scattering components, separately. Data sets have been collected at Boulder, Colorado, Fairplay, Colorado, Colstrip, Montana, and Pt Mugu, California.

(Author)

A79-14118 **Long-term availability of water resources for energy development in the Central United States** L J Habegger, S-Y Chiu, and L J Hoover (Argonne National Laboratory, Argonne, Ill.) In *Energy and the environment*, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977. Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 344-349.

As part of an integrated assessment of impacts and constraints related to future energy development, an analysis has been made of water resources and demands over the next 40-50 years in the Central U.S. Included in the analysis are portions of the Great Lakes Basin and the Upper and Lower Mississippi, Ohio, Missouri, Souris-Red Rainy and Arkansas-White Red River Basins. Although cumulative water supplies are adequate in this region to satisfy foreseeable energy requirements, this paper identifies various sub-regions in which significant water shortages are likely to occur. These shortages would constrain energy development patterns, restrict development of competing water uses, or alternatively, require implementation of water resource enhancement options. (Author)

A79-14120 **Recent operating experience of the Wellman-Lord FGD process on a coal-fired boiler** F F Delgado (Davy Powergas, Inc., Lakeland, Fla.) In *Energy and the environment*, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977. Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 398-403.

Consideration is given to the Wellman-Lord SO₂ recovery process. The chemistry is discussed and a process description is given. Operating experience of the Wellman-Lord flue gas desulfurization (FGD) process on a coal-fired boiler at the Nipsco plant in Gary, Indiana is reviewed. Figures are presented illustrating particulate removal results, SO₂ inlet and outlet results, and utilities and raw materials used.

B J

A79-14121 **Limestone SO₂ reactivity and causes for reactivity loss during multi cycle utilization** J C Montagna, R B Snyder, W I Wilson, I Johnson, and G J Vogel (Argonne National Laboratory, Argonne, Ill.) In *Energy and the environment*, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977. Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 409-414. 6 refs. ERDA-sponsored research.

Experiments pertaining to the fluidized-bed combustion of coal were performed. Ten sulfation/regeneration cycles were performed using Tymochee dolomite and Greer limestone in order to evaluate changes in reactivity (sulfur acceptance during combustion) and regenerability (sulfur release during regeneration). It is found that the loss of limestone-SO₂ reactivity and capacity with increasing number of sulfation/regeneration cycles is caused by rapid limestone sintering (or possibly by other internal structural changes) in the regenerator and not by buildup of ash on the limestone surface. It is suggested that the presence of CaSO₄ in the limestone when exposed to high temperature (1100 C) accelerates limestone sintering, causing a decrease in total porosity and thus a decrease in SO₂ reactivity.

B J

A79-14122 **The Research-Cottrell/Bahco SO₂ and particulate removal system at Rickenbacker Air Force Base** J E McCarthy (Research Cottrell, Inc., Bound Brook, N.J.) In *Energy and the environment*, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977. Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 421-427. Research supported by the U.S. Environmental Protection Agency, Contract No. F33617-75 90100.

A79-14123 **Particulate control for coal fired industrial boilers** N D Noe and J M Bruck (PEDCo Environmental, Inc., Cincinnati, Ohio.) In *Energy and the environment*, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977. Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 428-433.

The paper discusses fabric filters and electrostatic precipitators used for particulate control in industrial coal-fired boilers. Types of fabric filters, efficiency, temperature limitations, and variation in the air-to-cloth ratio are considered, and characteristics of mechanical-shake, reverse-air and pulse-jet fabric filters are reported. Electrostatic precipitator function and efficiency are characterized. Factors involved in the evaluation of particulate control devices are surveyed, and it is suggested that fabric filters will probably be the control device of choice within the next few years.

M L

A79-14124 **The direct reduction of sulfur dioxide** J Buenrostro and D B Wilson (New Mexico State University, Las Cruces, N. Mex.) In *Energy and the environment*, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977. Dayton, Ohio, American Institute of Chemical Engineers, 1978, p 441-446. 11 refs. Research supported by the New Mexico Energy Resources Board.

The direct reduction of sulfur dioxide to sulfur by use of reducing agents normally found in low-BTU coal gas is examined and recommended as feasible, although the need for catalyst development is noted. Low-BTU coal gas composition and the chemical equilibrium compositions formed after reaction are reported. The

A79-14125

described reduction procedure is compared with the Claus procedure, and difficulties caused by undesired side reactions in the low-BTU coal gas reduction process are considered M L

A79-14125 Simultaneous nitrogen oxides and sulfur dioxide removal by absorption-reduction scrubbing T Sekiya (Asahi Chemical Industry Co., Tokyo, Japan) and W Ellison (NIJS Corp., Tokyo, Japan) In Energy and the environment, Proceedings of the Fifth National Conference, Cincinnati, Ohio, November 1-3, 1977 Dayton, Ohio American Institute of Chemical Engineers, 1978, p 447-452 5 refs

A79-14136 * Technology for aircraft energy efficiency J M Klineberg (NASA, Washington, D C) In International Air Transportation Conference, Washington, D C, April 4-6, 1977, Proceedings New York, American Society of Civil Engineers, 1977, p 127-171

Six technology programs for reducing fuel use in U S commercial aviation are discussed. The six NASA programs are divided into three groups: Propulsion - engine component improvement, energy efficient engine, advanced turboprops, Aerodynamics - energy efficient transport, laminar flow control, and Structures - composite primary structures. Schedules, phases, and applications of these programs are considered, and it is suggested that program results will be applied to current transport derivatives in the early 1980s and to all-new aircraft of the late 1980s and early 1990s M L

A79-14138 * Alternate aircraft fuels prospects and operational implications R D Witcofski (NASA, Langley Research Center, Hampton, Va.) In International Air Transportation Conference, Washington, D C, April 4-6, 1977, Proceedings New York, American Society of Civil Engineers, 1977, p 197-241 14 refs

The paper discusses NASA studies of the potentials of coal-derived aviation fuels, specifically synthetic aviation kerosene, liquid methane, and liquid hydrogen. Topics include areas of fuel production, air terminal requirements for aircraft fueling (for liquid hydrogen only), and the performance characteristics of aircraft designed to utilize alternate fuels. Energy requirements associated with the production of each of the three selected fuels are determined, and fuel prices are estimated. Subsonic commercial air transports using liquid hydrogen fuel have been analyzed, and their performance and the performance of aircraft which use commercial aviation kerosene are compared. Environmental and safety issues are considered M L

A79-14260 Solar energy installations for pumping irrigation water J T Pytynski (New Mexico State University, Las Cruces, N Mex.) *Solar Energy*, vol 21, no 4, 1978, p 255-262 55 refs

A79-14261 Performance of a tilted solar cell under various atmospheric conditions J V Dave (IBM Scientific Center, Palo Alto, Calif.) *Solar Energy*, vol 21, no 4, 1978, p 263-271 6 refs

A numerical simulation is used to represent the performance of a Ga(1-x)Al(x)As GaAs cell as a function of its tilt angle for five different models of the terrestrial atmosphere as well as for several elevations of the sun. The atmospheric models correspond to average cloudfree midlatitude summer conditions with different aerosol and atmospheric gas conditions. Values of both the direct solar radiation and of the diffuse sky radiation incident upon the cell were calculated at 77 unequally spaced wavelengths in the spectral region 0.305-2.5 microns, and the field of the diffuse radiation was evaluated at several azimuth angles and points in the zenith. Effects of atmospheric conditions, solar position, orientation of the cell, and ground reflectivity on solar cell parameters are considered M L

A79-14262 Simulations of the performance of open cycle desiccant systems using solar energy J S Nelson, W A Beckman, J W Mitchell, and D J Close (Wisconsin University, Madison, Wis.) *Solar Energy*, vol 21, no 4, 1978, p 273-278 15 refs Contract No E(111) 2588

A feasibility study of open cycle air conditioning systems that use solid desiccants and solar energy has been performed. The two configurations evaluated are the ventilation mode, in which ambient air is continually introduced into the room, and the recirculation mode, in which room air is recirculated. Seasonal simulations for Miami, Florida, show that the auxiliary energy requirement for the ventilation mode is about one half that for the recirculation mode. The seasonal COP for the system using solar energy as the auxiliary is approximately 0.75. A conventional flat plate solar energy system of moderate size can provide a large fraction of the energy required to meet the sensible and latent loads of a typical house (Author)

A79-14263 Optimal sizing of solar collectors by the method of relative areas C D Barley and C B Winn (Colorado State University, Fort Collins, Colo.) *Solar Energy*, vol 21, no 4, 1978, p 279-289 10 refs Research supported by the Eastman Kodak Co and Colorado State University

A method is presented for calculating directly, without iteration, the approximate collector area which minimizes the total life cycle cost of an active solar space and/or domestic hot water heating system. The method is based on an empirical relationship between annual solar load fraction and relative collector area. This relationship was determined by correlating data that were generated by the Klein, Beckman and Duffie F-Chart program, which in turn is based on a correlation of digital computer simulation results. The calculations may be performed in a few minutes using a hand held calculator. Required data are tabulated for 170 locations, and a solved example is included. Compared to results from the F-chart program, deviations of total life cycle costs from the minima are typically less than 3 per cent. Uncertainty of future energy prices is regarded as the limiting factor in the accuracy of the optimization calculations. A detailed economic analysis is included (Author)

A79-14264 The photogalvanovoltaic cell J M Mountz and H T Tien (Michigan State University, East Lansing, Mich.) *Solar Energy*, vol 21, no 4, 1978, p 291-295 10 refs Research supported by Michigan State University

A method of combining a photovoltaic (PV) cell and a photogalvanic (PG) cell to obtain a photogalvanovoltaic cell (PGV), which will have the combined properties and advantages of both of its constituents, is described. The PV cell immediately converts light to electricity. Although the PG cell can in principle be used either for immediate conversion or for energy storage, the specific light induced high-energy redox species of the described PG system degenerate via the rapid back reaction which precludes use of the combined cell system as an efficient short term storage system. Composition and properties of the PV, PG, and PGV cells are reported. Both electrodes are photoactive and the total emf produced is the sum of the single electrode potentials. The PGV process is cyclic, and it is suggested that the cell can be used to convert solar energy to electricity M L

A79-14265 Solar and wind energy applications in Hawaii G T Koide (Hawaii University, Hilo, Hawaii) and P K Takahashi (Hawaii University, Honolulu, Hawaii) *Solar Energy*, vol 21, no 4, 1978, p 297-305 9 refs NSF Grant No AER-76 05596

A79-14266 Solar water pumping M N Bahadori (Pahlavi University, Shiraz, Iran) *Solar Energy*, vol 21, no 4, 1978, p 307-316 34 refs

The principles of solar water pumping are briefly described. The mechanical energy needed for pumping water may be produced by thermodynamic, or direct conversion methods. In thermodynamic conversion a fluid with high internal energy is produced in solar collectors or concentrators. The internal energy of the fluid may be utilized in Rankine, Brayton, or Stirling-cycles or in specially designed devices. The nature of irrigation in the arid regions calls for scattered water pumping stations, hence small solar pumps. These pumps may be mass produced and delivered to the site. The direct conversion includes photovoltaic, thermoelectric and thermionic processes. With the current prices of solar cells photovoltaic water

pumping seems to be economically competitive with the current solar Rankine cycle system in the power ranges of below 5 kW, especially when both systems have to be imported by a developing country (Author)

A79-14267 Output power variations with solar power satellites R J Gutmann (Rensselaer Polytechnic Institute, Troy, N Y) *Solar Energy*, vol 21, no 4, 1978, p 323-330 12 refs

The first comprehensive evaluation of output power variations expected from solar power satellites is presented. The various factors are classified in a two-tier manner as deterministic (either periodic or nonperiodic) and statistical (either constant with system life or changing with life). The largest variations are due to seasonal periodic factors, namely variations in the solar constant (plus or minus 3.3 per cent) and a solar illumination variation with the photovoltaic array held perpendicular to the orbit plane (plus or minus 4.2 per cent). Other key factors delineated which are being quantified presently include power reductions due to microwave power-tube failure and silicon solar cell radiation damage, while multiple shadowing of adjacent power stations in geosynchronous orbit and rectenna structural factors and combining efficiency variations are representative of areas that need further study (Author)

A79-14268 Use of plastics in solar energy applications. A Blaga (National Research Council Div of Building Research, Ottawa, Canada) *Solar Energy*, vol 21, no 4, 1978, p 331-338 59 refs

Solar energy applications of several plastics poly-(methylmethacrylate), polycarbonate, glass fiber-reinforced polyester, poly(vinylfluoride), fluorinated ethylene propylene copolymer, poly(ethylene terephthalate), and various foamed plastics - are discussed. Actual and potential uses include covers (glazings), honeycomb structures and housings for flat-plate collectors, reflecting surfaces, optical lenses, shells, structural and support members for solar concentrating collectors, insulation, and piping. Shapes and characteristics of available plastics are considered, aging behavior is briefly described, and limitations of knowledge concerning the short-term performance and long-term durability of plastics are indicated. M L

A79-14269 * Total solar irradiance at Table Mtn, California 1926-77 R C Wilson and C P Butler (California Institute of Technology, Jet Propulsion Laboratory, Pasadena Calif) *Solar Energy*, vol 21, no 4, 1978, p 351, 352 10 refs Contract No NAS7 100

It is suggested that the mean direct solar irradiance at Table Mountain, California (100 km NE of Los Angeles at an elevation of 2460 m) in July over the 1926-77 period has not changed by more than the standard errors associated with the means of the observations. Data were not collected systematically in the years between 1952 and 1977. If the conclusion which is based partly on a single month of observation in 1977 is valid, change in the atmospheric transmission solar 'constant' product does not exceed plus or minus one percent. M L

A79-14270 Advanced batteries B C Tofield, R M. Dell (Atomic Energy Research Establishment, Harwell, Oxon, England), and J Jensen (Odense Universitet, Odense, Denmark) *Nature*, vol 276, Nov 16, 1978, p 217-220 30 refs

The Anglo-Danish interdisciplinary study of advanced battery technology is surveyed. The sodium sulfur battery which uses beta-alumina is described, the investigation of fast-ion conducting materials is reviewed, vehicular and stationary applications of advanced batteries are noted, and the development of the second generation of advanced batteries is considered. The use of TiS₂ as a solid-solution electrode is described. M L

A79-14289 The brake system for the DOE/Sandia 17-meter vertical axis wind turbine C W Dodd and W N Sullivan (Southern Illinois University, Carbondale, Ill) *Wind Technology Journal*, vol 2, Spring-Summer 1978, p 5-11. Research supported by the U.S. Department of Energy

A79-14290 Design of a direct wind energy converter to heat water by agitation in a closed tank S Neyeloff and W W Gunkel (Cornell University, Ithaca, N Y) *Wind Technology Journal*, vol 2, Spring-Summer 1978, p 12-17 10 refs

Results of a systematic design procedure to match the performance of a wind turbine to a direct water heating system using an agitator operating in an enclosed system are presented. With this system, shaft power delivered to the agitator from a wind turbine is directly converted to heat. The power required to drive the agitator is proportional to the cube of the angular velocity at high Reynolds number. Matching the water heater to the wind turbine permits the turbine to operate at its optimal power coefficient. Using dimensional analysis and a model approach, a suitable design equation was developed. The use of this equation to design a water heating system for a typical dairy farm is discussed. (Author)

A79-14291 A low cost blade design for a Darrieus-type vertical-axis wind turbine D K Ai (Alcoa Research Laboratories, Pittsburgh, Pa) *Wind Technology Journal*, vol 2, Spring-Summer 1978, p 18-23 13 refs

A brief description of the Darrieus-type vertical-axis wind turbine (VAWT) is given, followed by a short history of its development. Blade characteristics for the Sandia 5 m and 17 m research turbines are also shown. With the mass-balance condition removed, a low cost blade based on a single piece of aluminum extrusion became feasible. A set of 6 in chord blades of all airfoil section is used for Sandia's 5 m research wind turbine. This blade is now commercially available. Other VAWTs using this blade include the 5 m Dynergy machine and the Clarkson College/Alcoa/Agway/Niagara Mohawk machine. Blades of larger chords of a similar design are in the planning. It is expected that an 11 in chord blade will be used for the DOE 8 kW machine to be installed at Rocky Flats, Colorado, and a 24 in chord blade for the DOE's low cost 17 m machines. It is believed that within the size limitation of the existing extrusion presses, the all-aluminum single piece extrusion blade represents the most cost-effective blade for the Darrieus type VAWT. (Author)

A79-14292 Alternative energy for domestic hot water - Wind or solar A L Weisbrich (Kaman Aerospace Corp., Bloomfield, Conn) *Wind Technology Journal*, vol 2, Spring-Summer 1978, p 24-31 11 refs

A comparative parametric analysis on energy cost is presented for wind energy conversion systems (WECS) and solar collector systems designed for heating water. An assumption is made that each system type has equal structural interface compatibility for application. Solar collector systems and certain advanced WECS designs are showing good and comparable adaptability and aesthetic interface potential with common structures including buildings. Results of this analysis suggest that selection between these alternative energy systems may be warranted in the future under appropriate circumstances. Results presented may aid a process of selection between solar and wind energy conversion systems for hot water generation at sites with known insolation and wind characteristics and relatively equal structural interface compatibility of either system type. (Author)

A79-14293 Dynamic response of a wind turbine system and its effect on performance T G Porter and D R Lacey (Cornell University, Ithaca, N Y) *Wind Technology Journal*, vol 2, Spring-Summer 1978, p 32-37 11 refs

Presented are results of an analytical study to determine the effects of wind fluctuation frequency and amplitude and turbine/load inertia on system performance. Wind variability was modeled as a steady mean with a superimposed sinusoidally fluctuating component. Amplitude and frequency of fluctuation were varied within typical meteorological limits. The turbine system used for analysis was a vertical axis Cycloturbine mechanically coupled to a fluid agitation heater. System inertias greater than and less than that calculated for this system were explored. Results show increased wind fluctuation frequency, amplitude, and system inertia all

decrease the power coefficient of the system. The significance to operation of wind systems and field testing of turbines is discussed (Author)

A79-14294 Generalized wind characteristics and their effect on wind turbine output. W. C. Cliff (Battelle Pacific Northwest Laboratories, Richland, Wash.) *Wind Technology Journal*, vol 2, Spring-Summer 1978, p 38-44. Contract No. EY-76-C-06-1830

A method is proposed which provides rule-of-thumb curves for estimating wind turbine performance using only the annual mean wind speed as the wind characteristic input. Estimation of wind turbine average power, percent down time, and percent time operating at rated power is discussed. The results are compared with those obtained on the basis of data from 16 sites scattered throughout the United States and Puerto Rico. The comparisons are found to be extremely favorable. The analysis presented is recommended only for locations where the annual mean wind speed at the expected wind turbine hub (center) height is not less than 4.5 m/sec. S D

A79-14295 Generic power performance estimates for wind turbines. C. G. Justus and A. Mikhail (Georgia Institute of Technology, Atlanta, Ga.) *Wind Technology Journal*, vol 2, Spring-Summer 1978, p 45-62. 5 refs. Contract No. EY-76-S-06-2439

The output power curves for a very wide range of wind turbine designs can be represented by two simple expressions - one for constant rpm machines and one for variable rpm machines. Generic methodologies are presented for evaluation of average power output over short periods (e.g., 1 hr) or long periods (e.g., monthly or annual). Both short-period and long-period average results indicate relatively little difference in average output power from variable rpm machines and constant rpm machines with maximum power coefficient at rated speed ($C_{pm} = C_{pr}$). A set of wind turbines covering a wide range of design parameter values have been run through reference wind distributions to evaluate long-term mean power output. The ratio of mean power output to rated power was found to vary significantly with the wind speed ratio, with the power coefficient ratio, and with the variance (Weibull k value) of the wind distribution. No significant variation with the design speed ratio was found. Values of regression coefficients are given which can be used for simple estimation of mean power output for any time period over which the mean wind speed is observed. (Author)

A79-14321 Projecting energy resource utilization - The geothermal case. J. G. Leigh, M. M. Scholl, and R. K. Trehan (Mitre Corp., Metrek Div., McLean, Va.) *Energy (UK)*, vol 3, Aug 1978, p 485-491. 13 refs. Contract No. E(49-18)-2268

This paper presents a simple and systematic approach to deriving energy resource-utilization projections using the geothermal resources as an example. The near-term projections are derived from considerations such as present resource development status and lead times for further development. The long-term projections are founded on experience with conceptually similar industries, size of available resources, and demands on exogenous physical resources and institutional constraints. It is suggested that such first-order analysis is valuable in the energy program-planning process. (Author)

A79-14323 Breakdown of rapid rail energy costs - A study of three systems. M. F. Fels (Princeton University, Princeton, N. J.) *Energy (UK)*, vol 3, Aug 1978, p 507-522. 14 refs. Research supported by the General Motors Corp.

The total energy consumption of three urban rapid rail systems is analyzed to obtain a detailed breakdown of the traction and station contributions. The systems chosen, PATH, PATCO and BART, span a wide range of characteristics representing age, service region and size. The primary data source for the analysis is monthly bills, whose disaggregation determines the ultimate breakdown of the total energy consumption for each system. For one system, traction energy is separated into propulsion and dead-heading contributions, with the result that a large fraction is used to keep the cars 'hot'. For

the same system, station lighting accounts for most of the energy used by the stations, for another, heating can double station energy use during cold weather. For the cold weather systems, total energy consumption correlates well with climatological data. (Author)

A79-14324 Exploring future energy options - An economic analysis. R. G. Richels and R. H. Males (Electric Power Research Institute, Palo Alto, Calif.) *Energy (UK)*, vol 3, Aug 1978, p 523-532. 9 refs.

The paper discusses the economic benefits and optimal timing of new sources of electric energy, with emphasis on those technologies which offer the promise of a nearly inexhaustible electric energy supply - the fast breeder reactor, solar energy, and controlled fusion. Benefits are calculated under varying assumptions concerning capital costs, development lead times, and resource availability. The interdependence between benefits from new technologies is examined. B J

A79-14325 Total energy and labor requirements for an electric commuter railroad. P. S. Penner (Illinois University, Urbana, Ill.) *Energy (UK)*, vol 3, Aug 1978, p 539-542. 18 refs.

Input-output analysis is used to examine an electric commuter railroad operating out of New York City in 1971. The direct and indirect energy costs of propulsion, station operation and rail-plant investments are all computed per passenger-mile of travel. A similar analysis is conducted to determine direct and indirect employment generated per passenger-mile. Results show that, with electricity valued at 11,032 Btu/kWh, commuter rail travel required 9900 Btu and 8.5 millionths of a job per passenger-mile. (Author)

A79-14398 Fuel-cell power plants. A. P. Fickett (Electric Power Research Institute, Palo Alto, Calif.) *Scientific American*, vol 239, Dec 1978, p 70-76

The paper describes fuel cells, which convert the chemical energy of a fuel into electricity directly with no intermediate combustion cycle, and considers the use of fuel cell power plants as a means of generating electricity without emitting pollutants. A fuel cell consists of two electrodes separated by an electrolyte which transmits ions but not electrons, the fuel, usually hydrogen, is supplied to the anode while oxygen in air is supplied to the cathode. The economics of energy demand and of fuel-cell power plants are examined, and it is suggested that fuel-cell systems might be used in the 1980s for handling peak loads and for load following. M L

A79-14400 # Summary of international energy research and development activities 1974-1976. Research supported by the National Science Foundation and Energy Research and Development Administration, NSF Grant No. AER 74-20678, Contract No. EX-77-C-01-2639. Elmsford, N. Y., Pergamon Press, Inc., 1977. 679 p. \$50

Included in the directory is information covering 3017 ongoing and recently completed energy research projects conducted in Canada, Italy, the Federal Republic of Germany, France, The Netherlands, the United Kingdom, Denmark, Sweden, Israel, and 18 other countries. Organic sources of energy are considered, taking into account gas and oil, coal, peat, hydrocarbons, and nonfossil organic sources. Projects related to fission sources and energy production are examined, giving attention to reactor fuels assemblies, fuel management, reactor materials, reactor components, reactor thermodynamics, thermohydraulics, reactor mechanics, reactor safety and control, reactor testing and operations, reactor analysis, reactor and nuclear physics, and uranium exploration and mining. Other projects discussed are in the areas of thermonuclear energy and plasma physics, geophysical energy sources, conversion technology, transport and transmission of energy, energy utilization and conservation, and energy systems. Projects exploring environmental aspects of energy conversion and use are also listed. G R

A79-14452 # On the ion energy balance in TFR with and without neutral injection heating J P Girard (EURATOM and Commissariat à l'Énergie Atomique sur la Fusion, Département de Physique du Plasma et de la Fusion Contrôlée, Fontenay aux-Roses, Hauts-de-Seine, France) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Československa Vedecko Technická Společnost, 1978, p 1-15 17 refs

Consideration is given to the ion energy balance of a tokamak fusion reactor plasma During the ohmic heated and fast neutral injection phases, the expression for ion heat conduction approaches the neoclassical expression in the case of a D plus plasma It is larger by a factor of 2.5 for an H plus plasma A higher value for particle diffusion is also found More careful measurements of electron and ion temperatures up to the plasma boundary are required to determine the presence of an anomalous energy transfer between fast ions and the plasma S C S

A79-14453 # Recent results from the PLT tokamak V Arunasalam, C Barnes, K Bol, D Boyd, K Brau, N Bretz, M Brusati, S Cohen, S Davis, and D Dimock (Princeton University, Princeton, N.J.) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Československa Vedecko Technická Společnost, 1978, p 17-28 11 refs

The paper presents results obtained from the Princeton Large Torus tokamak in the areas of impurity behavior, discharge type, and energy-confinement schemes Low-temperature discharge cleaning has been observed to reduce the amount of oxygen (the principle low-Z impurity) in the device This yields a maximum electron density of 10 to the 14th power/cu cm, a gross energy confinement time of 70 msec, and a transport confinement time of over 85 ms It was found that tungsten concentration is a major consideration in the determination of operating parameters Measurements of ion and electron temperatures have indicated the relation between edge temperature and tungsten concentration Various discharge regimes having similar current and toroidal field values are discussed hollow discharge, peaked m=2 discharge, sawtooth discharge with gas programming, high density helium, a discharge with low-Z contamination It is suggested that edge cooling of the plasma inhibits tungsten influx and yields the development of discharges with 70-msec confinement S C S

A79-14454 # Review of tokamak theory results V D Shafranov (Akademiya Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Československa Vedecko Technická Společnost, 1978, p 29-38 45 refs

Tokamak analytical results are discussed for macroscopically stable plasmas, macroinstabilities, and the problems associated with reactor plasmas Macroscopically stable plasmas are considered with reference to transport phenomena, energy losses due to impurities, the relaxation processes of runaway electrons, HF heating, neutral-atom injection, and the high-beta problem and the evolution of two-dimensional equilibrium Two types of macroinstabilities are outlined internal kink modes and internal local instabilities of the Sydram type Thermonuclear, i.e., reactor plasmas are reviewed noting particle losses and the interaction of the plasma and vessel walls S C S

A79-14455 # Progress in tokamak experimental research in the Soviet Union G A Bobrovskii (Akademiya Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Československa Vedecko Technická Společnost, 1978, p 39-48 17 refs

Soviet tokamak research is discussed with reference to impurities, disruptive instabilities runaway electrons, and additional heating sources It has been found that impurity influx to the column periphery does not lead to impurity accumulations in the central hot regions Impurity accumulation may be prevented by an outward diffusion of ions in higher ionization stages Several disruptive instabilities are identified an internal mode caused by m=1 and m=2 modes, small disruptions, precursors (i.e., small disruptions initiated by m=2 modes at the periphery), and large disruptions It is felt that stabilizing the m=2 mode is central for suppressing disruptive instabilities Helical perturbations (combined with ionization and radiation at high initial pressure) prevents, at initial discharge stages, skin formation This results in increased impurity influx from the walls It is recommended that the existence of suprathreshold electrons be taken into account when measuring electron temperature Frequencies over the lower-hybrid frequency may be applicable to plasma heating in large tokamaks S C S

A79-14456 # Review of results from DITE tokamak J W M Paul, A E Costley, S J Fielding, M J Forrest, R D Gill, J Hugill, G M McCracken, N J Peacock, and P E Stott (EURATOM and UK Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Československa Vedecko Technická Společnost, 1978, p 49-61 12 refs

The behavior of the DITE tokamak is discussed in relation to the origin, effect and control of impurities The beneficial effects of gettering the walls, a cold plasma blanket and the bundle divertor are discussed and plasmas with an effective Z of about 1, zeta about 4, and a total energy confinement time of about 30 ms are described Power balance and transport are considered for three types of discharges, low-Z (oxygen) dominated, high-Z (metal) dominated and high density 'pure' plasmas Neutral injection into the latter produces electron heating and changes the current distribution (Author)

A79-14457 # Experiments on adiabatic compression of a tokamak plasma in Tuman-2 V E Golant (Akademiya Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Československa Vedecko Technická Společnost, 1978, p 63-72 14 refs

The paper presents a review of the results on minor radius compression of a tokamak plasma in the Tuman-2 device (a = 8 cm, R = 40 cm, initial magnetic field = 4 kG, maximum magnetic field = 12 kG, plasma current = 5 kA) The experiments showed an effective compression of plasma column and plasma heating during fast increase of a toroidal magnetic field Oscillations were strongly reduced in compressed column An essential improvement of energy confinement was found The maximum value of plasma pressure corresponded to beta I = 2-2.5 The paper includes also the description of first experiments on the modified Tuman-2A device (Author)

A79-14458 # Ohmic heating experiments in the W VII A stellarator In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Československa Vedecko Technická Společnost, 1978, p 73-92 6 refs

The confinement of plasma in W VII A was studied in the parameter regime initial magnetic field strength 20-35 kG, external transform 0.055-0.23, mean electron number density 5-2.5 x 10 to the 13th power/cu cm, electron temperature 300-700 eV, and ion temperature 150-300 eV In stationary discharges up to 500 ms, energy confinement times from 2 to 10 ms were found Ion temperature profile measurements show asymmetries Particle confinement times are derived from the H-alpha measurements The

stellarator field stabilizes the discharge at $q(a)=2$, where stationary operation is possible (Author)

A79-14459 # Heating and confinement in the CLEO stellarator D W Atkinson, D Bartlett, J Bradley, A N Dellis, S M Hamberger, D J Lees, J B Lister, W Millar, L E Sharp, and P A Shatford (EURATOM and U K Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Ceskoslovenska Vedecko Technicka Spolecnost, 1978, p 93-107 6 refs

Heating and confinement processes in the CLEO stellarator, operating at the full helical winding current and with a maximum toroidal field of 20 kG are reported Particular attention is given to plasma purity and resistance, electron cyclotron emission, and density fluctuations The results suggest the following (1) energy confinement is improved when operating at low ohmic heating currents, (2) the confinement at a given low current improves with increasing magnetic field strength when plasma density and temperature remain constant, (3) confinement is significantly worse for larger drift parameters, (4) the outer density region manifests a variety of fluctuations, (5) the plasma is nearly free of impurities, although resistance varies somewhat for different current and temperature profiles, and (6) confinement is not consistent with the semiempirical pseudo-classical scaling law due to Atkinson et al (1976) SCS

A79-14460 # Ohmic heating experiments in the L-2 stellarator I S Shpigel' (Akademii Nauk SSSR, Fizicheskii Institut, Moscow, USSR) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Ceskoslovenska Vedecko Technicka Spolecnost, 1978, p 109-128 11 refs

The current status of experiments with the L-2 stellarator is outlined and compared to the results of the CLEO and W-7A stellarators The L-2 experiments yield high density plasmas with a mean electron density of 5.20×10^{20} to the 12th power/cm³ Electron temperature is in the 800-200 eV range and ion temperature is in the 60-120 eV range As the current increases from 12 to 22 kA, the energy-confinement central electron temperature changes very slightly This may be explained by assuming that for currents over about 16 kA, the plasma column shrinks due to instabilities in the outer regions This constricts the current channel, increases gas influx from the walls, increases power input, and reduces the total energy confinement time The L-2 plasma temperature and confinement times are attributed to the influence of the poloidal component of the stellarator field SCS

A79-14461 # The mirror machine program in the USA F H Coensgen (California, University, Livermore, Calif) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Ceskoslovenska Vedecko Technicka Spolecnost, 1978, p 129-138 21 refs Contract No W 7405-eng-48

Highlights of the mirror fusion program since July 1975 are reviewed noting the 2X11B stabilization theory, 2X11B field reversed experiments, and the design of the Mirror Fusion Test Facility The US mirror research facilities are listed, noting the primary research taking place at each Attention is given to experimental evidence concerning the drift cyclotron loss-cone (DCLC) instability, means to suppress this instability including the use of electron cyclotron resonant heating of the electrons in the mirror trap, and a quasi-linear theory for the DCLC mode The tandem mirror experiment is described with reference to the development of a potential well between two mirror plasmas, the development of a scalable magnetic geometry, and the investigation of the plug-solenoid combination SCS

A79-14462 # Toroidal high-beta systems C Bobeldijk (EURATOM and Stichting voor Fundamenteel Onderzoek der Materie, Instituut voor Plasmafysica, Jutphaas, Netherlands) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Ceskoslovenska Vedecko Technicka Spolecnost, 1978, p 139-151 33 refs Research supported by the Nederlandse Organisatie voor Zuiver Wetenschappelijk Onderzoek and EURATOM

The Kruskal-Shafranov limit is used to divide toroidal axisymmetric systems, used for the confinement of high beta plasmas, into two categories reversed-field pinches and screw pinches Several existing reversed-field pinch experiments are described noting that in most the minor radius varies from 4 to 7.7 cm, the filling pressure varies from 10 to 100 mtorr, and the rise time varies from 1 to 10 microsec The observed low temperature is attributed to line radiation from impurities This may be improved by reducing impurities to about 0.1% or by a high initial temperature produced by fast compressional ion heating or anomalous resistivity Attention is also given to a series of proposed reverse-field experiments Research associated with screw pinch devices is outlined including the SPICA, STP-2 and 3, and ETL-TPE 1 and 2 projects SCS

A79-14463 # New results in high-beta stellarator and belt-pinch research E Funfer (EURATOM and Max Planck-Institut für Plasmaphysik GmbH, Garching, West Germany) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Ceskoslovenska Vedecko Technicka Spolecnost, 1978, p 153-169 55 refs

The paper discusses the theoretical basis of research associated with high-beta stellarators, including the HBS and Scyllac experiments Results are discussed with reference to helical equilibrium, $m=1$ stabilization, toroidal equilibria, and wall and/or feedback stabilization of the $m=1$ mode Consideration is also given to the finite ion Larmor radius and longtime effects The belt-pinch, representing an axisymmetric high-beta equilibrium, is reviewed including shock heated belt-pinch experiments and results on equilibrium and stability SCS

A79-14464 # Progress in laser-fusion research O N Krokhin (Akademii Nauk SSSR, Fizicheskii Institut, Moscow, USSR) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Ceskoslovenska Vedecko Technicka Spolecnost, 1978, p 171-182

A broad review of laser-fusion research is presented with reference to the development of high power, high-efficiency lasers, high-gain target performance, and fusion and fusion-fission concepts Laser radiation-plasma phenomena are considered noting flux density on targets, absorption, energy transport, and thermodynamic conditioning Numerical modeling of laser-target interactions and of the compression of fuel is discussed and the experimental data obtained on the 9-beam Kalmar device at the Soviet Lebedev Physical Institute are presented Experimental results obtained at the Lawrence Livermore Laboratory for the Argus project are given and compared to simulation parameters Computer simulations of pellet compression are outlined and reasons for the discrepancies observed are suggested SCS

A79-14466 # Generation and applications of high power ion beams to fusion research R N Sudan (Cornell University, Ithaca, N Y) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Ceskoslovenska Vedecko Technicka Spolecnost, 1978, p 191-200 25 refs ERDA-Navy-supported research

Ion diode technology is discussed noting the conditions necessary for the production of ion beams from a diode energized by a

high-power voltage pulse Techniques for generating the required ion-emitting dense plasma are described and two methods of electron-current suppression are noted electron reflexing and magnetic insulation Ion beam extraction and propagation are outlined for two cases propagation in vacuum and propagation across a magnetic field Attention is given to geometric and magnetic ion-beam focusing Potential applications of intense ion beams to fusion research are reviewed including pellet fusion and field-reversed ion rings
S C S

A79-14467 # Present status of two R F heating schemes - ICRH and LHRH T Consoli (EURATOM and Commissariat a l'Energie Atomique, Departement de Physique du Plasma et de la Fusion Contrôlée, Grenoble, France) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Ceskoslovenska Vedecko Technicka Spolecnost, 1978, p 201-216 28 refs

Two heating schemes for toroidal hot plasmas are discussed ion-cyclotron resonant heating (ICRH) and lower-hybrid resonant heating (LHRH) With reference to the LHRH scheme, it is noted that the coupling of a waveguide to a plasma is effective and that a reflection coefficient of 95 percent may be obtained when the Grill solution for launching LHR waves is well matched Ion-cyclotron wave launching and coupling are outlined for toroidal devices, and for the ST and ATC tokamaks For both tokamaks the determination of parallel and perpendicular components of ion temperature by charge-exchange and spectroscopic measurements is possible Disruptive instabilities are attributed to impurity influx, and not to the RF pulse
S C S

A79-14468 # Fusion reactor problems R Carruthers (EURATOM and U K Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England) In European Conference on Controlled Fusion and Plasma Physics, 8th, Prague, Czechoslovakia, September 19-23, 1977, Proceedings Volume 2 - Invited and Supplementary Papers Prague, Ceskoslovenska Vedecko Technicka Spolecnost, 1978, p 217-229 7 refs

Consideration is given to several plasma/engineering interface problems including the theoretical basis of plasma parameters and confinement systems, noting the likelihood of realizing such systems Engineering constraints associated with the power loading of the first wall are presented Control schemes are discussed with reference to trapped-ion mode-loss scaling and radiation from the pulsed injection of impurities Exhaust and refueling requirements are noted and start up procedures are outlined for the case of short energy confinement times
S C S

A79-14676 Annual Conference on Energy, 4th, University of Missouri-Rolla, Rolla, Mo, October 11-13, 1977, Proceedings Volume 4 Conference sponsored by the University of Missouri-Rolla, Missouri Department of Natural Resources, American Petroleum Institute, Ingersoll-Rand Co, and United States Metals Refining Co Edited by J D Morgan (Missouri-Rolla, University, Rolla, Mo) Rolla, Mo, University of Missouri-Rolla, 1978 717 p \$25

Papers are presented on energy conservation with reference to specific industries and on a variety of topics associated with solar energy such as the design of solar arrays, estimating hourly levels of solar radiation, and a solar energy system for space heating and cooling Attention is given to the industrial regulation of energy conservation systems and to bioconversion, noting forest residues as an energy source and energy farming A strategy for using nuclear power is presented and aspects of consumer energy management are suggested Consideration is given to the political and social implications of energy conservation programs and to energy pricing strategies Solar and wind energy resources are described with reference to programs in Missouri, Oklahoma, and Montana
S C S

A79-14677 # Design optimization for solar array of multiple collector types J O Bradley (Desert Research Institute, Boulder

City, Nev), D Posner, and C E Bingham (Solar Energy Research Institute, Golden, Colo) In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings
Rolla, Mo, University of Missouri-Rolla, 1978, p 25-37

Methodology is presented for optimizing solar arrays used for heating fluids from ambient to elevated temperatures The optimal array consists of the appropriate combination of available collector types which delivers the most energy per dollar invested in the array An example optimization is presented and verified using computer simulation of numerous combinations of collector types (Author)

A79 14678 # Estimating hourly solar radiation for one-axis tracking focusing collectors C E Bingham D M Posner (Solar Energy Research Institute, Golden, Colo), and J O Bradley (Desert Research Institute, Boulder City, Nev) In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 38-45 13 refs

A procedure is reported for converting the hourly values of total radiation on a horizontal surface (data available from the National Oceanographic and Atmospheric Administration) into a value for the direct radiation on the surface of a tracking collector The procedure consists of (1) estimating the horizontal beam component from hourly total horizontal data, (2) calculating the direct-normal radiation from the horizontal beam radiation, and (3) deriving beam radiation on the collector surface as a function of collector orientation Methods are also given for calculating the affected area as a function of collector geometry and solar position It is noted that the annual distribution of radiation is influenced by orientation, and different orientations are thus suited to different processes having various seasonal load profiles
S C S

A79-14679 # Coal gasification and its alternatives R L Huffman (Cities Service Gas Co, Oklahoma City, Okla) In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 46-55 7 refs

The paper discusses six groups planning Lurgi coal gasification plants with capacities of about 250 MMCFD of synthetic gas The present efficiencies and costs of natural gas and electricity are given in terms of production efficiency, transmission and distribution, and delivered energy efficiency Estimates of the cost of space heating and cooling equipment are presented for a typical home having 1,800 square feet of living space In contrast to nuclear energy, it is shown that coal has direct applications to industry, for the generation of electric power, and for the production of synthetic fuels It is demonstrated that synthetic gas from coal is less costly and more efficient than electricity made from the same coal from the point of view of the residential consumer
S C S

A79 14681 # Current state-of-the-art of electrochemical batteries from a users point of view J G Wolter, J A Gilbert, and J V Leonard (McDonnell Douglas Corp, St Louis, Mo) In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 64-70 11 refs

Several batteries are described in terms of design, operating characteristics, and applications The batteries include lead acid, zinc-air, silver oxide-zinc, lithium systems, and nickel-cadmium batteries Each type is further discussed as to its availability status It is noted that only limited activity of electric vehicles will be available in the near future (Author)

A79-14682 # Assessing environmental costs of energy procurement R G Alderfer (Harland Bartholomew and Associates, St Louis, Mo) In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 79-84

The paper describes an ecological approach to the assessment of environmental impact and associated costs of all major phases of energy procurement The approach is based on identification of

services performed and benefits offered by natural and modified ecosystems and requires that energy procurement activities be analyzed in terms of their impact on these services and benefits. A thorough cost assessment (including quantitative and qualitative factors) of alternate energy plans will aid both the selection of the most desirable alternate and the reduction of unforeseen costs and problems during and after construction. (Author)

A79-14683 # Life cycle costing of energy systems W R Baker (Wisconsin, University, Madison, Wis.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 108-114

Life-cycle costing is used to compute the total cost of possessing an energy system over the entire time span of ownership. It combines the initial purchase price with future anticipated expenses. Two methods are used for life-cycle cost analysis: the computation of the total present worth cost or the conversion of all costs to a series of end-of-year dollar amounts. Values are given for costs of corporate ownership for two systems noting the discounted yearly cash flow. SCS

A79-14684 # A methodology for evaluating the effectiveness of energy conservation programs H M Eckerlin (North Carolina State University, Raleigh, N.C.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 168-173

With increasing federal emphasis on energy and its conservation, programs to conserve energy are being proposed at all levels of industry, commerce, and government. Many of these programs promise results that can never be realized. This paper describes an operational methodology for estimating and measuring energy savings for these energy conservation programs. The assumptions and qualifications which form the basis of the methodology are discussed, and some techniques for interfacing the methodology with a company's energy conservation program are presented. (Author)

A79-14685 # A survey of energy information systems and its implications for industrial energy management Y Omurtag, H H Sineath, and H A Wiebe (Missouri-Rolla, University, Rolla, Mo.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 181-186

There is a need for state governments to prepare better strategic plans dealing with the use of their energy resources. These plans must be based on reliable information concerning energy resources and usage if they are to make a contribution to sound energy management. This paper presents the results of a survey which was conducted during 1976 and 1977 to determine the availability of comprehensive energy information systems for planning and controlling the state-wide energy related activities in the United States. (Author)

A79-14686 # A solar energy system for space heating and space cooling T J McNamara (V A Scavo and Associates, Chicago, Ill.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 187-196

The paper discusses a retrofit space heating and cooling solar energy system planned for the Museum of Science and Industry in Chicago, Illinois. The installation, designed to provide 50% of the Museum's energy requirements, is regulated by two separate free-standing control panels. The heating of air is effected by hot-water heating coils, cooling is effected by circulating chilled water from the absorption unit to cooling coils. The structural support can withstand 100 mph wind speeds and 13 lbs/sq ft snow loads. The collector array has 442 collector units arranged in 13 rows. The installation is designed for a 45-degree plane with the horizontal which yields the most efficient energy collection throughout the year. (Author)

A79-14687 # Barriers and incentives to the commercialization of solar heating and cooling of buildings D R Costello and D M Posner (Solar Energy Research Institute, Golden, Colo.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 197-205 13 refs

The paper reviews potential barriers to the widespread use of solar heating and cooling systems in residential and commercial buildings. Although solar systems have been technologically proven and are used to a limited extent today, economic, institutional, and legal barriers may slow future commercialization. Consideration of incentives which might reduce these barriers raises the question of how to evaluate alternative policy question options. (Author)

A79-14688 # The National Program for Solar Energy K Davidson, R J Gariboldi, and J J Purcell (U.S. Department of Energy, Chicago, Ill.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 206-210

The paper presents a survey of the National Program for Solar Energy as established by the Solar Energy Research Development Demonstration Act in 1974. Consideration is also given to the National Program for Solar Heating and Cooling of Buildings, founded in conjunction with HUD, NASA, DOD, and NBS. Procedures for the collection and evaluation of data to a wide range of users and commercial building demonstrations are outlined. Applications in industry, on farms, and projects associated with photovoltaic energy systems, wind energy, ocean thermal energy conversion, and passive solar heating are briefly noted. SCS

A79-14689 # Forest residues as an alternate energy source J G Riley and N Smith (Maine, University, Orono, Me.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 211-220 9 refs

Forest residues, in combination with more intensified timber production systems have potential as a substantial source of fuel wood. The extent and availability of this resource is discussed, with particular reference to the energetics and economics of existing and proposed harvesting systems. Utilization of residue wood fuels is considered and recent developments in small scale automatic wood chip burning heating systems for residential and commercial use are described. (Author)

A79-14690 # Steam raising with low-Btu gas generators and potential for other applications R O Williams, J R Goss (California, University, Davis, Calif.), B C Horsfield (Weyerhaeuser Co, Tacoma, Wash.), and R Hodam (California Energy Resources and Development Commission, Calif.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 221-229 9 refs

A pilot plant gas producer was installed at a Walnut processing plant to recover usable energy from cracked walnut shell. The shell was converted to a low-Btu fuel gas (producer gas) and this was used to replace natural gas in a steam boiler. Long-term continuous operation of the producer has yet to be achieved due to mechanical inadequacies of the fuel feed and grate systems. These problems are a result of special fuel characteristics of walnut shell, which are being further investigated on a laboratory scale gasifier. It is expected that component changes and/or fuel preparation can facilitate satisfactory long term operation. (Author)

A79-14691 # Economic optimization of heatpump assisted solar heating in Illinois A Shams and E A Mass (Center for the Biology of Natural Systems, St. Louis, Mo.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 258-269

This study undertakes the task of determining the optimal mix of solar and heat pump forms of heating. By installing a solar heating system a homeowner is considered to be an energy producer and thus

to apply the least cost methods used by firms in the competitive market for any given level of fuel conservation. The study will examine the simulated performances of air and liquid circulating systems in conjunction with heat pumps, in parallel as well as combined fashion. Optimization is achieved by equating the present value of the cost of solar and heat pump heating systems at margin (Author)

A79-14692 # Comparison of nuclear and coal power plants using Net Energy Analysis N Tsoufanidis and G Suwal (Missouri-Rolla, University, Rolla, Mo). In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 288-296 14 refs

Net Energy Analysis has been used to compare coal and nuclear power plants. Net Energy Analysis is a method by which a system is studied in terms of the energy needed to construct and operate every unit or item associated with that system, its effects to the environment and the energy produced by the system. The results of the comparison are expressed as the ratio of the total energy output divided by the total energy input (Author)

A79-14693 # Federal automobile fuel economy standards A status report S R Scheiner (National Highway Traffic Safety Administration, Washington, D C). In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 347-357

On the basis of the Energy Policy and Conservation Act, established in December, 1975, consideration is given to passenger car fuel economy standards for model years beginning in 1981. The standards are based on a variety of factors including reductions in acceleration capability, weight reduction, improved lubricants, and the application of diesel and other engine types. The impact of the standards on consumers and retailers is discussed, noting that a significant reduction in the need to import oil will be effected. S C S

A79-14694 # Residential energy design C E Dorgan (Wisconsin, University, Madison, Wis). In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 393-401

The paper considers cost-effective procedures for improving the energy design of residences. The energy efficiency of existing homes is evaluated, and the energy saved following onsite modification of a standard pre-cut home is reported for surfaces, doors, and windows. Energy usage of sample homes is described, the economics of some basic energy design improvements are examined, and a checklist of home features that affect energy requirements is presented. M L

A79-14695 # Heat pumps without supplemental heat C W Glaser (Union Electric Co., Special Projects Div., St. Louis, Mo). In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 402-408

The fact that heat pumps reduce the cost of heating by 30 to 50% over conventional electric resistance heating and that natural gas is not available in many parts of the country has resulted in more and more heat pumps being installed in homes. While the benefits to the user are sufficient to economically justify the added cost of installing the heat pump system, it can be a long term disaster for an electric utility with a winter peak. One solution is the development of a heat pump system used in conjunction with thermal storage that will limit the demand for electricity during periods of extremely cold weather to the requirements of the heat pump only. There would be no supplemental electric heating installed in the system. The present paper illustrates the feasibility of such a system. B J.

A79-14696 # Building energy standards and codes C E Dorgan (Wisconsin, University, Madison, Wis). In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 409-415, 417, 418

Steps necessary to reduce energy consumption are reviewed. These steps are (1) increase fuel unit cost, (2) allocate or limit to each user by need, (3) require energy expending sinks (engines, buildings, boilers, heating/cooling systems, etc.) to be more efficient by appropriate energy standards and codes, and (4) change in life style. Only step 3 is discussed in some detail, with special emphasis on its application to buildings. Performance, budget, and prescriptive standards are examined. S D

A79-14697 # Heat recovery devices for building HVAC systems R H Howell and H J Sauer (Missouri-Rolla, University, Rolla, Mo). In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 419-426

The opportunities and advantages of air-to-air heat recovery are described. The five basic types (rotary regenerative, coil loop run-around, open run-around, heat pipe, and plate type) are described and their typical performance is presented. The potential savings in operating costs as well as initial equipment costs for common applications are presented. (Author)

A79-14698 # Recovery of oil from oil shale - An overall technological perspective A Ahmad (Owens-Corning Fiberglass Technical Center, Granville, Ohio) and S Hasan (Control Data Corp., Houston, Tex). In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 437-441 19 refs

The hydrocarbon content of oil shale can be converted into liquid oil which is a possible energy resource for the future. Different aspects of shale oil recovery are briefly discussed. The technology of modified in situ oil shale retorting, which is receiving increasing attention for commercialization, is discussed in a little more detail. (Author)

A79-14699 # Development of industrial owned, small hydroelectric facilities J S Krikorian, Jr (Rhode Island, University, Kingston, R I). In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 451-460 13 refs. Research supported by the New England Regional Commission, Rhode Island Governor's Energy Office, and University of Rhode Island

A methodology is discussed for determining the economic feasibility of reclaiming industrial owned, small hydroelectric facilities. A cash flow computer model provides the means for coping with many of the diverse inputs that occur at different sites. A detailed case study is presented. Some institutional factors that aid or hinder development are discussed. (Author)

A79-14701 # Quantification of energy resource consumption W J Coad (Charles J R McClure and Associates, Washington University, St. Louis, Mo). In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 523-529

This paper addresses the fundamental issue of energy conservation in exploring the question - what is to be conserved. Following a brief chronology of the situation leading to the present day concerns regarding the energy intensity of our economy, the role of the engineering community in addressing solutions is discussed. The conclusion developed is that the engineering disciplines must assume the lead in channeling energy conservation efforts toward the salient goal of reducing excessive use of energy resource matter. (Author)

A79-14702 # Airfoil data for use of wind turbine designers M H Snyder (Wichita State University, Wichita, Kan). In Annual Conference on Energy, 4th, Rolla, Mo, October 11-13, 1977, Proceedings Rolla, Mo, University of Missouri-Rolla, 1978, p 578-587

A79-14703

This paper reviews design procedures for wind-axis turbine rotors. An 'on-design' routine for rotor blade design is presented as well as an 'off-design' performance calculation program. Resulting from this review are analyses of desirable characteristics of airfoil sections and of types of data which rotor designers need. Included in the paper are airfoil characteristics for candidate blade sections including 360 degree data for GA(W)-1 and GA(W)-2 airfoils.

(Author)

A79-14703 # A small horizontal axis wind turbine feeding power into the utility grid G C Thomann, M Jong, and M H Snyder (Wichita State University, Wichita, Kan.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 588-602

The paper discusses a small, horizontal-axis wind turbine which has a 2-kW power output from an 18-ft-diam rotor set to rotate from 75-180 rmp and a GA(W)-1-blade airfoil. The rotor is built from sitka spruce mounted on a commercially available propeller-hub system. The rotor speed is stepped up to 1800-3600 rpm by a chain drive and a helical drive system and drives a generator connected to the utility grid. Future improvements will aim at adding an induction mode to the presently available synchronous mode, installing an automatic data recording system, and integrating a microprocessor automatic control system.

S C S

A79-14704 # A systems study of our energy problems S C Lee (Missouri Rolla, University, Rolla, Mo.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 623-635 22 refs

A variety of alternatives associated with the diminishing supply of petroleum and natural gas is presented including (1) nuclear energy generated by fission or fusion, (2) fossil fuel such as petroleum and natural gas, coal, subbituminous coal, lignite, shale, oil, and tar, and (3) renewable resources including hydroelectric power, biomass fuels, solar energy, wind power, geothermal energy, and ocean energy. Approaches to energy conservation are noted with reference to increased use of mass transit facilities, building insulation, and the further development of renewable energy sources.

S C S

A79-14705 # Low head power generation with bulb turbines J L Carson and R S Samuelson (International Engineering Co., Inc., San Francisco, Calif.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 673-682

It is shown that axial turbines, such as bulb systems, provide an efficient and economical means for supplying power at very low-head hydroelectric installations. Particularly for installations having net operating heads less than 60 feet, bulb turbines have significant advantages over vertical-shaft Kaplan turbines. These advantages include lower machinery costs, construction savings, runner accessibility, reduced costs for civil engineering features, and low profiles adaptable to installations under spillways or weirs. The installation of bulb turbines is considered from an economic point of view for Idaho Falls and Ohio River projects in Vanceburg, Kentucky.

S C S

A79-14706 # Economics and net energy analysis - Is a new analytical technique needed for energy decision making W J Kravant (General Accounting Office, Washington, D C.) In Annual Conference on Energy, 4th, Rolla, Mo., October 11-13, 1977, Proceedings Rolla, Mo., University of Missouri-Rolla, 1978, p 683-693 32 refs

The paper compares how net energy analysis (NEA) and economics, the technique traditionally associated with allocation, address allocation questions, where allocation is the core of the energy problem. The principal properties of NEA concern system boundaries, aggregation across fuels, estimating external effects,

estimating human labor and estimating time involved. It is shown that NEA does not, and probably cannot, give reasonable answers to allocation questions. At present, the costs of studying energy problems by means of NEA probably outweigh the benefits such studies produce, so that NEA can play only a minor role in energy policy formulation and evaluation.

S D

A79-14718 Annual review of energy Volume 3 Edited by J M Hollander (California, University, Berkeley, Calif.), M K Simmons (Solar Energy Research Institute, Golden, Colo.), and D O Wood (MIT, Cambridge, Mass.) Palo Alto, Calif., Annual Reviews, Inc., 1978 550 p \$17

Wind, waves, and tides are considered along with energy as it relates to the quality and style of life, passive solar design, energy technologies and natural environments, alternative breeder reactor technologies, a progress report concerning the efforts of industry to save energy, and international variations in energy use. Attention is also given to the evolution of the nuclear debate, industrial cogeneration, proliferation resistant nuclear fuel cycles, the environmental impacts of industrial energy systems in the coastal zone, soft energy technologies, and aggregate energy, efficiency, and productivity measurement.

G R

A79-14719 Wind, waves, and tides M F Merriam (California, University, Berkeley, Calif.) In Annual review of energy Volume 3 Palo Alto, Calif., Annual Reviews, Inc., 1978, p 29-56 56 refs

Wind, waves, and tides are of interest today as possible future energy sources primarily because of their nondepletable character and their favorable environmental aspect, in comparison with energy technologies presently in use. Studies comparing the cost of energy often have difficulties making a case for immediate economic viability of the renewable sources. If, however, oil and gas resources of the world do in fact become progressively and substantially depleted over the next 25 years, price increases and shortages will ensue and implementation of presently uneconomic alternatives will occur on a large scale. A review is presented of the present state of knowledge and experience with wind, wave, and tidal energy. The power density in the wind may, at a good site, average some hundreds of watts per square meter. Wave power being transported across a plane perpendicular to the wave propagation direction, at a good site, is from 10-100 times as large. Questions concerning the value of energy from an intermittent source are also considered.

G R

A79-14720 Passive solar design B N Anderson and C J Michal (Total Environmental Action, Inc., Harrisville, N H.) In Annual review of energy Volume 3 Palo Alto, Calif., Annual Reviews, Inc., 1978, p 57 100 11 refs

The use of the term 'passive' was introduced several years ago to describe those methods of employing solar energy that do not use mechanical power but instead use natural energy flows for the transfer of thermal energy into, out of, and through a building. Passive solar systems in the social context are examined and a description of the major passive systems is presented. These systems are related to the direct admission of sunlight into the space to be heated, the employment of convective loops utilizing an absorber surface remote from the building space to absorb incidental radiation, the use of thermal storage walls, attached greenhouses, a utilization of various forms of heat storage, and approaches of heat transfer control. Attention is given to domestic hot water heating, thermosiphoning air collectors, specific designs involving passive schemes, Trombe walls, solar roof ponds, and cost and energy data regarding thermosiphoning air panels.

G R

A79-14721 Energy technologies and natural environments - The search for compatibility J Harte and A Jassby (California, University, Berkeley, Calif.) In Annual review of energy Volume 3 Palo Alto, Calif., Annual Reviews, Inc., 1978, p 101 146 123 refs

An investigation is conducted regarding the impact which present and future energy activities will have upon ecosystems. An overview of the major energy activities is presented, taking into account hydropower, solar space heating and cooling, biomass conversion, wind conversion, the solar central receiver system, ocean thermal conversion, geothermal conversion, surface mining of coal, deep mining of coal, the cooling requirements of electric generating plants, the combustion of fossil fuels, petroleum in the environment, the nuclear fuel cycle, oil shale mining and conversion, energy conversion, and cross technology comparisons. It is found that the various energy sources and technologies differ greatly in the type and degree of ecological risk they pose to nature and to society. The solar technologies, with some important exceptions, are relatively benign. Others such as oil shale and coal conversion to synthetic fuels and hydroelectric power can generate quite serious impacts on eco systems. G R

A79-14722 Environmental impacts of industrial energy systems in the coastal zone C A S Hall (Cornell University, Ithaca, N Y), Woods Hole Oceanographic Institution, Woods Hole, Mass.), R Howarth (Woods Hole Oceanographic Institution, Woods Hole, Mass.), B Moore, III (Woods Hole Oceanographic Institution, Woods Hole, Mass., New Hampshire, University, Durham, N H), and C J Vorosmarty (New Hampshire, University, Durham, N H) In Annual review of energy Volume 3 Palo Alto, Calif., Annual Reviews, Inc., 1978, p 395-475 673 refs. Research supported by the Leslie F and Lola Hubbart Fund and Woods Hole Oceanographic Institution.

The presented review has the primary objective to provide a clear and meaningful picture of the major issues, which merit critical public evaluation, by characterizing the environmental problems associated with construction and operation of energy facilities in the coastal zone, and by describing some attempts at 'solving' them. Attention is given to oil and electricity systems since they provide, by far, the most important and potentially serious direct environmental impositions on the coastal zone. The review shows that the coastal regions of the U S are relatively rare, biologically important, and vulnerable to anthropogenic perturbation. The coastal zone has been and will probably continue to be important in the industrial development of the nation. The placement of energy facilities there generates environmental impacts and creates conflicts in the utilization of the U S coastal resources. G R

A79-14726 Seminar on Geothermal Energy, 1st, Brussels, Belgium, December 6-8, 1977, Proceedings Volumes 1 & 2 Seminar sponsored by the Commission of the European Communities. Luxembourg, Commission of the European Communities, 1977. Vol 1, 390 p, vol 2, 355 p. In English, French, and Italian. Price of two volumes, \$38.75.

Papers are presented on geothermal survey methods, geophysical methods of geothermal investigation, geochemistry, low enthalpy resources, and high enthalpy resources and hot dry rocks. Particular consideration is given to such topics as shallow magmatic reservoirs as a heat source of geothermal systems, geothermal surveying in France, Denmark, Netherlands, and the United Kingdom, geomagnetic anomalies in geothermal areas, optimal uses of geothermal waters for home heating in Europe, and well testing in two-phase geothermal wells. B J

A79-14727 Shallow magmatic reservoirs as heat source of geothermal systems - Preliminary interpretation of data available for the Neapolitan active volcanic areas. F Barberi, F Innocenti (Pisa, Università, Pisa, Italy), G Luongo (Osservatorio Vesuviano, Naples, Italy), C Nunziata, and A Rapolla (Napoli, Università, Naples, Italy) In Seminar on Geothermal Energy, 1st, Brussels, Belgium, December 6-8, 1977, Proceedings Volume 1. Luxembourg, Commission of the European Communities, 1977, p 19-37 16 refs.

A79-14732 Magnetotelluric and geoelectric measurements for geothermal exploration in the Phlegraean Fields /preliminary results/ G Musmann, U Hunsche, J Duske, and W Kertz (Braunschweig, Technische Universität, Braunschweig, West Germany) In Seminar on Geothermal Energy, 1st, Brussels, Belgium, December 6-8, 1977, Proceedings Volume 1. Luxembourg, Commission of the European Communities, 1977, p 217-239 7 refs. Research supported by the Commission of the European Communities and Bundesministerium für Forschung und Technologie.

A79-14734 Improvement of direct-current electrical prospecting methods for the geothermal investigation of the Rhine Graben (Amélioration des méthodes de prospection électrique en courant continu pour l'étude géothermique du Fosse Rhenan) R Horn (Bureau de Recherches Géologiques et Minières, Orleans, France) In Seminar on Geothermal Energy, 1st, Brussels, Belgium, December 6-8, 1977, Proceedings Volume 1. Luxembourg, Commission of the European Communities, 1977, p 321-337 6 refs. In French.

Two major difficulties are associated with electrical prospecting methods for the investigation of geothermal resources: (1) the great depths of geothermal reservoirs, which implies very long lines when using Schlumberger soundings, and (2) the high conductivity of geological formations which results in the measurement of low level signals which are difficult to detect in industrial areas because of the high noise levels. In an effort to solve these problems, a study has been carried out to: (1) adapt a minicomputer system to improve the SNR by stacking and utilizing FFT computations, and (2) to investigate the utilization of various electrode arrays (especially dipole arrays) which result in better outputs for deep exploration soundings. The equipment has been tested on a well-known geothermal anomaly in the Rhine Graben. B J

A79-14736 Study of the applicability of the geochemistry of gases in geothermal prospecting F D'Amore (CNR, Istituto Internazionale per la Ricerca Geotermica, Pisa, Italy) In Seminar on Geothermal Energy, 1st, Brussels, Belgium, December 6-8, 1977, Proceedings Volume 2. Luxembourg, Commission of the European Communities, 1977, p 441-453 12 refs.

A79-14737 Suggestions for a geochemical prospecting of geothermal systems - A first survey of the Italian thermal springs C Panichi (CNR, Istituto Internazionale per la Ricerca Geotermica, Pisa, Italy) In Seminar on Geothermal Energy, 1st, Brussels, Belgium, December 6-8, 1977, Proceedings Volume 2. Luxembourg, Commission of the European Communities, 1977, p 469-480 8 refs.

A79-14739 Investigation of the optimal use of geothermal waters for the heating of several types of dwelling in various European climates D Lamethe (Electricité de France, Direction des Etudes et Recherches, Chatou, Yvelines, France) and G Laurent (Infratel, Villemonble, Seine-Saint-Denis, France) In Seminar on Geothermal Energy, 1st, Brussels, Belgium, December 6-8, 1977, Proceedings Volume 2. Luxembourg, Commission of the European Communities, 1977, p 559-570. In French.

A79-14740 Preliminary results of the new geothermal domestic heating system at Creil P Jéud (Electricité de France, Direction des Etudes et Recherches, Chatou, Yvelines, France) In Seminar on Geothermal Energy, 1st, Brussels, Belgium, December 6-8, 1977, Proceedings Volume 2. Luxembourg, Commission of the European Communities, 1977, p 571-580. In French.

The geothermal residential heating system designed in Creil, France is discussed with reference to the results obtained during the 1976-1977 winter season. The heating system consists of three plane collectors, three heat pumps connected in series, and a system of traditional boilers. Estimates are made for energy consumptions, comparing geothermal heating (using collectors alone or in conjunction with heat pumps) to conventional methods. S C S

A79-14741 Design study of a thermohydraulic loop for the conversion of geothermal energy/low enthalpy/ into electricity D Borgese (Ente Nazionale per l'Energia Elettrica, Rome, Italy) In Seminar on Geothermal Energy, 1st, Brussels, Belgium, December 6-8, 1977, Proceedings Volume 2 Luxembourg, Commission of the European Communities, 1977, p 581-589 In Italian

The paper describes a low-enthalpy thermogravimetric system capable of supplying 25 kW of power A thermogravimetric pilot plant is being constructed at the ENEL power station at Castelnuovo Valecino The design and principle of operation of the system are discussed with reference to the parameters of four system cycles (1) the Freon cycle, (2) the process water cycle, (3) the geothermal vapor cycle, and (4) the cooling water cycle Consideration is also given to construction materials and basic hydraulic components Basic technical diagrams are presented B J

A79-14744 Study of acoustic and microseismic emissions associated with a hydraulic fracture F H Cornet (Paris VI, Universite, Paris, France) In Seminar on Geothermal Energy, 1st, Brussels, Belgium, December 6-8, 1977, Proceedings Volume 2 Luxembourg, Commission of the European Communities, 1977, p 685-691 8 refs

A numerical model has been used to evaluate acoustic and microseismic emissions associated with a hydraulic fracture The model is based on a displacement discontinuity technique (Crouch, 1976) and a critical strain energy release rate fracture criterion (Irwin, 1957) Exact solutions for the displacements and stresses in an infinite or semiinfinite medium, resulting from normal or tangential uniform displacements, are found The solutions are applicable to any boundary value problem The model applies only to perfectly brittle linearly elastic materials Kinetic energy is not taken into account Laboratory tests, conducted to verify the numerical results, have indicated that during hydraulic fracturing, acoustic and microseismic signals are generated, having their source at the fracture tip, in the fluid flow through the pipes, or in the fracture itself A planned hydraulic fracture experiment is outlined C S C

A79-14757 The oxidation of sulfur dioxide to sulfate aerosols in the plume of a coal-fired power plant J F Meagher, L Stockburger, E M Bailey, and O Huff (Tennessee Valley Authority, Muscle Shoals, Ala) *Atmospheric Environment*, vol 12, no 11, 1978, p 2197-2203 16 refs Research supported by the Tennessee Valley Authority and U S Environmental Protection Agency

A79-14760 Miami International Conference on Alternative Energy Sources, Miami Beach, Fla, December 5-7, 1977, Proceedings of Condensed Papers Conference sponsored by the U S Department of Energy and University of Miami Edited by T N Veziroglu (Miami, University, Coral Gables, Fla) Coral Gables, Fla, University of Miami, 1978 954 p \$50

Consideration is given to such areas as solar energy economics, solar collectors, ocean thermal energy conversion, coal conversion, geothermal energy, nuclear breeders, and fusion power Papers are also presented in such fields as power generation and transportation, hydrogen energy, solar heating and cooling, energy transmission, bioconversion, energy conservation, photovoltaics, heat storage and transfer, wind energy, and synthetic fuels B J

A79-14761 # Results of a tilt-tilt low profile heliostat test program G L Brown (Honeywell, Inc, St Petersburg, Fla) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla, December 5-7, 1977, Proceedings of Condensed Papers Coral Gables, Fla, University of Miami, 1978, p 231-234

The paper describes a test program which evaluated the performance of four prototype heliostats to be used for electric power generation Emphasis is placed on a description of the hardware, the critical performance requirements, the tests methods

used, and the results obtained Particular consideration is given to (1) demonstration of the open loop tracking accuracy, (2) demonstration of the optical characteristics of the mirror modules along with system flux intensity distributions, and (3) environmental effects on both daily performance and survivability, with wind forces being of primary concern B J

A79-14762 # Historical developments of the use of solar energy for pumping irrigation water J T Pytlinski (Kansas State University of Agriculture and Applied Science, Manhattan, Kan) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla, December 5-7, 1977, Proceedings of Condensed Papers Coral Gables, Fla, University of Miami, 1978, p 449-460 37 refs

A79-14763 # Basic technical and economical aspects of the use of solar energy for pumping irrigation water J T Pytlinski and N D Eckhoff (Kansas State University of Agriculture and Applied Science, Manhattan, Kan) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla, December 5-7, 1977, Proceedings of Condensed Papers Coral Gables, Fla, University of Miami, 1978, p 461-469 10 refs US Department of Agriculture Contract No WA-76-4277

After a brief review of the principles of solar energy conversion, the paper presents cost-evaluation results for eight solar irrigation systems distributed into four basic options (prototype units) Cost projections for solar systems, performed on the basis of an evaluation only of the major system elements, are compared to costs for a conventional diesel engine B J

A79-14764 # Solar energy - Past and present developments J T Pytlinski (Kansas State University of Agriculture and Applied Science, Manhattan, Kan) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla, December 5-7, 1977, Proceedings of Condensed Papers Coral Gables, Fla, University of Miami, 1978, p 611-622 38 refs

A historical review of solar energy utilization is presented, with consideration given to the work of Archimedes, Lavoisier's solar furnace, Mouchot's solar steam engine, Ericsson's Stirling type solar engine, and Goddard's solar devices Attention is also given to more recent achievements in solar energy, including the Odeillo solar furnace, the solar irrigation plant in Willard, New Mexico, and the solar power plant in Albuquerque, New Mexico B J

A79-14765 * # Calibration standards and field instruments for the precision measurement of insolation M S Reid and C M Berdahl (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla, December 5-7, 1977, Proceedings of Condensed Papers Coral Gables, Fla, University of Miami, 1978, p 643-645 5 refs Contract No NAS7-100

The paper describes the development of an absolute calibration standard for irradiance measurements This field instrument, designated the Kendall Radiometer System Mark 3, is identical to the PACRAD (Primary Absolute Cavity Radiometer) except for a modification to ensure all weather operation Two Mark 3 radiometers have been in operation at the JPL's Goldstone Deep Space Communications Complex for over two years and are continuing to provide data which are within plus or minus 1% of the absolute value A calibration stability analysis is presented for the two instruments B J

A79-14766 * # A probabilistic model of insolation for the Mojave desert-area O V Hester and M S Reid (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla, December 5-7, 1977, Proceedings of Condensed Papers Coral Gables, Fla, University of Miami, 1978, p 649-651 5 refs Contract No NAS7-100

A preliminary solar model has been developed for the area around the JPL's Goldstone Space Communications Complex The

model has the capability of producing any or all of the following outputs (1) a clear sky theoretical amount of radiation, (2) solar radiation for clear sky, cloudy sky or partially clear sky depending on certain probabilistic parameters, and (3) an array of average solar energy reception rates (solar intensities) in kW/sq m for a specified length of time. This model is based on the ASHRAE clear day model, which is modulated by the effects of clouds. The distribution of clouds for any given time is determined by the combination of statistical procedures, measured insolation values over a six-months period, and a data bank of 19 years of cloud cover information. B J

A79-14767 # Partial energy supply to electric vehicles through solar cell system. K S Varde (Michigan, University, Dearborn, Mich.) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., December 5-7, 1977, Proceedings of Condensed Papers. Coral Gables, Fla., University of Miami, 1978, p 657-659

The paper evaluates the feasibility of incorporating a solar cell system into an electric vehicle. The cell system would supply auxiliary energy to the vehicle batteries during a driving mode and when the vehicle is at rest. The specific case considered is that of an utility car with limited capabilities (carrying two passengers at a maximum speed of 80 km/hr) and to be used primarily in urban driving conditions. It is shown that the cost of such a system is prohibitive. B J

A79-14768 # Analysis of wind turbine generator rotor response to one-dimensional turbulence. W Frost (Tennessee, University, Tullahoma, Tenn.) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., December 5-7, 1977, Proceedings of Condensed Papers. Coral Gables, Fla., University of Miami, 1978, p 683-690. 12 refs

The problem of analyzing the response of a wind turbine generator to the turbulent atmosphere is considered as one of analyzing the rotational fluctuations of a simple rigid rotor to one-dimensional turbulence. Three models of turbulence are employed: (1) the spectral approach, (2) the discrete gust method, and (3) the turbulence simulation method. These three methods are applied to a simple unloaded constant lift/drag rigid rotor and compared in terms of their effectiveness in determining rotational fluctuation about an imposed constant angular rotation. B J

A79-14769 # Conservation as an energy source. J A Belding (US Department of Energy, Div of Conservation Research and Technology, Washington, D C.) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., December 5-7, 1977, Proceedings of Condensed Papers. Coral Gables, Fla., University of Miami, 1978, p 731-735

After a brief discussion of the transition to alternative fuels (coal, nuclear, and solar), the paper considers conservation through the development of economically attractive energy-efficient technologies. These include cogeneration, waste heat utilization, and fuel-efficient equipment. B J

A79-14770 # Toroidal accelerator rotor platforms for wind energy conversion. A L Weisbrich (Kaman Aerospace Corp., Bloomfield, Conn.) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., December 5-7, 1977, Proceedings of Condensed Papers. Coral Gables, Fla., University of Miami, 1978, p 799-806. 7 refs

The Toroidal Accelerator Rotor Platform (TARP) wind energy conversion system shows applicability and adaptability to a wide range of structures and environments, yielding improved economics and energy cost. Specifically, cost reductions are anticipated in the rotor system, drive system, site acquisition and preparation, support structure and facilities, maintenance, general operations, and com-

ponent replacement. This paper describes the concept and rationale of TARP and presents performance results. B J

A79-14771 # Feature review of some advanced and innovative design concepts in wind energy conversion systems. A L Weisbrich (Kaman Aerospace Corp., Bloomfield, Conn.) In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., December 5-7, 1977, Proceedings of Condensed Papers. Coral Gables, Fla., University of Miami, 1978, p 847-859. 21 refs

Several advanced wind energy conversion system concepts are presented in terms of principles of operation, advantages claimed or anticipated, and areas of concern. Consideration is given to the following systems: (1) Darrieus vertical axis, (2) diffuser augmented wind turbine, (3) tornado type, (4) windmill with tip vanes, (5) wind tip vortex concentrator, (6) vortex augmentor, (7) cylindrical Darrieus rotor, (8) variable geometry vertical axis windmill, (9) giromill, (10) precursor system, (11) tracked vertical airfoil, (12) cylindrical obstruction type concentrator, and (13) TARP. B J

A79-14772 # Salinity power station at the Swedish west-coast - Possibilities and energy-price for a 200 MW-plant. A T Emren and S Bergstrom (Goteborg, Universitet, Goteborg, Sweden). In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., December 5-7, 1977, Proceedings of Condensed Papers. Coral Gables, Fla., University of Miami, 1978, p 887-889

The feasibility of constructing on the west coast of Sweden a 200-MW salinity power plant utilizing electrochemical concentration cells is investigated. Consideration is given to problems associated with plant design, biofouling, plant siting, the environment, and energy costs. B J

A79-14773 # Useful power from ocean waves. M Semo. In Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., December 5-7, 1977, Proceedings of Condensed Papers. Coral Gables, Fla., University of Miami, 1978, p 895-902

Requirements for an ocean-wave power generator are stipulated and a novel concept to meet those requirements, based on submerged pressure transducer system, is described and discussed. A comparison between solar, wind and ocean-wave energy density is given. Calculations for 24 hour periods indicate that ocean-wave energy possesses the highest energy density per unit area - seven times more than solar energy under average conditions. (Author)

A79-14776 Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Edited by H Knoepfel (CNR, Centro Gas Ionizzati, Frascati, Italy). Oxford and New York, Pergamon Press, 1978. 656 p. \$52.65

Papers are presented on plasma-wall interactions, numerical analyses of impurity phenomena, MHD equilibrium and stability, and the characteristics of magnetic divertors. Tokamak designs are presented, including the FINTOR 1 design, and compact experiments for alpha-particle heating are described. Fuel technology is considered in relation to environmental questions and attention is given to energy sources and conventional magnets and to servicing requirements in fusion reactor designs. A method for fusion power on the basis of magnetic confinement is presented and the status of potential fission reactors is discussed. S C S

A79-14778 Review of experimental results I, II. H P Furth (Princeton University, Princeton, N J.) In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p 79-123. 41 refs. Contract No E(11-1)-3073

The basic elements of the tokamak confinement scheme are discussed and ohmic heating parameters are noted. The characteris-

tics of disruptive instabilities are described and limitations to ohmic heating are identified. Experimental results for plasma energy transport processes are presented showing that MHD-instability effects on the confinement may be distinguished only when they are strong. Empirical scaling laws for the energy confinement time are outlined. The application of intense nonohmic heating is expected to remove present uncertainties about these laws. Tokamak beta limits are discussed. SCS

A79-14779 MHD equilibrium and stability. D. Pfirsich (Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany). In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 125-150. 14 refs.

Consideration is given to the effects of noncircular cross sections and current profiles on the maximum beta obtainable in tokamak devices on the basis of MHD equilibrium. Four types of MHD instabilities are described: (1) external kinks which are the most severe modes, (2) internal modes, (3) localized modes, and (4) slip modes and general axisymmetric modes. SCS

A79-14780 Collisional transport. D. Pfirsich (Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany). In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 151-169. 9 refs.

Collisional particle and heat transport is treated in plane and toroidal geometry. In particular, temperature gradient effects on impurity diffusion, so-called temperature screening, are considered for the different collisional regimes. The existence of quasi-stationary self-consistent tokamak equilibria with finite resistivity and a possible limitation of the maximum beta caused by particle diffusion is discussed. (Author)

A79-14781 Magnetic divertors. M. Keilhacker (Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany). In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 171-197. 31 refs. EURATOM sponsored research.

The different needs for divertors in large magnetic confinement experiments and prospective fusion reactors are summarized, special emphasis being placed on the problem of impurities. After alternative concepts for reducing the impurity level are touched on, the basic principle and the different types of divertors are described. The various processes in the scrape-off and divertor regions are discussed in greater detail. The dependence of the effectiveness of the divertor on these processes is illustrated from the examples of an ASDEX/PDX-size and a reactor-size tokamak. Various features determining the design of a divertor are dealt with. Among the physical requirements are the stability of the plasma column and divertor throat and the problems relating to the start-up phase. On the engineering side, there are requirements on the pumping speed and energy deposition, and for a reactor, the need for superconducting coils, neutron shields and remote disassembly. (Author)

A79-14782 The 'FINTOR 1' design - A minimum size tokamak experimental reactor. E. Bertolini (Atomic Energy Research Establishment, Culham Laboratory, Abingdon, Oxon, England). In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 201-237. 13 refs.

The paper discusses the FINTOR 1 tokamak experimental reactor which has a plasma radius of 2.25 m, a major radius of 9 m, toroidal magnetic field on the axis of 3.5 T, thermal power of 90 MW, total wall loading of 0.08 MW/sq m, and plasma energy confinement time of 16 s. The three-step plasma model of FINTOR 1 is outlined noting Model A a plasma-engineering model for preliminary parameter selection, Model B for the self-consistent analysis of a quasi-steady-state plasma, and Model C for the self-consistent analysis of a plasma with radial profiles. The main

features of the reactor components are reported, including the vacuum vessel, poloidal field system, blanket wall and magnetic shield, radioactive aspects, dose rates, disassembly, and tritium recovery. SCS

A79-14783 Philosophy and physics of predemonstration fusion devices. J. F. Clarke (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 239-258. 16 refs. ERDA-sponsored research.

Consideration is given to the development of predemonstration fusion devices noting that such devices should operate with a near-ignition plasma. The machine thus requires a pulse time on the order of tens of seconds and efficient control of impurity buildup. The device must also be able to withstand large pulses of fusion power. Three experimental power reactor designs are presented noting parameters such as major and minor radii, maximum and toroidal fields, plasma beta, fusion core cost, and unit power cost. A candidate design, developed to satisfy the needs of the US fusion program in the 1980s, is described. The high beta operation permits ignition for either empirical or trapped particle mode scaling, and provides high wall loading. Moderate elongation optimizes trapped particle mode scaling and unit cost. The natural divertor property yields impurity control. SCS

A79-14784 Characteristics of a predemonstration fusion device. D. G. McAlees (Oak Ridge National Laboratory, Oak Ridge, Tenn., Exxon Nuclear Co., Inc.). In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 259-281. 26 refs. ERDA-sponsored research.

A predemonstration fusion device, developed for evaluating the flux-conserving tokamak concept, is reported on the basis of a time-dependent model which includes pseudo-classical, neoclassical, and dissipative trapped particle mode scaling along with radiation effects and cold fueling. Values are given for the plasma radius for ignition, neutron wall loading as a function of temperature, and beta as a function of density. Operating parameters are given for steady-state conditions. Ignition calculations are made for a pure plasma and for various impurity levels. MHD equilibria are calculated and compared to those of the high-beta flux-conserving tokamak system. Attention is given to the poloidal field system, the plasma start-up scheme, and neutral beam heating. SCS

A79-14785 Predemonstration fusion devices - Research and development needs. J. F. Clarke (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 283-301. 8 refs. ERDA-sponsored research.

The paper reports on research associated with predemonstration fusion devices (PDFD) including impurity evolution and control, scaling, high-beta equilibrium and stability, and high-field effects. Three start-up schemes for neutral beam injection are discussed along with beam efficiency requirements. It is noted that the candidate PDFD design requires both ohmic heating coils and equilibrium field coils. The design and fabrication of superconducting toroidal magnets are discussed. Fueling requirements are outlined with reference to the work of Gralnick (1973) and the pellet ablation theory of Parks et al. The goals of the tritium recycle system are identified as (1) removing and purifying unburned fuel, (2) separating high-purity deuterium, (3) preparing a hydrogen purge stream, (4) supplying fuel surge and storage, and (5) providing containment. SCS

A79-14786 Compact experiments for alpha-particle heating. B. Coppi. In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 303-326. 13 refs. Research sponsored by the Comitato Nazionale per l'Energia Nucleare and ERDA.

The development of devices which sustain sufficiently high plasma currents to confine the 3.5 MeV alpha particles produced in D-T reactions is reported. The devices are designed to have high ohmic heating rates and cores produced in duplicates for testing with different plasmas. Attention is given to the procedure for bremsstrahlung tunnelling during the heating of a confined D-T plasma toward ignition temperatures. A simplified energy-balance equation is developed for the evaluation of the density values for which ignition temperatures can be achieved. Several auxiliary heating systems are described including transverse neutral beam injection, lower-hybrid frequency heating, adiabatic compression, low-frequency modulation of the vertical magnetic field, and the low-frequency modulated induction of skin currents. SCS

A79-14787 Fuel technology and the environment J Darvas (EURATOM and Kernforschungsanlage Julich GmbH, Julich, West Germany) In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 331-358. 18 refs.

Attention is given to environmental aspects associated with the use of large quantities of tritium. The relevant properties of tritium and its natural occurrence in nature are presented. Health considerations concerned with exposure to tritium are identified as energy deposition (radiation effects) and transmutation (genetic effects). The primary incorporation routes are identified as ingestion in food or water, inhalation through the lungs, and diffusion through the skin. Tritium release data from European fission reactors is described noting the behavior of released tritium in the atmosphere, stack emissions, release to surface waters, and accidental releases. Consideration is given to tritium-handling components, equipment for reactor building, and environmental monitors. SCS

A79-14788 Superconducting magnets - Some fundamentals and their state of the art W Heinz (Karlsruhe, Kernforschungszentrum, Karlsruhe, Universitat, Karlsruhe, West Germany) In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 359-388. 22 refs.

An introduction to the basis of superconductivity is given. Materials suitable for use in superconducting magnets and their essential properties are presented followed by a discussion on the status of conductor development. A survey of stabilization methods, behavior of the superconductor under normal operating conditions and special requirements of superconductors for fusion magnets are given. Magnet technology and its status is briefly discussed. Existing magnet systems are introduced. Finally some of the most important problems encountered in developing big toroidal magnet systems are mentioned. (Author)

A79-14789 Superconducting magnet systems in EPR designs A F Knobloch (Max-Planck Institut fur Plasmaphysik GmbH, Garching, West Germany) In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 389-448. 64 refs.

Consideration is given to toroidal field coils, generally designed for an axial flux density of 3-6 T, noting the parameters of several potential designs. The article also discusses poloidal field coils with reference to the heating and equilibrium field windings, operating cycles, and flux density swing in the core. The mechanical structure necessary for the support of inside poloidal coils is described and possible failure modes are identified. Design studies are outlined in terms of toroidal shapes and associated strains, safety discharge, cooling procedures, component reliability, power supplies, and tokamak scaling. Recommendations are made for future research. SCS

A79-14790 Materials problems and possible solutions for near term tokamak fusion reactors G L Kulcinski (Wisconsin, University, Madison, Wis.) In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program.

Oxford and New York, Pergamon Press, 1978, p. 449-483. 41 refs. Research supported by the Wisconsin Electric Utilities Research Foundation.

The paper discusses radiation damage from neutrons including primary responses (displacements and transmutations) and secondary responses (sputtering, swelling, ductility loss, radioactivity). A series of first-generation reactors, experimental power reactors, and demonstration power reactors are compared in terms of selected operating parameters. Near-term tokamak reactors are discussed with reference to potential problems of neutron-irradiated materials: (1) for first-generation reactors, very little materials degradation is expected, (2) for experimental power reactors, problems may arise in conjunction with low-Z liners, and (3) for demonstration power reactors, difficulties may be associated with frequent blanket replacement. Potential facilities for materials testing for future tokamak reactors are described. SCS

A79-14791 Energy sources and conventional magnets K I Selin (Atomic Energy Research Establishment, Culham Laboratory, Abingdon, Oxon, England) In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 485-509. 5 refs.

The reference design of the Oak Ridge Tokamak EPR toroidal field magnet is described noting that the peak power demand is 300 MW, the plasma current is 7.2 MA, the plasma radius is 2250 mm, and the maximum field is 11. Each of the 20 coils is of an oval shape. Consideration is given to details of the coil cross section, voltage/current values at magnet terminals, and the cost of the magnet and magnet power. The required static power supply is outlined in terms of field voltage and applied by single switching or step-by-step, changes in power input, and load conditions. Cooling procedures are noted with reference to the water temperature along the conductor, cooling water flow rate, and recovered thermal energy. SCS

A79-14792 Auxiliary heating in breakeven tokamaks J Sheffield (EURATOM and U.K. Atomic Energy Authority, Culham Laboratory, Abingdon, Oxon, England) In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 511-528. 28 refs. Contract No. EURATOM 30-74 IFUA-C.

It is noted that auxiliary heating may be used in breakeven tokamak reactors in the start-up phase and to maintain a nonthermal ion distribution in two-component and three-component systems. An analysis is made of electron power balance with reference to bremsstrahlung, line radiation, recombination radiation, cyclotron radiation, ohmic power, alpha power, fusion power from nonthermal ion distribution, and conduction losses. Expressions are derived for auxiliary power requirements for both thermal and nonthermal plasmas. The characteristics of a representative breakeven tokamak are considered for various loss scalings. SCS

A79-14793 The impact of servicing requirements on tokamak fusion reactor design J T D Mitchell (EURATOM and U.K. Atomic Energy Authority, Culham Laboratory, Abingdon, Oxon, England) In Tokamak reactors for breakeven. A critical study of the near-term fusion reactor program. Oxford and New York, Pergamon Press, 1978, p. 559-574. 12 refs.

Regardless of the plasma confinement scheme, D-T fusion reactors must be designed in such a way that the structure of the first wall may be repaired. The deterioration of the wall primarily results from neutron irradiation and transmutation in the materials under conditions of stresses and high temperatures and surface corrosion and erosion. Servicing procedures are outlined for the Saturn 5-GW (t) laser fusion reactor, the UWMAK I and II designs, and the Culham MK II (CCTR II) design. SCS

A79-14794 Fusion power by magnetic confinement Program plan S O. Dean (U S Department of Energy, Washington, D C) In Tokamak reactors for breakeven A critical study of the near-term fusion reactor program Oxford and New York, Pergamon Press, 1978, p 577-610

The program goal of the fusion program is to develop and demonstrate pure fusion central electric power stations for commercial applications Research projects are described including tokamak engineering facilities, mirror devices, confinement schemes, critical parameter assessments, and testing procedures A detailed budget plan is presented SCS

A79-14837 Determining optimal angles of nonconvex solar battery panel mounting V S Mikhalevich, S V Rzhevskii, O N Tokareva, and G N Iun (*Aviatsionnaia Tekhnika*, vol 20, no 3, 1977, p 71-77) *Soviet Aeronautics*, vol 20, no 3, 1977, p 54-58 5 refs Translation

An optimization (continuous minimax with nonlinear programming) problem involving arrangement angles for a solar array (in the form of a system of M rectangular panels located along the contour of a regular polygon) which provides power for an earth-orbiting satellite is examined The problem is to find such arrangement angles for the panels that the average energy conversion efficiency coefficient is maximal for the 'worst' position of the satellite orbit relative to the sun This coefficient represents the ratio of the area of the sum of projections of illuminated parts of panels on the plane perpendicular to the solar flux vector to the total area of all the panels B J

A79-14926 Ash deposits and corrosion due to impurities in combustion gases, Proceedings of the International Conference, New England College, Henniker, N H, June 26-July 1, 1977 Conference sponsored by the Engineering Foundation, ASME, Research Committee on Corrosion and Deposits from Combustion Gases, EPRI, and DOE Edited by R W Bryers (Foster Wheeler Development Corp., Livingston, N J) Washington, D C, Hemisphere Publishing Corp., 1978 702 p \$44 50

The proceedings cover a wide range of the technology of fireside deposits and corrosion, with special emphasis on an in-depth coverage of specific problem areas The topics are assigned in sequence such that the fireside problems can be examined from their origin in the mineral matter found in coal and oil through the process of combustion on to postcombustion, high-temperature reaction A session is devoted to remedial efforts for conventional energy conversion technology Attention is given to advanced energy conversion processes, including fluidized-bed combustion, the combustion of refuse, and MHD The behavior of impurities during combustion, corrosion in gas turbines, and slagging-fouling-corrosion problems in advanced cycles are discussed S D

A79-14927 The fate of fuel nitrogen - Implications for combustor design and operation. M P Heap, T L Corley, C J Kau, and T J Tyson (Energy and Environmental Research Corp., Santa Ana, Calif) In Ash deposits and corrosion due to impurities in combustion gases, Proceedings of the International Conference, Henniker, N H, June 26-July 1, 1977 Washington, D C, Hemisphere Publishing Corp., 1978, p 129-144 23 refs U S Environmental Protection Agency Contracts No 68-02-1361, No 68-02-2196

The paper reviews major processes taking place during the combustion of fuels containing traces of bound nitrogen The discussion covers pyrolysis of nitrogen-containing fuels, heterogeneous reactions involving nitrogen, and homogeneous reactions Gas-phase fuel nitrogen reactions are emphasized, and information on the kinetic mechanism of fuel nitrogen reactions is used to define the combustor conditions which minimize nitrogen oxide emissions Limit case studies in which fuel NO formation is controlled chemically are discussed for advanced power cycles burning coal-

derived fuels Reactions proposed to account for the sulfur-nitrogen interaction are presented Total bound nitrogen at the exit of the fuel-rich primary section of a combustor may be minimized by using high preheat or combined parallel and sequential staged systems S D

A79-14930 Chloride corrosion and its inhibition in refuse firing D A Vaughan, H H Krause, and W K Boyd (Battelle Columbus Laboratories, Columbus, Ohio) In Ash deposits and corrosion due to impurities in combustion gases, Proceedings of the International Conference, Henniker, N H, June 26-July 1, 1977 Washington, D C, Hemisphere Publishing Corp., 1978, p 473-493 12 refs Research supported by the U S Environmental Protection Agency

Fireside corrosion from burning of municipal refuse alone and with high sulfur coal was investigated in field studies by the use of corrosion probes Corrosion rates of simulated boiler tubes were measured for periods up to 828 hours for carbon steel, low alloy steel, and stainless steels in an incinerator burning bulk refuse Similar experiments were conducted in co-firing of shredded refuse with high-sulfur coal in a stoker-fired boiler Detailed analysis of deposits, corrosion scale, and substrate metal showed that chlorine in the refuse is responsible for the most serious corrosion Sulfur, sodium, potassium, lead, and zinc also take part in the corrosion reactions The addition of sulfur to bulk refuse reduced the corrosion rates of carbon steel and stainless steels significantly In the co-firing of refuse-coal mixtures the initial corrosion rates of carbon steel were about an order of magnitude lower than those for 100 percent refuse, while those for stainless steels were 10-50 times lower (Author)

A79-14931 Investigation of the corrosion performance of boiler, air heater, and gas turbine alloys in fluidized combustion systems J C Holder, R D LaNauze, E A Rogers, and G G Thurlow (Coal Research Establishment, Cheltenham, Glos., England) In Ash deposits and corrosion due to impurities in combustion gases, Proceedings of the International Conference, Henniker, N H, June 26-July 1, 1977 Washington, D C, Hemisphere Publishing Corp., 1978, p 525-535

The paper reports the behavior of a range of air heater and turbine materials when subjected to long exposures to the bed environment and combustion gases typical of those proposed for advanced cycle power generation plants using fluidized bed coal combustion A comparative assessment of the corrosion resistance of materials exposed in the fluidized bed and in the freeboard for two 1000-hr tests is given Materials exposed to the bed material, which was primarily calcium sulfate, underwent greater attack than materials placed in the freeboard The austenitic steels generally showed least attack, while the nickel based alloys did not perform well The program highlights the need for more detailed information on the microenvironment within the fluidized bed combustor It would then be possible to determine the effect that operating variables might have on those conditions within the fluidized bed that lead to unacceptable metal loss (Author)

A79-14932 Corrosion of superalloys, inconels, and stainless steels by the products from fluidized-bed coal combustion H F. Wigton (Combustion Power Co., Inc., Menlo Park, Calif) In Ash deposits and corrosion due to impurities in combustion gases, Proceedings of the International Conference, Henniker, N H, June 26-July 1, 1977 Washington, D C, Hemisphere Publishing Corp., 1978, p 537-555 6 refs Contract No E(49-18)-1536

A79-14934 Coal slag effects in MHD generators J K Koester, M E Rodgers, R M Nelson, and R H Eustis (Stanford University, Stanford, Calif) In Ash deposits and corrosion due to impurities in combustion gases, Proceedings of the International Conference, Henniker, N H, June 26-July 1, 1977 Washington, D C, Hemisphere Publishing Corp., 1978, p 627-650 24 refs

The paper describes experimental and theoretical results on slag layer hydrodynamics, the electrical effects due to slag coatings, the chemical characterization of slag layers, and the effect of slag on electrode erosion, in relation to direct firing of coal under simulated MHD generator conditions. Axial slag breakdown and both diffuse and arc mode transverse discharges are observed by cinephotography. For diffuse conduction, the electrode must be in good electrical contact with the slag layer. It is found that mild steel makes good contact with slag due to the chemical interaction of the iron oxide scale with the slag, whereas nickel and stainless steel make poor contact with slag. Metal anodes are eroded more rapidly than cathodes due to electrolytic attack by either seed or slag deposits, for ceramic electrodes, the cathodes are attacked the most. Chemical attack may be minimized by operating the electrode wall at low temperatures in the arc mode. SD

A79-14935 **Corrosion and deposits in MHD generator systems** J B Dicks, L W Crawford, C K Petersen, and M S Beaton (Tennessee University, Tullahoma, Tenn.) In Ash deposits and corrosion due to impurities in combustion gases, Proceedings of the International Conference, Henniker, N H, June 26 July 1, 1977. Washington, D C, Hemisphere Publishing Corp., 1978, p 651-663. 8 refs. Research supported by the Tennessee Valley Authority, U S Department of the Interior Contract No 14-32-0001-1213, Contract No EX-76-C-01-1760.

Experiences in deposition of and corrosion-erosion by ash constituents and ash-additive mixtures in The University of Tennessee Space Institute MHD Laboratory are described. Particular components which are discussed include the combustor, the MHD generator and gas ducts, high temperature heat transfer surface, and low temperature heat transfer surface. Effects of the deposits on metallic and ceramic materials are considered. (Author)

A79-14936 **Controlled utilization of coal slag in the MHD topping cycle** D B Stickler and R DeSaro (Avco Everett Research Laboratory, Inc., Everett, Mass.) In Ash deposits and corrosion due to impurities in combustion gases, Proceedings of the International Conference, Henniker, N H, June 26 July 1, 1977.

Washington, D C, Hemisphere Publishing Corp., 1978, p 665-688. 27 refs.

Slag coating development for structural protection from gas dynamic erosion, and from current concentrations in the MHD channel, is described. Experimental and analytical study of the behavior of coal ash on the wall structures of MHD systems has resulted in an understanding of controlling transport processes. Experimental measurements under both subsonic and supersonic conditions indicate that on a wettable wall structure, operating at temperatures well below 250 K, slag develops by deposition from the gas flow at a predictable rate. A layer equilibrates with a viscosity temperature distribution defined by balancing of local mass flow in the layer with skin friction and pressure gradient forces driving it. Typically, at 0.3 wt% mineral matter in a Mach 1.4 flow, equilibration time is about 40 min. This is somewhat greater than predicted by simple theory, due to the existence of a finite rate of reentrainment prior to equilibration. The steady-state layer is on the order of one mm thick, with surface temperature about 1800 K. Effects of ash composition, combustion stoichiometry, flow field, and wall structure are discussed, together with corresponding analyses. (Author)

A79-14947 * # **Fuel cell on-site integrated energy system parametric analysis of a residential complex** S N Simons (NASA, Lewis Research Center, Cleveland, Ohio) U S Department of Energy, Fuel Cell Workshop, Sarasota, Fla., Nov 14-17, 1977, Paper 24 p. 7 refs.

The use of phosphoric acid fuel cell powerplant to provide all the electricity required by an 81-unit garden apartment complex is studied. Byproduct heat is recovered and provides some of the heat required by the complex. The on-site integrated energy system contains energy conversion equipment including combinations of compression and absorption chillers, heat pumps, electric resistance

heaters, and thermal storage. The annual fuel requirement for several onsite integrated energy systems as well as the fuel cell breakeven cost for one specific system were calculated. It is found that electrical efficiency cannot be traded off against thermal efficiency without paying a penalty in system efficiency. M L

A79-14956 * # **Correlations of catalytic combustor performance parameters** D L Bulzan (NASA, Lewis Research Center, Cleveland, Ohio) U S Environmental Protection Agency, Workshop on Catalytic Combustion, 3rd, Asheville, N C, Oct 3, 4, 1978, Paper 14 p. Contract No EC-77-A 31 1040.

A 12 cm-diameter catalytic combustor test rig using propane fuel at an inlet temperature of 800 K, a pressure of 300,000 Pa, and reference velocities from 10 to 20 m/s was studied. Combustion efficiency at the test conditions is a function of the catalyst bed cell density, cell circumference, reactor length, and the reference velocity, the efficiency was also dependent on the adiabatic reaction temperature to the tenth power. The percentage pressure drop is proportional to the reference velocity to the 1.5 power and is also proportional to the reactor length and inversely proportional to the cell hydraulic diameter, fractional open area, and the pressure. The minimum adiabatic reaction temperature required to meet the emissions goals is proportional to the reference velocity to the 0.1 power and inversely proportional to the cell circumference, cell density, and reactor length to the 0.1 power. The parameters which are a function of a catalyst factor are reported. M L

A79-14957 **Conference on Decision and Control, and Symposium on Adaptive Processes, 16th, and Special Symposium on Fuzzy Set Theory and Applications, New Orleans, La., December 7-9, 1977, Proceedings Volumes 1 & 2** Conference and Symposia sponsored by the Institute of Electrical and Electronics Engineers, Piscataway, N J, Institute of Electrical and Electronics Engineers, Inc., 1977. Vol 1, 1301 p., vol 2, 152 p. Price of two volumes, \$50.

Papers are presented on such topics as identification and estimation theory, estimation and control problems in energy systems, adaptive processes in biomedical systems, game theory, stochastic control, man-machine systems, geometric methods in control theory, application of modern control and estimation to aircraft systems, microprocessor-based climate control in solar heated buildings, and optimal control. Consideration is also given to the following: detection problems in naval systems, advanced automation, guidance and control of maneuvering reentry vehicles, pattern recognition, robotics, estimation and modeling in socioeconomic systems, stability and regulation, and theory and applications of fuzzy sets. B J

A79-14960 **Modelling energy storage systems for electric utility applications - Preliminary considerations** G L Blankenship, S Gruber, and I Lefkowitz (Case Western Reserve University, Cleveland, Ohio) In Conference on Decision and Control, and Symposium on Adaptive Processes, 16th, and Special Symposium on Fuzzy Set Theory and Applications, New Orleans, La., December 7-9, 1977, Proceedings Volume 1. Piscataway, N J, Institute of Electrical and Electronics Engineers, Inc., 1977, p 62-68. 22 refs. ERDA-supported research.

Storage of off-peak electric energy for use during peak load periods is an attractive operating feature of pumped hydroelectric systems. Other forms of energy storage such as compressed air in underground caverns or thermal energy as sensible or latent heat are becoming practical and so, the number of utilities for which storage is a feasible option is increasing. The choice of several storage devices with different characteristics complicates the design problem and suggests the need for a generic model of an energy storage system for use in a generation planning program. This paper contains preliminary considerations in the construction of such a model and in the development of accompanying algorithms for its optimal design and realization by physical energy storage devices. (Author)

A79-14979 **A microprocessor based solar controller** G R Johnson (Colorado State University, Fort Collins, Colo.) In Conference on Decision and Control, and Symposium on Adaptive Processes, 16th, and Special Symposium on Fuzzy Set Theory and Applications, New Orleans, La., December 7-9, 1977, Proceedings Volume 1 Piscataway, N J, Institute of Electrical and Electronics Engineers, Inc., 1977, p 336-340 16 refs. NSF Grant No DCR-75-03578

This paper presents the development, analysis, and simulated experimentation with a discrete control algorithm for optimal control of a solar energy system for heating buildings. The contents include the mathematical formulation of the system and objective function, the solution technique, the microprocessor control system and its components, and the results of tests conducted using a control-driven dynamic simulation computer model to perform comparisons with conventional controls (Author)

A79-15023 * **Joint Conference on Sensing of Environmental Pollutants, 4th, New Orleans, La., November 6-11, 1977, Proceedings** Conference sponsored by ACS, AIAA, AIChE, AMS, EPA, ERDA, IEEE, ISA, NASA, NOAA, HUD, U.S. Geological Survey, U.S. Department of State, and DOT. Washington, D.C., American Chemical Society, 1978 960 p \$50

Papers are presented on such topics as environmental chemistry, the effects of sulfur compounds on air quality, the prediction and monitoring of biological effects caused by environmental pollutants, environmental indicators, the satellite remote sensing of air pollution, weather and climate modification by pollution, and the monitoring and assessment of radioactive pollutants. Consideration is also given to empirical and quantitative modeling of air quality, disposal of hazardous and nontoxic materials, sensing and assessment of water quality, pollution source monitoring, and assessment of some environmental impacts of fossil and nuclear fuels. B J

A79-15032 **The impact of a coal fired power plant on ambient sulfur dioxide levels** B D Goodell and K W Ragland (Wisconsin, University, Madison, Wis.) In Joint Conference on Sensing of Environmental Pollutants, 4th, New Orleans, La., November 6-11, 1977, Proceedings Washington, D.C., American Chemical Society, 1978, p 44-48 10 refs. U.S. Environmental Protection Agency Grant No R-803971

A79-15052 **On the depletion of ambient ozone by a rural coal-fired power plant near Portage, Wisconsin** B M Bowen and C R Stearns (Wisconsin, University, Madison, Wis.) In Joint Conference on Sensing of Environmental Pollutants, 4th, New Orleans, La., November 6-11, 1977, Proceedings Washington, D.C., American Chemical Society, 1978, p 184-186 5 refs. Research supported by Wisconsin Power and Light, Madison Gas and Electric, Wisconsin Public Service Co., U.S. Environmental Protection Agency Grant No R 803971020

A79-15077 **The circumsolar measurement program - Assessment of the effects of atmospheric scattering on solar energy conversion** A J Hunt, D F Grether, and M Wahlig (California, University, Berkeley, Calif.) In Joint Conference on Sensing of Environmental Pollutants, 4th, New Orleans, La., November 6-11, 1977, Proceedings Washington, D.C., American Chemical Society, 1978, p 423-426

Circumsolar radiation is produced by small-angle scattering of sunlight from atmospheric aerosols with dimensions larger than the wavelength of light. The primary purpose of the project under consideration is to assess the impact of the aerosol scattering on focusing collector systems. Presently, four circumsolar telescopes have completed over one year of nearly continuous measurements at several locations. The resulting set of measurements is a thorough set of data displaying the effect of scattering on the solar intensity profile. The data indicate that significant corrections are necessary to the existing pyrheliometer data. V P

A79-15084 **Source emissions factors for refuse derived fuels** J M Carroll (Standard Oil Co., Cleveland, Ohio), J L Hall, A W Joensen, and D B VanMeter (Iowa State University of Science and Technology, Ames, Iowa) In Joint Conference on Sensing of Environmental Pollutants, 4th, New Orleans, La., November 6-11, 1977, Proceedings Washington, D.C., American Chemical Society, 1978, p 472-478 15 refs. Research supported by the Iowa State University of Science and Technology

F and Fc emission factors for processed refuse or refuse derived fuel (RDF) are determined. Emission rates were ascertained by both the emission factor technique and by direct sampling, and linear correlation between emission factors for RDF and the carbon percent by weight was found. The volume of effluent produced per million Btu of heat energy input was calculated by use of F or of Fc emission factors, and the values obtained by the two methods are compared. M L

A79-15115 **Environmental effects of burning solid waste as fuel** H R Shanks (U.S. Department of Energy, Ames Laboratory, Ames, Iowa), J L Hall, and A W Joensen (Iowa State University of Science and Technology, Ames, Iowa) In Joint Conference on Sensing of Environmental Pollutants, 4th, New Orleans, La., November 6-11, 1977, Proceedings Washington, D.C., American Chemical Society, 1978, p 739-741. Research supported by the American Public Power Association and Iowa State University of Science and Technology, U.S. Environmental Protection Agency Grant No R-803903010, Contract No W-7405-eng-82

Emissions and ash produced by burning various amounts of processed solid waste with high-sulfur-content Iowa coal are determined. The combustion occurs in a traveling grate boiler which is part of a municipal power plant. The facility consists of two traveling grate boilers and one tangentially fired boiler. The use of 50% coal and 50% refuse-derived fuel in place of 100% coal led to a 20 to 30% reduction in NOx emissions and a 30% reduction in the sulfur emissions. Trace element concentrations in coal and in refuse-derived fuel are compared, and the distribution of some elements (e.g., copper, lead, and zinc) after combustion of refuse-derived fuel is discussed. M L

A79-15137 **DOE programs in material development for fusion laser systems** J A Weiss (U.S. Department of Energy, Washington, D.C.) In Electro-Optics/Laser Conference and Exposition, Anaheim, Calif., October 25-27, 1977, Proceedings Chicago, Industrial and Scientific Conference Management, Inc., 1977, p 25-28

Attention is given to the Division of Laser Fusion of the Department of Energy with reference to optical materials and related materials technology. The development of large Nd glass lasers is reviewed noting optical problems associated with scaling the laser system to the 200-TW level and the intrinsic dielectric breakdown threshold of transparent dielectrics. The design of CO2 fusion laser systems is outlined noting optical materials having ultralow absorption coefficients and the 100-kJ laser system under construction at the Los Alamos Scientific Laboratory. Future work associated with photolytically pumped atomic species which lase in the green-red spectral regions is described. S C S

A79-15138 **Requirements and new materials for fusion laser systems** S E Stokowski, M J Weber, R A Saroyan, and W F Hagen (California, University, Livermore, Calif.) In Electro-Optics/Laser Conference and Exposition, Anaheim, Calif., October 25-27, 1977, Proceedings Chicago, Industrial and Scientific Conference Management, Inc., 1977, p 29-36 7 refs. Contract No W-7405-eng-48

Higher focusable power in neodymium glass fusion lasers can be obtained through the use of new materials with lower nonlinear index and better energy storage capabilities than the presently employed silicate glass. Silicate, phosphate, fluorophosphate, and beryllium fluoride glasses are discussed in terms of fusion laser requirements, particularly those for the proposed Nova laser. Examples of the variation in spectroscopic and optical properties

obtainable with compositional changes are given Results of a system evaluation of potential laser materials show that fluorophosphate glasses have many of the desired properties for use in Nova These glasses are now being cast in large sizes (30-cm diameter) and will be tested in prototype amplifiers in 1978 (Author)

A79-15139 Review of theories for predicting n_2 in glasses and crystals N L Boling (Owens-Illinois, Inc, Toledo, Ohio) In Electro-Optics/Laser Conference and Exposition, Anaheim, Calif, October 25-27, 1977, Proceedings Chicago, Industrial and Scientific Conference Management, Inc, 1977, p 37-41 11 refs

The operation of large glass laser systems in fusion studies is limited by the self-focusing of the laser beam Optical component materials having the lowest possible values of the nonlinear refractive index (n_2) coefficient minimize this self-focusing Several expressions for n_2 are presented, noting the derivations and limitations of each Consideration is given to the work of (1) Boling, Glass, and Owyong in which a semiclassical model of the nonlinear harmonic oscillator is used to derive an expression of n_2 , (2) Hellwarth, Cherlow, and Yang, in which measurements of Raman-scattering cross sections are used in conjunction with ellipse rotation results, (3) Fournier and Snitzer, where a general electronic susceptibility level theory is applied to a three-level quantum mechanical model, and (4) Wang, also representing a quantum mechanical approach

S C S

A79-15140 A survey of laser glasses G Dube (Owens-Illinois, Inc, Toledo, Ohio) In Electro-Optics/Laser Conference and Exposition, Anaheim, Calif, October 25-27, 1977, Proceedings Chicago, Industrial and Scientific Conference Management, Inc, 1977, p 42-45

Several types of commercially available laser glasses are described and compared with reference to the considerations influencing the selection of an optimal laser glass for a specific application Attention is given to the dopants present in laser glasses, added in order to aid manufacture or operation or to enhance particular properties The development of silicates, phosphates, fluorophosphates, and fluoroberyllates is outlined Properties such as saturated and unsaturated gain, pulse length, self-focusing, and repetition rates are reviewed for several types of glasses

S C S

A79-15143 Mechanical deflection analysis of diamond turned reflective optics J E Stoneking (Tennessee, University, Knoxville, Tenn) and H L Gerth (Union Carbide Corp, Oak Ridge, Tenn) In Electro-Optics/Laser Conference and Exposition, Anaheim, Calif, October 25-27, 1977, Proceedings Chicago, Industrial and Scientific Conference Management, Inc, 1977, p 55-62 5 refs

This paper describes an analytical technique for predicting the warpage of metal reflective mirrors caused by various support and load conditions The laser fusion project being conducted at LASL requires that metal reflective optics be fabricated by diamond turning The diamond turning process imposes some unusual loading conditions which result in mirror warpage The finite element method is used to compute mirror surface displacements resulting from these loads Surface warpage is then determined by a best fit comparison of this data to the desired surface contour The technique is not limited to diamond turning, but can be used to predict warpage from a variety of loading conditions placed on the mirrors (Author)

A79-15145 Techniques for preventing damage to high power laser components I F Stowers, H G Patton, W A Jones, and D E Wentworth (California, University, Livermore, Calif) In Electro-Optics/Laser Conference and Exposition, Anaheim, Calif., October 25-27, 1977, Proceedings Chicago, Industrial and Scientific Conference Management, Inc, 1977, p 75-80. Contract No W-7405-eng-48

The paper presents methods for the cleaning, assembly, and maintenance of laser components in such a way as to minimize damage to the optical surfaces Three damage mechanisms are described surface damage by flash-lamp heating of contaminated particles, optical coating damage by the laser beam, and attenuation due to films on optical surfaces Three class 100 cleaning rooms have been built for the assembly and testing of all Shiva laser optics Specific tasks include electro- and chemical-polishing, surface cleaning and particle removal, surface cleanliness verification, wavefront distortion testing, and optical testing S C S

A79-15171 Performance of the short-pulse oscillators for Argus and Shiva D J Kuizenga and W E Martin (California, University, Livermore, Calif) In Electro-Optics/Laser Conference and Exposition, Anaheim, Calif, October 25-27, 1977, Proceedings Chicago, Industrial and Scientific Conference Management, Inc, 1977, p 312-316 8 refs Contract No W-7405-eng-48

An actively mode-locked and Q-switched oscillator has been developed for large Nd glass laser-fusion systems such as Argus and Shiva Stable thermal conditions in the modulator are maintained by direct water cooling of the transducer The modulator, Q-switch, and Nd YAG rod are cut at Brewster's angle to eliminate spurious etalon effects or multiple reflections between components in the laser cavity The oscillator has operated with all the components firing in ten arms of Shiva The Argus oscillator has operated reliably for over six months S C S

A79-15245 Shock-tube measurements of induction and post-induction rates for low-Btu gas mixtures S S Penner, K G P Sutzmann, G E Parks, and J M Kline (California, University, La Jolla, Calif) In Shock tube and shock wave research, Proceedings of the Eleventh International Symposium, Seattle, Wash, July 11-14, 1977 Seattle, Wash, University of Washington Press, 1978, p 351-358 41 refs NSF Grant No AER 75-21364

The paper reports shock tube measurements of induction times and post-induction conversion rates for low Btu gas mixtures containing CH₄, CO, H₂, NH₃, H₂S, CO₂, N₂, and O₂ The induction times are represented by Arrhenius expressions after multiplication by the oxygen concentration and the square root of the equivalence ratio Appropriate correlation parameters were determined for post induction oxidation rates M L

A79-15247 Shock tube studies of coal devolatilization A I Lowenstein and C W von Rosenberg, Jr (Avco Everett Research Laboratory, Inc, Everett, Mass) In Shock tube and shock wave research, Proceedings of the Eleventh International Symposium, Seattle, Wash, July 11-14, 1977 Seattle, Wash, University of Washington Press, 1978, p 366-374 11 refs Contract No E(49-18)-2212

A 15 cm ID shock tube facility with a newly developed apparatus for forming coal dust dispersions has been used to heat 14 to 54 micron dia high volatile bituminous coal at low mass loadings in argon to 1000-1500 K and 16 atm Measurements behind reflected shock of pressure, visible absorption and infrared emission at several wavelengths were made In test times of 4-5 msec we infer from the signals, (1) the heating time of the particles, (2) absence of appreciable swelling or shattering, (3) volatile evolution, and (4) soot formation from the volatiles In addition unique geodesic cenospheres generated in these experiments are shown (Author)

A79-15260 The MHD interaction and plasma properties in a shock tube driven disk generator with swirl W J Loubisky, J K Lytle, J D Teare, and J F Louis (MIT, Cambridge, Mass) In Shock tube and shock wave research, Proceedings of the Eleventh International Symposium, Seattle, Wash, July 11 14, 1977 Seattle, Wash, University of Washington Press, 1978, p 498-507 16 refs

A 15-cm-diameter shock tube with cesium injection is used to study the use of inlet swirl in a disk generator for high-efficiency MHD power generation. In particular, the study is concerned with flow-interaction effects and plasma properties in a small disk with a 45-deg inlet swirl and a Mach number of 2.2. Electron density and temperature, voltage, and pressure measurements are obtained for tests in argon, N₂, and N₂/CO₂ mixtures. Information is presented on the behavior of electrothermally induced nonuniformities which reduce the average Hall parameter and electrical conductivity in both inert and reacting molecular gases at low pressure. Information is also presented on the complexities of the flow structure and the effects of chemical nonequilibrium in a disk driven by N₂/CO₂. The experimental data are in agreement with calculations based on a kinetics model. M L

A79-15301 Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, University of Colorado, Boulder, Colo., August 2-5, 1977 Conference sponsored by the Aerospace Corp., NBS, et al. Edited by K. D. Timmerhaus (Colorado, University, Boulder, Colo.). New York, Plenum Press, 1978. 765 p. \$49.50

The present volume deals with various aspects of superconductivity applications, cooling superconducting systems, heat and mass transfer, refrigeration and liquefaction, cryogenic techniques and applications, and LNG design and properties. Superconductivity applications are discussed relative to MHD magnets, energy storage, and rotating machinery. Attention is given to cryogenic applications as related to space technology, cryopumping, laser fusion, and health and safety. The information presented provides an in-depth coverage of research on technical materials in areas currently receiving primary attention by the cryogenic engineering community. S D

A79-15302 Commercial realization of MHD - A challenge for superconducting magnets V. A. Ovcharenko (United Nations, Center for Natural Resources, Energy and Transport, New York, N.Y.). In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo., August 2-5, 1977*. New York, Plenum Press, 1978, p. 1-8. 16 refs.

The magnetohydrodynamic (MHD) approach to electric power generation offers a unique combination of high efficiency large-scale power generation and the capability of meeting air quality standards even when high sulfur coal is used as fuel. The paper reviews the status of the development of fossil-fuel-fired open-cycle MHD generators and highlights the particular importance of the superconducting magnet. Parameters of existing MHD superconducting systems are presented, and requirements for future commercial systems are given for illustration. Major difficulties of full-scale magnet system realization are listed, and the importance of the joint United States-Soviet Union experimental testing of a new large-scale superconducting MHD magnet is stressed as a significant step toward the commercialization of such power generation. Some major issues for research and development are magnet type and technology of superconductors, stabilization, control and handling of emergency situations, designing support structures, shipping and assembling, and continuous operation of large cryogenic systems. S D

A79-15303 Cryogenic aspects of the U.S. SCMS superconducting dipole magnet for MHD research R. C. Niemann, S. T. Wang, J. D. Gonczy, K. Mataya, W. J. Pelczarski (Argonne National Laboratory, Argonne, Ill.), P. C. Vander Arend, S. Stoy (Cryogenic Consultants, Inc., Allentown, Pa.), and P. Smelser. In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo., August 2-5, 1977*. New York, Plenum Press, 1978, p. 9-16. ERDA supported research.

The paper outlines the design features and capabilities of the U.S. Superconducting Magnet System (U.S. SCMS). The MHD channel of this superconducting dipole magnet has the approximate dimensions of 0.18 m x 0.18 m at the entrance and 0.30 m x 0.30 m at the exit. The system consists of the superconducting magnet, a helium refrigerator/liquefier installation, a helium gas recovery system, and the control equipment necessary to operate the magnet

and its associated cryogenic equipment. The magnet cryostat is discussed relative to general description, helium consumption, load criteria, and construction. Attention is given to instrumentation used, cryostat fabrication, cryogenic support system, and operation experience. To avoid excessive thermal stresses, the temperature difference between the bore tube and the helium shell is monitored and controlled during cooldown from 300 to 100 K. The U.S. SCMS has been successfully operated at fields up to 5 T. S D

A79-15304 Fabrication experiences and operating characteristics of the U.S. SCMS superconducting dipole magnet for MHD research S. T. Wang, R. C. Niemann, R. L. Kustom, P. Smelser, W. J. Pelczarski, L. R. Turner, E. W. Johanson, E. F. Kraft, S. H. Kim, and J. D. Gonczy (Argonne National Laboratory, Argonne, Ill.). In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo., August 2-5, 1977*. New York, Plenum Press, 1978, p. 17-27. 8 refs. ERDA-supported research.

A79-15305 * Design study of superconducting magnets for a combustion magnetohydrodynamic (MHD) generator R. J. Thome, J. W. Ayers, T. M. Hrycaj (Magnetic Corporation of America, Waltham, Mass.), and J. A. Burkhart (NASA, Lewis Research Center, Cleveland, Ohio). In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo., August 2-5, 1977*. New York, Plenum Press, 1978, p. 28-36. Contract No. NAS3-19885.

Results are presented for a trade off and preliminary design study on concepts of a superconducting magnet system for a combustion MHD generator test facility. The main objective is to gain insight into the magnitude of the project in terms of physical characteristics and cost. The net result of a first-phase evaluation of attractive design alternatives is to concentrate subsequent efforts on (1) a racetrack coil geometry with an operating temperature of 4.2 K, (2) a racetrack coil geometry with an operating temperature of 2.0 K, and (3) a rectangular saddle coil geometry with an operating temperature of 4.2 K. All three systems are to produce 8 T, and use NbTi superconductor and iron for field enhancement. Design characteristics of the three systems are described. It is shown that the racetrack and rectangular saddle coil geometries seem most suitable for this application, the former because of its simplicity and the latter because of its efficient use of material. Advantages of the rectangular saddle over the two other systems are stressed. S D

A79-15306 Design of superconducting magnets for full-scale MHD generators A. M. Hatch, J. Zar, F. E. Becker (Avco Everett Research Laboratory, Inc., Everett, Mass.), R. Rhodenizer, D. Markiewicz, R. Ackerman (Intermagnetics General Corp., Guilderland, N.Y.), R. D. Hay, W. Langton, and E. J. Rappaport (Magnetic Engineering Associates, Cambridge, Mass.). In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo., August 2-5, 1977*. New York, Plenum Press, 1978, p. 37-47. ERDA-supported research.

The paper presents the results of a program directed at conceptual design studies and the preparation of preliminary designs and engineering data for full scale superconducting magnets for base-load MHD power generators, and scaled down designs for the size of magnet required for the MHD engineering facility. Major purposes in developing these designs are (1) identification of specific problems, both technical and manufacturing, that must be solved before full-scale base load magnets can be designed and built with assurance of meeting their requirements, and (2) the development of recommendations for R&D programs that should be undertaken before the construction of such large magnets can begin. The alternative 6-T base-load designs, circular and rectangular saddle, are upgraded during the preliminary design phase. No technological obstacles are encountered in designing the magnets considered. A critical item is motion and friction heating within winding during charging, along with the relation of this phenomenon to coil stability. S D

A79-15309 **Conductor for LASL 10-MW hr superconducting energy storage coil** A Petrovich, M S Walker, B A Zeitlin, J D Scudiere (Intermagnetics General Corp, Guilderland, N Y), and R I Schermer (California, University, Los Alamos, N Mex) In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo, August 2-5, 1977* New York, Plenum Press, 1978, p 78-87 10 refs ERDA supported research

The study addresses the conductor for an energy storage system with a capacity of 10 MWhr to be used in systems where discharge times of the order of 10 min are required. Such a device will fulfill the requirements for short-period variations as well as lead to the development of larger and more economical systems of more general application. The conductor concept is defined and a partial parametric analysis is performed. Conductor losses, conductor quantity (establishing cost), and requirement for conductor protection are defined in terms of three variables: stabilizer resistivity, lumped heat transfer parameter, and operating temperature. A winding scheme for the coil and conductor is suggested. The quantity of conductor and related capital cost are shown to be low relative to conductors of other categories, and electric losses are well within acceptable limits. The conductor described should stably provide the necessary winding current for the 10-MW hr energy storage coil. S D

A79-15318 **High-current power leads for tokamak fusion reactor superconducting magnets** R K Thomas, J R Purcell (General Atomic Co, San Diego, Calif), and R W Boom (Wisconsin, University, Madison, Wis) In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo, August 2-5, 1977* New York, Plenum Press, 1978, p 219-225 10 refs Contract No EY-76-C-03-0167 ERDA Project 38

A79-15324 **Liquid mixture excess volumes and total vapor pressures using a magnetic suspension densimeter with compositions determined by chromatographic analysis - Methane plus ethane** M J Hiza and W M Haynes (National Bureau of Standards, Boulder, Colo) In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo, August 2-5, 1977* New York, Plenum Press, 1978, p 594-601 10 refs Research supported by the British Gas Corp, Chicago Bridge and Iron Co, Columbia Gas Service Corp, et al

A79-15330 **Large-scale cryopumping for controlled fusion** L C Pittenger (California, University, Livermore, Calif) In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo, August 2-5, 1977* New York, Plenum Press, 1978, p 648-657 9 refs Contract No W 7405-eng-48

Various examples of large scale cryopumping for controlled fusion are presented. Attention is given to baffled cryopumps for high voltage test stands, the beam line for tokamak fusion test reactors, and the cryopumping system for the mirror fusion test facility. Operational considerations are outlined and pumping problems are identified. S C S

A79-15332 **A new method for producing cryogenic laser fusion targets** J R Miller (California, University, Los Alamos, N Mex) In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo, August 2-5, 1977* New York, Plenum Press, 1978, p 669-675 11 refs ERDA-supported research

A technique has been developed for producing cryogenic targets used in laser fusion systems. The technique, called fast isothermal freezing, reproducibly forms transparent, solid deuterium and tritium layers of excellent thickness uniformity on the inner surface of glass microballoon cores. The method uses a static heat-exchange gas for rapid target cooling following target heating by a focused laser beam. S C S

A79-15333 **Development of cryogenic targets for laser fusion** E R Grilly (California, University, Los Alamos, N Mex) In *Advances in cryogenic engineering Volume 23 - Proceedings of the*

Conference, Boulder, Colo, August 2-5, 1977 New York, Plenum Press, 1978, p 676-681 7 refs ERDA sponsored research

Various types of heat transfer have been used for cooling targets used in laser fusion studies. Experimental data have shown that target cooling by a high-conductivity fiber attached at one end to the bottom of the microballoon container provides good control over the condensate. Furthermore, there is no gas to degrade the vacuum or interfere with the plasma. Thermal radiation shields may therefore be omitted. Future research will involve thin fibers of various materials in order to minimize mass. S C S

A79-15334 **Cryogenic pellets for laser-fusion research - Theoretical and practical considerations** T M Henderson, R J Simms (KMS Fusion, Inc, Ann Arbor, Mich), and R B Jacobs (Robert B Jacobs Associates, Inc, Boulder, Colo) In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo, August 2-5, 1977* New York, Plenum Press, 1978, p 682-689 12 refs Contracts No EY 76-C-02-2709, No ES 77-C-02-4149

It has been suggested that the yield of thermonuclear neutrons may be enhanced if the fuel is condensed into the form of cryogenic pellets. The behavior of such pellets is reviewed noting fuel migration on the surfaces where the fuel condenses, gravitational effects, energy transfer rates, and dynamic effects. Techniques for using gaseous helium cooling or point contact conduction cooling for the processing and maintenance of cryogenic pellets are discussed. S C S

A79-15335 **Point-contact conduction-cooling technique and apparatus for cryogenic laser fusion pellets** T M Henderson, D L Musinski, R J Simms, G H Wuttke (KMS Fusion, Inc, Ann Arbor, Mich), and R B Jacobs (KMS Fusion, Inc, Ann Arbor, Mich, Robert B Jacobs Associates, Inc, Boulder, Colo) In *Advances in cryogenic engineering Volume 23 - Proceedings of the Conference, Boulder, Colo, August 2-5, 1977* New York, Plenum Press, 1978, p 690-698 8 refs Contracts No EY-76-C-02-2709, No ES 77-C-02-4149

A point-contact conduction-cooling procedure has been developed in order to enable laser illumination of cryogenic fuel configurations with the fuel condensed in either liquid or solid layers. The technique produces a uniform layer of liquid deuterium over the inside surface of a glass shell. By adding a retractable cryogenic shield, the procedure can produce a layer of solid fuel covering the entire inner surface of a glass shell. S C S

A79-15342 # **Supersonic flow in an MHD channel with a downwash flow at the inlet (O sverkhzvukovom techenii v kanale MGD-generatora so skoshennym potokom na vkhode)** A P Likhachev *Magnitnaia Gidrodinamika*, July-Sept 1978, p 49-56 10 refs In Russian

The analysis is carried out for two-dimensional inviscid nonheat-conducting gas flows in MHD channels with downwash at the inlet, neglecting the induced magnetic field. Numerical results are analyzed for supersonic flows in MHD channels with two solid electrodes and with two ideally segmented electrodes at downwash angles ranging from +6 to -6 degrees. V P

A79-15372 **Risk control in the development of energy processes** D A McBride and L R Albaugh (Hercules, Inc, Allegany Ballistics Laboratory, Cumberland, Md) In *Annual Reliability and Maintainability Symposium, Los Angeles, Calif, January 17-19, 1978, Proceedings* New York, Institute of Electrical and Electronics Engineers, Inc, 1978, p 151-156 8 refs

A system analysis technique applied to a coal gasification process demonstration unit is presented. The technique is illustrated by an example from the gasification process. Parallels of safety analyses and reliability analyses are considered. The efficiency and cost effectiveness of conducting safety and reliability analyses simultaneously is discussed. (Author)

A79-15378 Is there repair after failure H Ascher (U S Navy, Naval Research Laboratory, Washington, DC) and H Feingold (U S Naval Material Command, David W Taylor Naval Ship Research and Development Center, Bethesda, Md) In Annual Reliability and Maintainability Symposium, Los Angeles, Calif, January 17-19, 1978, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc, 1978, p 190-197 21 refs

This paper discusses the basic dissimilarities between repairable and nonrepairable system reliability concepts The methods of statistical analysis and interpretation appropriate to repairable systems reliability data are highly emphasized These methods are applied to most of the repairable system data sets which exist in the literature (to the best of the authors' knowledge) It is shown that appropriate analyses of these data sets often result in drastically different conclusions than those originally obtained Conclusions are drawn concerning future work in this area (Author)

A79-15396 A challenging role for the assurance sciences B Retterer and R Powell (ARINC Research Corp, Annapolis, Md) In Annual Reliability and Maintainability Symposium, Los Angeles, Calif, January 17-19, 1978, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc, 1978, p 330-335 13 refs

The gross economics of large-scale energy conversion are considered, and the role of the assurance sciences in helping to reduce the nation's dependence on imported oil and natural gas is discussed. The use of performance assurance activities to assure plant availability and operability is examined It is recommended that a formal performance assurance program be implemented and that the program should proceed in parallel with more fundamental research directed toward establishing process feasibility M L

A79-15504 * Advanced composites - Future space applications R A Boundy (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In Advanced composites technology, Proceedings of the Conference, El Segundo, Calif, March 14-16, 1978 El Segundo, Calif, Technology Conferences Associates, 1978, p 197-215 20 refs Contract No NAS7 100

Potential applications of composite materials in kilometer-size space systems are reviewed noting the advent of the NASA Space Transportation System Antenna configurations are considered with reference to the 10-m-diam wrapped-rib antenna used on the ATS-6 satellite, a 15-m-diam graphite/epoxy wrapped-rib antenna, and a folding planar array synthetic aperture radar antenna The heliogyro solar sail concept is presented along with solar power station designs based on either photovoltaic arrays or parabolic arrays of flat facets The development of beam fabricators is described S C S

A79-15507 Large filament wound structures for energy and transportation systems O Weingart (Structural Composites Industries, Inc, Azusa, Calif) In Advanced composites technology, Proceedings of the Conference, El Segundo, Calif, March 14-16, 1978 El Segundo, Calif, Technology Conferences Associates, 1978, p 257-271

A review of NASA wind turbine projects is presented noting the 150-ft blade program It is shown that although many components for large wind turbines are similar to commercially available equipment, the development of composite rotor blades for helicopters has been recommended Such blades are described with reference to the filament-wound E glass/epoxy leading edge spar, afterbody panels of paper honeycomb with E-glass cloth skins, and the pultruded trailing-edge spline Prototype spar tooling and equipment is described noting the low-cost steel mandrel, the spar-filament winding machine, and the cure oven S C S

A79-15572 # The improved rigid airship (Das verbesserte Starrschiff) K-D Decker (Neue Zeppelin Gesellschaft mbH, Rorschacherberg, Switzerland) *Deutsche Gesellschaft für Luft- und Raumfahrt, Deutsches Luftschiff-Kolloquium, 4th, Bonn, West Germany, Oct 10, 11, 1978, Paper 7* p In German

The basic characteristics of a family of rigid airships of 70,000 cu m nominal volume are presented These airships use helium as the lifting gas and are driven by turbines operating on blue gas Some of these characteristics are the following overall length - 133.6 m, largest diameter - 33.4 m, propulsion power - 920 kW, cruise speed - 130 km/h, load for 1000 km - 30 t/200 passengers, range with 5000 kg - 11,000 km, fuel consumption over 1000 km - 1622 cu m blue gas Costs of constructing a fleet of five such airships and operating them at 100% load factor for 4500 hr/yr operation are estimated. Profitability increases for larger airships P T H

A79-15574 * Control of wind turbine generators connected to power systems H H Hwang, H V Mozeico (Hawaii, University, Honolulu, Hawaii), and L J Gilbert (NASA, Lewis Research Center, Cleveland, Ohio) In Power system control and protection New York, Academic Press, Inc, 1978, p 239-259 16 refs Research supported by the Hawaii Natural Energy Institute and NASA

A unique simulation model based on a Mode-O wind turbine is developed for simulating both speed and power control An analytical representation for a wind turbine that employs blade pitch angle feedback control is presented, and a mathematical model is formulated For Mode-O serving as a practical case study, results of a computer simulation of the model as applied to the problems of synchronization and dynamic stability are provided It is shown that the speed and output of a wind turbine can be satisfactorily controlled within reasonable limits by employing the existing blade pitch control system under specified conditions For power control, an additional excitation control is required so that the terminal voltage, output power factor, and armature current can be held within narrow limits As a result, the variation of torque angle is limited even if speed control is not implemented simultaneously with power control Design features of the ERDA/NASA 100-kW Mode-O wind turbine are included S D

A79-15575 Operation and control of wind-electric systems R Ramakumar (Oklahoma State University, Stillwater, Okla) In Power system control and protection New York, Academic Press, Inc, 1978, p 261-290 35 refs

The paper examines the operational and control aspects of wind-electric systems referred to as intermittent base-load devices due to power generation by wind blowing alone A brief review of significant past work, future trends and research needs is presented Attention is given to operation fundamentals (constant vs variable speed operation, basic components of a wind-electric conversion system), and to generation schemes classified according to output type and operation mode Several combinations of speeds and outputs for wind energy utilization are proposed, depending on the end use of the electrical energy generated Influential factors and necessary means to control output power for optimum performance are identified and discussed S D

A79-15602 # Coupled heat and organic wastes stream pollution G A Becus (Cincinnati, University, Cincinnati, Ohio) In Developments in theoretical and applied mechanics Volume 9 - Proceedings of the Ninth Southeastern Conference, Nashville, Tenn, May 4, 5, 1978 Nashville, Tenn, Vanderbilt University, 1978, p 543-552 18 refs

A set of three nested one dimensional convection-dispersion equations is used to model the interaction between thermal and organic pollutions in a stream These equations are integrated using a finite difference scheme Results indicate that the discharge of heat in a polluted river accelerates the biodegradation process at the expense of the dissolved oxygen and that the relative change in BOD levels is less than the relative change in DO deficit concentrations (Author)

A79-15625 Self-adjusting laser-target system for laser fusion Iu I Kruzhiin (*Kvantovaya Elektronika* /Moscow/, vol 5, Mar 1978, p 625-631) *Soviet Journal of Quantum Electronics*, vol 8, Mar 1978, p 359-363 8 refs Translation

An analysis is made of methods for increasing the radiation density in laser fusion facilities. The utilization of wavefront reversal by a stimulated-Brillouin scattering (STBS) mirror substantially reduces the requirements for the manufacturing precision of the optical components, structural rigidity, and target feed precision. A detailed analysis is made of the optical and energy characteristics of such a system. Estimates show that a target chamber of approximately 1.5 m radius can be used with a focusing zone of approximately 0.01 cm diameter. (Author)

A79-15672 Power from glaciers - The hydropower potential of Greenland's glacial water. R. Partl (International Institute for Applied Systems Analysis, Laxenburg, Austria). *Energy* (UK), vol 3, Oct. 1978, p 543-573. 39 refs.

The paper analyzes the hydropower potential of water derived from the ice shield in the southern parts of Greenland. Every summer, melting occurs near the coast at heights approximately 1000 m above sea level. The report assesses available resources, analyzes technical problems for the utilization of hydropower and its integration into a global energy system, and provides a preliminary estimate of construction needs and costs. It is expected that 210-360 cu km of water will be available during the summer months at an average altitude of 1000 km, the available water corresponds to energy generation of 460-800 TWh. Large lakes in southwest Greenland would permit water storage for winter power generation, but the absence of lakes in the east might restrict power generation to the summer months. M. L.

A79-15673 Hot dry rock - A new geothermal energy source. J. J. Mortensen (California, University, Los Alamos, N. Mex.). *Energy* (UK), vol 3, Oct. 1978, p 639-644.

A project being conducted by the Los Alamos Scientific Laboratory is attempting to demonstrate the technical and economic feasibility of extracting energy from the hot, dry rock geothermal resource. The system being tested is composed of two deep boreholes drilled into hot, impermeable rock and connected by a hydraulically produced fracture. In September 1977, the circulation loop was closed for the first time and water was circulated through the downhole reservoir and through a pair of 10 MW (thermal) heat exchangers. A series of long-term experiments is planned for 1978 in order to evaluate the thermal, chemical and mechanical properties of the energy extraction system. (Author)

A79-15826 Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D. C., April 3, 4, 1978, Proceedings. Conference supported by the U.S. Department of Energy, Contract No. EG-77 S-04-4094. Salt Lake City, Utah, University of Utah, 1978. 356 p.

Papers are presented on such topics as the processing of instrumented data for the National Solar Heating and Cooling Demonstration Program, collection of data for estimating the probable life cycle costs of solar energy systems, system performance measurements for a packaged solar space heating system equipped with air heating collectors, and a microprocessor monitoring system for a solar energy installation. Consideration is also given to a low cost approach to the performance monitoring of a solar domestic hot water system, sensor selection and placement in the National Solar Data Program, and heat flow instrumentation in the Colorado State University solar houses. B. J.

A79-15827 * # Analysis of data user's needs for performance evaluation of solar heating and cooling systems. D. L. Christensen (Alabama, University, Huntsville, Ala.). In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D. C., April 3, 4, 1978, Proceedings. Salt Lake City, Utah, University of Utah, 1978, p 1-6. 7 refs. Research supported by the U.S. Department of Energy and NASA.

In a successful data acquisition program, the information needs must be evaluated, the design and cost factors of the program must

be determined, and a data management loop must be organized and operated in order to collect, process, and disseminate the needed information in useable formats. This paper describes each of these program elements in detail as an aid for the solar heating and cooling data manager and user to implement effective data acquisition and monitoring systems. Consideration is given to the development of evaluation techniques which will aid in the determination of solar energy systems performances. B. J.

A79-15828 # Collection of data for estimating the probable life cycle costs of solar energy systems. R. B. Stauffer (Dynamics Research Corp., Wilmington, Mass.). In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D. C., April 3, 4, 1978, Proceedings. Salt Lake City, Utah, University of Utah, 1978, p 29-34.

It is shown from the cost equations that a large fraction of the variables which combine to make up the life cycle cost of a solar heating system could, with a reasonable data base, be established with a fair degree of certainty. The limited number of variables which remain can, after simple rearrangement of the terms of the equations, be treated as multipliers or additive factors. In this role they can be tested over a wide range of values for their effect on life cycle cost without the necessity of reevaluating the total package. B. J.

A79-15829 # Acceleration of solar heating application via improved data evaluation. A. E. Scoville (Dynamics Research Corp., Wilmington, Mass.) and D. A. Gillett (Brookhaven National Laboratory, Upton, N. Y.). In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D. C., April 3, 4, 1978, Proceedings. Salt Lake City, Utah, University of Utah, 1978, p 35-38.

The paper discusses progress relating to a coordinated approach to solar system monitoring, data collection, and data base management, with particular reference to the DOE/HUD solar demonstration projects. Several methods of solar data reduction are briefly described, including multiple linear regression, time series analysis, Kalman filtering for parameter estimation, numerical search techniques for parameter optimization, and statistical experimental design using factorial analysis. B. J.

A79-15830 # Technique and instrumentation for measuring the performance of integrated solar heating/cooling systems. C. M. Wolff (Northrop Services, Inc., Houston, Tex.). In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D. C., April 3, 4, 1978, Proceedings. Salt Lake City, Utah, University of Utah, 1978, p 39-54.

A measurement package and technique has been designed to rate a solar system in a manner that will ultimately establish an acceptable rating standard (e.g., ASTM, ASHRAE). The system consists of thermocouples, flowmeters, wattmeters, a pyranometer, humidity transducers (for cooling only), auxiliary electric heaters (230 volt, 6 kilowatt), and a microprocessor based data acquisition/control system. The package will evaluate the following parameters: collector subsystem efficiency and loss rates, fraction of collector subsystem loss attributed to noncollector components, storage capacity and loss rate, distribution system efficiency, distribution system energy delivery as a function of storage temperature and duct return air temperature for heating and cooling, including heat pumps, energy delivered per energy absorbed, and useful per annum energy deliverable by the system. B. J.

A79-15831 # Considerations in choosing solar energy monitoring systems. M. R. Jacobs (Acurex Corp., Mountain View, Calif.). In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D. C., April 3, 4, 1978, Proceedings. Salt Lake City, Utah, University of Utah, 1978, p 55-59.

Low cost microprocessor-based systems have created a new era in solar data collection, monitoring and control. This paper addresses

the general characteristics that should be considered when choosing a monitoring system for a particular application. In addition, two applications and their selected monitoring systems are discussed.

(Author)

A79-15832 # Data acquisition using a modular data logger
R L Woell (North Dakota State University, Fargo, N Dak.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 61-67

A modular data acquisition system is used to monitor the performance of a solar heated building, as well as gather wind and insolation data. The system is very versatile in that it is semi-programmable, field portable, and can store data on cassette tape.

(Author)

A79-15833 # Experience gained and lessons learned from monitoring the solar building, Albuquerque
M W Wildin (New Mexico, University, Albuquerque, N Mex.), E J Hull, E R McLaughlin, and S F Gilman (Pennsylvania State University, University Park, Pa.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 83-94

A79-15834 # The use of computer-controlled data acquisition systems in determining solar heating and cooling system performance
T E Richtmyer (National Bureau of Standards, Center for Building Technology, Washington, D C.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 95-104 5 refs

A79-15835 # System performance measurements for a packaged solar space heating system equipped with air-heating collectors
D E Jones (National Bureau of Standards, Center for Building Technology, Washington, D C.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 105-114

A79-15836 # Instrumentation, data acquisition and monitoring system for an air heating solar system
S Karaki and P R Armstrong (Colorado State University, Fort Collins, Colo.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 115-128 5 refs Contract No E(11-1)-2868

The instruments and components of a data acquisition system used to monitor the performance of Solar House II at Colorado State University are described in this paper. While the calculation of heat flow quantities are elementary, difficulties in obtaining reliable values of air flow velocities and temperatures in a variable state system makes the performance analysis complex. Every system state introduces a different set of variables and when air leakage occurs at different rates with different states, the problems of heat flow calculations and heat balances are compounded. The problem of system monitoring is further made difficult by intermittent malfunction of instruments, the data logger, the processor and power failures. The experiences at Solar House II should be of assistance to other experimenters of solar air-heating systems.

(Author)

A79-15837 # Moderate cost, calculator-based data acquisition for solar HVAC systems
J I Craig and J R Williams (Georgia Institute of Technology, Atlanta, Ga.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 139-147 Research supported by the U S Department of Energy

A79-15838 # A microprocessor based solar monitoring system
W P Moran and G E Kouba (Tulsa, University, Tulsa, Okla.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 183-189

A monitoring and analysis system has been developed around the Heath H-8 microprocessor (Intel 8080 A), the Datal Sinecra 800, 32 channel 12 bit A/D multiplexer and the Intel 8253 programmable interval timer (PIT). Simple linearized thermistors measure temperatures to plus or minus 0.1 C. Flow rates, totals, and time are measured by 18 PIT's.

(Author)

A79-15839 # A microprocessor compatible temperature measuring system
G E Kouba (Tulsa, University, Tulsa, Okla.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 191-195

A low-cost microprocessor compatible temperature measuring system has been developed to provide accurate linearized temperature data over a wide range of temperatures. Details of design and construction are presented along with possible variations.

(Author)

A79-15840 # A microprocessor monitoring system for a solar energy installation
H E Taylor (Stockton State College, Pomona, N J.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 197-205 7 refs Research supported by the Stockton State College

An inexpensive Motorola 6800 microcomputer is used to continuously and automatically monitor the performance of four solar collectors and two heat storage units at Stockton State College's Energy House. The system currently monitors fourteen different temperatures and the insolation. Solid state temperature sensors, an inexpensive A to D Converter, a single multiplexing chip and a digital clock are the essential additions to the computer itself. Overall system cost is about \$1000.

(Author)

A79-15841 # Design of the data acquisition system at Solar One
J H Higgins (Delaware, University, Wilmington, Del.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 207-217

The capabilities and limitations of the data monitoring equipment at the University of Delaware's energy research laboratory, Solar One, are considered. A system description is presented and innovative techniques are described, emphasizing secondary multiplexing, digital recording on cassette tape, and redundancy. The results have application in both the 'scratch' built and off-the shelf type approaches to data monitoring.

B J

A79-15842 # A low cost approach to performance monitoring for the evaluation of a solar domestic hot water system
J Greenstein and J L Lipeles (Aztec Solar Co., Maitland, Fla.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 251-257

A79-15843 # Low-cost monitoring of solar system performance
J Russell (Conserdyne Corp., Glendale, Calif.) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 269-274

This paper describes work done in developing economical methods for metering the energy productivity of small solar domestic

hot water systems The results of an extensive data-collection program using an electromechanical technique to monitor solar system performance are presented and a second all-electronic metering technique is described Standard linear and MOS/LSI integrated circuits are used in the new system to hold costs to a very low level, while providing accuracy comparable to microprocessor-based data acquisition systems (Author)

A79-15844 # Sensor selection and placement in the National Solar Data Program H R Berry and V H Johnson (IBM Corp., Huntsville, Ala) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 291-298

The effective instrumentation of solar energy systems depends greatly on sensor selection and placement Factors such as calibration, versatility, maintainability, and reliability also become important when the monitoring life exceeds five years Commonality of sensors and clearly defined placement techniques provide the basis for an acceptable approach to data monitoring This paper discusses the basic factors that influence sensor selection and placement, and presents the results of operational experience with sensor selection and placement gained thus far in the National Solar Data Program (Author)

A79-15845 # Flow rate calibration for solar heating and cooling system evaluation G E Mattingly (National Bureau of Standards Fluid Engineering Div., Washington, D C) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 299-305 14 refs

A description is given of the flow metering calibration facilities at the National Bureau of Standards that pertain to solar collectors and the instrumentation required to evaluate their performance Alternative methods are also briefly described for obtaining the quantified assurance that the pertinent flow measurements are as good as they are quoted to be Flow metering problem areas are also discussed with suggestions for preventative or remedial action (Author)

A79-15846 # Temperature calibration for solar heating and cooling system evaluation J F Schooley (National Bureau of Standards, Temperature Section, Washington, D C) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 307-311 9 refs

The paper briefly discusses problems associated with the calibration of temperature instrumentation for the performance monitoring of solar systems Emphasis is placed on thermometer calibration services and associated programs available at the National Bureau of Standards Some recommended solutions to problems in the field of solar system thermometry are presented B J

A79-15847 # An inexpensive multiplexer temperature measuring system for monitoring and evaluation of solar collectors R D Evans (Florida Technological University, Orlando, Fla), D Greeley (Martin Marietta Aerospace, Orlando, Fla), and R Martin (Emerson Electric Co., Casselberry, Fla) In Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Washington, D C., April 3, 4, 1978, Proceedings Salt Lake City, Utah, University of Utah, 1978, p 327-334 Research supported by the Florida Solar Energy Center

A79-15849 # External single pass to superheat receiver G C Coleman (McDonnell Douglas Astronautics Co., Huntington Beach, Calif) and J M Friefeld (Rockwell International Corp., Rocketdyne Div., Canoga Park, Calif) *American Institute of Aeronautics and Astronautics and Arizona Solar Energy Research*

Commission, Conference on Solar Energy Technology Status, Phoenix, Ariz., Nov 27-29, 1978, AIAA Paper 78-1751 4 p

The present paper deals with a solar receiver design selected for the nation's first solar power plant The external single-pass-to-superheat multiple panel concept is shown to provide a receiver with a light weight and thermal response consistent with the highly transient nature of insolation and the seismic sensitivity of a tower-mounted central receiver Using modular panel assemblies, the external receiver can be arranged into any geometrical configuration required by system analysis for optimum central receiver performance and lowest system cost V P

A79-15851 # Boosting the performance of solar HVAC systems by improving component interactions A B Newton *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr 3-7, 1978, Paper 13 p*

The paper focuses on those components which are used a little differently in the optimized solar system than they are in the usual conventional system Major items considered are the storage system, the cooling equipment, the cooling tower, and the air handlers More specifically, building load pattern, component performance profiles, storage reactions, piping and ducting, air handler response, sink temperature, ambient range, collector performance map, control strategy, local insolation and cloud patterns, and system response are stressed The discussion points to the importance of recognizing the performance characteristics of all components of solar heating and air conditioning systems, and of providing control strategy to optimize the interactions between components Necessary steps for improved operation and reduced initial cost of solar heating and cooling systems are mentioned S D

A79-15852 # History of solar energy applications - Solar energy yesterday, today and tomorrow J I Yellott *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr 3-7, 1978, Paper 10 p*

It is safe to assume that solar energy will become increasingly important as the alternative sources of energy approach their inevitable exhaustion In the present paper, the history of solar energy research and application is reviewed, starting with the lens-type solar furnaces developed by Lavoisier, two hundred years ago, in France, via the silicon solar cell invented in the early 1950s, to the present, economically most effective system, of direct conversion of solar radiation into electricity V P

A79-15853 # Practical considerations for 'capturing the sun' N A Buckley (Chamberlain Manufacturing Corp., Elmhurst, Ill) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr 3-7, 1978, Paper 14 p*

Several types of solar arrays are described, and solutions to some installation problems are reviewed Problems considered include the logical solar array location, solar array support structure design, array piping and piping insulation, and on-site handling of collector panels Practical applications of solar energy conversion to thermal energy are stressed M L

A79-15854 # Long-term average performance of the Sunpak evacuated-tube collector. G R Mather, Jr and D C Beekley (Owens-Illinois, Inc., Toledo, Ohio) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr. 3-7, 1978, Paper 17 p 8 refs*

Incidence-angle effects are considered for the Sunpak evacuated-tube collector These effects are described in terms of an incidence-angle modifier which is evaluated for diffuse, cylindrical, involute, and V-trough reflector geometries It is shown that the daily-average slope-intercept characteristic upon which long-term performance estimates should be based, is related in a simple manner to the average daily incidence-angle modifier and that this average characteristic can differ significantly from the solar-noon slope-intercept characteristic B J

A79-15855 # Performance of evacuated solar collectors with compound parabolic concentrators. A Rabi (Argonne National

Laboratory, Argonne, Ill) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill , Apr 3-7, 1978, Paper 13 p 18 refs Contract No W-31-109-eng-38*

Compound parabolic concentrators (CPC) achieve the highest possible concentration for a given acceptance angle, permitting geometric concentration ratios up to about 2 in fixed solar collectors and up to about 10 in collectors with day-to day tilt adjustments Design, construction and test results are reported for several CPC collectors with evacuated receivers supplied by Corning Glass, by General Electric and by Owens-Illinois Efficiencies of 45% at Delta T = 150 K above ambient have been reached with a fixed collector This collector accepts more than half of the diffuse radiation in addition to all of the direct beam, for at least seven hours per day (Author)

A79-15856 # Tracking high temperature collectors L L Eldredge (Northrup, Inc , Hutchins, Tex) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill , Apr. 3-7, 1978, Paper 8 p*

The design features and capabilities of the tracking Fresnel lens solar collector for solar air conditioning, heating and process heat applications are described, along with the heliostat/central receiver concentrator and parabolic reflector devices Attention is given to the sun-activated tracking mechanism As an application, the world's largest solar heating and conditioning project at Trinity University is briefly examined, with special emphasis on the utility savings realized during the first months of operation When temperatures of 180-270 F are required for heating, cooling or processing, the tracking concentrator will provide the most cost-effective solar solution to the energy needs S D

A79-15857 # Solar energy for residential housing J H Martin (Sheaffer and Roland, Inc , Chicago, Ill) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill , Apr. 3-7, 1978, Paper 22 p*

An attempt is made to evaluate the feasibility of using energy conservation and solar energy harvesting to produce thermal comfort in residential housing Attention is given to questions of economic feasibility, the quality of life feasibility, aspects of institutional feasibility, guidelines concerning the use of appropriate building surfaces, energy valves and storage, and a sample solution The evaluation shows that carefully conceived energy conservation and harvesting of solar energy for residential buildings is very attractive economically, aesthetically, and institutionally It is found that energy conservation will provide a cost recovery of at least 28%/yr now and probably greater than 65%/yr, five years from now Energy conservation and solar harvest together will provide a cost recovery of at least 12%/yr now, and probably greater than 25%, five years from now The considered measures can reduce energy purchases for housing by 85%. G R

A79-15858 # Solar energy and the flat plate collector - An annotated bibliography F de Winter (Altas Corp , Santa Clara, Calif) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill , Apr. 3-7, 1978, Paper 33 p 130 refs Research sponsored by the Copper Development Association, NSF Grant No AG-502.*

A review is presented of the flat plate collector, emphasizing operation, design, different types of such collectors, utilization, and economics This is followed by a discussion of solar inputs for solar energy equipment, including methods for calculating and measuring terrestrial insolation values The text serves to 'annotate' the large bibliography which follows B J

A79-15859 # Passive solar heating of buildings. J D Balcomb, J C Hedstrom, and R D McFarland (California, University, Los Alamos, Calif) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr. 3-7, 1978, Paper 20 p 9 refs Contract No W-7405-eng-36 (LA-UR-77-1162)*

Passive solar heating concepts - in which the thermal energy flow is by natural means - are described according to five general

classifications direct gain, thermal storage wall, solar greenhouses, roof ponds, and convective loops Examples of each are discussed Passive test rooms built at Los Alamos are described and results are presented Mathematical simulation techniques based on thermal network analysis are given together with validation comparisons against test room data Systems analysis results for 29 climates are presented showing that the concepts should have wide applicability for solar heating (Author)

A79-15860 # Design of active solar heating systems J A Duffie and W A Beckman (Wisconsin, University, Madison, Wis) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill , Apr 3-7, 1978, Paper 33 p 14 refs*

Active solar heating systems to supplement good structural design and passive techniques are discussed Topics include descriptions of some solar heating systems, simulation methods for designing these systems, design of standard configuration systems by use of 'short-cut' design methods, and economic criteria and methods for evaluating solar energy systems Weather data and collector performance parameters are considered, and the use of f-charts is explained M L

A79-15861 # Solar absorption cooling. P Anderson (Arkla Industries, Inc , Evansville, Ind) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill , Apr 3-7, 1978, Paper 15 p*

A solar absorption unit is discussed in terms of refrigerant-absorbent requirements Pressure/temperature concentration charts are given for the water lithium bromide and aqua ammonia cycles Consideration is given to the operating cycle of a gas-fired absorption unit and a water-fired small concentration unit is outlined Three residential installations are discussed with reference to their dimensions, weight, input and output parameters, and heat rejection S C S

A79-15863 # Solar total energy systems T P Whaley (Institute of Gas Technology, Chicago, Ill) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill , Apr 3-7, 1978, Paper 30 p 6 refs*

Solar total energy (STE) systems are solar-electric systems that utilize reject heat from a heat engine or photovoltaic array to provide thermal energy to an application They can be used to provide (in addition to electricity) space heating, space cooling, and hot water to residential, commercial, or institutional applications, or process steam to industrial applications Capital costs are high, however, and considerable reductions in the costs of solar collectors, heat engines, and photovoltaic arrays will be required before market penetration can occur Market penetration is expected first in the industrial sector, and could occur as early as 1990-1995 if projected reductions in the cost of central receiver systems take place (Author)

A79-15864 # Theory of solar assisted heat pumps E Granryd (AGA, Heating Div , Stockholm, Sweden) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill , Apr 3-7, 1978, Paper 25 p 10 refs*

The paper outlines the theory of solar-assisted heat pumps, along with the performance and efficiency characteristics of commonly used heat pumps The concept of solar-assisted heat pump systems is discussed on the basis of a simple illustrative example, and basic schemes are provided Analysis results for the coefficient of performance of heat pump installations in Scandinavia are presented It is concluded that there exist many interesting technical possibilities in combining heat pumps and solar energy systems S D

A79-15865 # Residential and commercial thermal storage H G Lorsch and K W Kauffman (Franklin Institute, Philadelphia, Pa) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill , Apr 3-7, 1978, Paper. 16 p 19 refs*

The choices of thermal storage media and the design and operation of storage devices for the heating and cooling of buildings with solar energy are described Thermal storage by means of

sensible, latent, and chemical energy is defined, and the advantages and disadvantages of each technology for particular applications are contrasted. Present practice in both active and passive solar heating systems uses sensible heat storage in rock or water because of mechanical simplicity and low cost. Latent heat storage using the melting and freezing of solids may be accomplished in one-third to one-fifth of the volume required for water, but high heat transfer costs with latent storage and a past philosophy which over-emphasized low storage medium cost at the expense of poor performance have limited its commercial adoption. It is shown that latent storage is most attractive for passive solar heating. Areas of active research and development on latent and chemical storage are briefly reviewed. (Author)

A79-15868 # Biomass and wastes as energy resources - 1977 update. D L Klass (Institute of Gas Technology, Chicago, Ill.) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr 3-7, 1978, Paper 28 p 20 refs*

Work is continuing to develop processes and systems for the production of synfuels and energy-intensive products from renewable biomass and wastes. An update of the subject is presented in this paper, and selected recent research and commercial developments are summarized. Waste disposal represents an immediate problem and wastes are here now, so combined waste disposal-energy recovery processes are currently receiving the most attention. Biomass production directed specifically to energy applications has not yet been optimized for large-scale systems, and is in the initial development stages. In the long term, wastes offer a small but continuing supply of energy products and synfuels, and biomass can ultimately serve as a major source of supply. The primary problem today is to develop practical, economic system designs and to adapt known conversion processes to particular raw materials. Presuming that the work in progress will successfully achieve this goal, a long-term source of organic fuels as we know and accept them will be assured. There is no apparent reason why this effort should not succeed. (Author)

A79-15869 # An introduction to ocean thermal energy conversion /OTEC/ power plants. R J Pont (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr 3-7, 1978, Paper 23 p 13 refs*

The history and prospects of ocean thermal energy conversion (OTEC) are discussed, and the basic economics of OTEC are examined. An OTEC plant concept is described, some technical and institutional problems affecting OTEC plants are indicated, and possible solutions to the problems are considered. It is suggested that OTEC plants will be cost competitive with conventional plants in the Mexican Gulf region by about 2000. M L

A79-15870 # Wind energy conversion. A A. Fejer (Illinois Institute of Technology, Chicago, Ill.) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr 3-7, 1978, Paper 26 p 18 refs*

Effective utilization of wind energy requires systematic studies of the sites available for the location of wind energy conversion systems and careful evaluation of the type and size of machines to be used. The present paper describes an approach currently in use for the siting of wind generators. It describes also the aerodynamic features of various types of wind machines and indicates the present status of development and prospects of horizontal axis propeller type and vertical axis Darrieus turbines. (Author)

A79-15871 # The photovoltaic effect in CdS/Cu₂S solar cells. K W Boer (Delaware University, SES, Inc., Newark, Del.) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr 3-7, 1978, Paper 31 p 28 refs*

In the present paper, the CdS/Cu₂S solar cell is used as an example to explain the photovoltaic effect in heterojunctions. A self-consistent physical model, developed by Boer (1976, 1978),

which permits quantitative description of the current-voltage characteristics is reviewed and detailed. V.P

A79-15872 # A central receiver solar thermal power system. R L Gervais and R W Hallet, Jr (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr 3-7, 1978, Paper 20 p*

This paper presents an overview of a central receiver solar thermal electric system presently being developed for the United States Department of Energy. The design is distinct in that it uses (1) centrally supported, low-cost heliostats, (2) an external single pass to-superheat receiver, and (3) a sensible heat, thermocline-type thermal storage. In its commercial version, the system is capable of producing 100 MWe and is designed to accommodate peak to intermediate plant operational modes. The principal working medium is water-steam. The system is designed for a 30-year operational life with a 90% plant availability goal. The definition of a 10-MWe Pilot Plant is also presented. (Author)

A79-15873 # Simple procedure for predicting long term average performance of nontracking and of tracking solar collectors. M Collares-Pereira (Chicago, University, Chicago, Ill.) and A Rabl (Argonne National Laboratory, Argonne, Ill.) *Institute of Gas Technology, Energy from the Sun Symposium, Chicago, Ill., Apr 3-7, 1978, Paper 13 p 8 refs* ERDA-supported research

In the present paper, the Liu and Jordan (1963) procedure for calculating long-term average energy collection of plate collectors is simplified and generalized for tracking and nontracking collectors. The only meteorological input needed is the long-term average daily total insolation on a horizontal surface, together with average ambient temperature. In order to obtain the useful energy collected, this meteorological input is multiplied by several factors, which are given in analytical or graphical form. For illustration, the method is applied to a flat plate, a compound parabolic concentrator, and a tracking line focus parabolic reflector. V P

A79-15879 Energy technology V. Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978. Conference sponsored by DOE, EPRI, American Gas Association, and National Coal Association. Edited by R F Hill. Washington, D C, Government Institutes, Inc., 1978. 1076 p \$38

Papers are presented on such topics as particulate and sulfur oxide control options for conventional coal combustion, large-scale thermal energy storage for cogeneration and solar systems, an electric utility perspective on solar heating and cooling, the role and status of dispersed electric utility fuel cell power plants, ocean energy, energy from urban waste, and hybrid fossil-geothermal power plants. Also considered are solar power satellites, SNG production by the Rockgas process, OTEC program status and plans, petroleum plantations, and the fusion-fission energy concept. B J

A79-15880 Geothermal energy from a utility perspective. B W. Colston (San Diego Gas and Electric Co., San Diego, Calif.) In *Energy technology V. Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978* Washington, D C, Government Institutes, Inc., 1978, p 48-60 6 refs

This paper discusses geothermal energy from a utility perspective with emphasis on systems using liquid-dominated resources. The status of development for geothermal energy in the United States and other countries is described, including a discussion of development programs of appropriate organizations such as the Department of Energy and the Electric Power Research Institute. The geothermal program of San Diego Gas and Electric Company is covered, highlighting the Niland Geothermal Loop Experimental Facility and the proposed Heber Geothermal Demonstration Plant. Further, development of geothermal resources in the Imperial Valley of southern California is outlined. Next, the problems, risks and uncertainties associated with commercial geothermal power plants are addressed. Lastly, the economic aspects of geothermal systems are summarized. (Author)

A79-15881 * Large wind turbine generators R L Thomas and R M Donovan (NASA, Lewis Research Center, Cleveland, Ohio) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 64-82 17 refs

The large wind turbine portion of the Federal Wind Energy Program consists of two major project efforts (1) the Mod-0 test bed project for supporting research technology, and (2) the large experimental wind turbines for electric utility applications The Mod-0 has met its primary objective of providing the entire wind energy program with early operations and performance data The large experimental wind turbines to be tested in utility applications include three of the Mod-0A (200 kW) type, one Mod-1 (2000 kW), and possibly several of the Mod-2 (2500 kW) designs This paper presents a description of these wind turbine systems, their programmatic status, and a summary of their potential costs B J

A79-15882 Utility applications of wind power plants W D Marsh (General Electric Co, Electric Utility Systems Engineering Dept, Schenectady, N Y) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 83-96 Research supported by the Electric Power Research Institute

The paper describes the procedures and preliminary results of a study being performed for the Electric Power Research Institute under Project RP-740-1, 'Requirements Assessment of Wind Energy Systems' Three areas have been selected for this study Western Kansas, Northern New York, and Western Oregon It is shown that conventional electric utility planning methods can be successfully adapted to the study of wind power plants While significant capacity credit can be calculated using probability methods, it is yet to be determined if in actual practice such firm capacity will be granted wind power plants Although no study has yet been made of alternate utility characteristics or of wind power design characteristics, it is certain that these are major factors in the impact of wind power plants on utility systems There is little reason to believe that the addition of dedicated storage to a wind power plant improves its economic viability B J

A79-15883 Particulate and sulfur oxide control options for conventional coal combustion R A Byron (Envirotech Corp, Salt Lake City, Utah) and A Saleem (Chemico Air Pollution Control Co, N Y) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27 March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 142 156

It is found that coal precleaning may reduce the particulate and sulfur content of raw coal by 40-50%, but will not generally provide a total solution for emission control Flue gas desulfurization is the only certain option for meeting current and more stringent SO₂ emission standards being contemplated, with several process options available for consideration on a site-specific basis Particulate collection by means of an electrostatic precipitator is well established Fabric filter technology is also being developed and could become a viable option, especially for the collection of fine particulates B J

A79-15884 An overview of solar markets S H Butt (Olin Corp, Stamford, Conn) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 157-164

The direct applications of solar heat are reviewed, including domestic hot water, space heating, air conditioning, and industrial and agricultural process heat Consideration is also given to commercial markets for solar photovoltaics and solar-thermal electric applications B J

A79-15885 Flywheels for vehicles J L Mason (Garrett Corp, Los Angeles, Calif) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 167-175 10 refs Contract No EY-76-C-03-1213

The paper reviews the development of an advanced composite-material flywheel for use in a small electric vehicle The vehicle is powered by lead acid batteries as the primary power source and augmented by the flywheel, which is used to supply the peak power demands during stop-and-go city driving and to store the energy recovered during regenerative braking Attention is given to the flywheel design and to some of the more important performance characteristics and advantages The required high-vacuum environment for the high-speed flywheel is described B J

A79-15886 Large-scale thermal energy storage for cogeneration and solar systems C F Meyer (General Electric Co, Santa Barbara, Calif) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27 March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 176-188 32 refs

Experience with the large-scale aquifer storage of hot water is reviewed and consideration is given to the application of aquifer storage to cogeneration systems and solar systems Three cases of aquifer storage for solar systems are discussed, including continuous injection and continuous withdrawal, intermittent injection and continuous withdrawal, and intermittent injection and intermittent withdrawal First-order heat transfer modeling indicates that heat-recovery efficiencies of 50-80% or more may be achieved through the use of large-scale aquifer storage B J

A79-15887 SRC-II - Review of development and status D M Jackson and B K Schmid (Gulf Mineral Resources Co) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 331-346

Recent experience in large pilot plant operations with the Solvent Refined Coal (SRC) fuel oil process on a variety of high-sulfur bituminous coals has demonstrated the technical feasibility of the process for producing a clean coal-derived fuel oil and byproduct SNG Product characterization and testing of the SRC fuel oil product indicate a potential for displacement of petroleum fuel oil in industrial and utility boilers This paper describes the SRC-II process and gives attention to SRC fuel oil properties, preliminary combustion tests, the SRC module program schedule, and SRC fuels commercialization B J

A79-15888 H-Coal pilot plant project and status of commercial development at Ashland C Hoertz (Ashland Synthetic Fuels, Inc, Ashland, Ky) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27 March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 347 352

The H-Coal pilot plant being built in Kentucky and scheduled for completion in the first quarter of 1979 is sized to process from 250 to 600 tons per day of coal, depending on the reactor space velocity It is intended that pilot plant operation will furnish sufficient data to allow early design and engineering of a commercial H-Coal plant This paper presents the schedule for the pilot plant and considers commercial development of the H-Coal process in terms of an evaluation of product slate and an assessment of production potential B J

A79-15889 Status and outlook of the Exxon Donor Solvent coal liquefaction process development W R Epperly and J W Taunton (Exxon Research and Engineering Co, Bayton, Tex) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C, February 27 March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 353-364

A79-15890 **Solar heating and cooling - An electric utility perspective** D Nathanson (Arthur D Little, Inc, Cambridge, Mass) and J E Cummings (Electric Power Research Institute, Palo Alto, Calif) In *Energy technology V Challenges to technology*, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 370-378 Research sponsored by the Electric Power Research Institute

A preferred solar heating and cooling system both from the standpoint of the consumer and from that of the utility - is one that minimizes the total life-cycle energy costs for a building, encompassing capacity, energy, and transmission and distribution costs on the utility side of the electric meter and equipment costs on the consumer side of the meter. The design of such a system requires a stepwise approach which includes (1) energy conservation measures applied to the building structure and to the heating, ventilating, and cooling equipment, (2) control of electric demand by load management techniques, and (3) installation of a solar system to displace energy resources. System evaluation on the basis of the utility's cost of supply is discussed. B J

A79 15891 **Storage as an energy strategy for utilities** T R Schneider (Electric Power Research Institute, Palo Alto, Calif) In *Energy technology V Challenges to technology*, Proceedings of the Fifth Conference, Washington, D C, February 27 March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 379 386

The benefits that utilities would acquire from energy storage include (1) improvement in baseload plant capacity factor, (2) production cost saving, (3) use as spinning reserve, (4) improved reliability, (5) more efficient load following, and (6) better utilization of transmission systems. Several storage technologies are discussed and compared, including storage with solar energy, hydro pumped storage, compressed air storage, thermal storage, and battery storage. B J

A79-15892 **Electric vehicles challenge battery technology** J L Hartman, E J Cairns, and E H Hietbrink (GM Research Laboratories, Warren, Mich) In *Energy technology V Challenges to technology*, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 387-402 26 refs

The paper reviews battery performance requirements for electric cars and considers the major electric car battery candidates, including Pb/PbO₂, Fe/NiOOH, Zn/NiOOH, Zn/Cl₂, Li/TiS₂/, Na/S, and Li/FeS₂. These candidates are reviewed in terms of performance, durability, and cost. It is suggested that an electric automobile to mix smoothly with existing urban traffic would require a battery of at least 70 W-h/kg. This performance must be accompanied by adequate durability (at least 300 cycles, 100% DOD), and tolerable cost. B J

A79-15893 **A commentary on a methodology for assessment of the environmental impact of the electrical power system within the Connecticut River Basin** C N Shuster, Jr (Federal Energy Regulatory Commission, Washington, D C) In *Energy technology V Challenges to technology*, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 403-420 7 refs

A79-15894 **Role and status of dispersed electric utility fuel cell power plants** J P La Stella (Consolidated Edison Company of New York, Inc, New York, NY) In *Energy technology V Challenges to technology*, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 447-454

This paper reviews the progress of the Consolidated Edison 4.8 MW Fuel Cell Module Demonstrator Implementation Project and discusses its objectives. First, the basic advantages of the fuel cell concept are discussed, including environmental compatibility, dispersed generation, high efficiency and load following capability, and

modularity. Then, the Demonstrator Project is examined with reference to waste heat recovery (cogeneration), water cooling, coal-derived fuels, extended life test, and transmission line credit analysis. B J

A79-15895 **Development of central station power plants integrated with coal gasifiers** J P Ackerman (Argonne National Laboratory, Argonne, Ill) In *Energy technology V Challenges to technology*, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 455, 456

The DOE development program on molten-carbonate fuel cells has as its goal the operation of a coal fueled generator of approximately 50% efficiency before 1990. A number of intermediate milestones must be achieved to provide the technical and economic basis for proceeding with the construction of these 500-MW power plants. Among these are successful operation of smaller, less efficient power plants (1987), testing of molten-carbonate fuel cell stacks on coal gasifier output (1982-1985), and successful operation of small dispersed fuel cell generators retrofitted with molten-carbonate stacks (1983). B J

A79-15896 **SNG production by the Rockgas process** J K Rosemary and C A Trilling (Rockwell International Corp, Atomic International Div, Canoga Park, Calif) In *Energy technology V Challenges to technology*, Proceedings of the Fifth Conference, Washington, D C, February 27 March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 462 471

In the Rockgas process, coal is gasified within a highly turbulent sodium carbonate-based melt in a single-stage gasifier. The gasification is carried out either with air to produce a low-Btu gas or with oxygen and steam to produce a medium-Btu gas, which can be upgraded to substitute natural gas (SNG) by water gas shift, acid gas removal, methanation, and drying. This paper presents a description of the Rockgas process, the experimental results obtained with oxygen and steam gasification, the status of the process development unit, and the preliminary results of the systems study on the production of SNG. It is found that the Rockgas process is capable of generating SNG at competitively high thermal efficiency without byproducts, which otherwise would have to be marketed separately. B J

A79-15897 **Factors influencing solar energy commercialization** B J Walker (Arizona State University, Tempe, Ariz) In *Energy technology V Challenges to technology*, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 473-479 6 refs

The prospects for solar energy commercialization in Arizona are examined. Topics considered include the relative demand potential for selected solar energy products, factors influencing current and future demand for solar energy products, and recommended business and government actions to accelerate commercialization. A Delphi process was used to collect survey data. Water heaters were identified as the solar energy products with the greatest demand potential in 1982 and 1987. The high initial cost of products was cited as the major factor inhibiting current demand for solar energy products, while the high cost of energy was considered to be the main demand stimulating factor. M L

A79-15898 **Solar power satellites revisited** J E Drummond (Power Conversion Technology, Inc, San Diego, Calif) In *Energy technology V Challenges to technology*, Proceedings of the Fifth Conference, Washington, D C, February 27-March 1, 1978 Washington, D C, Government Institutes, Inc, 1978, p 487-498 32 refs

In the present paper, it is argued that a system of low-orbit solar power satellites could be much more cost effective than a system of geostationary solar power satellites. The parameters of this modified system are examined and found to be both necessary and sufficient for an economical utilization of solar power. Since the orbits of the satellites are chosen to be sun synchronous, the system is termed the

Isoinsolation Power System (meaning constant sunlight power system) This IPS modification of the satellite power station appears to be technologically viable and economically attractive V P

A79-15899 Biomimetic approach to solar energy conversion - Artificial photosynthesis J J Katz (Argonne National Laboratory, Argonne, Ill) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 499-510 12 refs

Green plants and certain bacteria use the energy of sunlight to drive chemical reactions that require an energy input to proceed in the desired manner Thus, green plants use solar energy to convert carbon dioxide and water to carbohydrates, proteins, and lipids that are the nutrients for all other living organisms Plants also produce natural fibers, such as cotton and flax, and polymers such as rubber The object of the solar conversion R&D program discussed in the present paper is to devise apparatus and systems for using solar energy for chemical purposes by methods that mimic those used by photosynthetic organisms Progress which has been made in the understanding of plant photosynthesis, sufficient to make artificial photosynthesis a reasonable goal, is reviewed V P

A79-15900 Materials problems and opportunities in coal conversion systems J Stringer (Electric Power Research Institute, Palo Alto, Calif) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 527-539 13 refs

In the present paper, some problem areas in the selection of construction materials for advanced coal conversion systems are reviewed It is seen that neither the 'pure materials' approach, nor the 'pure design' approach alone can provide a satisfactory solution to a given problem The need for a collaboration between the materials engineer and the design engineer is indicated In many cases, the limitations of existing materials place constraints on processes which are being developed It is important that these limitations and their economic consequences be recognized at an early stage in order to decide whether a particular technology should be abandoned or the development of new materials should be undertaken The lead-in time associated with the development of new materials can be as long as 10 and even 15 years and, therefore, areas requiring development of new materials should be identified as early as possible V P

A79-15901 Materials problems in solar, nuclear and storage of energy R S Claassen (Sandia Laboratories, Albuquerque, N Mex) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 540-553 Research supported by the US Department of Energy

Virtually all elements of the energy program involve materials problems because of cost, high temperatures, corrosive environments, and radiation effects Some of the energy technologies being developed exceed existing material capabilities In the present paper, the current status of the technologies of solar and nuclear power production and storage is reviewed, and some major problems associated with these technologies are illustrated by examples Some suggestions are made for material developments required to meet the stringent demands posed by water-cooled and breeder reactors and, particularly, by fusion reactors V P

A79-15902 OTEC program status and plans S Gronich (US Department of Energy, Div of Solar Technology, Washington, D C) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27 March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 554-575

In the past year, significant tests have been conducted on the thermal performance of heat exchangers, biofouling rates, cleaning and corrosion Results of those tests will be presented In addition,

major system studies are being conducted on the power subsystems, platform and cold water pipe, and electric cables Subsystem cost goals will be projected for each of these, and the relative economics of OTEC will be compared with those of more traditional baseload power systems Future program-plan options and assessments will be presented (Author)

A79-15903 Market penetration for OTEC R Cohen (US Department of Energy, Div of Solar Technology, Washington, D C) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 576-587

Ocean Thermal Energy Conversion (OTEC) offers two basic options electricity for transmission to shore by submarine cable and also for the production of energy-intensive products, such as ammonia, hydrogen, and aluminum In the present paper, the potential of OTEC in helping to meet our energy requirements is assessed with particular reference to the ocean thermal resources available in the Gulf of Mexico The markets which this OTEC power production can penetrate are examined V P

A79-15904 Incentives and requirements for gasification based power systems N A Holt (Electric Power Research Institute, Palo Alto, Calif) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 588-605 7 refs

The main incentives for the use of gasification based power systems over other coal based generating systems such as direct coal firing with stack gas scrubbing are markedly reduced emissions, better resource utilization, competitive capital cost, and cost of power The present analysis leads to the conclusion that the integrated gasification fuel cell combined cycle is superior to other gasification based power systems Its principal advantages are attractive economics and resource utilization, high potential for future improvement, and advanced status of the subsystem technology V P

A79-15905 Integrated low Btu gasification, combined cycle plant considerations and control D J Ahner (General Electric Co, Fairfield, Conn) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 606-617

Integrated low-Btu gasification is considered noting the performance of the gasification/gas cleaning process, the requirements of the turbine and steam controls, the startup/shutdown sequence, provisions for various contingencies (loss of electrical load or components), and power system requirements Individual control requirements and response characteristics are considered in terms of the components operating in an integrated plant mode Estimates are made of unit response requirements and capability in terms of unit commitment, daily load following, tie-line thermal backup, and frequency regulation Attention is given to a digital model of an integrated fixed bed combined cycle plant noting system response to a 1% step reduction in the system electrical load S C S

A79-15906 10-megawatt solar central receiver pilot plant J L Rasband (Southern California Edison Co , Rosemead, Calif) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 618-620

The paper describes a 10-megawatt solar thermal plant planned to begin operation in 1980 or 1981 The pilot plant, a cooperative effort of government and private industry, uses a central receiver and will be tested for five years Two thousand heliostats with a reflective area of 40 square meters per heliostat will be arranged in an ellipse which is about 2600 feet at the major axis and 2300 feet at the minor axis The receiver/boiler will use a once-through design with

rated steam conditions of 970 F and 1515 psia Total estimated cost is approximately \$100-120 million M L

A79-15907 Status of photovoltaic systems and applications. D G Schueler (Sandia Laboratories, Albuquerque, N. Mex) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 621-628 6 refs Research supported by the US Department of Energy

The paper discusses conceptual design and analysis studies of photovoltaic conversion systems intended for residential and central generation stations Some currently operating or planned application experiments, which range in size from a few hundred watts to 0.5 megawatts, are reviewed Unit and subsystem costs are considered The Department of Energy's Photovoltaic Conversion Program is described. M L

A79-15908 Ocean energy unlimited D D Woodbridge In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 664-674

An ocean swell and wave energy converter (OSWEC) is described The converter utilizes the vertical component of wave or swell motion by means of a 'slinky' coil attached at one end to a stable structure and at the other end to a floating mechanism Current is generated as the expanding or contracting coil passes through a magnetic field Energy production obtained from oscillating coil and fixed coil OSWEC systems is determined, and a wave amplification OSWEC system is explained It is suggested that a 3-megawatt OSWEC be combined with a 1-megawatt solar energy collection system in a 100-m-diameter complex M L

A79-15909 Solar engines - The thermal wheel and beyond A Crawford and R L. Hough (Hough Laboratories, Springfield, Ohio) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc., 1978, p 675-686 6 refs

The paper examines the feasibility of using the thermal wheel for power generation The thermal wheel produces torque when a thermal gradient is imposed on a vertically disposed configuration such that the lower portion of the wheel is warm with respect to the upper portion Working fluid, fluid flow pattern, fluid hydraulics, and thermal gradient are considered, and estimates of power output and operation economics are presented M L

A79-15910 Petroleum plantations M Calvin (California, University, Berkeley, Calif) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc., 1978, p 687-705 32 refs Research sponsored by the US Department of Energy

Photosynthesis is examined as a possible annually renewable resource for material and energy. The production of fermentation alcohol from sugar cane as a major component of materials for chemical feedstocks is examined as well as the direct photosynthetic production of hydrocarbon from known plant sources Experiments are underway to analyze the hydrocarbons from Euphorbias, Asclepias and other hydrocarbon-containing plants with a view toward determining their various chemical components Work is also underway on the development of chemical process techniques for the extraction of plant materials after harvesting In addition, efforts are being made to construct synthetic systems on the basis of our knowledge of the natural photosynthetic processes These systems could be used to produce fuel, fertilizer and power (Author)

A79-15911 Materials and economics of energy systems H E Frankel and S J Dapkunas (US Department of Energy, Washington, D C) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , Feb-

ruary 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 726-737 5 refs

It is suggested that the development of energy sources is restricted by limitations in the characteristics of presently available materials The developmental status of several energy technologies is considered The technologies of MHD, solar electric power, and fusion are dependent on either new materials or innovative designs or some combination of these two The economic feasibility of a coal conversion process is directly linked to plant characteristics which in turn are affected by material capabilities The importance of more intensive research for developing improved construction materials is indicated M L

A79-15912 Production and use of low and medium Btu gas R D Patterson and C A Bolez (Gilbert Associates, Reading, Pa) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 738-755 5 refs

The market for low Btu gas has become a reality for the industrial sector during 1977 It is projected that by early 1979, some ten to fifteen privately funded industrial coal gasification plants, consuming 3000 tons of coal per day, will be under design The present paper deals with some aspects of the production and application of low and medium Btu gas as an industrial fuel Specifically, the question of choosing between low and medium Btu gas is examined from a size and economic point of view V P

A79-15913 Perspective on the fusion-fission energy concept R C Liikala, R T Perry, and V L Teofilo (Battelle Pacific Northwest Laboratories, Richland, Wash) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 769-785 12 refs Contract No EY-76-C-06-1830

The paper deals with the concept of combining fusion and fission technology which appears to have potential for near-term application in the electric power sector of our energy economy The fusion-fission system is distinguished from its pure fusion counterpart by incorporation of fertile materials (uranium or thorium) in the blanket region of a fusion machine The neutrons produced by the fusion process can be used to generate energy through fission events in the blanket, or produce fuel for fission reactors through capture events in the fertile material The discussion indicates that the performance requirements for the fission component of hybrids are less stringent than those for pure fusion electric power plants The performance requirements for the fission component of hybrids have been essentially demonstrated The need for a modest investment of R&D funds is indicated V P

A79-15914 Power generation using thermal vapor pumping and hydro-pumped storage - Thermal gradient utilization cycle /TGUC/ S A Parker (21st Century Power Generation Co , Fort Worth, Tex) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 786-795

It is suggested that the described thermal gradient utilization cycle (TGUC) can be used to replenish an elevated water reservoir used for power generation TGUC, which utilizes the vertical temperature difference in the atmosphere, is a closed loop system involving the pumping of thermal vapor to a higher elevation, the vapor condenses at this elevation, and power is derived by a conventional hydro-prime mover along with a conventional regenerative Rankine Cycle Similarities and differences between TGUC and ocean thermal energy conversion are noted M L

A79-15915 New concepts in waste utilization and biomass. P F Bente, Jr In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D C , February 27-March 1, 1978 Washington, D C , Government Institutes, Inc , 1978, p 796-803

The present paper reviews some highlights in the rapidly developing field of bioenergy, i.e., the solar energy stored up in plant matter by the photosynthesis process. Particular attention is given to some remarkable research work that was carried out with euphorbia trees which produce a hydrocarbon-rich sap. V P

A79-15916 Industrial wastes to energy J F Collins (U.S. Department of Energy, Alternative Materials Utilization Branch, Washington, D.C.) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D.C., February 27-March 1, 1978. Washington, D.C., Government Institutes, Inc., 1978, p 804-807

In the past, with a few exceptions, waste organic materials from industrial processes were considered only from the viewpoint of disposal. Below-specification polymers, for example, were land filled or even incinerated. On the other hand, the paper pulp industry has achieved high rates of residuals utilization. Initially, however, this was to recover high value chemicals for reuse in the paper making process. This objective has now been extended to include the use of waste for energy production, so that some new paper/pulp mills will become completely energy independent - deriving all fuel needs from wood wastes and spent pulping liquors. Some aspects of this program are examined in the present paper. V P

A79-15917 Energy from urban waste J F Bernheisel (National Center for Resource Recovery, Inc., Washington, D.C.) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D.C., February 27-March 1, 1978. Washington, D.C., Government Institutes, Inc., 1978, p 808-816 5 refs

About one quad of the country's energy requirement could be displaced if urban waste were fully utilized. The technology for achieving this is in an initial stage of development, with many technical approaches needing testing. It is seen that at least 10 years development and operation will be required before the industry matures. In the meantime, the stimuli which encourage urban waste recycling (stringent waste disposal standards, rising energy costs, and available capital) must continue if resource recovery is to succeed without direct subsidy. V P

A79-15918 Solid waste and coal firing in industrial boilers J H Fernandes and G J Prohazka (Combustion Engineering, Inc., Windsor, Conn.) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D.C., February 27-March 1, 1978. Washington, D.C., Government Institutes, Inc., 1978, p 882-888 10 refs

In the present paper, it is shown that municipal refuse can be prepared for firing in utility and industrial type boilers as a supplement to other fuels. Approximately 2.3 pounds of refuse-derived fuel will conserve 1 pound of coal. Efficient combustion is possible with suspension or semisuspension firing in many existing furnaces of conventional design. Emissions from burning solid fuels can be controlled adequately with existing technology. V P

A79-15919 Advanced processes for more efficient use of forest products residual material D. R. Raymond (Weyerhaeuser Co., Gig Harbor, Wash.) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D.C., February 27-March 1, 1978. Washington, D.C., Government Institutes, Inc., 1978, p 907-918

The generation of energy in the pulp, paper, and forest products industry is accomplished by a number of technologies. These include self-generation of hydro and hydroelectric power, the burning of bark, the burning (and chemical recovery) of spent pulping liquors, and the burning of hog (shredded) wood wastes. In the present paper, the status of these technologies is reviewed, and the need for further research and development work in this field, including new forest management systems, harvesting and transportation systems, and energy conversion systems is pointed out. V P

A79-15920 Hybrid fossil-geothermal power plants H E Khalifa, R DiPippo, and J Kestin (Brown University, Providence, R.I.) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D.C., February 27-March 1, 1978. Washington, D.C., Government Institutes, Inc., 1978, p 960-970 14 refs Contract No EY-76-S-02-4051

The concept of hybrid utilization of fossil and geothermal energy is discussed. The concept is applied to two types of plant: the geothermal-preheat hybrid and the fossil-superheat hybrid. In the first, the geothermal fluid is used for preheating the feedwater in a Rankine steam power cycle; in the second, steam produced by flashing a geothermal fluid is superheated in a fossil-fired superheater. Results are given for a typical case of a geofluid at 200°C, and show that a geothermal-preheat hybrid plant can produce 4% more work than could be obtained from using the fossil fuel in a state-of-the-art power plant, or 60% more work than a state-of-the-art geothermal plant could yield, for the same input. For the fossil-superheat hybrid plant, the corresponding figures are 26% for fossil usage and 8% for geothermal usage. (Author)

A79-15921 Increasing the efficiency of coal-fired steam electric plants with thermionic topping O S Merrill (U.S. Department of Energy, Div. of Advanced Systems and Materials Production, Washington, D.C.), M Gunn (U.S. Department of Energy, Div. of Power Systems, Washington, D.C.), F N Huffman (Thermo Electron Corp., Waltham, Mass.), and G O Fitzpatrick (Rasor Associates, Inc., Sunnyvale, Calif.) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D.C., February 27-March 1, 1978. Washington, D.C., Government Institutes, Inc., 1978, p 971-978

A major reason for the waste in available fuel energy of present electric power plants is the narrow range of temperatures (1000 to 100 F) over which they operate. In the present paper, it is shown that thermionic energy conversion has considerable promise for fuel conservation as a topping cycle for central station power plants. It has a relatively high probability of success based on an established high-temperature technology, a history of steady improvement, and well-defined technical approaches to the electrode and plasma technologies aimed at improving performance. Furthermore, thermionic energy conversion development costs appear to be moderate compared to alternative topping systems, such as MHD and potassium Rankine cycles. V P

A79-15922 Coal-based electricity and air pollution control - A case for solvent refined coal W B Harrison. In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D.C., February 27-March 1, 1978. Washington, D.C., Government Institutes, Inc., 1978, p 1002-1007

A79-15923 Commercialization of fluidized-bed combustion systems by the State of Ohio E K Johnson, R S Ryan (Ohio Department of Energy, Columbus, Ohio), and A J Grant (Babcock Contractors, Inc., Pittsburgh, Pa.) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D.C., February 27-March 1, 1978. Washington, D.C., Government Institutes, Inc., 1978, p 1008-1016

A79-15924 Westinghouse fluidized bed coal gasification system - Experience and plans J D Holmgren and L A Salvador (Westinghouse Electric Corp., Pittsburgh, Pa.) In Energy technology V Challenges to technology, Proceedings of the Fifth Conference, Washington, D.C., February 27-March 1, 1978. Washington, D.C., Government Institutes, Inc., 1978, p 1017-1021. Research supported by the U.S. Department of Energy.

A79-15925 Hydrogen economy - An alternative B C. Campbell (Billings Energy Corp., Provo, Utah) In Energy technology V Challenges to technology, Proceedings of the Fifth Confer-

ence, Washington, D C, February 27-March 1, 1978
Washington, D C, Government Institutes, Inc., 1978,
p 1036-1041 14 refs

Various aspects of hydrogen-based energy are reviewed Attention is given to the hydrogen cycle, to methods of hydrogen production (chemical processing of hydrogen-bearing feedstocks, electrochemical water splitting, and direct thermochemical decomposition of water), storage, distribution, and safety features of hydrogen energy, and hydrogen applications and economics It is noted that the use of hydrogen fuel opens the way for decentralized energy production, in terms of both location and method B J

A79-16074 Opportunities for direct use of geohat in Central America and other tropical countries. S S Einarsson (United Nations, Office of Technical Cooperation, New York, N Y) *Geothermics*, vol 6, no 3-4, 1977, p 209-219 13 refs

Applications of geohat are surveyed with attention to technical constraints, and the use of geohat in Central America is considered Geothermal fields associated with volcanism have been found in each Central American country, more than 30 fields have been identified, while the potential of thermal springs has not been investigated Applications of geohat in the cane sugar industry and in the pulp and paper industries are discussed Use of geohat would permit bagasse to be used as a raw material rather than as a fuel It is estimated that the energy saved by potential geohat applications in Central America could be equivalent to millions of barrels of petroleum M L

A79-16075 A comparison of the silica and Na-K-Ca geothermometers for thermal springs in Utah P T Kolesar and J V Degraff (Utah State University of Agriculture and Applied Science, Logan, Utah) *Geothermics*, vol 6, no 3-4, 1977, p 221-226 13 refs

Temperatures determined by silica geothermometers and by Na-K-Ca geothermometers were found to differ by as much as 25 C when the temperatures of hot springs in Utah were measured The requirements for accurate temperature determination by chemical geothermometers are considered, and some of the temperature discrepancies are attributed to the mixing of hot and cold water It is suggested that the geology of the areas in which the springs arise should also be taken into account M L

A79-16076 Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex, April 18-20, 1978 Meeting sponsored by the Institute of Environmental Sciences Mount Prospect, Ill, Institute of Environmental Sciences, 1978 531 p \$22

Papers are presented on reliability development, Combined Environment Reliability Tests (CERT), and CERT equipment Consideration is also given to the fields of environmental planning and management, water and air quality assessment, and to such energy-related issues as the future role of petroleum, advanced solar systems, alternative energy sources, and the qualification of nuclear power plant components Also considered are digital control in reliability testing, dynamic test techniques, noise abatement procedures, combined climatic environments, and electromagnetic interference and compatibility B J

A79-16077 # Energy/environment technology areas to be developed S R Reznick (U S Environmental Protection Agency, Washington, D C) In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex, April 18-20, 1978 Mount Prospect, Ill, Institute of Environmental Sciences, 1978, p 1-7 6 refs

The status of energy technology and environmental needs is discussed with reference to energy extraction, conventional coal combustion, emerging energy technology, and health and ecological impacts The importance of a comprehensive multifaceted assessment

program in order to understand the potential impact of emerging technologies is emphasized In order for the program to be successful the following must be characterized and understood residuals, control techniques, transport and transformation phenomena, and health and ecological impacts B J

A79-16091 # Clean Air Act amendments of 1977 and the impact on control efforts J Divita (U S Environmental Protection Agency, Dallas, Tex) In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex, April 18-20, 1978 Mount Prospect, Ill, Institute of Environmental Sciences, 1978, p 135-138

While the 1977 amendments gave time extensions of five to ten years for attainment of air quality standards, they imposed many strict requirements on the development and adoption of state implementation plans, the implementation of the prevention of the significant deterioration program (SDP), and the development of additional new source performance standards (NSPS) The amendments are also very specific on such things as the designation of the attainment status of each area, compliance orders, primary nonferrous smelter orders, stack heights, and permit requirements B J

A79-16098 # Co-disposal of sewage sludge using refuse-derived fuel H L Kaufman and L M Grillo (Clinton Bogert Associates, Fort Lee, N J) In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex, April 18-20, 1978 Mount Prospect, Ill, Institute of Environmental Sciences, 1978, p 204-208

The potentially valuable technique of using refuse-derived fuel for disposal of sewage sludge is described, with discussion of the capabilities of current technology Emphasis is placed on the benefits of combining disposal of troublesome waste products with generation of fuel cheaper than fossil substances now used Possible problems with hardware and sludge burning are discussed, and alternative approaches to co-disposal, and their possible value, are characterized (Author)

A79-16100 # Time, technology and capital - Do we have enough to solve the energy crisis G Dutton In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex, April 18-20, 1978 Mount Prospect, Ill, Institute of Environmental Sciences, 1978, p 257-264 5 refs

The paper presents an analysis of (1) available domestic energy resources, (2) the state of the technology utilized in converting these resources to usable fuels, (3) the time necessary to bring on additional supplies in meaningful quantities, (4) the required capital investment, and (5) the prices necessary to generate such investments It is shown that restraints hindering the timely development of adequate domestic energy sources are primarily economic and environmental, including restricted access to public lands The elimination of these restraints is dependent on the legislative process and the development of a viable national energy policy B J

A79-16101 # Net energy analysis and environmental aspects for solar tower central receiver systems I - Methodology A C Meyers, III and A F Hildebrandt (Houston, University, Houston, Tex) In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex, April 18-20, 1978 Mount Prospect, Ill, Institute of Environmental Sciences, 1978, p 267-270 10 refs

Solar towers or central receivers with heliostat concentrator fields have been proposed for use as commercial electric power production systems But before these plants can be built, net energy and environmental impact studies must be done Net energy analysis is now mandated by law for all new alternative energy systems This

paper considers the various net energy factors, gross energy production, net energy production and the energy amplification factor (EAF) This first part provides the background necessary to do the net energy analysis and to identify the environmental aspects for many different systems (Author)

A79-16102 # Thermal gradient-hydro generation cycle /TGUC/ S A Parker (Century Power Generation Co., Fort Worth, Tex.) In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex., April 18-20, 1978 Mount Prospect, Ill., Institute of Environmental Sciences, 1978, p 271-277

The described thermal gradient utilization cycle (TGUC) makes use of the vertical atmospheric temperature difference TGUC is a closed loop system Thermal vapor is pumped to higher elevations where condensation occurs, and power is derived by a conventional hydro-prime mover along with a conventional regenerative Rankine cycle TGUC and ocean thermal energy conversion are contrasted, in oceans the thermal gradient is warmest at the top of the ocean, while in the atmosphere air is warmest near the ground surface M L

A79-16103 * # Hail risk model for solar collectors C Gonzalez (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex., April 18-20, 1978 Mount Prospect, Ill., Institute of Environmental Sciences, 1978, p 278-286 27 refs Contract No NAS-7-100

This report presents the results of a study assessing the probability of solar arrays being struck by hailstones of various sizes as a function of geographic location and service life The study complements parallel studies of solar array sensitivity to hail damage, the final objective being an estimate of the most cost effective level for solar array hail protection A key element of this study involves the generation of a statistical model describing the probability of impact by hailstones of various sizes and estimating the mean time between hits (Author)

A79-16104 # Verification of wedge concentration using a helium neon laser M H Cobble and E F Thacher (New Mexico State University, Las Cruces, N Mex.) In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex., April 18-20, 1978 Mount Prospect, Ill., Institute of Environmental Sciences, 1978, p 287-290

On the basis of multiple reflections, the concentration of a wedge is given, noting an expression for the concentration ratio as a function of the wedge half angle and the included angle of incidence Predicted values of approach angles, points of contact, and concentration ratios are compared to experimental data using a helium neon laser as a collimated beam It is noted that the wedge yields high concentration for small wedge angles and that for a given included angle of incidence, tracking is not required S C S

A79-16105 # Solar-earth homes and cities D Secrist (Solar-Earth Energy, Inc., Columbus, Ohio) In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex., April 18-20, 1978 Mount Prospect, Ill., Institute of Environmental Sciences, 1978, p 291-297

The paper describes a solar-heated in-ground dwelling located in Ohio with reference to wintertime performance Comparative costs and maintenance requirements are given for in-ground and above-ground solar-heated dwellings It is noted that in-ground dwellings, aside from being less costly, are more secure against utility outages, wind, fire, and theft S C S

A79-16106 # Hot dry rock, an abundant clean energy resource B R Dennis (California, University, Los Alamos, N Mex.) In Combined environments Technology interrelations, Proceedings

of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex., April 18-20, 1978 Mount Prospect, Ill., Institute of Environmental Sciences, 1978, p 300-306 8 refs

The paper deals with a demonstration project of the hot rock heat extraction concept In the technique discussed, a man made geothermal reservoir is formed by drilling into an identified region of impermeable hot rock and creating a very large surface area for heat transfer by means of large-scale hydraulic fracturing techniques A circulation loop is formed by drilling a second hole and steering it (by directional drilling techniques) to intersect the fractured region Cold water injected into the deeper hole is heated by the rock during its flow through the fractured region The heated water is brought to the surface through the second hole by the natural buoyancy of hot water The energy extracted at the surface is used directly as heat or to produce electric power Some experience gained in this project is discussed V P

A79-16107 # A proposed conceptual plan for integration of wind turbine generators with a hydroelectric system S J Hightower and A W Watts (US Department of the Interior, Bureau of Reclamation, Denver, Colo.) In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex., April 18-20, 1978 Mount Prospect, Ill., Institute of Environmental Sciences, 1978, p 307-309-D

The paper is concerned with performance, cost, and marketing aspects of a large windpower system integrated with an existing hydroelectric network According to this proposal, power from approximately 49 wind turbines arrayed at a site near Medicine Bow, Wyoming (a very windy place) would be integrated with the existing hydroelectric system within the Colorado River Storage Project Generation at the hydropower plants would be reduced by an amount equal to the power generated by wind turbines An innovative marketing plan which takes into account the variability and high cost of wind power is described, and environmental considerations are examined M L

A79-16116 * # Simulated hail impact testing of photovoltaic solar panels D Moore, A Wilson, and R Ross (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Combined environments Technology interrelations, Proceedings of the Twenty-fourth Annual Technical Meeting, Fort Worth, Tex., April 18-20, 1978 Mount Prospect, Ill., Institute of Environmental Sciences, 1978, p 419-430 13 refs

Techniques used to simulate and study the effect of hail on photovoltaic solar panels are described Simulated hail stones (frozen ice spheres projected at terminal velocity) or steel balls were applied by air guns, gravity drop, or static loading Tests with simulated hail and steel balls yielded different results The impact strength of 10 commercially available flat-plate photovoltaic modules was tested It was found that none of the six panel designs incorporating clear potting silicone material as the outermost layer remained undamaged by 1-in simulated hailstones, while a photovoltaic module equipped with a 0.188-in-thick acrylic cover sheet would be able to withstand the impact of a 2-in-diameter hailstone M L

A79-16120 A multivariate-utility approach for selection of energy sources S Ahmed and A A Hussein (Iowa State University of Science and Technology, Ames, Iowa) *Energy (UK)*, vol 3, Dec 1978, p 669-700 31 refs Research supported by the Iowa State University of Science and Technology

A deterministic approach is devised to compare the safety features of various energy sources The approach is based on multiattribute utility theory (MAUT) The method is used in evaluating the safety aspects of alternative energy sources used for the production of electrical energy Four alternative energy sources are chosen which could be considered for the production of electricity to meet the national energy demand These are nuclear, coal, solar, and geothermal energy For simplicity, a total electrical system is considered in each case A computer code is developed to

evaluate the overall utility function for each alternative from the utility patterns corresponding to 23 energy attributes, mostly related to safety. The model can accommodate other attributes assuming that these are independent. The technique is kept flexible so that virtually any decision problem with various attributes can be attacked and optimal decisions can be reached. The selected data resulted in preference of geothermal and nuclear energy over other sources, and the method is found viable in making decisions on energy uses based on quantified and subjective attributes. (Author)

A79-16121 A comparative analysis of three of ERDA's major R & D programs. J P Weyant (Harvard University, Cambridge, Mass.) *Energy (UK)*, vol 3, Dec 1978, p 701-735. 35 refs. Research supported by the Rand Corp., and the University of California.

The paper describes a model which considers technologies as integral elements of the total US energy system rather than as isolated entities. The model, which is applied to a study of three ERDA research and development programs, simulates the dynamics of the evolution of the total energy system by requiring both existing and new technologies to compete for introduction (i.e., commercialization) on a cost-competitive basis. The three programs involve the liquid-metal fast breeder reactor, synthetic fuels derived from coal and shale, and improved efficiencies for end-use devices (e.g., space heaters). The relation between synfuels commercialization and the introduction of more efficient end-use devices is discussed. M.L.

A79-16122 A methodological note on the evaluation of new technologies - The case of coal gasification. D L Kaserman (Oak Ridge National Laboratory, Oak Ridge, Tenn.) *Energy (UK)*, vol 3, Dec 1978, p 737-745. 12 refs. Contract No. W-7405-eng-26.

The traditional methodology of engineering cost analysis employed in the evaluation of emerging technologies implicitly assumes an economic independence between output and factor markets. For certain processes currently under investigation in the energy area (e.g., coal gasification), this assumption is violated. As a result, a bias is introduced into the process evaluation procedure by use of the conventional methodology. This paper proposes and demonstrates a simple revised methodology that incorporates an economic analysis of the relevant cross-market price effect with the engineering cost results to correct this bias. (Author)

A79-16126 Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings. Congress sponsored by the Canaveral Council of Technical Societies. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978. 216 p. \$25.

Papers are presented on the current status of space transportation, technology transfer from Federal laboratories to the public and private sectors, solar energy utilization, and energy management and conservation. Consideration is also given to future space programs (e.g., space industrialization and advanced space transportation systems), NASA technology utilization programs, and advanced space technology (e.g., space power systems and large-area space systems). B.J.

A79-16130 Technology transfer at Department of Energy laboratories - Selected case studies from the Lawrence Livermore Laboratory. D W Dorn (California, University, Livermore, Calif.) In *Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings*. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978, p 2-14 to 2-18. 6 refs. Contract No. W-7405-eng-48.

A79-16132 An economist looks at solar energy - The government's role. E J Roseman (U.S. Department of Energy, Washington, D.C.) In *Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings*. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978, p 3-1 to 3-6. 8 refs.

The paper places solar energy in the context of a marketplace for energy and justifies the role of government in influencing solar

energy market development and market penetration. Consideration is also given to the concept of commercialization with respect to solar energy, the effect of government incentives, and the proper timing of government involvement. B.J.

A79-16133 * Identification of cost effective energy conservation measures. H S Bierenbaum (Planning Research Corp., Cocoa Beach, Fla.) and W H Boggs (NASA, Kennedy Space Center, Cocoa Beach, Fla.) In *Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings*. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978, p 3-13 to 3-21.

In addition to a successful program of readily implemented conservation actions for reducing building energy consumption at Kennedy Space Center, recent detailed analyses have identified further substantial savings for buildings representative of technical facilities designed when energy costs were low. The techniques employed for determination of these energy savings consisted of facility configuration analysis, power and lighting measurements, detailed computer simulations and simulation verifications. Use of these methods resulted in identification of projected energy savings as large as \$330,000 a year (approximately two year break-even period) in a single building. Application of these techniques to other commercial buildings is discussed. (Author)

A79-16134 Current solar applications and economics. D E Root. In *Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings*. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978, p 3-22 to 3-35. 36 refs.

The paper reviews some important considerations relating to the evaluation of alternative energy sources. These considerations include a review of the status of simple solar harvesting techniques, and direct economic comparisons and socioeconomic ramifications of several of the most promising solar alternatives. Particular consideration is given to solar water heating system designs, and to solar space heating and air conditioning. B.J.

A79-16135 * The Solar Heating and Cooling Commercial Demonstration Program at Marshall Space Flight Center - Some problems and conclusions. R L Middleton (NASA, Marshall Space Flight Center, Huntsville, Ala.) In *Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings*. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978, p 3-36 to 3-54. 13 refs.

The origin and evolution of the Solar Heating and Cooling Commercial Demonstration Program by the Department of Energy and the Marshall Space Flight Center activities supporting this program from its conception are defined and discussed. Problems are summarized in the design and financial areas. It is concluded that the program has significantly assisted the creation of a viable solar testing and cooling industry. The cost effective procedures evolving from the program are expected to make a major contribution to reducing the effective life cycle cost of solar installation. (Author)

A79-16136 Large-scale human benefits from the industrialization of space. C L Gould (Rockwell International Corp., El Segundo, Calif.) In *Space Congress, 15th, Cocoa Beach, Fla., April 26-28, 1978, Proceedings*. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1978, p 4-1 to 4-13.

Results to date on an 18-month study on space industrialization are summarized, with emphasis given to future national and world needs. The broad areas of space industrialization are covered: (1) information services, (2) energy sources, (3) materials, (4) weather, environment, and climate monitoring, predicting, or controlling, and (5) other uses of space, including medical treatment and tourism. During the study several space industrialization program options were identified and the various viable opportunities were integrated into evolving programs, each with a step-by-step development of the required hardware and returning intermediate benefits leading toward longer-range goals. B.J.

A79-16137

A79-16137 Economic opportunities of space enterprise in the next decades K P Heiss (Econ, Inc, Princeton, N J) In Space Congress, 15th, Cocoa Beach, Fla, April 26-28, 1978, Proceedings Cape Canaveral, Fla, Canaveral Council of Technical Societies, 1978, p 4-14 to 4-21

The successful deployment of the Space Shuttle System in the early 1980s will enable the redirection of the U S Space Program from an emphasis on means to an emphasis on the scientific and economic application goals of space technology This redirection effort is discussed with reference to four topics (1) the development of global information systems, (2) applications of large space structures, (3) space as an energy base for mankind, and (4) likely phases of space application development B J

A79-16143 * Space power for space J P Mullin (NASA, Space Power Systems Branch, Washington, D C) In Space Congress, 15th, Cocoa Beach, Fla, April 26-28, 1978, Proceedings Cape Canaveral, Fla, Canaveral Council of Technical Societies, 1978, p 6-1 to 6-18

The total energy demanded by space missions of the future is expected to exceed past needs by orders of magnitude The unit costs of this energy must be reduced from present levels if these missions are to be carried out at projected budget levels The broad employment of electric propulsion and the capability to utilize novel high power sensors hinge on the availability of systems lighter by factors of ten or more than have flown to date The NASA program aimed at providing the technological basis to meet these demands is described in this paper Research and technology efforts in areas of energy conversion, storage and management are covered In addition, work aimed at evolving the understanding necessary to cope with space environment interactions and at advanced concepts is described (Author)

A79-16145 * A technology program for large area space systems A Guastaferro (NASA, Langley Research Center, Hampton, Va) and L M Jenkins (NASA, Johnson Space Center, Spacecraft Design Div, Houston, Tex) In Space Congress, 15th, Cocoa Beach, Fla, April 26-28, 1978, Proceedings Cape Canaveral, Fla, Canaveral Council of Technical Societies, 1978, p 6-42 to 6-53

The large space systems technology program (LSST) is discussed The purpose of LSST is to define and develop technology for large space systems and associated subsystems required for projected NASA space missions Goals involving structural concepts and supporting technology are surveyed The application of LSST to the design of the solar power satellite is considered M L

A79-16146 # Future space transportation systems G M Hanley (Rockwell International Corp, Space Div, Seal Beach, Calif) Canaveral Council of Technical Societies, Space Congress, 15th, Cocoa Beach, Fla, Apr 26 28, 1978, Paper 11 p 14 refs

Potential scenarios (excluding military missions) driving space transportation system requirements in the future are presented Of these scenarios, the one with the most impact on transportation requirements and concepts contains the operational satellite power system (SPS) program The SPS program has a significant impact on the evolution of the Space Shuttle through 1995, on new launch vehicles beyond 1995, and on new orbit transfer vehicles (OTV's) Transportation options for earth to low-orbit and orbit transfer vehicles potentially meeting the future requirements are described Comparisons of the capabilities of these transportation concepts to meet future requirements are made, and the major technology areas needing development are described (Author)

A79-16177 National Computer Conference, Anaheim, Calif, June 5-8, 1978, Proceedings Conference sponsored by IEEE, ACM, SCS, and DPMA Edited by S P Ghosh and L Y Liu (IBM Corp, San Jose, Calif) Montvale, N J, AFIPS Press (AFIPS Conference Proceedings Volume 47), 1978 1326 p

Papers are presented on applications of computer modeling to energy technology and on computerized image processing for remote

sensing of earth resources Consideration is also given to special purpose terminals, artificial intelligence, design automation and computer graphics, and simulation B J

A79-16226 A new amorphous silicon-based alloy for electronic applications S R Ovshinsky and A Madan (Energy Conversion Devices, Inc, Troy, Mich) *Nature*, vol 276, Nov 30, 1978, p 482-484 16 refs

The development of an amorphous silicon-based alloy that eliminates the physical problems associated with silicon-hydrogen alloys is reported The alloy described has silicon and fluorine as its main structural elements, is multielemental, includes hydrogen, and can also include other elements, such as oxygen, without deleterious effects Properties of the Si-F-H alloy (fabricated from a 10:1 Si:F:H₂ gas ratio) are compared with those of the best Si-H alloy It is noted that the intrinsic properties of the Si-F-H alloy are only weakly dependent on the substrate temperature and that neither the peak in the IR spectrum at 2000 kaysers corresponding to the Si-H stretch nor the H-Si-H scissors mode at 900 kaysers appears in the Si-F-H films The Si-F-H alloy is shown to be superior to silane-based films for electronic applications since there is a much lower density of states at the Fermi level and no photostructural effects have been observed F G M

A79-16245 Ocean thermal energy conversion, Proceedings of the Energy Technology Conference and Exhibition, Houston, Tex, November 6-9, 1978 Conference sponsored by the American Society of Mechanical Engineers Edited by O M Griffin (US Navy, Naval Research Laboratory, Washington, D C) New York, American Society of Mechanical Engineers (Ocean Engineering Symposia Series OED Volume 5), 1978 110 p Members, \$9 00, nonmembers, \$18

An overview of the US OTEC program is presented and consideration is given to OTEC power systems development, and the capital cost optimization of OTEC power modules Attention is also given to advances in the ocean engineering aspects of OTEC, and power cables to accommodate the motions of an OTEC plant B J

A79-16246 # Some early and recent novel OTEC systems O M Griffin (US Navy, Naval Research Laboratory, Washington, D C) In Ocean thermal energy conversion, Proceedings of the Energy Technology Conference and Exhibition, Houston, Tex, November 6-9, 1978 New York, American Society of Mechanical Engineers, 1978, p 1-6 9 refs

An historical review of OTEC concepts and designs is presented with attention given to D'Arsonval's ideas (1881), the work of Claude in the 1920s, and tropical OTEC plant design studies performed in the 1940s at Energie des Mers, a subsidiary of Electricite de France Attention is also given to more recent developments, including the 100 MWe floating OTEC plant proposed by the Andersons (1966), and the suggested combination of OTEC power production technology with the utilization of icebergs for fresh water (i.e., the ICETEC system) B J

A79-16247 # An overview of the US OTEC development program R Cohen (US Department of Energy, Div of Central Solar Technology, Washington, D C) In Ocean thermal energy conversion, Proceedings of the Energy Technology Conference and Exhibition, Houston, Tex, November 6-9, 1978 New York, American Society of Mechanical Engineers, 1978, p 7-34 67 refs

Ocean Thermal Energy Conversion (OTEC) is one of the solar energy options for which technology is being developed by the US Department of Energy Successful demonstration of OTEC systems may be achieved by 1985, followed by construction of commercial OTEC power plants up to about 500 MWe net power output These plants will produce electricity for transmission to shore by submarine cable and for the manufacture of energy-intensive products such as ammonia, hydrogen, and aluminum In the past year, significant test results have been obtained regarding thermal performance of OTEC

heat exchangers and on biofouling, cleaning and corrosion of the exchangers. Major system studies are being conducted on the power subsystems, platform, cold water pipe, and submarine cables. Test results and conclusions from the subsystem studies are presented, including cost projections and OTEC economics and market penetration. (Author)

A79-16248 # OTEC power systems J S Horowitz (Argonne National Laboratory, Argonne, Ill.) In Ocean thermal energy conversion, Proceedings of the Energy Technology Conference and Exhibition, Houston, Tex., November 6-9, 1978. New York, American Society of Mechanical Engineers, 1978, p 35-50. 13 refs

The paper reviews power system development (PSD) for the OTEC program. PSD activity is currently divided into three parts: (1) PSD I which is the design of a 50 MWe power system using shell and tube heat exchangers in which three contractors are involved, (2) PSD II which will be a parallel effort pursuing the same goal with the use of non-shell and-tube heat exchangers, and (3) support activities which center around the development of heat exchangers. B J

A79-16249 # Capital cost system optimization of OTEC power modules D A Horazak and T J Rabas (Westinghouse Electric Corp., Steam Turbine Div., Lester, Pa.) In Ocean thermal energy conversion, Proceedings of the Energy Technology Conference and Exhibition, Houston, Tex., November 6-9, 1978.

New York, American Society of Mechanical Engineers, 1978, p 51-63. 10 refs. Contract No. EG-77-C-03 1569

The purpose of this paper is to demonstrate the feasibility of a computer system optimization program for an entire power plant, the Ocean Thermal Energy Conversion (OTEC) power module. The design and cost algorithms are discussed in general terms with emphasis on how they can be developed and simultaneously integrated into the system program. A comprehensive optimization routine is presented for this complex system. A procedure is presented by which the optimum system parameters can be checked to guarantee that they are the true rather than local optimum values. Finally, the impact of enhanced heat transfer surfaces is discussed in terms of both cost and performance. (Author)

A79-16250 # Advances in ocean engineering aspects of ocean thermal energy conversion W G Sherwood (U.S. Department of Energy, Div. of Solar Technology, Washington, D.C.) and W P Trzaskoma (Gilbert Associates, Inc., Washington, D.C.) In Ocean thermal energy conversion, Proceedings of the Energy Technology Conference and Exhibition, Houston, Tex., November 6-9, 1978. New York, American Society of Mechanical Engineers, 1978, p 65-100

After a brief review of the goals, organization, and functional structure of the OTEC program, the paper focuses on the ocean engineering aspects of the OTEC program, with particular reference to pilot plant and commercial plant studies. Overviews are presented of the cold water pipe subsystem, hull/platform development, and platform stationkeeping. Appendices are presented which discuss pilot plant study details. It is predicted that experimental OTEC plants in the 10-20 MWe range can begin delivering energy by 1983. B J

A79-16251 # Power cables to accommodate the motions of an OTEC plant C A Pieroni, D O Libby, and R T Traut (Simplex Wire and Cable Co., Portsmouth, N.H.) In Ocean thermal energy conversion, Proceedings of the Energy Technology Conference and Exhibition, Houston, Tex., November 6-9, 1978. New York, American Society of Mechanical Engineers, 1978, p 101-106. Contract No. EG-77-C-05-5359

Electrical and mechanical requirements on a power cable running from an OTEC plant to the ocean floor, and possible design of such a cable are discussed. Potential problems caused by the motions of such a cable are considered. A possible cable support system that limits loads in the cable and allows maximum plant movement is presented. (Author)

A79-16365 Effect of force field nonuniformity on flow in an MHD channel V A Biturin, V N Zatelepin, and G A Liubimov (*Akademiya Nauk SSSR, Izvestiya, Mekhanika Zhidkosti i Gaza*, Jan-Feb 1978, p 3-12.) *Fluid Dynamics*, vol 13, no 1, Sept 1978, p 1-8. 12 refs. Translation

The transition of uniform flow into a complex three-dimensional flow in an MHD power generator is examined, and the factors responsible for the transition are discussed. Effects associated with secondary flows arising at the corners of a rectangular channel are reviewed. The analysis is centered on the interaction between an initially uniform flow of an electrically conducting ideal fluid and a nonconservative Lorentz force that generates a three-dimensional secondary flow. The solution obtained yields the three-dimensional pattern of the distribution of the velocity components and pressure in a rectangular MHD channel. V P

A79-16415 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978, Technical and Symposium Papers *ASHRAE Transactions*, vol 84, pt 2, 1978. 511 p

Papers are presented on such topics as the testing of solar collectors according to ASHRAE Standard 93-77, the use and limitations of ASHRAE solar algorithms in solar energy utilization studies, a parametric study of an open air cycle air conditioner using moist air thermodynamics, and the design optimization of air conditioning systems. Consideration is also given to such topics as the analysis of thermostat setback, control equipment for solar heating and cooling systems, the performance of solar energy components and systems, and the maintenance of building air conditioning equipment. B J

A79-16416 The use and limitations of ASHRAE solar algorithms in solar energy utilization studies E F Sowell (California State University, Fullerton, Calif.) (*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978*) *ASHRAE Transactions*, vol 84, pt 2, 1978, p 77-92. Discussion, p 93. 13 refs

A79-16417 Testing of solar collectors according to ASHRAE Standard 93-77 J E Hill, J P Jenkins, and D E Jones (National Bureau of Standards, Washington, D.C.) (*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978*) *ASHRAE Transactions*, vol 84, pt 2, 1978, p 107-125. Discussion, p 126. 17 refs. Research sponsored by the U.S. Department of Energy

A proposed procedure for testing and rating solar collectors based on thermal performance was published by the NBS in 1974. The procedure prescribed that a series of outdoor steady-state tests be conducted to determine the near-solar-noon efficiency of the collector over a range of temperature conditions. The ASHRAE Standard 93-77 is similar to the original NBS procedure but calls for additional tests to determine the collector time constant as well as an incident angle correction factor that can be applied to the near-solar-noon efficiency to determine collector performance both early in the morning and late in the day. Two test facilities have recently been built at NBS in accordance with Standard 93-77, one for modular water-cooled collectors and the other for air heaters. The present paper describes the test procedure as well as the facility at NBS, and gives results of a complete series of tests made according to the Standard on several commercially available collectors. B J

A79-16418 Controls for residential solar heating E S Peltzman (Rho Sigma, Inc., North Hollywood, Calif.) (*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978*.) *ASHRAE Transactions*, vol 84, pt 2, 1978, p 367-371. Discussion, p 372. 5 refs

Solar heating systems require controllers which can provide one or more of the following functions: differential thermostat (on-off or

proportional), freeze control (motor or valve), high set (motor or valve), auxiliary heat, and adjustable maximum storage temperature. The present paper describes several control types for use in residential solar heating and domestic hot water systems. These include (1) solar assisted hot water system, (2) solar assisted hot water system for freezing areas, (3) pool and spa heating, (4) hot water and space heating. Some economic considerations are presented. B J

A79-16419 Solar controls and control modifications - New century town solar homes, Vernon Hills, Ill. L. R. Smeltzer (Urban Investment and Development Co., Chicago, Ill.) (*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978*) *ASHRAE Transactions*, vol. 84, pt. 2, 1978, p. 373-379, Discussion, p. 380

A79-16420 Controls for heat reclaim with thermal storage coupled with solar heating. F. E. Filson, Jr. (Filson Minnich and Associates, Inc., Harrisburg, Pa.) (*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978*) *ASHRAE Transactions*, vol. 84, pt. 2, 1978, p. 381-386

The paper describes a field-erectable heat pump system of chilled-water type with an automatic temperature control system, which uses three-way bypass or diverting valves, heat sensors, limit controls, and thermostats. By the installation of a solar system, convertor, circulating pump, and a closed loop system, it is possible to add additional tank temperatures to the system. Diagrams illustrating different system configurations are presented. B J

A79-16421 Using controls to reduce component size and energy needs for solar HVAC. A. B. Newton (*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978*) *ASHRAE Transactions*, vol. 84, pt. 2, 1978, p. 387-391

It is shown that the use of dual storage systems at different temperature levels can significantly increase the amount of useful heat collectable from solar collector arrays in solar HVAC (heating, ventilation, air conditioning) systems. In addition, better performance can be achieved by using controls to limit the heating fluid or the energizing fluid temperature to the building heating or cooling equipment. In cooling, the utilization of the proposed control principles for energizing absorption equipment further reduces the energy needs. Utilization of these control concepts may reduce the area of solar collector arrays by 35-40% on many heating and cooling installations for a given amount of solar contribution to total building requirements. B J

A79-16422 * A graphical approach to the efficiency of flat-plate collectors. M. K. Selcuk (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) (*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978*) *ASHRAE Transactions*, vol. 84, pt. 2, 1978, p. 395-408, Discussion, p. 409. Research sponsored by the Southern California Gas Co.

A nomogram is described which can be used to determine the thermal performance of flat plate solar collectors, resulting in two performance factors: the net absorptance and the net heat loss coefficient. The nomogram takes into account angle of incidence, collector slope, absorber plate design, insulating materials, thicknesses, optical properties of absorbing surfaces and glazing materials, and flow factors. A case example is given to illustrate the use of the nomogram. B J

A79-16423 The application of ASHRAE Standard 93-77 to the thermal performance testing of air solar collectors. S. A. Mumma, J. I. Yellott, and B. Wood (Arizona State University, Tempe, Ariz.) (*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978*) *ASHRAE Transactions*, vol. 84, pt. 2, 1978, p. 410-417, Discussion, p. 418

Several areas of ASHRAE Standard 93-77 are discussed which can cause significant errors in the execution of the thermal performance testing of air solar collectors. These areas include the following: (1) air collector flow rate specification, (2) precision thermometers for air temperature measurements, (3) testing arrangement for air solar collectors, (4) computation of air flow rates with a commercial pitot tube and nozzle, and (5) stabilization time between test points when using an altazimuth mount rack. Some specific recommendations for improving the Standard are made. B J

A79-16424 Performance of vacuum tube solar collector systems. G. Engholm and J. Herz (General Electric Co., Valley Forge, Pa.) (*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978*) *ASHRAE Transactions*, vol. 84, pt. 2, 1978, p. 419-433, Discussion, p. 434

Vacuum tube solar collectors have minimal heat losses, therefore, their efficiency is relatively insensitive to ambient temperatures, wind conditions and insolation levels. Inlet temperature increases from 85 C up to 132 C reduce the average efficiency by only 13%. Thus, it is simpler to predict performance of vacuum tube collectors than conventional flat plate collectors. A simple manual procedure is presented to predict the performance of vacuum tube collector systems. It is based on the results of many hourly computer simulations for various applications and of correlative test data. (Author)

A79-16425 The El Camino Real Solar Cooling Demonstration Project. E. F. Sowell, P. W. Othmer (California State University, Fullerton, Calif.), and K. E. Smith (McCaughy and Smith Energy Associates, Tustin, Calif.) (*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Annual Meeting, Albuquerque, N. Mex., June 25-29, 1978*) *ASHRAE Transactions*, vol. 84, pt. 2, 1978, p. 435-449. 13 refs. Research supported by the U.S. Department of Energy.

The El Camino Real Solar Cooling Demonstration Project involves the conversion of the existing air conditioning system of an elementary school building (the El Camino Real Elementary School in Orange County, California) to provide a large fraction of input energy from solar thermal collectors. The existing hot water loop, driving absorption chillers and heating coils, is connected to the solar loop through a heat exchanger without storage. The solar loop consists of approximately 465 sq m of tubular glass collectors, a heat rejector, and the load-side heat exchanger. This paper describes the final design and its evolution, discusses analytical studies, and presents performance simulation results. B J

A79-16451 International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures. Symposium Workshop sponsored by the National Science Foundation. Edited by T. N. Veziroglu and H. W. Hiser (Miami, University, Coral Gables, Fla.) Coral Gables, Fla., University of Miami, 1978. 580 p. \$50.

The volume considers such topics as the economics and policy of alternative energy sources, solar collector design and performance, solar heating and cooling principles, thermal storage of solar energy, and integrated solar building system design. Papers are also presented on such topics as solar hydrogen production at high temperatures, solar energy transportation and production of hydrogenated fuels, the use of satellites in solar applications, solar-based agricultural systems for the Middle East, and solar energy planning for developing countries. B J

A79-16453 # Possibilities for solar energy utilization in Egypt. I. A. Sakr (National Research Centre, Solar Energy Laboratory, Cairo, Egypt). In *International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures*. Coral Gables, Fla., University of Miami, 1978, p.

35-43

A79-16454 # The economics and policy of alternative energy sources - A review T M Khalil and A Arias (Miami, University, Coral Gables, Fla.) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla., University of Miami, 1978, p 45-60 8 refs

The need to develop unified objective and realistic methodologies for the evaluation of alternative energy sources is discussed. Some available economic comparison models are assessed, with emphasis placed on comparison of solar energy systems with conventional systems. A unified model is then proposed for the feasibility study of solar energy utilization in certain applications. The unified model serves to illustrate considerations needed for the completeness of comparative cost analysis relative to decision making. B J

A79-16455 * # -Solar collectors. I - Fundamentals and collectors of the past and present M K Selcuk (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla., University of Miami, 1978, p 63-79 17 refs Contract No NAS7-100

The paper is a state-of-the-art review aiming to familiarize those who are new in the solar energy field with past accomplishment in solar energy utilization. Consideration is given to the design features and performance definition of solar collectors. The characteristics of planar collectors, line focusing collectors, and point focusing collectors (including the central receiver concept) are briefly discussed. B J

A79-16456 # Solar collectors II - Recent developments and future performance data and economic analysis. R K Collier (California, University, Los Alamos, N Mex.) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla., University of Miami, 1978, p 81-105 12 refs

Black chrome selective surfaces are briefly discussed along with optically transparent honeycombs developed to suppress convective heat transfer between the absorber and the glazing of flat plate collectors. Consideration is then given to the design and performance characteristics of several types of collectors, including the all-glass evacuated tube collector, tracking and nontracking concentrating collectors, and heat pipe collectors. B J

A79-16457 # Principles of solar cooling and heating A J Parker, Jr., D E Cassel (Mueller Associates, Inc., Baltimore, Md.), and T N Veziroglu (Miami, University, Coral Gables, Fla.) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla., University of Miami, 1978, p 107-127

An overview of solar cooling and heating systems for buildings is presented from a practical engineering point of view. It is recommended that building cooling and heating requirements be satisfied at the lowest level of technology and that passive solar energy systems and energy conservation be applied before active energy systems. The three major types of active systems - water heating, space heating, and space cooling - are discussed. The simple payback economic analysis is shown to be an adequate method for initial system selection considerations. Several thermal analysis methods are discussed, with the FCHART program recommended as a good choice for hot water and space heating systems. B J

A79-16458 # Solar heating and ventilating by natural means E Bilgen (Ecole Polytechnique, Montreal, Canada) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla., University of Miami, 1978, p 129-155 26 refs Research supported by the National Research Council of Canada and CINEP

A computer thermal simulation study performed for the Montreal region shows that natural air-conditioning of buildings in

Canada can be accomplished through the use of integrated solar collector-storage units. South-facing vertical surfaces appear to be most suitable for this purpose, though other east and west facing vertical surfaces can be used in combination with the former. Solar energy utilization for the heating and ventilation of buildings by this method is found to be economically feasible and competitive with other energy sources. B J

A79-16459 # Thermal storage of solar energy S Kalac and Y Yener (Middle East Technical University, Ankara, Turkey) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla., University of Miami, 1978, p 159-176 13 refs

Two systems for solar heat storage for space heating applications are characterized: (1) sensible-heat storage systems, which can be of the water storage or packed-bed storage type, and (2) phase-change storage systems. Chemical techniques for solar heat storage are also reviewed. These various systems are compared in terms of performance and cost. B J

A79-16460 # Integrated solar building systems A Bowen (Miami, University, Coral Gables, Fla.) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla., University of Miami, 1978, p 177-232 71 refs

The many factors that go into solar building design are reviewed. It is noted that successful application of solar energy in buildings involves the best economic blend of energies readily available to the building's site and function. Exogenous and endogenous forces together determine this blend of energies to ensure economic and harmonious results. These forces are present at various scales and it is necessary to determine their appropriate uses by type and level of availability to the building's function. In this paper these factors are reviewed with respect to diagnostic bioclimatology, thermal behavior in materials, thermal exchange in buildings, luminous behavior in materials and buildings, and building orientation, perimeter shape, volume and morphology. An integrated solar building system is proposed on the basis of these factors. B J

A79-16461 # Application of solar cooling for a school building in subtropics A J Parker, Jr., D E Cassel, R E Hedden (Mueller Associates, Inc., Baltimore, Md.), and T N Veziroglu (Miami, University, Coral Gables, Fla.) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla., University of Miami, 1978, p 233-254

A solar cooling and service hot water system was designed for a new 6000 sq m floor area elementary school building in Dade County, near Miami, Florida. The square, two-level building incorporates various energy conservation measures including earth berms covering the first level walls and energy recovery from exhaust air. The solar energy system includes 1730 sq m of high-performance flat-plate collectors, 230 cu m of 70 C to 110 C hot water energy storage, and four nominal 90 kW cooling capacity lithium bromide-water absorption chillers. The system is expected to provide 70 percent of the large cooling load and 90 percent of the small service hot water load. Simplicity in design and competitive, well-controlled bidding procedures resulted in a very low actual bid price, competitive with large solar space heating and water heating systems. (Author)

A79-16462 # Energy utilization analysis of buildings. M Lokmanhekim (California, University, Berkeley, Calif.) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla., University of Miami, 1978, p 255-271 7 refs

Fundamental principles employed in ASHRAE procedures for the energy analysis of buildings are outlined and brief descriptions of computer programs using these procedures are given. Consideration is given to programs which are capable of (1) simulation of the thermal response of a building to all sources of heat gains and losses,

(2) accounting for all nonthermal energy requirements in the building or on the sites, (3) translation of building operating schedules into energy demand and consumption, (4) identification of peak capacity requirements of heating and cooling equipment, and (5) an economic analysis for selecting the most economical overall owning and operating cost equipment and an energy source which would minimize the building's life cycle cost B J

A79-16463 # Solar-hydrogen energy system and solar-hydrogen production methods T N Veziroglu and S Kakac (Miami, University, Coral Gables, Fla) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla, University of Miami, 1978, p 275-296 37 refs

Various methods of producing hydrogen using solar energy are discussed, including direct thermal, thermochemical, electrolytical, and photosynthetic methods. The methods are compared and the advantages of each are described. In addition, attention is given to the advantages of using hydrogen to store solar energy. Indirect forms of solar energy, such as ocean thermal, ocean current, wind, and hydraulic, are also considered as primary energy sources for producing hydrogen B J

A79-16464 # Solar hydrogen production at high temperatures E Bilgen (Ecole Polytechnique, Montreal, Canada) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla, University of Miami, 1978, p 297-302 11 refs

Solar energy thermal processes at temperatures exceeding approximately 1500 K are reviewed, and attention is given to the thermodynamics of water decomposition to produce hydrogen. Hydrogen production at such high temperatures is found to offer three major advantages over other methods: (1) high thermal efficiency with minimum thermal energy requirements, (2) minimum pollution and ecological impact, and (3) the possibility of reducing the number of chemical cycles to a minimum. One-step, two-step, or maximum three-step chemical cycles are possible at high temperatures, making possible the reduction of capital and operating costs, since the amount of chemicals used is reduced B J

A79-16465 # Prospects for ambient energy and cogeneration utilization in urban and regional planning A Bowen (Miami, University, Coral Gables, Fla) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla, University of Miami, 1978, p 305-350 71 refs

The paper develops strategies and a methodology for the utilization of available fossil and non-fossil energy sources in relation to urban and regional planning needs. Consideration is given to such factors as bioclimatic comfort, urban modification of regional climate, energy responsive shelter and settlement, regional implications of ambient energy utilization, access to ambient energies, and ambient energy utilization techniques for buildings and sites. Regional energy utilization patterns are reviewed and attention is given to the projected utilization of responsive energy hybrid systems. Many illustrative figures are included B J

A79-16466 * # Solar thermal conversion M K Selcuk (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla, University of Miami, 1978, p 353-371 21 refs Contract No NAS7 100

A brief review of the fundamentals of the conversion of solar energy into mechanical work (or electricity via generators) is given. Both past and present work on several conversion concepts are discussed. Solar collectors, storage systems, energy transport, and various types of engines are examined. Ongoing work on novel concepts of collectors, energy storage and thermal energy conversion are outlined and projections for the future are described. Energy costs for various options are predicted and margins and limitations are discussed (Author)

A79-16467 # Solar electricity production M A Kettani (University of Petroleum and Minerals, Dhahran, Saudi Arabia) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla, University of Miami, 1978, p 373-393 29 refs

In the present paper, such concepts of solar-to-electric energy conversion as direct conversion, conversion through a heat stage, conversion through a mechanical stage, and conversion through a chemical stage are reviewed. Particular attention is given to direct energy conversion schemes, such as photovoltaic conversion, conversion of solar heat into electricity, thermionic power conversion, and photomagnetic power conversion V P

A79-16468 # Use of satellites in solar applications H W Hiser (Miami, University, Coral Gables, Fla) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla, University of Miami, 1978, p 395-408 17 refs

Of the two solar satellite applications discussed in the present paper, one is intended for obtaining detailed global maps of available solar energy, the other application is to provide platforms for solar power stations in space that will beam electric energy to earth by microwave transmission. Equatorial geostationary meteorological satellites can provide continuous monitoring of solar energy between 55 deg N and 55 deg S latitude. Polar orbiting satellites can provide similar coverage at high latitudes, however, the coverage is discontinuous, and depends on orbiting times. Both types of satellite monitor cloud cover. The cloud data are used to compute sunshine and solar energy. The solar power station concept uses geostationary satellites with collectors to convert solar energy directly to electricity by the photovoltaic process V P

A79-16469 # Solar pumping M A Kettani (University of Petroleum and Minerals, Dhahran, Saudi Arabia) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla, University of Miami, 1978, p 411-424 9 refs

Solar pumping involving a heat stage and solar heating involving an electric stage are discussed. It is suggested that the electrical stage process might become economically competitive in the near future and that the process is already economical in remote locations. In a case study, costs are estimated for a town of 10,000 people using 500,000 cu m/year of water pumped 50 km to a hydraulic head of 100 m M L

A79-16470 # Inexpensive solar energy utilization in human settlements A Bowen (Miami, University, Coral Gables, Fla) In International Symposium-Workshop on Solar Energy, Cairo, Egypt, June 16-22, 1978, Symposium Lectures Coral Gables, Fla, University of Miami, 1978, p 499-561 71 refs

Several solar energy applications for use in or near houses are surveyed, and some simple air and liquid solar collectors and storage systems are described. Equipment required for applications such as cooking, drying, dehydration, distillation, and desalination is discussed, and the use of solar energy to aid or accelerate bioconversion is examined. Other topics include the solar sterilization of medical instruments, a passive icemaker, and passive heating or cooling M L

A79-16478 Open-cycle magnetohydrodynamic electrical power generation Edited by M Petrick (Argonne National Laboratory, Argonne, Ill) and B Ia Shumiatskii (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) Argonne, Ill, Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978 727 p

The present US/USSR joint report on open-cycle MHD electrical power generation first examines general problems of MHD power plants, including discussion of general plant characteristics, selection of optimal configurations and plant layouts, evaluation of technical and economic aspects of open-cycle MHD power plants

along with an outlook for their future application in power generation, and protection of the biosphere. Then the electrical equipment of an MHD installation is discussed relative to MHD generator and superconducting magnet system and the dc conversion (inverter) system. The high-temperature oxidizer preheater, the fuel processing and combustion system, steam generator, turbines, compressors, and the ionizing seed system are assessed. Also discussed are relevant problems of high-temperature materials for MHD energy conversion as well as plasma diagnostics in an MHD installation. S D

A79-16479 # **The MHD power plant and its environmental aspects - Introduction.** M Petrick (Argonne National Laboratory, Argonne, Ill.) and B Ia Shumiatskii (Akademii Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) In *Open-cycle magnetohydrodynamic electrical power generation*. Argonne, Ill., Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 1-15. 45 refs

The concept of MHD energy conversion becomes a viable possibility only with the proper combination of fluid velocity, electrical conductivity, and magnetic field strength. The search for that proper combination has led to the development of three distinct approaches to MHD power generation, viz the open-cycle plasma, closed-cycle plasma, and liquid metal MHD concepts. This paper is concerned solely with the status of development of open-cycle MHD and is essentially based on the work carried out in the United States and the Soviet Union. Attention is given to factors motivating the development of open-cycle MHD, energy situation in the United States and the Soviet Union. Also discussed are recent advances in MHD and programs for the development of open-cycle MHD in both countries. S D

A79-16480 # **MHD power plant characteristics.** W E Amend and G N Morozov In *Open-cycle magnetohydrodynamic electrical power generation*. Argonne, Ill., Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 16-48. 11 refs

The general system features of an MHD power plant are described in terms of process requirements, MHD plant systems and components, and component performance constraints. In addition, basic thermal cycles are outlined, with special emphasis on methods of obtaining high initial temperatures, use of generator exhaust gas heat in low-temperature cycles, effect of regenerative oxidizer preheating on plant efficiency, simplification of high-temperature air preheater systems, compression of the oxidizer, and methods of utilizing low-potential heat. It appears that the use of a high-temperature regenerative preheater is an effective method of increasing efficiency and is especially important in the context of a coal-burning MHD power plant, and that a steam turbine installation is presently considered to represent the best use of combustion products in the bottoming cycle. S D

A79-16481 # **Layout and design characteristics of MHD power stations.** F A Hals and G N Morozov In *Open-cycle magnetohydrodynamic electrical power generation*. Argonne, Ill., Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 49-87. 6 refs

The advantages and disadvantages of different open-cycle MHD plant layouts that have been proposed are reviewed and discussed. The layouts depict plants with both horizontal and vertical MHD generators and with different turbine arrangements. Turbine arrangement, however, is not critical in generator layout in either case. Methods of removing the channel from the magnet system are presented. Basic design characteristics of a first-generation gas- or oil-fired MHD power station as well as of a coal-fired MHD power station are described. Structural diagrams of a first-generation MHD power plant fired by natural gas and of a coal-fired MHD power plant are presented and discussed. It is suggested that MHD power stations will have large power outputs, probably of the order of 2000 MW electrical power, and that the economics become more favorable as

unit sizes increase. Such stations may also be used as cogeneration plants where appropriate. The horizontal arrangement of the MHD generator seems the most logical. S D

A79-16482 # **Technical and economic aspects of open-cycle MHD power plants.** M Petrick (Argonne National Laboratory, Argonne, Ill.), B Ia Shumiatskii (Akademii Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR), and G M Koriagina In *Open-cycle magnetohydrodynamic electrical power generation*. Argonne, Ill., Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 88-126. 61 refs

The technical-economic system studies of open-cycle MHD power plants have identified the technological, operational, and cost parameters necessary for central station application. Among them are required hours of operation, air preheat temperature, oxygen enrichment of oxidizer, ionizing seed concentration, injection, recovery, and regeneration, magnetic field, electrical load coefficient, working fluid velocity in the MHD generator, initial pressure of combustion products, cycle and system configuration, and cost and type of fuel utilized. The required performance levels and the sensitivity of overall system performance to variations of these parameters are delineated. MHD power systems for intermediate- and peak-load applications as well as comparative cost studies are examined. The results of the system studies are summarized in a table which lists the performance values of critical plant parameters that will have to be achieved for both the near-term and the advanced plants. S D

A79-16483 # **Protection of the biosphere.** D Bienstock and V M Maslennikov In *Open-cycle magnetohydrodynamic electrical power generation*. Argonne, Ill., Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 127-156. 28 refs

The study shows how MHD power stations can substantially reduce pollutant emissions (sulfur oxides, nitrogen oxides) and meet the environmental clean air and thermal pollution standards. Moreover, the existing technology is capable of achieving adequate removal of particulate impurities from flue gases. Technical economic analysis indicates that electricity from an MHD power station can be made 10-15% less expensive through production of nitric acid from NOx taken from the stack. S D

A79-16484 # **MHD generators.** J F Louis and V I Kovbasiuk In *Open-cycle magnetohydrodynamic electrical power generation*. Argonne, Ill., Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 157-228. 131 refs

Various types of MHD generators are examined, viz Faraday generator, Hall generator, and diagonal generator. The critical generator fluid mechanics, which affects efficiency and influences design and performance limitations, is discussed. The all-important electrode-insulator problem and MHD channel design considerations are reviewed. Finally, instrumentation and control of MHD generators are considered from an operating standpoint. The present status of generator development is highlighted, and critical design criteria and limitations for building a commercial-scale MHD plant are established. S D

A79-16485 # **Superconducting magnets.** D B Montgomery and B V Zenkevich In *Open-cycle magnetohydrodynamic electrical power generation*. Argonne, Ill., Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 229-274. 80 refs

The paper outlines the base load-scale magnet requirements, the status of design concepts, the economic considerations, the status of past and present magnet constructions, and required future developments for large superconducting magnets for MHD application. Enough magnet systems have been built and tested to establish the qualitative design trends that are most likely to lead to reliable base load-scale magnets of minimum risk. Future work will logically focus on the following areas: (1) conductor development for very large

currents, 50 kA typically, (2) development of economical structural concepts that will limit dissipative disturbances that could upset the stability of the superconductor, (3) development of construction concepts that minimize on-site construction, and (4) development of cryogenic and protection concepts allow for safe operation under all potential fault situations SD

A79-16486 # Inverter systems E Levi, S I Pishchikov, and B M Antonov In Open-cycle magnetohydrodynamic electrical power generation Argonne, III, Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 275-319 22 refs

Inverters are referred to as electrical or electronic power conditioners that take dc power input and produce ac power output. Inverters for MHD applications are examined in terms of source interface, inverter bridge, utility interface, and high frequency links. Attention is directed to design principles for two MHD power plants using a segmented Faraday channel and a diagonal channel, respectively. Operational experience with a power grid inverter is discussed, along with an economic analysis of an MHD inversion system designed to provide the highest possible efficiency of reliable service at the lowest life-cycle costs attainable. Capacitors connected in series at the ac terminals of the inverter may improve both commutation and the power factor of the system. Harmonics filter control can be used to reduce the need for power-factor control condensers. It is concluded that cost-effective inverters can be designed to operate reliably with MHD generators SD

A79-16487 # High-temperature oxidizer preheater F A Hals and A V Volovik In Open-cycle magnetohydrodynamic electrical power generation Argonne, III, Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 321-390 84 refs

Combustion air preheating in open-cycle fossil-fuel MHD energy conversion systems can be accomplished through the use of directly or indirectly fired heaters. Preheater subsystems are discussed relative to types of preheaters, system requirements and controls, and materials requirements. The design elements of high temperature preheater subsystems are described, including analysis and design of regenerators of different types, and air preheaters under development in the United States and the Soviet Union. Experimental results for directly and indirectly fired regenerators as well as for directly-fired recuperators are summarized SD

A79-16488 # Fuels and combustion. J I Joubert and S A Tager In Open-cycle magnetohydrodynamic electrical power generation Argonne, III, Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 391-464 82 refs

Various aspects of designing open-cycle MHD combustion systems are discussed. The relevant design requirements and thermodynamic considerations for defining combustor operating parameters are presented. The many elements leading to the specification of combustor geometry and hardware are considered, followed by a review of operating experience with experimental combustors. Finally, scale-up considerations are discussed, and the current status of MHD combustor development is assessed. SD

A79-16489 # Steam generator and turbomachines L W Carlson, U Zitsow, Iu I Rabkin, and G N Morozov In Open-cycle magnetohydrodynamic electrical power generation Argonne, III, Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 465-494 10 refs

The paper first provides a brief description of experience and problems encountered in the design and operation of conventional fossil-fueled steam generators used in electric power plants. Thereafter, the unique operating conditions and design requirements for MHD-steam generators are discussed. Then the operating experience gained from the U-25 plant in the Soviet Union is reviewed, evaluated, and placed in perspective. Finally, the requirements and problems associated with turbomachinery are reviewed. It is shown

that steam turbines for MHD power plants are likely to be similar to conventional power plant turbines, i.e., when the compressor drive is not coupled to the main generator turbine. Cycled compressors for MHD power plants must operate over a wide range of conditions, thereby differing significantly from compressors for gas turbines and other applications. Elimination of large seed deposits on semiradiant heating surfaces may require recirculation of exhaust gases downstream of the radiant portion SD

A79-16490 # Ionizing seed P D Bergman and I L Mostinski In Open-cycle magnetohydrodynamic electrical power generation Argonne, III, Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 495-533 46 refs

The study outlines experience and efforts in the field of seed handling, utilization, and reprocessing in the United States and the Soviet Union. Operating experience in the U-02 and U-25 pilot plants fired with natural gas is described, and U.S. information on seeding in a coal fired environment is presented. Major advantages and shortcomings associated with the injection of seed in solution and as a dry powder are discussed. Information on world seed resources and seed economics is provided. Expansion of research efforts in the areas of seed injection, removal, and regeneration can be expected in the near future SD

A79-16491 # Materials S J Schneider, H P R Frederikse, G P Telegin, and A I Romanov In Open-cycle magnetohydrodynamic electrical power generation Argonne, III, Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 535-621 155 refs

The paper outlines the present status of materials development in MHD through discussions of the scope and nature of the relevant problems, definition of materials selection criteria and candidate materials, along with description of materials performance under actual or near actual MHD conditions. Present evaluation of the most promising materials are summarized for MHD generators, cold electrodes, insulators, preheater, combustor, and steam generator. Test results from the Soviet U-02 and U-25 installations are also presented SD

A79-16492 # Plasma diagnostics in an MHD installation. S. A. Self, I. A. Vasil'eva, and A. P. Nefedov In Open-cycle magnetohydrodynamic electrical power generation Argonne, III, Argonne National Laboratory, Moscow, Izdatel'stvo Nauka, 1978, p 622-680 82 refs

The plasma parameters that determine the operating efficiency of an MHD generator are the plasma temperature, electrical conductivity, concentration of charged particles, concentration of easily ionized seed atoms, and the velocity and turbulence intensity of the working fluid in the MHD channel. The paper examines methods of measuring the physical parameters of the working fluid of an MHD generator. In all cases, it is important to achieve adequate spatial and temporal resolution for measurements of boundary layer structure and fluctuation amplitudes and spectra. In particular, many of the useful techniques developed for measuring plasma flow properties need refinement and further development in the direction of improved reliability and ease of use, improved spatial and temporal resolution, and application in the presence of magnetic fields and ash-laden flows SD

A79-16523 The effects of different energy strategies on the atmospheric CO2 concentration and climate J Williams (International Institute for Applied Systems Analysis, Laxenburg, Austria) In Carbon dioxide, climate and society, Proceedings of the Workshop, Laxenburg, Austria, February 21-24, 1978

Oxford and New York, Pergamon Press, 1978, p 239-248 9 refs

Future atmospheric CO2 concentration is estimated by application of three models - an energy model for estimating the future use

of fossil fuels, a carbon cycle model for estimating the amount of fossil fuel CO₂ remaining in the air, and a climate model for estimating the effects of atmospheric CO₂. Three energy scenarios - a 35 TW reference scenario, a 30 TW scenario with nuclear and solar energy production, and a 50 TW scenario with fossil fuels - are characterized, and the CO₂ emissions, atmospheric CO₂ concentration, and temperature change are estimated for each scenario for the years up to 2050. Limitations associated with the models are considered. M L

A79-16524 The atmospheric CO₂ consequences of heavy dependence on coal. R M Rotty (Oak Ridge Associated Universities, Inc., Oak Ridge, Tenn.). In Carbon dioxide, climate and society, Proceedings of the Workshop, Laxenburg, Austria, February 21-24, 1978. Oxford and New York, Pergamon Press, 1978, p 263-273 9 refs

A79-16545 Analysis of optical behavior and collector performance of a solar concentrator. K C Bordoloi, T M Murray, and E J Chaves (Louisville, University, Louisville, Ky) In SOUTHEASTCON '78, Proceedings of the Southeast Region 3 Conference, Atlanta, Ga., April 10-12, 1978. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1978, p 261-264

This paper is concerned with the study of the optical behavior and the collector performance of a nontracking, half-circular concentrator. To date, studies of the optical properties have been sufficient to select classes of receivers for the particular mode in which that concentrator can be used. The receiver is designed to have placement and size which takes into account the changing orientation of incoming beam radiation from the sun as declination changes throughout the year. The receivers under study are (a) circular and (b) triangular in cross section. The study pertains to (a) geometrical considerations in relationship to the incident sunlight and (b) the optical parameters such as the concentration ratio and the average number of reflections. Also, a brief look at the thermodynamical parameters suggests that the concentrator performs satisfactorily under non-tracking mode. (Author)

A79-16559 Dynamics and feedback control of ISX tokamak. O Burenko (Oak Ridge National Laboratory, Oak Ridge, Tenn.) and J M Bailey (Tennessee, University, Knoxville, Tenn.). In SOUTHEASTCON '78, Proceedings of the Southeast Region 3 Conference, Atlanta, Ga., April 10-12, 1978. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1978, p 492-494 9 refs. Research sponsored by the US Department of Energy.

Perturbation equations of a plasma equilibrium position in a tokamak are developed. A plasma motion dynamics function is derived by neglecting second and higher order effects. This function has been used for syntheses of the required radial and axial plasma equilibrium position feedback control systems for the impurities study experiment (ISX) tokamak. Theoretical design and actual hardware step function responses of the radial plasma equilibrium position feedback control system are shown to be identical for all practical purposes. M L

A79-16565 A microprocessor-based control system for solar heating and cooling. R A Payton and T M Murray, Jr (Louisville, University, Louisville, Ky) In SOUTHEASTCON '78, Proceedings of the Southeast Region 3 Conference, Atlanta, Ga., April 10-12, 1978. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1978, p 545-548

The described microprocessor based control system regulates a solar-energy collection system and operates a HVAC system. The control system is completely automatic and can be altered by a change in software. Collector, HVAC, and back-up control are examined, and instrumentation, microcomputer, and data reduction are characterized. The system was designed for an astronomical

observatory administration building which serves as a solar energy research facility. M L

A79-16601 * Radiation energy conversion in space, Conference, 3rd, NASA Ames Research Center, Moffett Field, Calif., January 26-28, 1978, Technical Papers. Conference sponsored by NASA. Edited by K W Billman (NASA, Ames Research Center, Moffett Field, Calif.) New York, American Institute of Aeronautics and Astronautics, Inc (Progress in Astronautics and Aeronautics, Volume 61), 1978 687 p. Members, \$24, nonmembers, \$45

Concepts for space-based conversion of space radiation energy into useful energy for man's needs are developed and supported by studies of costs, material and size requirements, efficiency, and available technology. Besides the more studied solar power satellite system using microwave transmission, a number of alternative space energy concepts are considered. Topics covered include orbiting mirrors for terrestrial energy supply, energy conversion at a lunar polar site, ultralightweight structures for space power, radiatively sustained cesium plasmas for solar electric conversion, solar pumped CW CO₂ laser, superelastic laser energy conversion, laser-enhanced dynamics in molecular rate processes, and electron beams in space for energy storage. P T H

A79-16602 * # The solar power satellite concept evaluation program. R O Piland (NASA, Johnson Space Center, Houston, Tex.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 3-24 12 refs

The paper describes in detail one of the preliminary baseline concepts for the solar power satellite (SPS). A large space freighter with payload capacity of 424 metric tons will deliver the material to a construction base in low earth orbit where the eight modules of the satellite are constructed. Electric thrusters will propel the modules to a smaller geosynchronous base, where the modules are docked and the solar arrays are deployed to form a satellite capable of providing 5 GW power from each of two end-mounted antennas to the two ground rectennas. The solar array is 5.3 km by 21.3 km to provide a total platform area of 113 sq km. The solar array employs silicon solar cells with a concentration ratio of unity. Details on transportation, construction bases, rectenna, and solar array design are given along with material requirements and cost estimates. P T H.

A79-16603 * # SPS microwave subsystem potential impacts and benefits. R M Dickinson (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 25-35 9 refs. Contract No NAS7-100

The paper examines the possible environmental and societal effects of the construction, installation, and operation of the space end and earth end of the microwave power transmission subsystem that delivers satellite power system (SPS) energy (at about 5 GW per beam) to the power grid on earth. The intervening propagation medium near the earth is also considered. Separate consideration is given to the spacecraft transmitting array, propagation in the ionosphere, and the ground-based rectenna. Radio frequency interference aspects are also discussed. P T H.

A79-16604 * # Large active retrodirective arrays for solar power satellites. R Chernoff (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 36-57 10 refs. Contract No NAS7-100

An active retrodirective array (ARA) transmits a beam toward the apparent source of an illuminating signal called the pilot. The array produces the RF power. Retrodirectivity is achieved by

retransmitting from each element of the array a signal whose phase is the 'conjugate' of that received by the element Application of the ARA to the solar power satellite concept has been proposed A method of providing a reference phase is described, called 'central phasing', which eliminates the need for a rigid structure ordinarily needed in order to realize accurate retrodirectivity P T H

A79-16605 * # Orbiting mirrors for terrestrial energy supply K W Billman, W P Gilbreath (NASA, Ames Research Center, Moffett Field, Calif), and S W Bowen In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif, January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1978, p 61-80 15 refs

A system of orbiting reflectors termed 'SOLARES' is proposed as a means of reducing the diurnal variation and increasing the average intensity of sunlight for terrestrial solar power systems The paper discusses orbital considerations for the placement of the reflectors, insolation profiles, ground conversion options, costs, and environmental and social effects P T H

A79-16606 # Application of electron beams in space for energy storage and optical beam generation R M Salter (Rand Corp, Santa Monica, Calif) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif, January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1978, p 81-94 14 refs

Examination is made of the potential for in-space-propagated electron beams for storage rings that buffer solar energy collected in low-orbit satellites An example case in a 4828-km equatorial orbit utilizes a nine-beam helical configuration to store 5.8 TJ in 60 MeV electrons Electron energized optical and RF generators are covered including transmission of a 3-GW synchrotron radiation beam of center wavelength of 1000 Å over 6000 km to a ground receiver with an 827-m aperture (Author)

A79-16607 * # Energy conversion at a lunar polar site J D Burke (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif, January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1978, p 95-103 23 refs Contract No NAS7-100

The polar regions of the moon may have peaks of perpetual light from which the sun is always visible and valleys of perpetual darkness where sunlight never penetrates This suggests the possibility of collecting sunlight continuously at one location and rejecting waste heat continuously at another This paper presents some concepts for a steady-state solar-powered, inhabited station at a lunar polar location P T H

A79-16608 * # A search for space energy alternatives W P Gilbreath and K W Billman (NASA, Ames Research Center, Moffett Field, Calif) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif, January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1978, p 107-125 36 refs

This paper takes a look at a number of schemes for converting radiant energy in space to useful energy for man These schemes are possible alternatives to the currently most studied solar power satellite concept Possible primary collection and conversion devices discussed include the space particle flux devices, solar windmills, photovoltaic devices, photochemical cells, photoemissive converters, heat engines, dielectric energy conversion, electrostatic generators, plasma solar collectors, and thermionic schemes Transmission devices reviewed include lasers and masers P T H

A79-16609 # Ultralightweight structures for space power J M Hedgepeth (Astro Research Corp, Santa Barbara, Calif) In Radiation energy conversion in space, Conference, 3rd, Moffett

Field, Calif, January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1978, p 126-135

This paper discusses some proposals for ultralightweight space structures for collecting solar energy and radiating waste heat Effectiveness of a high concentration ratio power-generating system is studied on the basis of assumed low structural weights for the collector A novel concept of rejecting waste energy from the heat engine is discussed P T H

A79-16610 * # Overview of novel photovoltaic conversion techniques at high intensity levels R J Stirn (California Institute of Technology, Jet Propulsion Laboratory, Energy and Materials Research Section, Pasadena, Calif) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif, January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1978, p 136-151 7 refs

The paper describes several photovoltaic devices currently under development that can operate under light intensities considerably higher than can silicon solar cells The technologies discussed include GaAs heteroface solar cells, multi-color systems, thermophotovoltaics, and laser energy conversion Array costs for the GaAs and multi-color elements are estimated P T H

A79-16611 # Multicolor solar cell power system for space J Jurisson (Honeywell, Inc, Minneapolis, Minn) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif, January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1978, p 152-158

In this paper a solar cell power system concept is put forth with potential conversion efficiency in excess of 30% This concept uses solar cells with differing energy gaps so that each array of solar cells responds to different parts of the solar spectrum Separation of the solar spectrum into bands corresponding to the spectral response of the different cells is accomplished by dichroic beam splitters Multilayer stacks of transparent dielectric materials would be used for this purpose, typical designs are shown It is argued that the spectral beam splitter technology is well developed but that further work must be done on GaP and InP/InGaAs solar cells to make the multicolor technique a reality (Author)

A79-16612 * # Absorption of solar radiation by alkali vapors A T Mattick (Washington, University, Seattle, Wash) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif, January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1978, p 159-171 10 refs Grant No NGL-49-002 044

A theoretical study of the direct absorption of solar radiation by the working fluid of high temperature, high efficiency energy converters has been carried out Alkali vapors and potassium vapor in particular were found to be very effective solar absorbers and suitable thermodynamically for practical high temperature cycles Energy loss via reradiation from a solar boiler was shown to reduce the overall efficiency of radiation-heated energy converters, although a simple model of radiation transfer in a potassium vapor solar boiler revealed that self-trapping of the reradiation may reduce this loss considerably A study was also made of the requirements for a radiation boiler window It was found that for sapphire, one of the best solar transmitting materials, the severe environment in conjunction with high radiation densities will require some form of window protection An aerodynamic shield is particularly advantageous in this capacity, separating the window from the absorbing vapor to prevent condensation and window corrosion and to reduce the radiation density at the window (Author)

A79-16613 * # A high temperature Rankine binary cycle for ground and space solar engine applications A Hertzberg and C V Lau (Washington, University, Seattle, Wash) In Radiation energy

conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 172-185 8 refs Grant No NGL-49-002 044

A Rankine cycle covering the range of plasma temperatures possible from a solar radiation boiler is studied. The working fluid is potassium. A binary cycle with potassium as the topping cycle fluid and a conventional steam cycle as the bottoming cycle for earth-based applications is analyzed. Operation in conjunction with a wave energy exchanger is considered. P T H

A79-16614 * # MHD conversion of solar energy C V Lau and R Decher (Washington, University, Seattle, Wash.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 186-200 10 refs Grant No NGL 49-002-044

Low temperature plasmas wherein an alkali metal vapor is a component are uniquely suited to simultaneously absorb solar radiation by coupling to the resonance lines and produce electrical power by the MHD interaction. This work is an examination of the possibility of developing space power systems which take advantage of concentrated solar power to produce electricity. It is shown that efficient cycles in which expansion work takes place at nearly constant top cycle temperature can be devised. The power density of the solar MHD generator is lower than that of conventional MHD generators because of the relatively high seed concentration required for radiation absorption and the lower flow velocity permitted to avoid total pressure losses due to heating. (Author)

A79-16615 # Radiatively sustained cesium plasmas for solar electric conversion A J Palmer (Hughes Research Laboratories, Malibu, Calif.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 201-210 10 refs

A new concept for solar electric conversion based on the maintenance of an optical discharge in cesium vapor by concentrated solar radiation is proposed. The radiation is absorbed on excited state photoionization transitions and dimer transitions and electric power is coupled out of the plasma via MHD. The results of a computer model of the radiatively maintained discharge predict that an optical discharge can be maintained at a plasma temperature of 3000 to 3500 C by solar radiation concentrated by a factor of a few thousand incident on cesium vapor at a vapor pressure of about one atmosphere. The conductivity of the plasma is about 1000 mho/m, which is comparable to the plasma conductivity in existing MHD generators. (Author)

A79-16616 # Thermionics and its application to the SPS G O Fitzpatrick and E J Britt (Rasor Associates, Inc., Sunnyvale, Calif.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 211-221 6 refs

The paper analyzes the effect of converter operating point assumptions on the performance of the thermionic solar power satellite. Essential operating characteristics of the thermionic energy conversion process are reviewed, and key variables are identified. Pertinent converter hardware experience is cited in order to establish available and projected performance levels. The results of a simple parametric analysis of a solar power satellite using thermionics illustrate system tradeoffs as a function of converter emitter temperature, emitter current density, and performance level. P T H

A79-16617 * # Magnetically confined plasma solar collector C T Walters, G Wolken, Jr., and G D Purvis, III (Battelle Columbus Laboratories, Columbus, Ohio) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January

26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 222-240 17 refs NASA Order W-14280

The possibility of using a plasma medium for collecting solar energy in space is examined on the basis of a concept involving an orbiting magnetic bottle in which a solar-energy absorbing plasma is confined. A basic system uses monatomic cesium as working fluid. Cesium evaporates from a source and flows into the useful volume of a magnetic bottle where it is photoionized by solar radiation. Ions and electrons lost through the loss cones are processed by a recovery system, which might be a combination of electromagnetic devices and heat engines. This study concentrates on the plasma production processes and size requirements, estimates of the magnetic field required to confine the plasma, and an estimate of the system parameters for a 10 GW solar collector using cesium. P T H

A79-16618 * # Laser aircraft propulsion A Hertzberg and K Sun (Washington, University, Seattle, Wash.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 243-263 23 refs Grant No NGL-49-002 044

The concept of using a high energy continuous wave laser beam from a power satellite in geosynchronous orbit to power a commercial air transport during cruise, i.e., a laser powered airplane, is examined. These studies indicate that a laser powered airplane is a nearly fuelless and pollution free flight transportation system which is cost competitive with the fuel conservative air transport of the future. This laser flight system involves the integration of a conventional aircraft with a laser power satellite and a set of laser driven turbofans, all of which can be fabricated with existing or projected technology. The dominant cost of the laser powered flight transportation system is the cost of the power satellite. (Author)

A79-16619 # Laser-powered aircraft and rocket systems with laser energy relay units W S Jones (Lockheed Missiles and Space Co., Inc., Palo Alto, Calif.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 264-270 8 refs

The transmission of laser energy between the upper atmosphere or low earth orbit and synchronous equatorial (syn eq) orbit requires very large transmitter apertures to maintain a reasonable size receiver on laser-powered aircraft or rockets. The laser beam spot size at the receiver is a function of the diffraction limited beam spread, the optical quality of the beam as it exits the laser, beam jitter, the wavefront error as the beam leaves the transmitting aperture, the range of transmission, and atmospheric effects in the case of laser-powered aircraft. The use of space-based Laser Energy Relay Units enhances laser powered aircraft and orbit to orbit rocket systems by reducing the size requirements of the transmitter aperture on the laser and the receivers on the aircraft and rockets by effectively reducing the range of transmission, i.e., the range of transmission between the relay and aircraft or rocket is much less than from the laser to the aircraft or rocket. Relays also reduce pointing and tracking requirements and they permit transmission of energy to aircraft and rockets that are not within the line-of sight of the laser transmitter. (Author)

A79-16621 # The use of lasers for the transmission of power J F Coneybear (Ball Brothers Research Corp., Arlington, Va.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 279-310 22 refs

Consideration is given to laser generation and beam-control capabilities in the 1980-1990 period noting spot sizes and spot/aperture size ratios for several configurations and two distances. Beam characteristics are described with reference to control procedures applicable to scaling to gigawatt levels. Methods for converting laser radiation to electricity and heat are presented and the collection

and generation of primary power are outlined. Requirements for space and lunar missions are discussed in terms of lightweight inflatable structures, station-changing platforms, and lunar-base solar-cell subsystems. Attention is given to estimated costs of space transportation through 1990. SCS

A79-16622 * # New candidate lasers for power beaming and discussion of their applications. J D G Rather (W J Schafer Associates, Inc., Arlington, Va.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 313-332. 6 refs. Contract No NASw-3048.

Solar power has obvious advantages for long-duration high-power laser operations in space, provided that cost effective conversion of solar photons to laser photons can be accomplished. Both the CO baseline system and the iodine direct pumped system described in the present paper imply total system weights of 50 to 150 thousand kilograms per 100 MW of power transmitted. To equal the contemplated 5 to 10 GW of each microwave-linked space power system now being studied would require 50 to 100 STAG-type devices having total weights in orbit in the range of (2.5 to 15.0) by 10 to the sixth kilograms. The analysis indicates that laser options can be from 2 to 20 times more favorable weight wise than other space power system options. The cost advantages would scale similarly. V P

A79-16623 * # Systems efficiency and specific mass estimates for direct and indirect solar-pumped closed-cycle high-energy lasers in space. D J Monson (NASA, Ames Research Center, Moffett Field, Calif.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 333-345. 11 refs.

Based on expected advances in technology, the maximum system efficiency and minimum specific mass have been calculated for closed-cycle CO and CO₂ electric-discharge lasers (EDL's) and a direct solar-pumped laser in space. The efficiency calculations take into account losses from excitation gas heating, ducting frictional and turning losses, and the compressor efficiency. The mass calculations include the power source, radiator, compressor, fluids, ducting, laser channel, optics, and heat exchanger for all of the systems, and in addition the power conditioner for the EDL's and a focusing mirror for the solar-pumped laser. The results show the major component masses in each system, show which is the lightest system, and provide the necessary criteria for solar-pumped lasers to be lighter than the EDL's. Finally, the masses are compared with results from other studies for a closed-cycle CO₂ gasdynamic laser (GDL) and the proposed microwave satellite solar power station (SSPS). (Author)

A79-16624 * # A new concept for solar pumped lasers. W H Christiansen (Washington, University, Seattle, Wash.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 346-356. 8 refs. Grant No NGL-48-002-044, Contract No NAS3-21134.

A new approach is proposed in which an intermediate body heated by sunlight is used as the pumping source for IR systems, i.e., concentration solar radiation is absorbed and reradiated via an intermediate blackbody. This body is heated by focused sunlight to a high temperature and its heat losses are engineered to be small. The cooled laser tube (or tubes) is placed within the cavity and is pumped by it. The advantage is that the radiation spectrum is like a blackbody at the intermediate temperature and the laser medium selectively absorbs this light. Focusing requirements, heat losses, and absorption bandwidths of laser media are examined, along with energy balance and potential efficiency. The results indicate that for lasers pumped through an IR absorption spectrum, the use of an intermediate blackbody offers substantial and important advantages. The loss in radiative intensity for optical pumping by a lower-

temperature body is partly compensated by the increased solid angle of exposure to the radiative environment. SD

A79-16627 # Progress in nuclear-pumped lasers. F P Boody, M A Prelas, J H Anderson, S J S Nagalingam, and G H Miley (Illinois, University, Urbana, Ill.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 379-410. 52 refs.

Nuclear-Pumped Lasers (NPLs) directly convert the charged particle energy from nuclear reactions into coherent light energy. Since they avoid thermal processes and since excitation can come from throughout the volume of the laser, nuclear pumped laser systems are intrinsically capable of greater efficiency and higher power than electrically pumped lasers. Twelve NPLs have been demonstrated and more are being actively pursued by several university and national lab teams. Applications studies have been performed on the design of a fast burst reactor based multi-MJ pulsed NPL, on a neutron-feedback nuclear-pumped laser fusion reactor, and on applications in outer space. (Author)

A79-16629 * # The TELEC - A plasma type of direct energy converter. E J Britt (Rasor Associates, Inc., Sunnyvale, Calif.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 421-436. 5 refs. Contract No NAS2-9109.

The Thermo-Electronic Laser Energy Converter (TELEC) is a high-power density plasma device designed to convert a 10.6-micron CO₂ laser beam into electric power. Electromagnetic radiation is absorbed in plasma electrons, creating a high-electron temperature. Energetic electrons diffuse from the plasma and strike two electrodes having different areas. The larger electrode collects more electrons and there is a net transport of current. An electromagnetic field is generated in the external circuit. A computer program has been designed to analyze TELEC performance allowing parametric variation for optimization. Values are presented for TELEC performance as a function of cesium pressure and for current density and efficiency as a function of output voltage. Efficiency is shown to increase with pressure, reaching a maximum over 45%. SCS

A79-16631 # Energy exchanger technology applied to laser heated engines. R T Taussig, P H Rose, J F Zumdick (Mathematical Sciences Northwest, Inc., Bellevue, Wash.), and A Hertzberg (Washington, University, Seattle, Wash.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 465-478. 15 refs.

A description is presented of the theory of energy exchanger operation, the history of its engineering and conceptual development, and recent reduction to practice. The energy exchanger is a device which transfers work from one gas to another by unsteady gas dynamic compression and expansion within tubes which rotate with respect to stationary supply and exhaust manifolds. Attention is given to a wave superheater used to provide high-temperature air for reentry simulation, fluid-to-fluid energy exchangers, methods of analysis, and proposed future applications. These applications are related to a power plant topping cycle and a high thermal efficiency advance fusion fuel reactor. Because of the high gas temperatures which can be produced by laser heating, the energy exchanger/gas turbine combination is a prime candidate for high efficiency laser heat engine applications. In a study conducted by Taussig et al (1978) this engine concept was one of three singled out for detailed analysis. The major results pertaining to the energy exchanger/turbine combination are summarized. GR

A79-16632 * # Quasi-isentropic laser engines M Garbuny In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers
New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 479-497 12 refs Contract No NAS2-9185

This study examines laser engine processes in which coherent radiation is converted, at least in principle, completely into mechanical work (i.e., without the need for heat rejection) This type of engine process utilizes all coherence properties with minimum degradation, i.e., with minimum increase of entropy The conversion is based on a heat pump operated by gaseous resonance absorption, followed by a heat engine B J

A79-16635 * # Status and summary of laser energy conversion G Lee (NASA, Ames Research Center, Moffett Field, Calif.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers
New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 549-565 33 refs

This paper presents a survey of the status of laser energy converters Since the inception of these devices in the early 1970's, significant advances have been made in understanding the basic conversion processes Numerous theoretical and experimental studies have indicated that laser energy can be converted at wavelengths from the ultraviolet to the far-infrared These converters can be classified into five general categories photovoltaics, heat engines, thermoelectronic, optical diode, and photochemical The conversion can be directly into electricity (such as the photovoltaic, thermoelectronic, and optical diode) or it can go through an intermediate stage of conversion to mechanical energy, as in the heat engines The photochemical converters result in storable energy such as hydrogen Projected conversion efficiencies range from about 30% for the photochemical to nearly 75% for the heat engines (Author)

A79-16639 # Generation of the new coherent radiation by harmonic conversion and nonlinear mixing for certain applications C Y She (Colorado State University, Fort Collins, Colo.) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers
New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 602-612 29 refs

Nonlinear optical interactions are proposed as a means for generating coherent radiation for space- and energy-related applications Consideration is given to third-harmonic generation, third-order sum and difference frequency generation, and coherent Raman mixing in molecular media Coherent radiation thus generated in the infrared is applicable for space power transmission, isotope separation, atmospheric absorption, and molecular-species detection in planetary atmospheres S C S

A79-16641 * # Methods for the photochemical utilization of solar energy R E Schwerzel (Battelle Columbus Laboratories, Columbus, Ohio) In Radiation energy conversion in space, Conference, 3rd, Moffett Field, Calif., January 26-28, 1978, Technical Papers
New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 626-657 10 refs Research supported by the US Department of Energy, Battelle Memorial Institute, and NASA.

The paper considers the 'ground rules' which govern the efficiency of photochemical solar energy conversion and then summarizes the most promising approaches in each of three categories photochemically assisted thermal systems for the heating and/or cooling of structures, photogalvanic systems for the production of electrical power in applications, such as photorechargeable batteries or inexpensive 'solar cells', and photochemical formation of fuels for combustion and for use as chemical feedstocks or foods Three concepts for the photochemical utilization of solar energy in

space are found to be particularly promising (1) photochemical trans-cis isomerization of indigold dyes for photoassisted heating or cooling, (2) the redox stabilized photoelectrolysis cell for the production of hydrogen (and/or oxygen or other useful chemicals), and (3) the liquid-junction photovoltaic cell for the production of electrical power (Author)

A79-16725 # Landsat - Developing techniques and applications in mineral and petroleum exploration C J Simpson *BMR Journal of Australian Geology and Geophysics*, vol 3, Sept. 1978, p 181-191 45 refs

The extensive research into satellite data technology that followed the launch of Landsat-1 (ERTS 1) in 1972 has resulted in progressive improvements to product quality and digital data analysis techniques Improved image quality has direct significance to the many mineral and petroleum exploration organizations that are now routinely applying conventional photogeological interpretation techniques to Landsat multispectral scanner imagery Photogeological techniques will continue to be the main means of Landsat interpretation, however, even the best quality imagery may contain less than one quarter of the total data recorded and computer techniques offer the only adequate means of analysing all the data in a Landsat scene Considerable progress has been made with computer analysis of Landsat digital data and some techniques have definite application to mineral and petroleum exploration In specific environments direct detection of iron weathering products associated with both hydrothermal alteration and uranium deposits has been achieved Various computer-enhancement techniques have also been employed to reveal structural and lithological information not obvious on conventional Landsat imagery or aerial photography (Author)

A79 16726 Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers Conference sponsored by the Institute of Electrical and Electronics Engineers New York, Institute of Electrical and Electronics Engineers, Inc., 1978 286 p Members, \$18.75, nonmembers, \$25

Consideration is given to such topics as energy storage for tokamak devices, solar-thermal-electric energy conversion, energy economics, energy management, and the control of energy systems Papers are also presented on energy saving technologies, energy conservation, renewable energy sources, energy systems planning, electric utility technology, solar power satellites, energy systems modeling, computers and energy, and wind energy systems B J

A79-16727 Energy storage for tokamak reactor cycles C H Buchanan (General Electric Co., Schenectady, N.Y.) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers
New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 15 Contract No EY-76-C-02 3073

Energy storage to permit a fusion reactor powerplant to produce electric power during the inherent reactor downtime is feasible and inexpensive Of the many energy storage methods and techniques that are possible throughout the plant heat transfer mechanisms, the preferred approach is the incorporation of a flash steam capability into the intermediate energy transfer loop medium/steam heat exchanger (Author)

A79-16728 Compatibility of direct energy storage devices with ac processing power system components K Denno (New Jersey Institute of Technology, Newark, N.J.) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers
New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 6-10 9 refs

This paper presents comprehensive study for setting up criteria for compatibility involving economic as well as operational ranges in a system of interconnections between direct energy devices and appropriate output ac processing subsystems Relationships describing economic performance for the redox storage battery is also derived (Author)

A79-16729 Flywheel energy storage system for JT-60 toroidal field coil H Kishimoto, R Shimada, S Tamura (Japan Atomic Energy Research Institute, Tokai, Japan), S Itoh, Y Sawada, H Takano, T Furusawa, and K Kimura (Tokyo Shibaura Electric Co., Ltd., Yokohama, Japan) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 11 15

For plasma confinement in large fusion devices, a magnetic field of several teslas is necessary. The large pulsed power supply requirement can be met with a flywheel energy storage system. This paper presents a detailed investigation of the flywheel energy storage system for the JT-60 toroidal field coil based on parameter studies with regard to the following: (1) optimum hybrid system of M-G (motor-generator) flywheel set and electric power from the commercial power line, (2) preliminary design comparison between the vertical shaft waterwheel type low speed M-G set and horizontal high speed M-G set, and (3) optimum choice of design parameters in the case of a vertical shaft waterwheel type low speed M-G set. B J

A79-16730 Solar Thermal Electric Program G W Rhodes (U.S. Department of Energy, Operations Office, Albuquerque, N. Mex.) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 16-18

The primary purpose of the Solar Thermal Power Program is to achieve the initial commercial implementation of dispersed systems by the mid-1980s and to establish the economic viability of central solar thermal power systems (40-60 mills/kWh) for electric utility networks. The strategies for achieving this and several related goals are discussed. B J

A79-16731 A status report on the Solar Thermal Test Facility B W Marshall (Sandia Laboratories, Albuquerque, N. Mex.) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 19-23. Research supported by the U.S. Department of Energy.

The Solar Thermal Test Facility (STTF) at Sandia Laboratories in Albuquerque, New Mexico is made up of a field of heliostats which concentrate sunlight onto experiments located on a central tower. The facility is designed to deliver up to 5 MW of thermal power to experimental equipment, and successful operation at a partial power of approximately 1.8 MWt was achieved in May, 1977. The STTF will serve as the DOE's primary solar facility for testing components required in solar thermal electric power plants and will also serve researchers from other government agencies, research institutes, universities, and industry as a major R&D center for materials and process work which requires high solar flux conditions. B J

A79-16732 Factors affecting market initiation of solar total energy R W Harrigan (Sandia Laboratories, Albuquerque, N. Mex.) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 24-29. 13 refs.

This paper introduces an economic methodology for quickly visualizing the effect of various economic, technical and programmatic actions on the early commercialization of solar total energy. Process heat users are identified as primary candidates for earliest market initiation. In addition, while technical factors such as improved power conversion efficiency and mirror reflectivity do affect time of market initiation, programmatic and economic factors such as government induced mass production of solar collectors and investment tax credits have even greater influence on the market initiation of STE. (Author)

A79-16733 Non-adaptive optics for solar thermal electric power J D Reichert (Texas Tech University, Lubbock, Tex.) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 30-34

For solar thermal electric power there is a trade-off in performance and cost between systems based upon fully adaptive optics and those employing non-adaptive optics. Adaptive optical systems, such as the Solar Tower (Tower/Heliostat), offer the promise of high performance in the sense of annual energy capture and a high temperature resulting from large concentration ratios. Non-adaptive systems, such as the Solar Gridiron (Fixed Mirror Distributed Focus, FMDf), seek good performance with emphasis on lower capital cost. To illustrate the application of non-adaptive optics, a nominal 5MWe Solar Gridiron power system is described. The description is based upon the work of the U.S. Dept. of Energy/Texas Tech University Crosbyton Solar Power Project. (Author)

A79-16734 The Power Wheel - Elimination of energy-consuming drive components G S Goldman (Gold Line Engineering Consultants, Fullerton, Calif.) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 95-99

The Power Wheel is a compact, self-contained motor in a wheel that establishes a torque drive. Dual-functioning circuitry that performs brushless commutation and polyphase rectification is also contained entirely within the wheel. Thus, with a substantial reduction in both the number of external control system components and mechanical drive-system couplings, this electric motor can power a 4-wheel-drive vehicle in normal driving modes and can serve as a power recovery generator during braking. The integral design of a motor in a wheel, combined with efficient microprogrammed control, assures compactness of design, ease of fabrication, and reduction in the cost, complexity, and number of components associated with motor and generator assemblies. The Power Wheel contains no transmission, gear or belt drives, rotating axles, differentials, universal joints, or drive shafts. Hence, energy losses incurred through mechanical drive system couplings are eliminated. (Author)

A79-16735 Energy conservation by means of recycling J A Savage (Southern Methodist University, Dallas, Tex.) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 102-105. 10 refs.

Millions of dollars worth of electrical energy can be conserved each year by means of recycling such materials as aluminum cans, newspapers, and glass bottles. Calculations of savings were made using the cost per kilowatt hour of electrical energy as a variable. Graphs are presented showing the savings in energy for the reuse of aluminum, glass, and paper. B J

A79-16736 The impact of advanced technology on the future electric energy supply problem T Gonen (Iowa State University of Science and Technology, Ames, Iowa) and P M Anderson (Electric Power Research Institute, Palo Alto, Calif.) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 117-121. 10 refs. Research supported by the Iowa State University of Science and Technology.

Various alternate energy sources and conversion technologies are briefly discussed, including coal, nuclear fission and fusion, geothermal, solar, wind power, and tide power. It is noted that these techniques must be considered as possible alternatives, rather than as certainties. The impact of pollution control on future energy supply is discussed briefly. B J

A79-16737 Input-output method applied to energy planning C Kashkari (Akron, University, Akron, Ohio) In Energy '78, Annual Conference, Tulsa, Okla., April 16-18, 1978, Record of

Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 122-126 9 refs

Leontief's input-output method of economics is being used to forecast the effects of shortages of oil and other energy resources on the outputs of different economic sectors An input-output table provides a basis for determining how the total output of a particular industrial product is related to the final demands of other sectors The table is a convenient means of describing in quantitative terms the interdependence of industries The present paper describes the input-output method and applies it to a simple four sector economic system B J

A79-16738 * Design considerations for solar power satellites G D Arndt and L Leopold (NASA, Johnson Space Center, Houston, Tex) In Energy '78, Annual Conference, Tulsa, Okla , April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 153-157 8 refs

This report summarizes the performance characteristics of a conceptual solar power satellite (SPS) system with emphasis on the microwave power transmission system The latest tradeoff studies on photovoltaic and thermal systems for converting solar energy into electricity at the satellite are reviewed The microwave system, consisting of dc-RF amplifiers, a 1 km phased array, and a ground antenna/rectifier scheme is capable of delivering 5 GW of power to the commercial grid The transmission efficiencies of smaller system sizes (down to 1 GW) are compared with that of the nominal 5 GW system At present the frequency region of interest is the IMS (industrial, medical, and scientific) band at 2450 plus or minus 50 MHz Economic and technical tradeoffs as a function of the microwave operating frequency are considered Candidate dc-RF power converter tubes, including medium power amplitrons, high power klystrons, and low-power solid state amplifiers, are examined

(Author)

A79-16739 Attitude and pointing control system for the microwave antenna of the solar power satellite M Y Wu (Colorado, University, Boulder, Colo) In Energy '78, Annual Conference, Tulsa, Okla , April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 158-162 18 refs

An overall study on the attitude and pointing control system for the SPS microwave antenna is presented Preliminary analyses on the external disturbance torques, attitude sensors, actuators and controller implementation are given Quantitative analyses on the system key parameters such as the moment of inertia and the control frequency are also given (Author)

A79-16740 Temperature dependent parameter analysis of thermoelectric devices L J Paden (Oklahoma State University, Stillwater, Okla) and K R Rao (Texas, University, Arlington, Tex) In Energy '78, Annual Conference, Tulsa, Okla , April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 167-170. 10 refs NSF Grant No SMI-76-83578

The electrical analog of the thermal model of a thermoelectric (TE) device is developed with emphasis on directly relating physical and mathematical parameters The problems of placing the capacitances with respect to the resistances, and those of relating temperature dependent parameters with the nodes are considered. The numerical method of solving the differential equations describing the transient response is described The numerical analysis is general in the sense that it is applicable to various geometries of the TE devices and also under various current excitation functions. A digital computer software package which readily allows alteration of the physical parameters to be studied is designed and examples of its application are illustrated (Author)

A79-16741 Macro-energy model - Impact of public policy on technological development W E Rice (Colorado, University, Boulder, Colo) In Energy '78, Annual Conference, Tulsa, Okla ,

April 16-18, 1978, Record of Conference Papers

New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 171-174 13 refs

This paper discusses why a macro-energy model is needed to analyze and evaluate relationships of the energy market system The model is presented in detail, defining the functions of energy availability, economic conditions, environmental conditions, governmental policy, technology, and social expectations Foundations of energy consumption evolution are outlined, and the fallacies of cost effective evaluation are brought out in relation to current public policy concerning oil and gas exploration The problems of research and educational direction are viewed in perspective to the policy of funds administration Political tokenism and areas of public red tape are presented as major blocks to any change in the current system Conclusions as to possible directions for change are suggested

(Author)

A79-16742 On the use of eddy-current couplings in wind-driven synchronous machines A Q Qazi (Pakistan University of Engineering and Technology, Karachi, Pakistan) and R Ramakumar (Oklahoma State University, Stillwater, Okla) In Energy '78, Annual Conference, Tulsa, Okla , April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 242-246 12 refs

This paper discusses the suitability of eddy current couplings in the mechanical interfaces of wind-driven synchronous machines Based on the computer simulation results presented under gusting wind conditions, recommendations are made for choosing the coupling design parameters for satisfactory operation Eddy current couplings turn out a very good performance even under severe gusting and highly variable wind regimes and therefore are strongly recommended for application in wind electric conversion systems

(Author)

A79 16743 Controlling a wind generator for increased efficiency M E Valdez and E R Kittlaus (California State University, Long Beach, Calif) In Energy '78, Annual Conference, Tulsa, Okla , April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 247-249

Two procedures for controlling a wind generator-storage battery system to obtain increased efficiency are presented - one optimal and the other practical It is shown that an existing generator and blade designed as a battery charger can be used for supplying a much larger load By simply fixing the field current to a value given by the average wind conditions and increasing the size of the storage batteries, more energy can be obtained This concept is applicable to small and medium-size installations B J

A79-16744 Efficient use of wind energy by using static slip recovery systems - A simulator study V Rajagopalan (Quebec, Universite, Trois-Rivieres, Canada), K S Rao, and M N S Swamy (Concordia University, Montreal, Canada) In Energy '78, Annual Conference, Tulsa, Okla , April 16-18, 1978, Record of Conference Papers New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 250-254 6 refs

Consideration is given to the computer simulation of an efficient wind energy scheme utilizing a slip energy recovery system A new simulator WESS (Wind Energy System Simulator) is very useful in designing the static power converter system by repeated analysis This simulator is particularly effective in making an optimum choice of di/dt limiting reactor and dv/dt limiting snubber components, resulting in considerable reduction in high frequency line current harmonics Experimental results obtained on a 2-kW scheme are compared with results obtained from a simulator run B.J

A79-16745 Motor vehicle lead emissions in the United States - An analysis of important determinants, geographic patterns and future trends G Provenzano (Illinois, University, Urbana, Ill) *Air Pollution Control Association, Journal*, vol 28, Dec 1978, p 1193-1199 31 refs NSF Grant No ENV-74-24276

A79-16747 Energy requirements of a limestone FGD system E S Rubin and D G Nguyen (Carnegie-Mellon University, Pittsburgh, Pa) *Air Pollution Control Association, Journal*, vol 28, Dec 1978, p 1207-1212 9 refs Research supported by the US Department of Energy, Pennsylvania Science and Engineering Foundation, and Middle Atlantic Power Research Committee

A computerized simulation model has been developed to compute energy requirements of a limestone slurry flue gas desulfurization (FGD) system as a function of FGD system design parameters, power plant characteristics, coal properties, and sulfur dioxide emission regulation Results are illustrated for a 'base case' plant of 500 MW, burning 3.5% sulfur coal, meeting the federal new source performance standard of 1.2 lb SO₂/1 million Btu The flue gas is cleaned by an electrostatic precipitator followed by a limestone FGD system with a TCA scrubbing vessel and an optimized in-line steam reheater The total FGD system energy requirement for this case was found to be 3.4% of the total energy input to the boiler Sensitivity analyses were then performed in which the nominal values of ten system parameters were individually varied This caused the total FGD system energy requirement to vary between 2.5% and 6.1% of the gross plant output for the range of parameters tested The most sensitive parameters were scrubbing slurry pH and stack gas exit temperature In all cases, FGD energy requirements were minimized when the SO₂ emission standard was met by partially bypassing the scrubber (Author)

A79-16786 # Selection of a characteristic quantity defining the self-ignition of a fuel in a stream (K voprosu o vybore kharakternoi velichiny, opredelivushchei samovosplamnenie topliva v potoke) V N Gruzdev, N A Malishevskaya, and M D Tavger *Aviatsionnaya Tekhnika*, vol 21, no 3, 1978, p 42-45 In Russian

In the experiments described, the self-ignition of kerosene TS-1 in a flow of nonequilibrium combustion products was studied to determine the degree to which the ignition delay characterizes the process as a whole The ignition time is found to decrease with increasing flow temperature and increasing density of active centers It is proposed to use the critical flow velocity (which forms the upper bound of the possible range of self-ignition) as the criterion of self-ignition V P

A79-16800 # Study of a heat exchanger with heat pipes within the system of a small-scale gas-turbine engine (Issledovanie teploobmennika s teplovymi trubami v sisteme malorazmernogo gazoturbinnogo dvigatelya) V K Shchukin, I I Mosin, N V Lokai, and Iu V Matveev *Aviatsionnaya Tekhnika*, vol 21, no 3, 1978, p 127-132 In Russian

In the present paper, the structural elements of a heat exchanger employing heat pipes is theoretically optimized with a view toward using such exchangers as liquid coupled indirect transfer regenerators for gas-turbine plants A regeneration ratio of 0.82 at duct pressure losses of less than 6 percent is obtained This theoretical value is verified by model experiments V P

A79-16984 Bibliographic and numeric data bases for fiber composites and matrix materials F E McMurphy and T M Quick (California, University, Livermore, Calif) In ICCM/2, Proceedings of the Second International Conference on Composite Materials, Toronto, Canada, April 16-20, 1978 Warendale, Pa, Metallurgical Society of AIME, 1978, p 33-43 8 refs Contract No W-7405-eng 48

The Data Management Group at the Lawrence Livermore Laboratory is conducting research leading to the creation of data bases for energy storage systems These data bases are computer-based and will contain bibliographic information, material properties data, and data on essential criteria for energy storage systems Access to these central files will be from remote terminals over computer networks and by telephone dialup, in addition to the more conventional means of computer-generated reporting, and dissemination on magnetic tapes Bibliographic and numerical data bases have been created for fiber composites and matrix materials, with particular emphasis on their application to modern flywheel technology B J

A79-17075 Reducing inefficiency and emissions of large steam generators in the United States B P Breen and J G Sotter (KVB, Inc, Tustin, Calif) *Progress in Energy and Combustion Science*, vol 4, no 3, 1978, p 201-220 26 refs

Efficiency and emission problems associated with steam generators are considered, and combustion control procedures which result in efficiency improvements and pollution reductions are discussed Topics include boiler design and operation, combustion equipment, flame mechanisms, and fuel characteristics Subjects related to boiler and cycle efficiency, including lowered O₂ and other effects on smoke limits, comparison of methods for improving boiler efficiency, heat recovery for boilers, and air preheaters, are examined Economizers, financial evaluation procedures, and steam turbine cycle efficiency are considered Pollution control techniques, in particular the thermal deNO_x process, are described M L

A79-17120 # The Netherlands experimental vertical axis wind turbine J B D H Bolt (Fokker-VFW, Schiphol Airport, Netherlands) In *Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1977* Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1978, p 5-1 to 5-8

The paper gives a general description of an experimental 5.3-m-diam vertical axis wind turbine and its associated power conversion system and other subsystems The two glass-fiber reinforced plastic blades are strengthened by bonded light-metal plates As design-criteria for the static strength of the blades, a maximum blade rotation speed of 450 rpm in calm weather conditions and a reducing speed of 2.5 rad/sq sec at 325 rpm are used The rotor operates in two modes constant speed, and constant blade-speed/wind-speed ratio Block diagrams of the mechanical-hydraulic energy conversion system and the control and protection systems are presented The test program will comprise measurement of vibration characteristics of the turbine when stationary and running, with or without tethering, measurement of turbine efficiency at constant rotor rpm and blade-speed/wind-speed ratio, measurement of tension in the blade roots, and measurement of the influence of tension in the guy wires on dynamic behavior of the turbine P T H

A79-17124 Space Shuttle - America's wings to the future M H Kaplan (Pennsylvania State University, State College, Pa) Fallbrook, Calif, Aero Publishers, Inc, 1978, 215 p \$14.95

This book describes the Space Shuttle program, its scope, goals, status, future, and benefits in a style addressed to the general public The discussion covers the development of the concept of the Space Transportation System, the Shuttle launch, operations in space, and return from orbit and landing Considerable emphasis is placed on the benefits for mankind that may result from the Space Transportation System Projects made possible by a Shuttle type system are discussed, including solar power stations in space, giant orbiting antenna systems for communications, and space colonies Possibilities for a new generation of Shuttles are discussed P T H

A79-17171 Historical review of adaptive optics technology L C Marquet (MIT, Lexington, Mass) and J Hardy (Itek Corp, Lexington, Mass) In *Adaptive optical components, Proceedings of the Seminar, Washington, D.C., March 30, 31, 1978* Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1978, p 2-10 DARPA-sponsored research

The 25-year history of adaptive optics technology is presented, noting (1) optically low-grade light buckets used for collecting radiation from distant astronomical objects and for large-scale solar energy collection, (2) figure-control systems for large primary telescope mirrors, (3) the atmospheric compensation concept which has led to real-time atmospheric compensation and image sharpening, and (4) the adaptive antenna concept which is used for the coherent optical adaptive technique S C S

A79-17218 Energy systems. An analysis for engineers and policy makers Edited by J E Bailey (Arizona State University, Tempe, Ariz) New York, Marcel Dekker, Inc (Energy, Power, and Environment Volume 2), 1978 130 p \$19.50

Energy dilemmas in the US are considered along with energy delivery systems, energy research problems and approaches, and an energy dialogue. Attention is given to the politics of energy in 1977, nuclear power and the history of the future, the energy/ecology dilemma, the human side of the fuel crisis, Arizona's energy alternative, an energy financing projection, prospects for geothermal energy in Arizona, the status of solar energy, urban wastes as an energy source, potential research problems in energy systems analysis, a research analysis concerning energy economics, an energy and input-output analysis, and energy, labor, and capital considerations in productivity enhancements. G R

A79-17219 **The status of solar energy** C E Backus (Arizona State University, Tempe, Ariz.) In *Energy Systems: An analysis for engineers and policy makers* New York, Marcel Dekker, Inc., 1978, p 69-73

It appears from most indications, both technical and nontechnical, that solar energy technology will have a chance to prove itself useful during the next few years. Domestic hot water is perhaps the most economically justified solar application presently. The reason for this is that hot water is needed fairly uniformly throughout the year. Solar collectors for the space heating of buildings are not as economically justifiable as solar hot water heaters at the present time. This is primarily due to the seasonal nature of the heating load for buildings in addition to the low price of natural gas. Attention is also given to thermal electric generation, photovoltaic cells, and foreign solar industry. It is pointed out that solar energy is not a panacea for the energy problems of the US. For a solution of these problems it will be necessary to develop fully all available energy sources. G R

A79-17220 **Urban wastes as an energy source** J L Kuester (Arizona State University, Tempe, Ariz.) In *Energy systems: An analysis for engineers and policy makers* New York, Marcel Dekker, Inc., 1978, p 75-78 7 refs

The main ingredient of urban refuse that is convertible to energy forms is cellulose. Available cellulose type material in urban refuse is limited, i.e., only about 2-5 percent of the US energy needs could be fulfilled utilizing waste municipal sources. If one considers agricultural and forest wastes as well as 'energy farms', the supply becomes virtually unlimited. Thus the use of cellulose as an energy source would appear to depend on availability of reliable conversion processes with attractive economics. Several options exist for useful conversion of cellulose type materials for energy purposes. Methane gas recovery from existing landfills is a possibility for 'suitable' sites with relatively simple technology. Suitable sites are limited, however. Biological processes are capable of producing methane, compost, and glucose. Attention is also given to refuse characteristics, a list of resource recovery systems, economics, markets, and environmental considerations. G R

A79-17221 **Potential research problems in energy systems analysis** H W Welch (Arizona State University, Tempe, Ariz.) In *Energy systems: An analysis for engineers and policy makers* New York, Marcel Dekker, Inc., 1978, p 81-99 40 refs

It is pointed out that the potential for research in energy must be viewed from a much broader perspective than that provided by physical science and technology. Solar energy, fusion, efficient transportation, improved building construction, and waste recycling are all significant objectives. However, a higher level of objectives is needed to deal with the social, economic, and lifestyle implications of the energy problem. A few comments are presented about this need for objectives and, in particular, the importance of balance in objectives. A description is given of some examples of approaches to energy systems analysis in the broader perspective and potential applications in Arizona. Attention is given to problems associated with the implementation of results of research and suggestions for the role of the academic community. Definitions, units, and some typical energy quantities are given in appendices. G R

A79-17222 **Energy economics - A research analysis.** D A Huettnner (Oklahoma, University, Norman, Okla.) In *Energy systems: An analysis for engineers and policy makers* New York, Marcel Dekker, Inc., 1978, p 101-108 24 refs

Energy economics is simply the application of economic analysis to energy problems. Three topics related to energy economics are discussed. It is pointed out that since the fall of 1973, control of world energy prices has passed to the hands of the OPEC Cartel. Since current and future energy prices play a pivotal role in energy policy, a description is presented of the stability of the OPEC Cartel, the substitute energy sources, and the role of energy independence. Arizona energy prospects are examined as the second topic, taking into account traditional energy forms and nontraditional energy options. In the discussion of the third topic, attention is given to net energy analysis vs economic analysis. It is found that energy analysts employing economic principles will generally reach different conclusions from energy analysts using noneconomic principles. G R

A79-17223 **Energy and input-output analysis** C D Hoyt and G L Berry (Arizona State University, Tempe, Ariz.) In *Energy systems: An analysis for engineers and policy makers* New York, Marcel Dekker, Inc., 1978, p 109-113 10 refs

Work conducted by the Office of Economic Analysis (OEA) is discussed, taking into account the 1958 Income and Output Study and a 1963 update of the 1958 Input-Output Study. Attention is given to the Input-Output matrix, the structure of the US economy, the energy industries, an input-output analysis, approaches of planning for the future, the use of energy units in input-output tables, energy costs of goods and services, electric power generation, the new energy technology impact, an energy tax and trade markup, and the energy intensity of US tradeable goods. It is concluded that input-output analysis is obviously a very powerful tool for attempting to divine the future consequences of decisions made today. The defects of the concept and use of input-output analysis are not to be denied, however, and the limitations in the available data head the list of these. G R

A79-17228 **An analysis of air pollution control costs in NSW** J D Court and R C Coughlin (New South Wales State Pollution Control Commission, Sydney, Australia) In *International Clean Air Conference, Brisbane, Australia, May 15-19, 1978, Proceedings* Ann Arbor, Mich., Ann Arbor Science Publishers, Inc., 1978, p 19-35 17 refs

The cost of air pollution control in New South Wales has been estimated to be approximately \$17 per head in 1977 and could rise to approximately \$40 by 1985 if satisfactory air quality is to be maintained. These estimates incorporate costs for stationary plant control, costs for motor vehicle control, and costs for restrictions on fuels. The most rapid increase in control cost will occur in the control of 'emerging' pollutants such as photochemical smog, though urban growth will necessitate increased expenditure on 'traditional' pollutants such as acid gases. Consideration is given to possible applications of these data to economic analysis. B J

A79-17249 **Advanced emissions control and test facility of the Electric Power Research Institute** O J Tassicker (Electric Power Research Institute, Palo Alto, Calif.) and H W Spencer, III (Western Precipitation Corp., Los Angeles, Calif.) In *International Clean Air Conference, Brisbane, Australia, May 15-19, 1978, Proceedings* Ann Arbor, Mich., Ann Arbor Science Publishers, Inc., 1978, p 469-486 7 refs. Research supported by the Electric Power Research Institute.

A facility for testing devices that remove particulates, SO_x, and NO_x is described, and preliminary results for a two-stage precipitator are reported. The facility, which utilizes boiler flue-gas side streams, can test devices at flows from 1 to 20 cu m/sec. Data on all process parameters are analyzed and displayed in real time. The tested precipitator which is described, uses a high-intensity ionizer array followed by four conventional collector fields. Corona V-I characteristics are reported. M L

A79-17250 The fate of trace elements in coal after combustion D J Swaine (Commonwealth Scientific and Industrial Research Organization, Fuel Geoscience Unit, North Ryde, New South Wales, Australia) In International Clean Air Conference, Brisbane, Australia, May 15-19, 1978, Proceedings

Ann Arbor, Mich, Ann Arbor Science Publishers, Inc, 1978, p 519-525 9 refs

Data are given for 22 trace elements in fly ash from the combustion of pulverized bituminous coals in power stations and in a pilot-scale furnace. The coals were from New South Wales (7 samples) and Queensland (2 samples). The range of values are similar to those for Australian bituminous coal ashes. The results are discussed in relation to the presence of trace elements in the atmosphere and ensuing environmental effects (Author)

A79-17253 The influence of lead compounds on automotive exhaust catalysts C F Cullis (City University, London, England) In International Clean Air Conference, Brisbane, Australia, May 15-19, 1978, Proceedings

Ann Arbor, Mich, Ann Arbor Science Publishers, Inc, 1978, p 591-602 17 refs

Studies are reported on the effects of lead bromide and lead chloride on the catalytic activity and other properties of several unsupported and alumina-supported transition metal oxides used for the control of air pollutants in motor vehicle exhausts. The amounts of lead required to deactivate unsupported oxides and cobalt oxides are contrasted, and the absorption of lead halides by alumina supports and by oxides is characterized. It is found that catalytic activity can be restored by removing deposited lead halides with steam M L

A79-17262 A methodology for assessing the potential impact on air quality resulting from geothermal resource development in the Imperial Valley P H Gudiksen, M C Axelrod, D L Ermak, K C Lamson, and R Lange (California, University, Livermore, Calif) In International Clean Air Conference, Brisbane, Australia, May 15-19, 1978, Proceedings

Ann Arbor, Mich, Ann Arbor Science Publishers, Inc, 1978, p 719-734 5 refs Contract No W-7405-eng-48

This paper presents the methodology in use in the Imperial Valley for assessing the potential impact on air quality that may result from the development of geothermal resources. The installation of a network of air quality stations for characterizing the air quality and atmospheric transport properties in the valley prior to development is discussed. Analyses of geothermal fluids for various gases are performed to evaluate the potential emission rates from future geothermal power plants. The principal pollutant of concern is H₂S because of its noxious odor and potential release rate. These estimated source emission rates and the appropriate meteorological measurements are used as input to a three-dimensional, atmospheric transport code to estimate the potential changes in air quality that result from various scenarios for development of geothermal power (Author)

A79-17275 * # Overview of future programs - USA R F Freitag (NASA Office of Space Transportation Systems, Washington, D C) *Canaveral Council of Technical Societies, Space Congress, 15th, Cocoa Beach, Fla, Apr 26-28, 1978, Paper 67 p*

An overview of U S manned space flight is presented and recent advanced studies are considered. In connection with long range mission planning, studies are being conducted of future space systems, space vehicles, and space operations. An early Space Construction Base is being studied for launch in 1985 and associated geosynchronous operations are projected for 1987. The Space Construction Base is envisioned as a facility for erecting large structures in space, for basing Manned Orbital Transfer Vehicles that operate between low earth orbit and geosynchronous orbit, and for the conduct of industrial operations and scientific experiments in space. Ways and means for erecting large structures in space are examined. One particular plan involves the development of the technology to demonstrate the capabilities of a solar power station to translate solar energy to electrical energy for use on commercial power stations on earth. Advanced transportation is also being studied, particularly for needs that complement the Shuttle. The use of the Shuttle System as a Heavy Lift Launch Vehicle to place large

diameter payloads up to 200,000 pounds in weight is also being explored G R

A79-17276 Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volumes 1, 2 & 3 Congress sponsored by the International Solar Energy Society and UNESCO Edited by F de Winter and M Cox (Altas Corp, Santa Cruz, Calif) Elmsford, N Y, Pergamon Press, Inc, 1978 Vol 1, 619 p, vol 2, 775 p, vol 3, 825 p Price of three volumes, \$150

The volumes examine such topics as international and national solar energy programs, economic aspects of solar energy utilization, and policy, social, and implementation aspects of solar energy. Consideration is given to such technical aspects of solar energy utilization as solar radiation characteristics, energy storage, photovoltaics (including space power), photochemistry and photobiology, flat plate collectors (including solar ponds and selective surfaces), concentrating systems, solar heating and cooling, solar thermal power systems (including ocean thermal gradient systems), wind power, and agricultural and industrial applications of solar energy B J

A79-17277 Analysis of alternatives for U S international cooperation in solar energy H C Yim (Energy Systems International, Washington, D C) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1

Elmsford, N Y, Pergamon Press, Inc, 1978, p 12-16 8 refs

A study to examine U S policies, priorities, criteria, needs and benefits of international cooperation in solar energy identified four major program components for increased emphasis, namely, research and development cooperation, development and demonstration cooperation, demonstration and assistance cooperation, and assistance in commercialization programs involving U S industry. Utilizing phased program planning and establishing approaches, guidelines, criteria and priorities, U S multilateral and bilateral cooperative programs can be effectively explored on a mutual benefit basis with developed and developing countries. This paper summarizes some of the study results to encourage the much needed dialogue among those interested in furthering the development of solar energy through U S international cooperation (Author)

A79-17278 The solar energy R & D programme of the European Communities. A S Strub (Commission of the European Communities, Brussels, Belgium) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1

Elmsford, N Y, Pergamon Press, Inc, 1978, p 22-25

The paper reviews the 'indirect action' program (1975-1979) on solar energy of the Commission of the European Communities. The aim of the program is to sponsor contract research, normally on a 50/50 cost sharing basis. The program consists of six sectors: (1) flat plate collectors and their application to dwellings, (2) self-contained generating sets for the production of mechanical and/or electrical power, (3) photovoltaic conversion, (4) photochemical, photoelectrochemical, and photobiological processes, (5) photosynthetic production of organic matter, and (6) data network relating to solar radiation B J

A79-17279 Solar energy in Latin America - An overview

M Alonso and M de Santiago (Organization of American States, Dept of Scientific Affairs, Washington, D C) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1

Elmsford, N Y, Pergamon Press, Inc, 1978, p 33-38

This paper analyzes in general terms the energy problem in Latin American countries, emphasizing the strong dependence of the region on oil. An outline of the available alternative energy sources is presented and it is concluded that solar energy, on account of the special geographic and social characteristics of the region, could contribute substantially to the development of isolated rural communities. There is also, for each country, a brief report of the state of the art in solar energy and a list of the main institutions working in research and development (Author)

A79-17280 **Report on the development of solar energy in France.** M B Devin (Commissariat à l'Énergie Atomique, Paris, France) and M J Pheline (Délégation aux Énergies Nouvelles, Paris, France) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 54-58

Organizational aspects of the development of solar energy in France are discussed, with emphasis on the type and scope of efforts currently under way and the advances which may be anticipated in the short and medium terms The French National Program is described with attention given to (1) thermal conversion and its applications to dwellings, (2) thermodynamic conversion and power production, (3) direct conversion via photocells, (4) bioconversion, and (5) such applications as the drying, cooking, desalination, and solar-powered telecommunications B J

A79-17281 **The accomplishments of the United States Federal Solar Energy Program** L O Herwig (U S Department of Energy, Div of Solar Energy, Washington, D C) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 64-67

The US Solar Energy Program has grown rapidly from a very low level of Federal funding in 1970 to about \$290M in 1977 These funds have been applied to research, development and demonstration (RD&D) of solar technologies including water heating, space heating and cooling, industrial process heat, solar electric systems including solar thermal, photovoltaic, wind and ocean thermal technologies, and, fuels from biomass Results of RD&D indicate strongly that solar heating, wind conversion, and fuels from biomass can begin to contribute significantly to US energy resources by 1985 As these technologies continue to grow in impact, other solar technologies could begin to contribute in the late 1980's and early 1990's leading to a substantial impact on US energy needs by the end of this century (Author)

A79-17282 **Solar energy research, development and demonstration program in Kuwait** M A S Malik, A Shihab-Eldin, V M Puri (Kuwait Institute for Scientific Research, Kuwait), A S Debs (Georgia Institute of Technology, Atlanta, Ga), M Lokmanhekim (California, University, Berkeley, Calif), M S Sodha (Indian Institute of Technology, New Delhi, India), and G Warfield (Delaware, University, Newark, Del) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p

68-71 10 refs

Kuwait has established a modest RD&D program in solar energy in the recent past The program concentrates on three main areas namely solar cooling and heating of buildings, solar thermal conversion and agricultural applications of solar energy The objective of this program is to commercialize solar technology in Kuwait In this paper some of the projects in the solar energy program are described (Author)

A79-17283 **Solar energy activities in Austria** G Faninger and M Bruck (Austrian Solar and Space Agency, Vienna, Austria) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 75-78

Austrian R & D activities in the field of solar energy are currently focused on (1) the production of low temperature heat,

including the gathering of solar related meteorological and climatological data, collector development, and standardization of test methods, and (2) the production of high-temperature heat, including the production of a solar cooling system for developing countries, the planning and construction of a 10-kWe solar power plant for developing countries, and cooperation with the IEA for the planning of two 500-kWe solar power plants Also considered are R & D activities in the fields of photoelectrical, photobiological, and photochemical utilization of solar energy B J

A79-17284 **Solar energy R&D in Iran - The approach and the philosophy** S Vojdani and V J Woollam (Aryamehr University of Technology, Teheran, Iran) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 106-117 7 refs

The basic philosophy behind the solar energy program of the Materials and Energy Research Centre (MERC) of Iran is reviewed The MERC program consists of (1) the creation of a data base through long-term studies of climatology, availability of solar energy, and energy consumption patterns, particularly in village communities, (2) state of the art studies, selection, testing, and evaluation of solar energy components and systems which may have possible applications in Iran, (3) long-term research projects focused on new developments in fabrication or new materials for solar cells, and (4) investigation of the economics of solar energy utilization, and (5) international cooperation with experienced companies and institutions abroad B J

A79-17285 **Plans and prospects for solar energy utilisation in Malawi** W K Kennedy (Malawi Polytechnic, Blantyre, Malawi) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 123-127 9 refs

The paper outlines progress made over the past few years in the solar energy field in Malawi Solar energy developments include water heating, agricultural processing and preservation, and rural water supplies The following features of a proposed solar energy program are discussed feasibility studies, the establishment of an alternative energy development and implementation unit, the promotion of pilot projects, and the formulation of a national energy policy, including a plan for village energy development A strategy for solar energy development in both urban and rural areas in Malawi is suggested B J

A79-17286 **Prospects for harnessing renewable energy sources in developing countries** R Ramakumar (Oklahoma State University, Stillwater, Okla) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 140-144 11 refs Research supported by the Oklahoma State University

Renewable energy sources can provide a viable alternative to supply energy to satisfy the basic needs of life and build up rural economic units that are vital to the stability and well being of developing nations and eventually of the entire world Judicious utilization of both the human and the energy resources, without the sudden infiltration of advanced technology in a primitive environment, can initiate the multiplier effect in their economies and lead to a better life for millions of people around the world Prospects for accomplishing this objective are discussed along with some system concepts and their economics (Author)

A79-17287 **Solar energy in Southern Africa** B G A Schaller In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 145-149 7 refs

This paper reviews the state of solar energy research and application in Southern Africa The history of energy and solar energy, the requirements at present and various predictions for the

future are outlined Wind, wave, wood, and similar solar energy resources are also briefly discussed (Author)

A79-17288 Estimation of collector and electrical energy cost for STEPS in Japan T Tani, S Sawata, T Tanaka, K Sakuta, T Horigome (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tanashi, Tokyo, Japan), and S Karaki (Colorado State University, Fort Collins, Colo.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y., Pergamon Press, Inc., 1978, p

175-179 6 refs

Analyses of primary systems are used to study the feasibility of solar thermal electric power systems in Japan In order to evaluate the collector areas for various rated electric power capacities and electrical costs, the experimental data of the model system developed at the Electrotechnical Laboratory, the cost models based on recent (1976) prices, and the relative distribution of direct normal solar flux density were used (Author)

A79-17289 Solar electrification and rural electrification - A techno-economic review B G Desai In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y., Pergamon Press, Inc., 1978, p

211-213 6 refs

It is shown that conventional electrification of rural areas in India by means of distribution lines from large central stations is very uneconomical Instead it is found that many rural load requirements in India can be satisfied by solar electrification systems A preliminary cost analysis suggests that solar electrification is cheaper in some ways than conventional electrification It is concluded that a detailed technoeconomic study of various alternative technologies must be made before committing scarce resources to any rural electrification program B J

A79-17290 Energy balances as a means for the evaluation of solar energy in developing countries D Cavard and P Criqui (IEJE, Grenoble, France) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y., Pergamon Press, Inc., 1978, p 214-218

An attempt is made to show how a yearly national energy balance can be used to determine the energy needs based on local renewable resources for developing countries Attention is given to social aims and needs for useful energy, priorities in useful energy needs, potential energy resources, production of primary energy from local renewable resources, transformation of primary energy into useful work, and the construction of possible energy balances Criteria for choosing among the different possible solutions are briefly considered F G M

A79-17291 Cost of solar energy J J Kowalczewski and J C Sheridan (Commonwealth Scientific and Industrial Research Organization, Div of Mechanical Engineering, Highett, Victoria, Australia) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y., Pergamon Press, Inc., 1978, p 219-223 4 refs

The need for a standard procedure for calculating the cost of solar energy is stressed A procedure is proposed, similar to those currently used by power and fuel handling authorities, and based on unit cost of energy used This concept is applied to compare the cost of energy provided by solar radiation with the cost of the same amount of energy, if it were to be provided by other energy sources that can be purchased, viz oil, gas, electricity, LPG, wood, etc The technique is extended to predict the likely cumulative benefit or loss, in present worth dollars, that the owner of the plant could expect in the future if he were to invest in solar energy now The use of the procedure is demonstrated on selected examples (Author)

A79-17292 Solar energy and the second law of thermodynamics J F Kreider In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y., Pergamon Press, Inc., 1978, p 224-228

Advantages of a use of the second law of thermodynamics compared to an employment of the first law for energy use efficiency considerations are examined It is pointed out that the second law provides a means of assigning a quality index to energy The concept of available energy provides a useful measure of energy quality Using this concept, it is possible to analyze means to minimize the consumption of available energy to perform a given process, thereby insuring the most efficient possible conversion of energy for the required task It is found that the second law provides an analytic framework for the assessment of the potential displacement of fossil fuels by solar energy The most promising areas are those which have entropy levels corresponding to the entropy level of the solar resource as converted to heat in various types of solar collectors G R

A79-17293 Economic evaluation and optimization of solar heating systems M J Brandemuehl (Wisconsin, University, Madison, Wis.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y., Pergamon Press, Inc., 1978, p 239-247 5 refs

Life cycle cost analysis is used to evaluate economic comparisons between residential solar heating systems and conventional heating systems The comparison is expressed as the life cycle savings of the solar system over the conventional system A procedure which simplifies the life cycle cost comparison is developed by introducing two economic parameters These parameters relate all life cycle considerations to the first year fuel savings or the initial solar system investment cost They can accommodate arbitrary time variation of annual costs and discounting of future costs to present dollar values, while expressing the life cycle savings equation in a compact form Assuming a linear relationship between the solar system investment cost and the collector area, the simplified savings equation is optimized with respect to collector area This optimization method is applied to a standard domestic water heating system, a combined space and domestic water heating system with air as the transfer medium, and a combined system with liquid as the transfer medium (Author)

A79-17294 Impacts of the National Energy Plan on solar economics F Roach (California, University, Los Alamos, N Mex.), S Ben-David, S Noll (New Mexico, University, Albuquerque, N Mex.), and W Schulze (Southern California, University, Los Angeles, Calif.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y., Pergamon Press, Inc., 1978, p 253-262 Research supported by the U S Department of Energy

The National Energy Plan offers subsidies (income tax credits) for solar equipment, and the efficacy of these subsidies for encouraging the use of solar energy is considered Conventional energy prices are examined, and the economic feasibility of solar energy for residential space heating and domestic hot water is discussed Several conclusions concerning relative costs are summarized, for example, it is concluded that solar residential space heating costs remain higher than conventional natural gas and heating oil prices in both the 20- and 30-year life cycle cost time horizons, even with the inclusion of incentive structures M L

A79-17295 A comparison between sun and wind as energy sources in irrigation plants M Gaia and E Macchi (Milano, Politecnico, Milan, Italy) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y., Pergamon Press, Inc., 1978, p 265-272

The mechanical power needed for irrigation pumps can be obtained from two renewable sources of energy, wind and sun In

order to investigate the construction costs, the engine performance at various loads and the reliability, two prototypes of Rankine cycle engines using tetrachloroethylene as the working fluid were built, having a power output of about 4 kW. Engine data and measured performance are reported. Optimum collecting temperatures for cylindro-parabolic collectors and flat-plate collectors associated with organic fluid engines are discussed, referring to commercial collectors. Thereafter engine costs for 10 kW and 100 kW units are extrapolated. A 4 m diameter Darrieus wind turbine was also built and the cost for small series production was computed as a function of turbine diameter. A comparison of the useful energy cost for both the solar engine and the wind turbine is reported and the problems of pump/engine matching are discussed for deep and shallow wells (Author)

A79-17296 **Costs and impacts of financial incentives for solar energy systems.** R H Bezdek (US Department of Energy, Office of the Assistant Secretary for Conservation and Solar Applications, Washington, D C) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 301-305

This paper estimates the costs and the impacts on market penetration of four different types of tax credits for solar energy systems. The public and private costs of each incentive are calculated and the impact on the number and type of solar systems installed and resulting energy displacement are estimated. Some problems involved in developing tax incentives for passive solar applications are discussed briefly (Author)

A79-17297 **The economics of solar heating and cooling - A cautious view.** L C Rosenberg (NSF, Washington, D C) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 306-314

This paper takes a cautious view of solar thermal energy use as a reasonable alternative to fossil fuels for heating and cooling of buildings. The paper emphasizes two problems. One is the relationship between solar thermal heating and cooling of buildings and electric utility rates. The other is the social and private opportunity costs of solar thermal heating for single-family residences (Author)

A79-17304 **The relationship between diffuse and total solar radiation in computer simulation of solar energy systems.** F Butera, G Panno, and G Ruisi (Palermo, Università, Palermo, Italy) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 384-388 9 refs. Research supported by the Consiglio Nazionale delle Ricerche

A79-17305 **Measurement of solar radiation for energy conversion.** A Mani (Raman Research Institute, Bangalore, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 392-399 6 refs

The types of solar radiation measurements that are required for purposes of solar energy conversion are discussed along with techniques for obtaining them. Consideration is given to the following radiation measuring instruments and methods: observation global and diffuse pyranometers, albedometers, normal incidence pyrhemometers, spectral measurements, pyrgeometers, and sunshine duration measurements. The standardization of radiation measurements, the accuracy of measurements, and the computation of radiation data are all examined. B J

A79-17307 **Design of radiometer for measurement of total and net exchange solar radiation.** K N Agarwal and V V Verma (Central Building Research Institute, Roorkee, India) In Sun Mankind's future source of energy, Proceedings of the International

Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 415-429 7 refs

The design of radiometers and solarimeters is considered, and a net exchange radiometer and solarimeter is described. The device uses copper plating, and factors such as the total number of wire turns, diameter of constantan wire, dimension of bakelite plate, current, and thickness of plating were studied theoretically and verified experimentally. The calibration procedure and optimum values of design parameters are reported. M L

A79-17308 **Dependence of solar radiation availability on atmospheric turbidity.** M Chandra (Central Building Research Institute, Roorkee, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 430-434 8 refs

In the determination of available radiant energy of the sun for use in application oriented problems, the computational methods, generally, play an important role. In this paper certain empirical relations for direct and diffuse components of solar radiation on a horizontal surface, which are based on measurements at Roorkee for clear (cloudless) sky conditions are discussed. The two components of radiation are expressed as polynomials in sine functions of solar altitude for three different ranges of atmospheric turbidity specified in terms of Linke's turbidity factor. The radiation values based on these polynomial relations are also tabulated. (Author)

A79-17310 **Determining the terrestrial, incident solar flux on an arbitrarily oriented surface using available solar/weather data.** J A Clark (Michigan, University, Ann Arbor, Mich) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc., 1978, p 438-442 7 refs

A79-17311 **Solar radiation studies for utilization of flat-plate collectors in an equatorial region.** T N Goh and K J Tan (University of Singapore, Singapore) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 443-447 9 refs

The feasibility of estimating total solar radiation on a horizontal plane through sunshine hours and other meteorological factors is examined with analyses of data from Singapore. No empirical relationships appear to give consistent estimates over different periods of time. The use of weather indicator is suggested for improvement of solar radiation estimation. A set of charts are prepared for convenient estimation of radiation on tilted planes. (Author)

A79-17312 **A solar energy system with a dual-source heat pump and long-term storage.** E Hewitt (Solar Associates, Hartford, Conn) and K Raman (Connecticut, University, Storrs, Conn) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 463-470b

The performance and economics of a solar energy system with a dual-source heat pump and long-term storage are discussed. Results are presented for the collector and storage sizing, and the variation of the life cycle costs as a function of the various system parameters. The special role of the collector performance and the price of electricity in determining the optimum range of collector and storage sizing are pointed out. The advantages of the type of solar-assisted system considered here are summarized. (Author)

A79-17313 **Long-term thermal storage in solar architecture in northern latitudes, with reference to typical single family dwellings.** D Michaels (Solar Energy Developments, London, En-

gland) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N.Y., Pergamon Press, Inc., 1978, p 471-473 10 refs

A79-17314 Long-term storage of solar energy in native rock M Riaz (Minnesota, University, Minneapolis, Minn.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N.Y., Pergamon Press, Inc., 1978, p 474-479 6 refs Contract No EY-76-S-02-4009

Long-term storage (annual or seasonal storage) of solar-collected thermal energy in native rock or sandstone appears to be both technically feasible and economically attractive. In this storage concept, a large bed of crushed or naturally formed porous rock is heated by hot air flowing from a central manifold to two cold manifolds, on discharge, the flow is reversed and cold air, introduced at the top and bottom manifolds, is heated in passing through the porous media so that hot air can be harvested at the central manifold. The advantages of this concept are due to the low cost inherent in the preparation of on-site native materials using various construction techniques adapted to local geological conditions and siting constraints with minimal environmental impact. The paper discusses some of the basic factors and constraints which govern the performance of such earth thermal storage units and evaluates several possible construction methods of interest from which a storage cost assessment can be made (Author)

A79-17315 Energy storage requirements for autonomous and hybrid solar thermal electric power plants J J Iannucci (Sandia Laboratories, Livermore, Calif.), R D Smith (Rocket Research Co., Redmond, Wash.), and C J Swet (U.S. Department of Energy, Washington, D.C.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N.Y., Pergamon Press, Inc., 1978, p 482-486 5 refs Research supported by the U.S. Department of Energy

The cost of electricity from an autonomous solar thermal electric conversion (STEC) plant which uses the (SO₃/SO₂/O₂) reaction for seasonal storage is compared to that of a solar plant with alternate energy backup (i.e., a hybrid solar plant). The cost of this alternate energy (provided by an on-site combustion turbine or purchased from a utility whenever necessary) is balanced against the economics of the STEC plant to determine the optimum (i.e., minimum busbar energy cost) solar/backup mix of the hybrid plant as well as the storage requirements of that mix. Over a range of alternate energy costs and geographic locations, the hybrid system was found to be economically superior to the autonomous STEC plant. B J

A79-17316 Chemically driven heat pumps for solar thermal storage P O Offenhartz In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N.Y., Pergamon Press, Inc., 1978, p 488-489b 5 refs

Methods of storing solar thermal energy by means of chemical reactions in heat-pump cycles are reviewed. These chemical reactions involve one or two solid (or, in one case, liquid) substrates plus a carrier gas. Charging the system involves decomposing a solid (or liquid) complex into a solid (or liquid) plus a gas, the gas in turn liquefies under pressure - or reacts with a second substrate - at a lower temperature. Discharging the system involves boiling the liquid (or decomposing the second substrate-gas complex) at a low temperature and reforming the original complex at a temperature suitable for heat exchange. In this way heat is pumped on discharge from a low-temperature source (ambient air or an underground reservoir) to a higher temperature, storage and heat pumping are inseparably involved. Different systems are noted which show promise for solar air conditioning as well as for thermal storage and heat pumping. Other systems should be capable of delivering more

heat than input via the solar collector, thus reducing solar collector size (and cost) (Author)

A79-17317 Underground aquifer storage of hot water from solar energy collectors C F Tsang, M J Lippmann, and P A Witherspoon (California, University, Berkeley, Calif.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N.Y., Pergamon Press, Inc., 1978, p 490-495b 17 refs Research sponsored by the U.S. Department of Energy

A study has been made on the physical feasibility of using underground aquifers as a storage system for hot water from solar energy collectors. Two different numerical models were used in this study. The first is a sophisticated program that computes the transient heat and mass flow in three dimensional water-saturated porous media. The second is a simplified model which considers a horizontal two-dimensional aquifer in which steady state fluid flow is assumed. Four cases were considered: a) daily storage, b) seasonal storage with semiannual cycles, c) seasonal storage with annual cycles, and d) a two-well (doublet) system, in which one well supplies the water to be heated by solar energy and the other well stores the heated water underground. The hydrodynamic and thermal behavior of the storage system were analyzed and illustrated. In all cases studied, the energy retrieval was found to be over 80 percent (Author)

A79-17318 A simulation study of phase change energy store K Rajagopal and T H Ong (Rio de Janeiro, Universidade Federal, Rio de Janeiro, Brazil) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N.Y., Pergamon Press, Inc., 1978, p 496-499 Research supported by the Financiadora de Estudos e Projetos

Heat transfer to a phase change material in a cylindrical annulus was studied experimentally. Heat is transferred through the outer wall of the annulus with a circulating fluid. Different flow rates and inlet temperatures were used in both cooling and heating. The temperature histories in the material during heating showed interaction of transient conduction and natural convection. Heat transfer rate during heating is convection controlled with main resistance in the molten material. Cooling is controlled by transient conduction. The experimental results are correlated using simple convection correlations. These results are useful in the design of phase change thermal storage system (Author)

A79-17319 Investigation of physical and chemical properties of phase change materials for space heating/cooling applications D Heine and A Abhat (Stuttgart, Universität, Stuttgart, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N.Y., Pergamon Press, Inc., 1978, p 500-506 5 refs Bundesministerium für Forschung und Technologie Contract No ET-4060-A

A79-17321 * Phase change thermal storage for a solar total energy system. R E Rice and B M Cohen (Comstock and Wescott, Inc., Cambridge, Mass.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N.Y., Pergamon Press, Inc., 1978, p 511-515 Research supported by the U.S. Department of Energy, Contract No NAS3-20615

An analytical and experimental program is being conducted on a one-tenth scale model of a high-temperature (584 K) phase-change thermal energy storage system for installation in a solar total energy test facility at Albuquerque, New Mexico, U.S.A. The thermal storage medium is anhydrous sodium hydroxide with 8% sodium nitrate. The program will produce data on the dynamic response of the system to repeated cycles of charging and discharging simulating

those of the test facility Data will be correlated with a mathematical model which will then be used in the design of the full-scale system (Author)

A79-17322 A passive integrated unit for the collection, thermal storage in fusion materials and distribution of solar energy for home heating and other applications. J C Kapur (Kapur Solar Farms, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 516-520

A79-17323 Theoretical and experimental analysis of a latent heat storage system C Benard (Ecole Supérieure d'Electricité, Gif-sur-Yvette, Essonne, France), D Gobin (Ecole Centrale des Arts et Manufactures, Châtenay-Malabry, Hauts-de-Seine, France), D Levesque, and A Wirgin. In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 524-530

Low-temperature (20-100 C) thermal storage of solar energy is investigated A latent-heat storage system with good temperature regulation is analyzed The storage material chosen is paraffin, since it is highly inert, noncorrosive, and nonsupercooling in the temperature range cited The experimental apparatus is conceived in such a way that the system behavior may be simulated on a computer through the use of a set of one-dimensional heat equations The discussion covers the general behavior of the storage system, daytime and nighttime behavior, overnight storage, long range regulation effect, heat conduction, and radiation propagation through paraffin The most prominent features of this system are determined, including the long-range regulation effect, and phase change of paraffin during daytime for higher storage efficiency S D

A79-17324 A thermal storage analysis on packed bed of alumina spheres T Asahina and M Kosaka (Government Industrial Research Institute, Nagoya, Japan) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 537-540

A heat storage is one of the most important problems in solar energy systems This paper dealt with heat transfer problems in a heat storage unit of packed pebble bed type and results of calculation were compared to those of experiments performed with a small scale alumina spheres heat storing system (Author)

A79-17325 Performance studies of a finned heat pipe latent thermal energy storage system A Abhat (Stuttgart, Universität, Stuttgart, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 541-546 8 refs Bundesministerium für Forschung und Technologie Contract No ET-4060-A

Performance studies of a modular heat-pipe heat exchanger concept for use in a latent thermal energy storage system for solar heating applications have been undertaken The thermal analysis provides the influence of various geometric and thermal parameters on the storage charging time and temperature gradients for heat flow into two markedly different storage substances Additionally, experiments are performed with a small 6 l test model filled with a paraffin Results indicate the capability of the heat exchanger concept to operate within small temperature swings (less than 10 K) for realistic heat input rates Comparisons between data and prediction for the test model showed adequate agreement (Author)

A79-17326 Stratification effects in the short and long term storage of solar heat C W J van Koppen, L S Fischer (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands), and

A Dijkmans (Pechiney Nederland, Vlissingen, Netherlands). In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 1 Elmsford, N Y, Pergamon Press, Inc., 1978, p 554-558

The application of a given exergy formula - expressed in terms of specific heat, temperature of heat-carrying medium, and reference temperature, i.e. temperature at which the usefulness of the heat equals zero - to a stratified storage with linearly increasing temperature is briefly discussed Illustrative examples for the exploitation of thermal stratification in the storage of solar heat are presented. The systematic use of thermal stratification generally leads to an increase in the heat gain of solar heating installations of the order of 15% Moreover, the dimensions of several components of the installation can be substantially reduced The discussion reveals that the application of thermally stratified storage forms part of a broader strategy which can be shortly described as the conservation of exergy S D

A79-17327 Use of monolithic structures for the short term storage of solar energy A R Balakrishnan, P L Silveston, and H F Sullivan (Waterloo, University, Waterloo, Ontario, Canada) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 560-565 14 refs

'Monolithic' structures represent an alternative to randomly packed beds of gravel for the short term storage of solar energy These structures can be used in a nonvertical position and can be shaped to fit space available in buildings Pressure drops are lower for the same heat capacity of thermal performance With the proper form choice, containers for the storage unit can be dispensed with Whether or not the pressure drop saving will pay for the much greater cost of the storage material will depend on the material, its form, amortization rate and the cost of electric power (Author)

A79-17328 A passive rock bed - Design, construction, and performance J Cook (Arizona State University, Tempe, Ariz) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 571-573

A79-17329 Mechanical energy storage system for a 10 KWe solar power pack. B S Magal (Indian Institute of Technology, Bombay, India) and S V Jain In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 574-578

An energy storage system is a necessary adjunct to any solar power generating unit to ensure continuity of supply An attempt has been made to design a 400-KWh flywheel storage system using indigenous technology, material, and equipment available in developing countries for a 10-KWe power pack A thermal energy storage system for the above power pack has also been designed, and these two systems have been compared with respect to their effect on collector area, generator capacity, and capital cost This exercise indicated that a flywheel energy storage system is feasible to build, operate, and maintain in a developing country using intermediate technology, but, it is very costly when compared with the hot water storage system (Author)

A79-17330 Investigation on the feasibility of using a two-phase thermosyphon for solar storage, space heating and cooking. S C Bhattacharya (G B Pant University of Agriculture and Technology, Pantnagar, India) and V K Kapur (Kanoria Chemicals Pvt, Ltd, Renukoot, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 579-582

A79-17331 A study for optimum use of metallic plates for thermal storage in solar processes C V P Rao (Ministry of Defence, Madras, India) and V M K Sastri (Indian Institute of Technology, Madras, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc., 1978, p 583-587 5 refs

A system with two metallic plates with a gap in between them is considered for study for optimum use as thermal storage medium. The performance of the systems of different sizes for different flow rates of charging fluid, different flow cross sectional areas and different metals is found and discussed. The economical charging times for different systems are given (Author)

A79-17332 Analysis of thermal storage unit for solar energy V Sriramulu and S B Ahmed (Indian Institute of Technology, Madras, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc., 1978, p 588-591 5 refs

This paper focuses attention on the thermal storage unit for a solar power plant using a system of flat plate collectors. The basic equations governing the processes occurring in the storage unit have been solved for an assumed load pattern. The effects of flow rate of working fluid through the load, stratification in the storage unit and the insolation on the performance characteristics have been studied. A control function simulates the switching on and off of the load and collector pumps. The collector pump is turned on if the collector output temperature is greater than the minimum temperature in the storage unit, otherwise, it is turned off. The temperature distribution in the storage unit changes with the flow rate of water. The effect of the storage volume on the overall performance appears to be small (Author)

A79-17333 Trends in silicon solar-photovoltaic cells - An invited talk G C Jain (National Physical Laboratory of India, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 592-608

The principles of photovoltaic conversion are discussed, with emphasis on factors affecting efficiency and the effects of impurities and imperfections in silicon. Trends in silicon solar cells are then reviewed with attention given to the following polycrystalline cells, heterojunctions, single crystal cells, shallow junctions, back surface built-in fields, the status of p(+)/n cells, and thin film polycrystalline cells. Emphasis is on production processes and solar cell characteristics. B J

A79-17334 Simulation and cost of photovoltaic generators C Vauge (CNRS, Paris, France) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 609-614 11 refs

A simulation model of solar photovoltaic generators is developed which can be used to easily estimate electrical production, investment, and operating costs for a given generator configuration. The user must specify meteorological conditions, generator size and structure, and time variations of the power demand. A computer program simulates operation of the complete system and provides data for evaluating its electrical and cost performance. The model is applied to two systems each with five collectors and 20 silicon flat panels per collector. B J

A79-17335 A new fabrication process for single crystal silicon solar cells R C Dubey, H S Kothari, and B R Marathe (Central Electronics Engineering Research Institute, Pilani, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 617-621 6 refs

The paper reports a new fabrication process for removal of a part of the surface diffused layer by preferential etching, resulting in improvement in the short circuit current of the solar cell. Measurement of spectral response of these cells are included in support of this claim (Author)

A79-17336 Role of high performance solar cells in practical photovoltaic systems V K Jain (Solid State Physics Laboratory, Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 622-624 8 refs

The conventional solar cell is considered as a near ideal absorber of the solar radiation. An integrated photovoltaic solar thermal (P-ST) system using concentrated solar radiation can be a match to its high 'energy collection' efficiency. Cell requirements for such a system are discussed. Conventional silicon and hetero-GaAs based cells are promising. Their effective performance under solar concentration is analyzed on the basis of probable panel cost and area. It is shown that even the high technology costly high performance cells promise viable P-ST systems for large-scale harnessing of the solar energy (Author)

A79-17337 On the role of interface states in MOS solar cells S Kar, D Shankar, and S P Joshi (Indian Institute of Technology, Kanpur, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 625-630 16 refs

This paper indicates the various ways the interface states can affect the operation of MOS solar cells. It has been shown that the open-circuit voltage is determined by the zero-voltage silicon bandbending, the oxide transmission factor at open-circuit, and the change in the oxide voltage between short- and open-circuit, all of which are influenced by the interface states. The present analysis indicates that a decrease in state density with increasing oxide thickness will lead to an increase in the open-circuit voltage. Experimental data seem to support this conclusion (Author)

A79-17338 Potential for low cost, high efficiency solar cells using indium tin oxide on semiconductor /OSOS/ solar cells J B DuBow, J Shewchun, C Wilmsen, and W S Duff (Colorado State University, Fort Collins, Colo.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 631-637 6 refs

OSOS solar cells have been fabricated and have exhibited over 13% conversion efficiency. This paper describes the fabrication procedure and presents an analytical model in which these cells are modeled as SIS structures. The oxide semiconductor, indium tin oxide, serves as an antireflection coating, a conductive front contact, and one side of the junction. Cell operation is based on the fact that the work function difference between the oxide semiconductor and the base semiconductor results in an induced, zero-depth p-n junction. The cost advantages of this procedure are discussed. B J

A79-17339 Amorphous semiconductors in photovoltaic and solar thermal conversion R W Griffith (Brookhaven National Laboratory, Upton, N Y) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 638-642 10 refs

It is shown that for photovoltaic applications acceptable efficiencies in large-area Schottky cells may be possible if hole transport in amorphous silicon can be improved. Reasonable upper limits of approximately 6% efficiency have been reported for small-area cells (approximately 1 sq mm). For solar thermal applications, studies on Si(1-x)B(x) alloys point toward the realization of solar coatings that are stable at high temperatures, and that satisfy the dual requirement of high solar absorptance and low infrared emittance. B J

A79-17340* Large area silicon sheet by EFG C V H Rao, T Surek, B Mackintosh, K V Ravi, and F V Wald (Mobil Tyco Solar Energy Corp, Waltham, Mass) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 643-650. 8 refs Contract No NAS7-100

The edge-defined, film-fed growth (EFG) technique has been employed to grow silicon ribbons for photovoltaic applications. Considerable progress has been made in recent years in developing the technique to the point that long lengths of silicon ribbon can be routinely grown. In order to attain the full low-cost potential of the EFG technique, several further developments such as the growth of thinner and wider ribbons, increase in ribbon growth rate, and improvements in material quality are needed. The technological problems to be solved and the approaches employed to achieve these goals are discussed (Author)

A79-17341 Characterisation of amorphous semiconductor materials for solar cell applications D K Paul (Indian Institute of Technology, Kanpur, India) and S S Mitra (Rhode Island, University, Kingston, RI) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N.Y., Pergamon Press, Inc, 1978, p 651-653 9 refs

The essential parameters for the preparation and characterization of the amorphous material which is metastable at best must precede any commercially successful solar device fabrication. This paper presents a novel characterization scheme based on the annealing kinetics in amorphous materials, enabling the correlation of the parameters and properties of the process. Moreover, a new material, amorphous $\text{Ge}(x)\text{Si}(1-x)$, is reported for use as a composite absorber. This material shows sharper absorption edges and utilizes solar emission spectra better than silicon B J

A79-17342 Interface properties and stability of Schottky barriers and MIS solar cells J P Ponpon, R Stuck, and P Siffert (Commissariat à l'Énergie Atomique, Centre de Recherches Nucléaires de Strasbourg, Strasbourg, France) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 654-660

The interface properties and the stability of gold Schottky barriers and MIS solar cells on n-type silicon have been studied. It has been shown that these properties are directly correlated to the formation of the potential barrier at the gold silicon contact both in the case of a conventional Schottky structure and for MIS devices (Author)

A79-17343 Photovoltaic effect in metal-insulator-semiconductor structure F G Wakim, M El-Gabaly, Y Sawan, and A Katnani (Kuwait University, Kuwait) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 661-664 6 refs Research supported by the Kuwait Institute for Scientific Research

Metal-insulator-semiconductor solar cells are described where the metals used are gold or aluminum, and the oxide layer is obtained by placing the n-silicon in boiling nitric acid which oxidizes the surface of the silicon. The open circuit photovoltage shows a rise followed by a decrease as the oxide layer thickness increases, as has been observed for silicon wafers which were oxidized by heating in oxygen. The photovoltaic spectral distributions for $\text{Au-SiO}_2\text{-S}$ shows a sharp peak at 700 nm which could be due to surface states (Author)

A79-17344 Investigation on junction formation and realization of high open-circuit voltage in $\text{Cu}/x/\text{S-CdS}$ solar cells S Deb, M K. Mukherjee, P N Dixit, S Das, K Maitra, D Mukherjee, and S

Mukherjee (Jadavpur University, Calcutta, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2. Elmsford, N Y, Pergamon Press, Inc, 1978, p 665-669

A79-17345 Improvement of efficiency and stability by copper-treatment and front contacting of $\text{Cu}/x/\text{S-CdS}$ solar cells. F Pfisterer, G Bilger, H W Schock, and W H Bloss (Stuttgart, Universität, Stuttgart, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 670-674 19 refs Bundesministerium für Forschung und Technologie Contract No ET-45

A79-17346 Sprayed CdS thin films for CdS/Cu₂S heterojunction solar cells A Banerjee, P Nath, S R Das, and K L Chopra (Indian Institute of Technology, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 675-677 8 refs

Thin films of CdS and $\text{Zn}(x)\text{Cd}(1-x)\text{S}$ have been prepared by solution spray technique. The structural, optical and electrical properties of these films have been studied. Heterojunction solar cells of 4% efficiency have been fabricated using these films by the conventional chemiplating technique. The effect of ZnS addition to CdS on the cell characteristics have been investigated (Author)

A79-17347 The photovoltaic effects in CdS/Cu₂S solar cells K W Boer In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 678-688 25 refs

The current in Cu₂S, as determined by generation, recombination, and diffusion to outer surface and junction, is computed through the junction to be proportional to the difference of carrier density in the Cu₂S bulk and at the CdS side of the junction interface. A photovoltaic diode-like I-V characteristic is obtained by connecting the voltage drop in CdS with the current from Cu₂S. The trap density below the electron quasi-Fermi level in the CdS side of the junction is probably of the order of 10 to the 17th per cu cm for present CdS/Cu₂S solar cells, hence the field in the junction may increase to a value within the range where high-field effects occur. Theoretical results are compared to experimental data B J

A79-17348 Role of the diode exponential factor in CdS solar cells H Saha (Chloride India, Ltd, Calcutta, India), P Basu, and K Mukhopadhyay (Kalyani, University, Kalyani, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 689-693 9 refs Research supported by the University Grants Commission

An expression for the diode exponential factor (A) of CdS/Cu₂S solar cell has been derived on the basis of Cleve model and ignoring the effect of interfacial layer. The wide scattering in the reported values of A can thus be explained assuming different values of the ratio of the thickness of compensated layer and the corresponding electron diffusion length. The dependence of A on the saturation current density is also correlated. The experimental determinations of A under illumination, on ceramic CdS/Cu₂S solar cell thus indicate a possible growth of the compensated layer with (1) time of heat treatment during optimization and (2) gradual degradation, assuming the electron diffusion length to be unaltered. The spectral variation of A for these ceramic cells is also determined (Author)

A79-17349 Stoichiometric Cu₂S thin films for solar cells S R Das, P Nath, A Banerjee, V D Vankar, and K L Chopra (Indian Institute of Technology, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar

Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2
Elmsford, N Y, Pergamon Press, Inc, 1978, p
694-697 Research supported by the Department of Science and
Technology

Cu₂S thin films of well controlled thickness and stoichiometry
have been prepared by a solid state reaction between CdS and CuCl
films in the temperature range 200-250 C The Cu₂S films grow
topotactically on CdS and the orthorhombic chalcocite phase is
obtained on reaction with both wurtzite and sphalerite structures of
CdS The electrical and optical properties of the Cu₂S/CdS thin film
solar cells fabricated with these films exhibit efficiencies of approxi-
mately 5% Better degradation characteristics are observed in a new
geometry where Cu₂S is placed below the CdS layer (Author)

A79-17350 **Transparent conducting coatings for solar
cells** E Shanthi, D K Pandya, and K L Chopra (Indian Institute of
Technology, New Delhi, India) In Sun Mankind's future source of
energy, Proceedings of the International Solar Energy Congress, New
Delhi, India, January 16-21, 1978 Volume 2
Elmsford, N Y, Pergamon Press, Inc, 1978, p 698-702 7 refs

Transparent and conducting films of pure and antimony doped
tin oxide have been prepared by spray technique An optimum value
of 18 ohm per unit area sheet resistance with 82% optical transmis-
sion has been obtained Detailed studies of electrical and optical
properties of these films have been made as a function of antimony
concentration The films behave like degenerate semiconductors The
low value of effective mass for undoped tin oxide films indicates a
distortion in Fermi surface The effective mass was found to increase
with antimony concentration up to 6 mole % and the Fermi level
shifted towards the conduction band These films have been used as
base contact layers in the special inverted configuration of sprayed
Cu₂S-CdS solar cells (Author)

A79-17351 **A pilot line for the production of large area
Cu/xS-CdS solar cells** H W Schock, W Arndt, G Bilger, G H
Hewig, F Pfisterer, and W H Bloss (Stuttgart, Universitat, Stuttgart,
West Germany) In Sun Mankind's future source of energy, Pro-
ceedings of the International Solar Energy Congress, New Delhi,
India, January 16-21, 1978 Volume 2
Elms-
ford, N Y, Pergamon Press, Inc, 1978, p 705-708 8 refs Bundes-
ministerium fur Forschung und Technologie Contract No ET-
4045-A

CdS-Cu(x)S thin film solar cells have been developed with regard
to low material costs and simplicity of the production process The
fabrication of solar cells of a size 7 x 7 sq cm is described An average
efficiency of 4% is indicated by a statistics about the yield of the
pilot-line production of more than 600 cells Field tests show
promising results concerning the long time stability of the cells
(Author)

A79-17352 **Design and fabrication of silicon solar cells for
concentrated light** S C Bawa, T B Desai, K S Yadav, V Holla,
and B R Marathe (Central Electronics Engineering Research
Institute, Pilani, India) In Sun Mankind's future source of energy,
Proceedings of the International Solar Energy Congress, New Delhi,
India, January 16-21, 1978 Volume 2
Elms-
ford, N Y, Pergamon Press, Inc, 1978, p 709-713 Research
supported by the Department of Science and Technology

Work is reported on the development of small-area single-crystal
silicon solar cells for use with concentrated sunlight Solar cells of
sizes 2.5 mm square and 1.25 mm square were studied, planar
technology was used and the diffused areas were 0.0484 sq cm and
0.0126 sq cm, respectively The advantages of such cells are
discussed, and consideration is given to the performance of these
cells with variations in silicon resistivity, p-n junction depth, and
concentration B J

A79-17353 **Response of p-n junction solar cells to concen-
trated sunlight and partial illumination** S R Dhariwal (Government
College, Ajmer, India), L S Kothari (Delhi, University, Delhi, India),
and S C Jain (Defence Research and Development Organization,

New Delhi, India) In Sun Mankind's future source of energy,
Proceedings of the International Solar Energy Congress, New Delhi,
India, January 16-21, 1978 Volume 2
Elms-
ford, N Y, Pergamon Press, Inc, 1978, p 714-719 12 refs

Current voltage relationship of a solar cell irradiated by concen-
trated sunlight is obtained by using the exact boundary condition
and the ambipolar diffusion equation Saturation effects for photo-
voltage and photocurrent are considered Effect of trap saturation
and internal current under partial illumination are also discussed
(Author)

A79-17354 **Concentrator photovoltaic systems for eco-
nomical electricity and heat** J Furber (US Congress, Office of
Technology Assessment, Washington, DC) In Sun Mankind's
future source of energy, Proceedings of the International Solar
Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2
Elmsford, N Y, Pergamon Press, Inc, 1978, p
720-724 14 refs

Design considerations for concentrating solar collectors are
discussed The 'best' concentrator/photovoltaic design will depend
on the cells available, and on the concentrator materials available
Cell cost and performance at various concentration ratios (CR) and
temperatures will affect optimal CR A design equation is presented
The concentrator materials which have proven to be most durable to
weather are glass and polymethyl-methacrylate plastic Glass is heavy
and breaks if not tempered, but it costs one tenth as much as
acrylic The parabolic backing could be foamglass, or it might be an
inexpensive foamed plastic, such as styrofoam The structure
represents an application of straightforward mechanical engineering,
and there are several commercial concentrators (without solar cells)
on the market today Attention is also given to sun tracking controls
and drives, aspects of cell mounting, the plumbing system, and
questions of operation and maintenance G R

A79-17355 **On the design of CPC photovoltaic solar
collectors** R M Graven, A J Gorski, and W R McIntire (Argonne
National Laboratory, Argonne, Ill) In Sun Mankind's future
source of energy, Proceedings of the International Solar Energy
Congress, New Delhi, India, January 16-21, 1978 Volume 2
Elmsford, N Y, Pergamon Press, Inc, 1978, p
725-728 ERDA-supported research

Ordinarily, the cost in dollars per watt is the dominant design
consideration Another basic principle for the design of photovoltaic
solar collectors should be to develop a durable, maintenance free
product A description is presented of two new photovoltaic
collectors The devices produce more electrical power and use
significantly less photovoltaic material per unit area than the present
state-of-the-art flat panel arrays A reflective style Compound
Parabolic Concentrator (CPC) optical system was used for one
collector, and a dielectric style (DCPC) optical system was used for
the other collector to concentrate sunlight onto custom designed
photovoltaic solar cells For these two panels only periodic angular
adjustments are required, which eliminates the need for two-axis
tracking Polymethyl-methacrylate was used to form the dielectric
CPC troughs G R

A79-17356 **Transcell, a novel approach for improving
static photovoltaic concentration** A Luque, J M Ruiz, A Cuevas,
J Eguren, and J M Gómez (Madrid, Universidad Politécnica,
Madrid, Spain) In Sun Mankind's future source of energy,
Proceedings of the International Solar Energy Congress, New Delhi,
India, January 16-21, 1978 Volume 2
Elms-
ford, N Y, Pergamon Press, Inc, 1978, p 729-733

A two sided solar cell, called Transcell, is proposed to be used in
proper Winston mirrors which permit double static concentration
gain for a given acceptance angle Theory and experiments show that
the $V(oc) \times I(sc)$ is higher in the Transcell than in conventional or
BSF cells A model of the series resistance is presented and applied
for homogeneous and nonhomogeneous illumination with the calcu-
lated results in good agreement with measurements The geometric
structure and dimensions are optimized for the Transcell, and their

efficiency and open circuit voltage are calculated for several illumination conditions, showing that efficiencies of 11.2 percent can be obtained at ten AM2 suns
(Author)

A79-17357 Response of a solar cell to intense and nonuniform illumination when used with solar concentrators. A Agarwala, M K Madan, and V K Tewary (Birla Institute of Technology and Science, Pilani, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 734, 735 5 refs Research supported by the Department of Science and Technology

A theoretical study of the effects of intense and nonuniform irradiation on solar cells is presented. Partial Fourier transforms are applied to the general ambipolar diffusion equations for the p side of a p-n junction, and an expression proportional to the current crossing the junction is obtained. The limiting cases of low and high injection are considered, and expressions for input and output power are compared. An explanation of an effect reported by Blinov et al (1966) is presented. The effect involves a decrease in the open circuit voltage of a p-n junction cell at intensities of approximately 100,000 watt/sq cm
M L

A79-17358 The feasibility of constructing a photoelectric unit utilizing effluent heat. B A Bazarov, Kh Bazarov, V D Tereshin (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR), B D. Tairov (Polytechnical Institute, Ashkhabad, Turkmen SSR), and D S Strebkov. In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 737-748

It is suggested that, since the efficiency of a solar power station might be as low as 5%, and 95% of the energy which is released into the environment might be transformed into mechanical energy with an efficiency close to that of thermal power plants that burn organic fuels. The released effluent heat would be used to run a steam turbine. Rankine cycle characteristics are calculated for various power plant and turbine designs, and the economics of solar power plants with photoelectric and thermodynamic transformers and with different efficiencies are considered. It is suggested that a system using a 10-m-diameter concentrator and Freon, and which operates at 60-190 C, could economically operate a 10 kW turbine
M L

A79-17360 Sensitivity calculations for the design of solar cells I - Schottky barrier devices. M K V V Thampuran, T L Viswanathan, and R Sharan (Indian Institute of Technology, Kanpur, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 754-759 6 refs

A computer-aided nonlinear sensitivity analysis is proposed for obtaining the sensitivity curves of solar cells in terms of material and fabrication parameters. The flow diagram of the program used for evaluating the relevant sensitivities consists mainly of two parts, first, the nonlinear diode circuit model is solved for different values of the load resistance to obtain the maximum power output condition, second, another circuit known as the adjoint of the circuit model is solved, which helps evaluate the sensitivities. The proposed method is quite general and can be used for the analysis of p-n junction, Schottky barrier, MOS and other types of solar cells. A Schottky barrier solar cell is evaluated as an illustrative example. It is suggested that the sensitivity curves are suitable for making proper choice of material and fabrication parameters at each stage of development of solar cells, so that optimum improvement in cell efficiency is achieved
S D

A79-17361 A diagnostic study on the polycrystalline nature and its relationship with the yield of CdS solar cell. M K Mukherjee and A K Das (Jadavpur University, Calcutta, India) In

Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 760-765 10 refs

SEM photographs which confirm the columnar nature of CdS crystallites are presented, and the effect of disordered regions on CdS solar cell efficiency is examined. A distribution function is derived and applied to the calculation of the cell efficiency for a number of cells. Results are found to agree fairly well with experimental data. Statistical techniques are used because it is thought that the nature of the crystallite surface is determined by the aggregate of the nature of the individual cross sections
M L

A79-17362 Efficiency of conventional silicon solar cells. C M Singal (Central Electronics, Ltd, Sahibabad, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 766-771 5 refs Research supported by the Department of Science and Technology

The photovoltaic power conversion efficiency of conventional silicon solar cells is studied taking into account the practical limitations in the material characteristics and in the fabrication process. The highest efficiency obtainable under these conditions, and the solar cell design parameters for it, are arrived at. The analysis incorporates a number of important physical phenomena, such as series resistance, surface recombination of minority carriers, front surface reflection, band gap shrinkage at high fields in the space charge region, and different minority carrier life times in the base and the diffused regions
(Author)

A79-17363 Possibility of production of low cost solar grade silicon by trichlorosilane process. N S K Prasad (Bhabha Atomic Research Centre, Bombay, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 772-775 30 refs.

It is suggested that solar-grade silicon can be produced economically in countries with low labor costs by means of the trichlorosilane process. In this process SiHCl_3 , prepared from Si and HCl by a continuous vapor deposition procedure, is thermally decomposed on a hot silicon filament or in a fluidized bed of fine silicon particles. In addition to the pure Si, SiCl_4 is obtained, and industrial uses of this compound are considered
M L

A79-17367 Energy through solar aided bio-gas systems. S C Gupta (Allahabad Agricultural Institute, Allahabad, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 791-796 6 refs

Solar energy can effectively be utilized to accelerate the anaerobic fermentation of organic matter by heating the slurry in the digester to the optimum temperature during cold winters. Gas production rate can further be improved by adding some catalytic agents. A flat plate solar water heater has been coupled to a spiral heat exchanger embedded in the digester slurry of a bio-gas plant. Effects on gas production rate and on waste retention period in presence of different additives are studied at different temperatures. An analysis of the techniques to improve the quality of produced gas is also discussed
(Author)

A79-17368 Efficiency of sugar cane and cowpea as solar energy converters. C Varlet Grancher, R Bonhomme, and P Chartier (Institut National de la Recherche Agronomique, Versailles, France) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 797-803 26 refs

The efficiency of solar energy conversion of two crops - sugar cane, a C4 specie and cowpea, a C3 specie, is studied. The overall efficiency observed for sugar cane, 2.1 percent over the whole year, is one of the highest value that can be obtained with a canopy. A lower efficiency is observed for cowpea, 0.6 percent, which is a common value for many crops in good condition. The best performance of the sugar cane is due to the superiority of both the perennial character and the so-called C4 cycle of the photosynthetic process. (Author)

A79-17370 Direct photoelectrochemical conversion and storage of solar energy P N Moorthy, M D Karkhanavala, and P V Kamat (Bhabha Atomic Research Centre, Bombay, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 808-813 6 refs

The performance in direct sunlight of a photoelectrochemical cell employing n-type TiO₂ film as the photoanode, a graphite rod as the cathode and air saturated NaOH as the electrolyte has been studied. Over a period of several days its output was found to remain stable, depending only on the intensity of incident sunlight, and there was no measurable chemical change in the electrolyte or the electrode. The power conversion efficiency was found to be a maximum at 1/5th the maximum incident sunlight intensity (110 mW/sq cm total). One of the possible causes of reduced efficiency at higher intensities is inferred to be the slowness of the cathodic reaction. It has been shown that energy storage, both internally (in a suitable redox system) and externally (in conventional lead-acid accumulator), is feasible. (Author)

A79-17371 Saur vidyut kosh - The solar cell M Sharon, S G Sharan, B M Prasad, A P Bholagur, and R R Pradhananga (Poona, University, Poona, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2

Elmsford, N Y, Pergamon Press, Inc, 1978, p 814-821 15 refs
Research supported by the Tata Energy Research Institute

A solar electrochemical cell based on KI, graphite powder, HCl and zinc/zinc chloride was built and tested that gave a potential of 1.29 volts and a current of 60-100 mA. A matrix of seven cells in parallel and seven in series gave a potential of 9 volts and a current of about 300 mA. A concentration cell was also built on the same design, except that zinc/zinc chloride solution was replaced by a saturated thiosulfate solution and a carbon electrode. Experiments showed that the Fe(2+)/I₂ system gives a fully reversible photochemical reaction, and a cell was built using a solution mixture of Fe(2+), Fe(3+), KI, H₂SO₄, and Rhodamine-B. The cell is exposed directly to sunlight and generates 40 W. P T H

A79-17372 Harvesting solar energy using biological systems R K Mishra (All-India Institute of Medical Sciences, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 822, 823 10 refs
Research supported by the Ministry of Defense of India

Preliminary results are briefly discussed for experiments in which attempts were made to develop potentials by using a photoviscosity effect on a membrane that separated a chamber containing a medium and chlorophyll from a chamber containing the medium alone. The results indicate that electrons generated by photolysis of water under conditions where one photosystem is blocked are highly likely to be trapped in water, possibly as hydrated electrons. It is noted that suitable band gaps in a single-crystal ZnO electrode can be employed to 'harvest' these electrons and that a Lorenz force from a permanent magnet can drive hydrated electrons to a collector. F G M

A79-17373 Bio-mass energy for rural areas K V Gopalakrishnan and B S Murthy (Indian Institute of Technology, Madras, India) In Sun Mankind's future source of energy, Proceedings of

the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 824-828 7 refs

This paper presents the case for the adoption of Biomass Energy System for supplying electrical energy to the rural areas of developing countries. Its advantages as against conventional generating systems and other methods of solar energy utilization are presented. The various aspects of this system are discussed. The problem areas in the system requiring research and development are identified. Finally, the research efforts under way in the authors' institution to solve some of these problems is reported. (Author)

A79-17374 Status report on selective surfaces H Tabor (Scientific Research Foundation, Jerusalem, Israel) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 829-836 30 refs

The report assumes familiarity with the theory of selective surfaces and the references as given in two earlier ASHRAE publications by the author. The requirements of practical selective surfaces are indicated and examples given covering the major classifications of selective surfaces, i.e., those made by generating an IR transparent layer on a metal base and those resulting from the topology of the metal surface such as dendritic surfaces. Reference is also made to IR reflecting windows as an alternative to low emittance absorbers. (Author)

A79-17375 Investigation and perspectives on iron oxide, zinc conversion coating, zinc oxide, cobalt oxide and tungsten oxide as spectral selective solar absorber surfaces M van der Leij (Delft, Technische Hogeschool, Delft, Netherlands) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 837-841 13 refs

A79-17376 Selective coatings for solar energy conversion P K Gogna, D K Pandya, and K L Chopra (Indian Institute of Technology, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 842-844 5 refs

Optical and thermal properties of electrolytically deposited selective coatings of black nickel, chrome, and copper on galvanized iron have been studied. Correlation between these properties and deposition parameters and structure of the coatings has been established. Stable and adherent black nickel coatings on galvanized iron yield an absorptance of 0.94 and an emittance of 0.09 at 100 C. At an inlet-outlet temperature differences of 61 C, selectively coated collector is 3.7 times more efficient than the nonselectively coated collector. (Author)

A79-17377 DC reactively sputtered metal carbide and metal silicide selective absorbing surfaces G L Harding (Sydney, University, Sydney, Australia) and I T Ritchie In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 845-848 8 refs

Metal-carbon and metal-silicon films deposited on various metal substrates show promise as high temperature stable selective surfaces for solar energy photothermal conversion. This paper discusses the absorptances, emittances and ageing properties of homogeneous reactively sputtered metal carbide and metal silicide films deposited on copper, nickel and stainless steel substrates, and the enhanced absorptances obtained by depositing multilayer or graded films on copper. (Author)

A79-17378 **Studies on the selective absorption surface on stainless steel** T Ishibashi and K Horibe (Yazaki Buhin Co., Ltd., Kosai, Shizuoka, Japan) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 849-854 8 refs

As the results of examinations on durability, heat resistance and weather-proofness for both selective surfaces of stainless steel and copper with the measurements of specular and diffused reflection as well as angular dependency, it was found that the stainless steel selective absorption surface is superior to those of the copper one. The absorptance measured by use of the integrating sphere resulted in 0.91 to 0.93 for stainless steel and 0.88 for copper. This present paper examined the possibilities as to whether a lower radiation property of the selective surface on stainless steel in the infrared zone could be obtained without decreasing considerably the high level absorptance. (Author)

A79-17379 **New processes for black coatings useful in harnessing solar energy I - A room temperature black chromium plating bath** I Rajagopalan, W Gripps, N Vasudevan, S R Rajagopalan, and S Ramaseshan (National Aeronautical Laboratory, Bangalore, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 855-858 11 refs

The fundamental requirements for a solar selective absorber are reviewed and various methods of obtaining selectivity together with high absorptivity are discussed. Conventional black chromium plating process is briefly surveyed. It is pointed out that its major limitation to industrial application arises from the necessity of using high current densities (75 to 150 amp/sq dm) and low temperatures (10-15 C), which demands refrigeration. Black chromium plating has now been achieved at current densities as low as 7.5 am/sq dm (i.e., same as that used for normal chromium plating) and at room temperature or even higher (up to 60 C). The optical properties and corrosion resistance of the coatings produced using this new process are discussed. (Author)

A79-17380 **On the use of grating for mesh selective filters to increase the efficiency of flat plate solar collectors** C Bénard, A Ekouhoho, D Gobin, and A Wirgin (CNRS, Laboratoire des Signaux et Systèmes, Gif-sur-Yvette, Essonne, France) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 859-863 6 refs

Losses in a flat plate collector resulting from reemission of infrared radiation can be reduced by the introduction of a selective filter which is transparent to visible solar radiation and highly reflecting for reemitted infrared radiation. Planar periodic structure filters are considered herein. It is shown that a grating composed of very thin parallel equidistant metallic strips is insufficient for the considered application, however, a planar structure composed of two identical crossed strip gratings might constitute a suitable filter for increasing the efficiency of low to medium temperature flat plate collectors. (Author)

A79-17381 **Preparation and properties of pure and tin doped indium oxide selective coatings** B K Gupta, A Raza, S S Mathur, and O P Agnihotri (Indian Institute of Technology, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 865-869 5 refs

A79-17382 **Selective absorption of solar energy by ultra-fine metal particles** G A Niklasson and C G Granqvist (Chalmers Tekniska Hogskola, Goteborg, Sweden) In Sun Mankind's future

source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 870-874 22 refs

Individually isolated chromium particles have been prepared by gas evaporation onto KBr substrates in a reduced atmosphere of argon + air. Particle diameters were typically 5 to 13 nm. Optical transmittance at normal incidence was recorded in the wavelength interval from 0.3 to 25 microns by double-beam spectrophotometry. Excellent spectral selectivity was found with high absorptance at wavelengths less than 2 microns and high transmittance farther out in the infrared. The optical data were compared with calculations based on the Maxwell Garnett (1904) theory, which was generalized so as to encompass dipole-dipole interaction among aggregated spheres. Agreement between theory and experiments was achieved by considering particles forming linear chains. (Author)

A79-17383 **Spectral selective properties of black chrome and nickel electrodeposited coatings for solar absorber** M R Rao, J Balachandra, and K I Vasu (Indian Institute of Science, Bangalore, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 875-880

A79-17384 **The structure and properties of Cu based selective surfaces formed on an Al-Cu alloy by chemical brightening and etching treatments** P M Driver and P G McCormick (Western Australia, University, Nedlands, Australia) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 881-884 6 refs

A79-17385 **A heat pipe collector for low temperatures** J C Francken (Groningen, Rijksuniversiteit, Groningen, Netherlands) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 885-889 8 refs

The heat pipe collector described in this paper consists of an array of heat pipes designed for the purpose, cooled by a common heat exchanger. All parts are made of aluminum sheet bonded together with an appropriate glue. The heat balance of the collector is analyzed and experimental results with heat pipe elements are given. The advantages of the design are indicated and an outline is given for a further improvement of its performance. (Author)

A79-17386 **Cost effective optimum design of solar air heaters** V R Muthuveerappan and K Iynkaran (Annamalai University, Annamalaiagar, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 890-894

The initial and maintenance costs of solar devices are the stumbling blocks for the utilization of solar energy. Improving the thermal efficiency of solar collectors utilizing costly materials and manufacturing methods should be discouraged. An attempt has been made to define a cost effective performance coefficient for a solar air heater, taking into account its thermal performance and the equivalent cost. Such a definition will make the research scientist cost-conscious and encourage him to optimize a design with respect to thermal performance and cost. This approach is bound to bring down the cost and make the utilization of solar energy commercially viable in the near future. (Author)

A79-17387 **Optimum collection geometries for copper tube - copper sheet flat plate collectors** F de Winter (Altas Corp., Santa Cruz, Calif.) and W S Lyman (Copper Development Association, Inc., New York, N Y) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New

Delhi, India, January 16-21, 1978 Volume 2
Elmsford, N Y, Pergamon Press, Inc, 1978, p 895-899 10 refs

Normally the flat plate collector of solar energy for heating liquids features a series of tubes fastened at intervals to a copper collection plate of uniform thickness. Copper can be used in a more cost effective way if the collection plate is not of uniform thickness, but of tapered cross-section between the tubes. A number of different cross-sections were investigated in a study described in this paper, including 'ideal' profiles which are unlikely to be practical, as well as compromise profiles likely to be feasible. It was found that tapered profile material can cost somewhere between 28% and 36% more per unit weight than flat (constant thickness) sheet, and still be equally cost effective as flat sheet (Author)

A79-17388 Cheap packed bed absorbers for solar air heaters P Singh (Punjab Agricultural University, Ludhiana, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 900-904

The feasibility of using two cheap packed bed absorbers for solar air heaters have been investigated. The absorbers consist of iron shavings and iron wires. Both of these materials are available in abundance as scrap and are extremely cheap. Two solar air heaters using these materials for absorber were fabricated and their performance was studied experimentally, with single glass cover, two glass covers, single pass flow, two pass flow (Author)

A79-17389 An analytical and experimental study of pumped solar water heaters B Nimmo (University of Petroleum and Minerals, Dhahran, Saudi Arabia), J Pearce, and W Clark (Florida Technological University, Orlando, Fla) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 907-911 10 refs Research supported by the Florida Solar Energy Center and U S Navy

This paper describes and presents the results of an analytical and experimental study of forced circulation solar water heaters. A transient computer model which allows for fluctuating insolation, and ambient temperature as well as draw off of hot water at random times, has been developed. The system model has been successfully used to predict the performance of an installed forced circulation solar water heater under 'in use' conditions. New experimental data for such a system are presented. They include environmental operating conditions such as insolation and ambient temperature, as well as hot water load draw off. Results are shown for predicted and experimental collector inlet and outlet temperatures. The percent load carried by solar energy during each day of a week of operation is also given (Author)

A79-17390 Flat plate collector dynamic evaluation J C Sager, B Goldberg, and W H Klein (Smithsonian Radiation Biology Laboratory, Rockville, Md) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 912-916 11 refs Contract No EY-76-S-05-4241

Three flat plate collectors were tested over a one year period to quantify the mean collector transmittance-absorptance product and the mean collector heat loss coefficient. These parameters in conjunction with the critical insolation provide a means of evaluating the collector performance over the dynamic range of insolation received. The collector performance is seen to follow the relative values of the transmitter-absorptance product to heat loss coefficient ratio (Author)

A79-17391 A parametric investigation on flat-plate solar collectors. A Arafa, N Fisch, and E Hahne (Stuttgart, Universitat, Stuttgart, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New

Delhi, India, January 16-21, 1978 Volume 2
Elmsford, N Y, Pergamon Press, Inc, 1978, p 917-923 6 refs. Bundesministerium fur Forschung und Technologie Contract No ET-4045-A

In the present work, the thermal behavior of a solar collector is investigated for steady and unsteady state working conditions. A model is developed describing the collector by means of a set of partial coupled differential equations for fin, pipe, fluid, cover plates and insulation. The temperature distribution as a function of position and time is achieved by solving this set of equations numerically. Different parameters which influence the collector performance are thoroughly examined. The results show that a collector design is strongly dependent on the material used and the weather conditions if an optimal thermal efficiency is to be obtained. A single node is not adequate to such simulations. The comparison of experimental results to predicted values for different collector types based on the present analyses shows a maximum average deviation of 5% for collector efficiency and 2 K for fluid temperature (Author)

A79-17392 A comparison among various flat plate collectors with honeycomb structures A A M Sayigh (Riyadh, University, Riyadh, Saudi Arabia) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 924-929 11 refs

Eight flat plate collectors with some form of honeycomb structure were compared and discussed. Some of them were tested and compared (Sayigh, 1976), while four new types of honeycomb collectors were tested under identical conditions. Two of them were also tested with two cover plates. For those two, the efficiencies were plotted and compared with flat plate collectors without honeycomb structure. Another plot showing the effectiveness of honeycomb collectors and their comparison with ordinary flat plate collectors is also given (Author)

A79-17393 Solar energy use in Denmark /56 deg N/ and higher latitudes in Scandinavia F Bason (Silkeborg Amtsgymnasium, Silkeborg, Denmark) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 930-934 5 refs

The paper deals with the current status of the solar energy effort in Denmark. An analysis of the prospects of using solar energy in that country points to the feasibility of developing systems of modest size to supplement the home heating load, particularly for hot water supply during the summer months. Small water heaters provide 50% of the water heating load for homes, schools, and other institutions V P

A79-17394 Comparative outdoor measurements on flat-plate solar collectors in a metropolitan area in Western Germany W Schwaigerer and E Hahne (Stuttgart, Universitat, Stuttgart, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 935-941 Bundesministerium fur Forschung und Technologie Contract No ET-4045-A

Measurements on the efficiency of two flat-plate collectors under outdoor conditions and performed simultaneously are reported. The registered data are quantity and fluctuation of insolation, incident angle and fluctuations of water outlet temperature. Test procedure and data were compared to American test instructions. The applicability of these instructions for outdoor measurements in Western Europe was critically examined and proposals for improvement are given (Author)

A79-17395 Reflecting horizontal collector A A Delyannis and E A Delyannis (Democritus Nuclear Research Centre, Athens, Greece) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 942-944

A novel design of a solar collector, having absorbing and reflecting surfaces under the glass cover, has been developed. The required inclination is given to finned tubes, instead of the collector body and hence the reflecting collector can be installed nearly horizontally. Because of larger heat input, the performance of the reflecting collector is quite higher than a similar flat plate collector of the same absorbing surface. Design details and performance are presented. (Author)

A79-17396 Economic use of materials in the design of solar water-heating collector plates of the pipe and fin type. A W K MacGregor (Napier College of Commerce and Technology, Edinburgh, Scotland) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 945-949

This paper examines methods of improving the cost-effectiveness of solar water heating plates. A survey of plate types indicates that the pipe and fin type is best for domestic water heating. A comparison of materials shows that aluminium is the most cost effective for the plate. A method for joining aluminium plates to copper pipes is described. Selection of the best combination of plate thickness and pipe spacing is examined with a view to optimising the cost-effectiveness of the whole system. The derivation of a simplified expression for fin efficiency is given. (Author)

A79-17397 Performance of flat plate solar collector with fluid undergoing phase change R S Soin, K S Rao, D P Rao, and K S Rao (Birla Institute of Science and Technology, Pilani, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 952-955 Research supported by the Department of Science and Technology and Birla Institute of Science and Technology

The experimental set up for evaluating the performance of a solar collector with a fluid undergoing phase change is described. The effect of insolation and the liquid level on the collector performance has been studied with acetone and petroleum ether 40 - 60 C. The Hottel-Whillier equation, when modified to include the fraction of liquid level, correlates the experimental data. The collector efficiency increases linearly with liquid level. (Author)

A79-17398 An interferometric investigation heat transfer in honeycomb solar collector cells B A Meyer, M. M El-Wakil, and J W Mitchell (Wisconsin, University, Madison, Wis) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 956-959 Research supported by the U S Department of Energy

Local and average heat transfer coefficients for natural convection between parallel plates with honeycomb cells in between have been experimentally studied using an interferometric technique. The experimental conditions are similar to those proposed for honeycomb solar collectors. Nusselt numbers were obtained experimentally for collector tilt angles of 60 deg and 90 deg, and various Grashof numbers and aspect ratios. This study also proposes varying the honeycomb angle (with respect to the plates) from the conventional 90 deg, and honeycomb angles of 90 deg and 60 deg are studied. The results are useful in determining the top convective loss coefficient, and therefore in minimizing losses and optimizing the design of honeycomb solar collectors. The results indicate that these losses are strong functions of the aspect ratio and that honeycomb angles below 90 deg help reduce these losses. (Author)

A79-17399 Effect of dust on flat plate collectors. A A M Sayigh (Riyadh, University, Riyadh, Saudi Arabia). In Sun Mankind's future source of energy, Proceedings of the International Solar

Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 960-964 8 refs

This paper deals with the effect of dust on the performance of flat plate collectors. Six flat plate collectors forming three pairs were tested. The first pair was placed at 60 deg, the second pair was placed at 30 deg and the third pair was placed at zero degree to the horizontal. In each group one collector was wiped daily while the other was left unwiped. The amount of absorbed solar energy by each collector was computed and compared with the results of the others. The damaging effect of dust was also studied and a storm strength at which this damaging effect will take place was deduced. A 32, two inches diameter, solar cell array covered with a 3 mm fiber glass cover was tested with no dust and then was left for 72 hours under normal conditions without wiping the top surface and the current characteristics were plotted versus time of day. The quantity of settling dust per day on a square meter of flat surface was also measured and the number of days with high dust storms in various parts of Saudi Arabia was shown on a plot. (Author)

A79-17400 Convective effects in 'slat collectors' H K Kay and W W S Charters (Melbourne, University, Melbourne, Australia) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 965-970 7 refs

This experimental investigation was carried out to validate previous numerical work done on natural convection in inclined cells with finite side walls. Vacuum techniques were employed in this investigation. Effects of aspect ratio, inclination angle, wall boundary conditions and Rayleigh number on the heat transfer were studied. The aspect ratios used were 1/3, 1/2 and 1. The inclination angles ranged from 0 deg to 90 deg. Two values of Rk (giving two different wall boundary conditions) were selected using glass and perspex materials for the lateral walls. The Rayleigh number ranged from 0 to about 100,000. The overall accuracy of the experimental technique can be judged from the experimental errors in the Nusselt number (about 7%) and the Rayleigh number (about 5.5%). (Author)

A79-17401 Simulation study of natural convection heat transfer in inclined air layers with application to solar energy collection S P Basu and D Chakraborty (Calcutta, University, Calcutta, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 971-974 10 refs Research supported by the University Grants Commission

The paper describes an experiment which can simulate natural convective heat transfer in inclined air layers as in a flat plate solar collector with only a single plate heater. The other plate being generated by optical inversion of the original plate with the help of a triangular path inverting interferometer. Values of Nusselt numbers for different Rayleigh numbers have been obtained and are found to be in good agreement with those obtained from theoretical correlations. The method offers many advantages over the conventional methods as in this method the aspect ratio or the Rayleigh number can be varied easily by simply changing the position of the plate heater. (Author)

A79-17402 Effect of buoyancy and tube inclination on heat transfer in a solar air heater M L Verma and B K Sthapak (Government College of Engineering and Technology, Raipur, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 978-981

An experimental investigation of the effect of buoyancy and tube inclination on heat transfer rates in a solar air heater has been reported. The test apparatus consisted of 915 mm long, 13 mm diameter uniformly heated tube with arrangement to keep the test section at a desired inclination. The range of mass flow rate of air

passing through the tube was varied from 0.014 to 0.84 kg/hr. The results indicate that buoyancy effect responsible for free convection depends upon the orientation of the tube. Higher heat transfer rates are obtainable with increasing tube inclination and with direction of buoyancy force opposite to that of bulk flow (Author)

A79-17403 Thermal performance of solar collectors used in the national solar heating and cooling demonstration program P G Patil (Systems Consultants, Inc., Washington, D C) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 982-987 6 refs

This paper is a report on the analyses and evaluation of collectors used in the national demonstration program for solar heating and cooling of non-residential buildings. The characteristics and performance of 17 solar collectors used in 32 representative demonstration projects are presented. The collectors are compared in cost, design, and thermal performance, and the advantages of each type of collector noted. An evaluation of physical characteristics such as absorber materials, heat transfer fluids, types of insulation, cover plate materials, and collector perimeter design is also presented (Author)

A79-17404 Some aspects towards the performance evaluation and ensuing design components of solar collector systems S P Sabberwal and S S Mathur (Indian Institute of Technology, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 988-991

In this paper, some general guidelines are presented for material selection and blending for flat-plate and concentrating type of collectors. One of the main emphasis has been on the cost reduction. Techniques to minimize the comprehensive testing procedures in terms of component, unit and scheme testing are outlined very briefly. It is concluded that such an effort may inch further the solar technology applications for industry (Author)

A79-17405 Comparative performance testing of flat-plate solar water heaters K S Ong (University of Malaya, Kuala Lumpur, Federation of Malaysia) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 993-997 7 refs

A simple experimental test facility was set up to compare the outdoor performances of various flat plate solar heat collectors operating under a once-through flow cycle. Simultaneous side-by-side tests were conducted on various collectors to demonstrate the effectiveness of the apparatus. The effects of providing single glazing, double glazing and a bank of horizontally-laid fluorescent light tubes as collector cover and using copper or aluminium as collector plate material were investigated (Author)

A79-17406 Proposal for efficient appreciation of solar thermal absorptive materials by high irradiance solar simulator K Kurokawa and T Hiruma (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tanashi, Tokyo, Japan) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 998-1003 8 refs

For the appreciation of solar thermal absorptive materials used in solar power generation systems, a high irradiance solar simulator (HISS) has now been developed successfully. It is very different from conventional one used in space and aeronautic development. The nominal maximum irradiance comes up to 700 kW/m² by using a 30 kW water-cooled xenon lamp and newly designed optics. HISS will play an essential role in the effective measurement of solar thermal energy absorption efficiency and rapid check of the durability of the materials (Author)

A79-17407 Thermal performance testing of flat-plate solar collectors J G Symons and P I Cooper (Commonwealth Scientific and Industrial Research Organization, Div of Mechanical Engineering, Highett, Victoria, Australia) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2

Elmsford, N Y, Pergamon Press, Inc., 1978, p 1004-1008 6 refs

Two experimental methods are outlined for the measurement of the solar collector efficiency characteristic, and another for the heat loss characteristic. These developments in thermal testing procedures for flat-plate solar collectors are receiving increasing attention in Australia, and a summary is presented here of the work undertaken within the CSIRO Division of Mechanical Engineering. Several small but quantifiable refinements to the method of correlating experimental data are suggested, and an outline of expected experimental accuracy is given (Author)

A79-17408 Optimal profile of solar energy collectors M Kovarik (Commonwealth Scientific and Industrial Research Organization, Div of Mechanical Engineering, Highett, Victoria, Australia) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1009-1013 5 refs

Economic aspects of design of solar energy collectors consisting of pipes provided with radiation absorbing fins are analysed. A variational problem is formulated such that its solution satisfies conditions of linear heat transfer within the fins and between the fins and their surroundings while minimising a functional which may be interpreted as minimum weight or minimum cost of the collector per unit heat output. The solution of this problem is found for a fin of variable thickness as well as for one of fixed thickness. The physical parameters of this solution are compared with the known solutions of the analogous problem of heat dissipation (Author)

A79-17409 The testing procedures of thermal performance of solar collector at Solar Research Lab, G I R I M Sando, S Tanemura, A Fujii, and T Noguchi (Government Industrial Research Institute, Nagoya, Japan) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1014-1020 23 refs

The testing apparatus which is similar to NBS type was installed in order to obtain the thermal performance characteristics of two collectors with different specification simultaneously. The collector efficiency was measured by following NBS procedures and the direct measurement of heat losses through the collector was also carried out after the sunset. Two collectors were tested. The factor F_{UL} of single glazing collector with black paint absorber evaluated from both experiments show the remarkable dependency on the wind speed around the collector as expected from the heat transfer theory on the collector. It is finally concluded that NBS procedure can be acceptable to describe the performance characteristics of a collector (Author)

A79-17410 Testing of water-heating collectors according to ASHRAE Standard 93-77 J P Jenkins and J E Hill (National Bureau of Standards, Center for Building Technology, Washington, D C) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1021-1028 12 refs. Research sponsored by the U S Department of Energy

A proposed procedure for testing and rating solar collectors was published by the National Bureau of Standards (NBS) in 1974. In early 1977, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) adopted ASHRAE Standard 93-77 which is a modified version of the NBS procedure. A test facility for water-heating collectors has been built at NBS in accordance with this Standard. The purpose of this paper is to briefly explain the recently adopted test procedure, describe the NBS test

facility, and to give typical test results for collectors commercially available in the United States (Author)

A79-17411 **Double-exposure collector system for solar heating applications** D C Larson and C W Savery (Drexel University, Philadelphia, Pa) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1033-1037 10 refs

A retrofit solar water-heating system has been installed in a three-story apartment building at Drexel University The system employs two conventional collector banks mounted at the latitude angle for Philadelphia of 40 deg from the horizontal and two double-exposure collectors (DEC's) mounted vertically in mirrored enclosures Although the DEC units are being used for year-round domestic water heating for the building, they are designed to provide maximum output in the winter and are therefore well-suited to solar space heating applications The performance of the DEC units relative to conventional collectors has been calculated (Author)

A79-17412 * **Solar thermal collectors using planar reflector** P N Espy (NASA, Marshall Space Flight Center, Space Sciences Laboratory, Huntsville, Ala) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1038-1042 9 refs

Specular reflectors have been used successfully with flat-plate collectors to achieve exceptionally high operating temperatures and high delivered energy per unit collector area Optimal orientation of collectors and reflectors can result in even higher performance with an improved relationship between energy demand and supply This paper reports on a study providing first order optimization of collector-reflector arrays in which single- and multiple-faceted reflectors in fixed or singly adjustable configurations provide delivered energy maxima in either summer or winter (Author)

A79-17413 **A channelled solar flat-plate booster** I A Sakr and A I Hegazi (National Research Centre, Solar Energy Laboratory, Cairo, Egypt) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1043-1055

This paper presents an analytical and experimental study of a stationary concentrator which has the flat-plate characteristics It is composed of an array of an E-W oriented trapezoidal channels with two side reflecting walls, tubular absorber and a glass cover The geometrical parameters of the channels are deduced for apex angles between 5 and 90 deg, either as double or single reflection channels The effect of beam deviation from the normal direction is carefully analyzed, specially on beam concentrator factor An annually routine is proposed to minimize the beam deviation, and a monthly adjustable system is shown to be satisfactory A collector of such type with apex angle of 40 deg was manufactured and tested at the Solar Energy Laboratory in Cairo The results show that absorber surface temperature is about 150 C (Author)

A79-17414 **Tilt, orientation and overshadowing of solar collectors in the Netherlands** J Hamaker and M de Wit (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p

1056-1059

Characteristics of winter solar radiation in the Netherlands are discussed with reference to house heating, urban design, and cost considerations An advisory board on energy research has suggested that 1.5% of the country's energy supply in the year 2000 should derive from solar energy, and it is suggested that the attainment of this goal would require that almost all houses built in the period 1985-2000 be suitably oriented and equipped with solar energy heating systems Studies conducted at the meteorological station in

De Bilt at 52 deg N indicate that cost effectiveness for solar space heating will not be reached unless the price of fossil fuel increases 100% M L.

A79-17415 **Annual collection and storage of solar energy for the heating of buildings** J T Beard, F A Iachetta, L U Lilleht, M D Duwall, L A Dirhan, Jr, and J W Dickey (Virginia, University, Charlottesville, Va) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1060-1066 10 refs ERDA-supported research

Results are presented of the first year's operation of a new system for year-round collection and storage of solar heated water for heating of buildings at the University of Virginia The system is composed of an energy storage subsystem, which stores hot water in an underground pool, and of a solar collector subsystem which acts not only to collect solar energy throughout the year but also to limit the evaporative and convective heat losses from the storage system System temperatures and rates of energy gain and loss are presented for the system operated in an energy collection mode Thermal performance results are presented illustrating the efficiency of the solar collector under summer conditions (without a reflector) and winter conditions (with assistance from a vertical reflector) Analog and digital models were used to determine the influence of various design modifications for improved collection and storage system performance (Author)

A79-17416 **Some studies on an experimental solar pond** D K Dixit, B D Shiwalkar, and V M Dokras (Visvesvaraya Regional College of Engineering, Nagpur, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1073-1077 9 refs

Solar ponds seem to be the only solution for collecting and storing solar energy for mechanical power production at competitive cost which will make the commercial exploitation of these systems feasible Solar radiation effects a considerable temperature rise in a nonconvecting pond of one meter depth. The pond is maintained nonconvecting when there is a temperature gradient in the pond, with the bottom warmer than the top, by means of a salt concentration gradient with greater density of the lower regions. Salt water at 46 C can be withdrawn for utilization from the pond bottom (Author)

A79-17417 **Field performance of certain selective and neutral surfaces in solar collectors** B Wright and J J Mason (Inco Europe, Ltd, Birmingham, England) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p

1080-1084 5 refs

This paper concerns the properties and performance of a newly-developed nickel foil for solar collectors with comparisons relating to other surfaces including chrome and nickel black Problems encountered in currently-available selective surfaces are discussed with an emphasis on costs and inadequate solar absorptivity Our data show that these limitations make some existing selectively-coated collectors superior only under a limited range of operating conditions and are indeed substantially inferior to black-painted collectors over the majority of normal operating conditions used by this type of flat-plate collector. Field results show that the nickel foil surface, when applied to flat plate collectors, is superior to both black-painted surfaces and some commercially-available nickel black surfaces under all useful operating conditions An initial economic evaluation of the new foil suggests that this route is likely to be more cost-effective than other methods of applying selective surfaces to flat-plate collectors (Author)

A79-17418 **Solar collector optimization** J S Saini and C P Gupta (Roorkee, University, Roorkee, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1087-1091 5 refs

In this paper a simple method of optimizing a solar collector system has been presented which predicts optimum values of energy collection area as well as the mass flow rate of carrier fluid for a system with given configurational and meteorological parameters. Although the present analysis has been carried out for flat plate collectors it can be suitably modified for predicting optimum design of focusing type collectors also (Author)

A79-17419 **Design and optimization of a flat plate collector for cooling application** U V Ladsaongkar (Tata Electrical Companies, Bombay, India) and P P Parikh (Indian Institute of Technology, Bombay, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1092-1101

The paper deals with optimization of design and operational parameters of a flat plate collector for an output design temperature of 140 C for a continuous ammonia absorption system. The various parameters optimized are angle of inclination, number of glass plates and the geometry of flow passages in the collector. The methods used for optimization are illustrated with specific examples. A nomogram is constructed for easy optimum design and evaluation of the performance of the collector for a given place and application. Collector efficiency factors are derived based on average collector temperature, contrary to the inlet temperature which has so far been used as the reference. Optimization study for design temperature of 140 C shows that optimum number of glass plates is 4 for ordinary surface and 3 for selective surface. A corrugated geometry with 90-deg vee is preferred to a 60-deg vee. The nomogram developed can also be used for the optimization of the design of the collector for other applications (Author)

A79-17420 **Anticonvective antiradiative systems** R Herrera, I S Alvarez, and E Hernandez (Universidad Nacional Autónoma de México, Villa Obregón, Mexico) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1102-1106 Research supported by the Organization of American States

The development of solar collectors has become of great interest. The efficiency and cost have been reported. At the same time, with the widespread use of computers new methods to improve design characteristics have been used. In this paper, a computer model of a flat plate collector with or without anticonvective-antiradiative system (honeycomb) is presented. The model can simulate a flat plate collector with one or more covers and with or without selective surfaces. The test simulated is that proposed by the National Bureau of Standards (U S A), where collector efficiency is plotted as a function of $(T_p - T_a)/I$ (deg C sq m/W), where T_p and T_a are the absorber plate and ambient temperatures respectively, and I is the incident radiation. It is also possible to simulate a working day for the collector, however, in this case some experimental data is needed as input data for the model (Author)

A79-17421 **Optimum tube pitch in solar collectors** B T Nigaguna and S U Shenoy (Karnataka Regional Engineering College, Karnataka, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1107-1110 7 refs

In tube and sheet type natural circulation solar collectors, the pitch of the fluid flow tubes is an important design parameter. Accordingly, it is essential to know the optimum fin height that would provide higher collector efficiency and at the same time

reduce collector cost. In the present paper, a simplified conventional fin height analysis is extended to solar collector and is used to predict tube pitches for various solar intensities V P

A79-17422 **Optimising the pitching of tubes in a flat solar collector for increasing the efficiency for use in vapour absorption refrigeration** T V L Rao (J N T U College of Engineering, Anantapur, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1111-1114

A79-17423 **A report on the various heat collection and heat storage systems evolved under the solar energy programme at BITS** I T S J S Patel, B K Raghunath, V K Tewary (Birla Institute of Technology and Science, Pilani, India), and G D Pande In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1115-1130

This paper is a report on the various heat collection and heat storage systems evolved at BITS. The paper reports the performance of flat-plate collectors heating a low boiling organic liquid as an adjunct to BITS Solar Pump. Also given in the paper is an economic alternative to a conventional solar water heater. Further, methods for space heating and cooling are discussed. Possibility of combining a collector and concentrator to achieve higher temperatures and to be able to raise-steam is also investigated (Author)

A79-17424 **Honeycomb type flat plate collectors - Experiments leading to drinking straw** S K Handa (Indian Institute of Management, Ahmedabad, India), B Bhushan (Administrative Staff College of India, Hyderabad, India), and K S Rao (Central Salt and Marine Chemicals Research Institute, Bhavanagar, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1131-1133 8 refs

Honeycomb type flat plate collectors have been demonstrated to be capable of achieving high temperatures. They operate through the mechanisms of suppressing convection currents and reducing the losses to a negligible level. This paper reports the use of drinking straw honeycomb of L/D ratio of 12 which achieved temperatures in excess of 230 C, when the honeycomb was thermally destroyed. Wet steam of up to 50 psi pressure has been generated on a 0.6 m x 0.6 m aluminum tube in sheet collector (Author)

A79-17425 **Flat plate collector - Experimental studies and design data for India** H P Garg (Central Arid Zone Research Institute, Jodhpur, India) and C L Gupta (Tata Energy Research Institute, Pondicherry, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1134-1146 19 refs

Various studies carried out by the authors on flat plate collectors such as optimization of collector configuration, optimum tilt of collector, conversion factors on inclined planes, dirt correction factor, heat loss coefficients, design curve for summer and winter use for Indian stations, honeycomb effect, mode of interconnection of absorbers, effect of mass flow rate and solar insolation and collector testing are reviewed. It was experimentally observed that under Indian conditions the optimized tube in plate type flat-plate collector performs better than the corrugated sheet type flat-plate collector and bond duct type of aluminum flat-plate collector (Author)

A79-17426 **Optimum tilt for the flat plate collector.** B S Jagadish (Indian Institute of Technology, Bombay, India) In Sun Mankind's future source of energy, Proceedings of the International

Solar Energy Congress, New Delhi, India, January 16-21, 1978
Volume 2 Elmsford, N Y, Pergamon Press, Inc.,
1978, p 1149-1153 7 refs

Optimization of the tilt of the flat plate solar energy collector is carried out for critical demand and maximum output conditions as the objective functions. The study is illustrated with the calculations using measured mean radiation data for four cities in India, covering varied range of climatic conditions. The results are analyzed for the radiation received at various optimum conditions and at the tilt angle equal to the local latitude (Author)

A79-17427 A contribution to evaluation of flat-plate solar collectors performance G Raffellini and E Zanchini (Bologna, Università, Bologna, Italy) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1154-1159 9 refs

By examination and critical analysis of some important notes about solar collectors performance, a new evaluation method is proposed. This method is employed to show the influence of some parameters on efficiency. An apparatus for testing flat-plate solar collectors has been set up to compare proposed method with experimental results, obtained during some days in different operative conditions. Good agreement has been found in low temperature conditions tested (Author)

A79-17428 Availability of solar energy at Baghdad, Iraq - Performance and design data for flat plate collectors J A Mynett (Salford, University, Salford, England) and I M Hussain (Baghdad, University, Baghdad, Iraq) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1160-1164 9 refs

A79-17429 Yield of ground storage of heat in solar ponds A Akbarzadeh and G Ahmadi (Pahlavi University, Shiraz, Iran) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1165-1170 14 refs. Research supported by the Ministry of Science and Higher Education of Iran and Pahlavi University

The thermal interaction between a large solar pond and the surrounding ground is considered. For a given sinusoidal variation of the temperature at the bottom of the pond, the time dependent temperature profiles in the ground are calculated and the corresponding heat fluxes to or from the ground as a function of time are obtained. The temperature variations in the ground for several years are plotted and the heat transfer between the solar pond and the ground thermal storage is discussed. The efficiency of the heat recovery is studied and its significance is pointed out (Author)

A79-17430 Viscosity stabilized solar ponds L H Shaffer (Bridgeport, University, Bridgeport, Center for the Environment and Man, Inc., Hartford, Conn) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1171-1175 14 refs ERDA-supported research

The solar pond is a device proposed for collecting and storing solar energy. Originally proposed as a heat source for a central solar power plant, a solar pond can be used also to supply domestic heat. For the latter application, it is proposed to render the pond static through addition of thickeners to the fluid. Data on the total solar input are summarized, and the relationship between the total available energy and the requirements for domestic heat is discussed. Preliminary design ideas for the development of pond configurations suitable for home heating are proposed V P

A79-17431 Conditions for absolute stability of salt gradient solar ponds C E Nielsen (Ohio State University, Columbus, Ohio) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1176-1180 6 refs. Research supported by the Ohio State University

Salt-gradient stabilized solar ponds normally consist of three zones: a convective surface layer, a nonconvective gradient zone, and a second convective layer at the bottom. The behavior of the convective-nonconvective zone boundaries determines the durability and thickness of the gradient zone and, hence, the reliability of the pond. In the present paper some previous work on salt gradient systems is reviewed. The origin of the convective zones in practical ponds is discussed, along with the nature of the boundaries. Data on the zone boundary behavior are examined, and the factors involved in the boundary behavior are discussed V P

A79-17432 Computer simulation of the performance of a solar pond in the southern part of Iran G Ahmadi and A Akbarzadeh (Pahlavi University, Shiraz, Iran) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1181-1189 13 refs. Research supported by Pahlavi University and Ministry of Science and Higher Education of Iran

A proposed solar pond for the collection and storage of solar energy is studied by means of a described computer model. The program computes pond temperature for various rates of energy removal. The conditions found in the area near Shiraz, Iran are assumed, and it was determined that the pond bottom becomes warm enough to permit energy extraction from the pond after only a few months of operation. Monthly climate conditions and corresponding effects on the pool are considered, and the effect of cloudiness is examined M L

A79-17433 Liquid solar collector K N Seetharamu and B V Baliga (Indian Institute of Technology, Madras, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1190-1194

Liquid Solar Collector is a novel type of collector which meets both the low cost and temperature requirements coupled with the ease of fabrication. Analytical and experimental study of the collector is carried out. In the unsteady state analysis carried out, the parameters which govern the physical system are identified and for various values of these parameters, the governing equations are solved on an IBM 370/155 Computer using the fourth-order Runge-Kutta method. The trend of the experimental results are in conformity with the analytical results (Author)

A79-17435 Evacuated solar flat-plate collectors for economic applications V Merges and H Schweig (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1201-1206

A flat-plate collector with moderate vacuum is described, in which air conduction is fully maintained but air convection is eliminated. The moderate vacuum does not incur additional sealing costs. Only one cover pane is necessary, so minimum optical collector losses are incurred. Calculations of daily energy gain at different mean absorber temperatures were performed for the moderate vacuum collector and compared with the high-vacuum limit. Cost analysis shows that the moderate-vacuum flat-plate collector cost about 1.5 times the single-pane collector with selective absorber. It will thus be more economical under conditions where it supplies more than 1.5 times the energy supplied by the single-pane collector with selective absorber. Economical applications include

desalination with large multistage evaporator plants, refrigeration plants with absorber machines, and current generation with organic Rankine machines PT.H

A79-17436 Construction and test of a test apparatus for determining the efficiency of solar collectors with the ASE-test method G Woessner (Esslingen, Fachhochschule für Technik, Esslingen, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1207-1211

The determining of the efficiency of solar collectors takes place at the ASE-test-method with a combined indoor and outdoor test To examine this proposed ASE-directions a test apparatus was constructed and tested by various flat plate collectors The paper reports about the construction of the test apparatus and the test method This is explained more detailed by a test collector and its results of measurement, which are plotted in curves It is shown, that the test apparatus delivers good results of measurement which are reproducible Therefore the ASE-directions should find application later in a DIN-Norm or in an international standardization (Author)

A79-17437 Theoretical and experimental yields of a solar heater with flat plate collectors R Poyart and J Colomes (Commissariat à l'Énergie Atomique, Service d'Études Énergétiques, Gif-sur-Yvette, Essonne, France) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1212-1216

The results obtained with a 320 sq m solar heater are compared with those given by the computer code ORIENT This code is then used to demonstrate the influence of thermal inertia on thermal energy production, which, referred to unit surface area, is shown to decrease with the size of the unit Some realistic orders of magnitude on the energy production of such heaters are given in conclusion (Author)

A79-17438 Performance of optimal geometry three step compound wedge stationary concentrator K D Mannan (Punjab Agricultural University, Ludhiana, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1218-1222 6 refs.

The concentration ratios including maximum ones obtainable with East-West aligned non-tracking three step compound wedge solar energy collector has been examined It has been shown that maximum concentration design is not the most practical design because of its requirement of disproportionately large reflecting surfaces It has been shown further that significant saving of reflecting surface can be effected with only small reduction in concentration ratios obtainable The experimental performance of a practical design has also been investigated (Author)

A79-17439 A compound parabolic concentrator for a high temperature solar collector requiring only twelve tilt adjustments per year M Collares-Pereira, J J O'Gallagher, A Rabl, and R Winston (Chicago, University, Chicago, Ill) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2

Elmsford, N Y, Pergamon Press, Inc., 1978, p 1223-1226 7 refs Research supported by the Instituto Nacional de Investigação Científica and Centro de Física da Materia Condensada, Contract No EY-77-S-02-2446

A79-17440 Compound parabolic concentrators with nonevacuated receivers - Prototype performance and a larger scale demonstration in a school heating system M Collares-Pereira, N B Goodman, P Greenman, J O'Gallagher, A Rabl, L Wharton, R Winston (Chicago, University, Chicago, Ill), and H Simmons

(Chicago, University, Chicago, Ill, Bureau of Indian Affairs, Gallup, N Mex) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1227-1232 6 refs Research supported by the Instituto Nacional de Investigação Científica and Centro de Física da Materia Condensada, Contract No EY-77-S-02-2446

The design and fabrication of two different prototype compound parabolic concentrators with nonevacuated receivers are discussed, and results of performance tests are presented One prototype is a tubular absorber with a design acceptance angle of approximately 6.4 degrees, truncated to a net geometric concentration of 6.5 The second prototype is a vertical fin receiver with an acceptance angle of approximately 18 deg slightly truncated to a concentration of 3 An array of this second prototype has been installed in an operating space heating application M L

A79-17441 P.E.R.I.C.L.E.S. - Design of a stationary spherical collector B F Authier (CNRS, Laboratoire d'Astronomie Spatiale, Marseille, France) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1235-1243 11 refs.

The paper describes a 10-m-diameter laboratory mock-up of the Pericles stationary spherical collector The high concentration and low concentration boilers and receivers are characterized, and the flux variation with respect to the zenith distance is investigated Optical properties and reflecting surfaces are discussed, and information on the final dimensions, the mounting, and the monitoring device is presented M L

A79-17442 An analysis of a cylindrical parabolic focussing collector for distributed collector power system T Tanaka, T Tani, S Sawata, K Sakuta, and T Horigome (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tanashi, Tokyo, Japan) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1244-1253 7 refs

The numerical analysis of a cylindrical parabolic focusing collector is presented The results are intended for application to the design of a 1000 kWe pilot solar thermal electric power plant The effects of several parameters including reflector reflectance, mass flow rate, absorptivity, dimensions, and inlet fluid temperature on collector performance are examined It is found that reflector loss and convective heat loss from the envelope are responsible for most of the collector energy losses for normal incidence M L

A79-17443 Geometrical aspects of a cylindrical parabolic collector S G Kandlikar (Indian Institute of Technology, Bombay, India) and S K Vij (Jyoti, Ltd, Baroda, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1254-1258 7 refs

Cylindrical parabolic collectors are attractive solar energy collection devices for attaining temperatures in the range 100-250 C This paper deals with a practical configuration of a parabolic reflector (axis north-south) with a circular absorber located at the focus For this case, the geometric relationships among various parameters are analysed The results should be useful for selecting different parameters of the parabolic collector system for a given application (Author)

A79-17444 Optimum design parameters of horizontal coaxial cylinders for a solar energy collector T Kunitomo (Kyoto University, Kyoto, Japan) and K Aizawa In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1259-1263 7 refs

In this paper, the optimum combinations of the design parameters of a solar collector system for thermal use of horizontal coaxial cylinders with a cylindrical parabolic mirror are discussed from the standpoint of exergy, collector efficiency and outlet temperature of a fluid. Heat balance calculation is carried out, using the exact relations of simultaneous radiative, convective and conductive heat transfer in the system (Author)

A79-17445 Development of solar collectors for low temperature level and of concentrators for thermal and photoelectric conversion H Kleinwachter (Research Institute KLER, Lorrach, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1264-1270

Some cheap solar collectors and related devices are described. Devices include plastic monotube and multitube collectors, an elastically bent cylindrical concentrator for concentrating 10- to 20-fold, a rotating parabolic mirror for operating temperatures of 300-800 C, and a concentrator used for photoelectric conversion when the energy density at the absorber is given. The use of plane mirror grooves and funnels for 200 C operating temperatures is considered M L

A79-17446 A cost effective total energy system using a faceted mirror sunlight concentrator and high intensity solar cells B L Sater, C Goradia (Cleveland State University, Cleveland, Ohio), W Rogers, and D Borton (Rensselaer Polytechnic Institute, Troy, N Y) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1271-1277 8 refs. Research supported by the U S Department of Energy

The design of an integrated photovoltaic/thermal High Intensity Solar Energy System (HISES) which can supply a major portion of the electrical and thermal energy needs of a residential/commercial site is presented. A novel sun-tracking faceted mirror sunlight concentrator is described in detail. A preliminary cost analysis is presented and capital investment and conservation aspects are also discussed. Energy costs of roughly 1 cent/kWh and 2 cents/kWh may be possible with the large scale use of HISES (Author)

A79-17447 Design fabrication and testing of three meter diameter parabolic dish heliostat system R M Engira and K D Mannan (Punjab Agricultural University, Ludhiana, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1278-1281

This paper describes the design, fabrication and preliminary performance evaluation of a parabolic dish collector and heliostat system. The system was designed to provide a medium concentration ratio of about 800. The parabola dish was fabricated using a specially designed reflector element fitted in the form of a mosaic on a supporting structure. The heliostat was fabricated by using plane mirrors, each 9 m x 3 m. The azimuthal as well as altitude tracking is accomplished by separate tracking motors based on on-off operations. The electronic control system acts in conjunction with the photocell sensors to maintain the pointing error to within an angle of 3 minutes. It has been found experimentally that the system concentrates solar energy on 10 cms dia disk (Author)

A79-17448 High temperature solar collector of optimal concentration - Non-focusing lens with secondary concentrator M Collares-Pereira, J O'Gallagher, A Rabi, R Winston (Chicago, University, Chicago, Ill), J Egger, and K Williams (Optical Sciences Group, San Rafael, Calif) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1282-1286 7 refs

Research sponsored by the Instituto Nacional de Investigação Científica and Centro de Física da Matéria Condensada

A solar thermal collector is described which consists of a line focus Fresnel lens plus second stage concentrator of the CPC type. The tracking axis runs north-south, with fixed tilt equal to latitude. The geometric concentration is 16, and the acceptance angle 2θ is 6 deg, this allows for large contour and tracking errors and permits collection of most or all of the circumsolar radiation. The receiver, coated with black chrome, is nonevacuated. The collector is designed for efficient operation in the temperature range of 200 to 300 C (Author)

A79-17449 The USA 5MW solar thermal test facility J V Otts, J T Holmes, L O Seamons, D J Kuehl, L K Matthews, D B Davis, D E Arvizu, D M Darsey, and G E Brandvold (Sandia Laboratories, Albuquerque, N Mex) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1287-1295

The solar thermal test facility, which is capable of delivering 5 million watts of thermal power to experimental equipment, is described. The facility, which will be fully operational in the spring of 1978, uses 222 heliostats to concentrate the sun's energy on a 61-m tall concrete tower. Power of about 1.8 million watts was achieved May 1977. Experiment capabilities and facility test programs are discussed M L

A79-17450 Receiver designs for tower-top solar collector J S Ansari (Osmania University, Hyderabad, India) and K Krishnaprasad (Indian Institute of Science, Bangalore, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1296-1298

In earlier studies on tower-top focus solar plant, the receiver has a bowl-like shape. For such a receiver, the flux density of incident reflected solar radiation is more or less uniform over its entire surface. It is pointed out in this study that if the receiver contains an evaporator and a superheater, the optimum flux densities for the two are different, the evaporator should receive higher power per unit area than the superheater. Hence, a modified geometry is suggested. Furthermore, a bowl-like shape does not conform with the sun's image formed at the receiver if rectangular mirrors are used (Author)

A79-17451 Distribution of beam radiation of the receiver plane of a CPC solar concentrator J F Kreider In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 1 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1299-1302

The Winston (1974) design of the compound parabolic concentrator (CPC) is examined, and thermal and optical effects are described. It is concluded that the thermal effects of nonuniform absorber flux are of no importance in engineering design of CPC. Variations of optical efficiency with incidence angle for truncated or untruncated CPC are large enough so that a value at one incidence angle is too inaccurate for use in a CPC system design procedure analogous to the f-chart. It is recommended that weighted average value should be used instead. The incidence angle modifier can be either positive or negative, and this single parameter will not accurately represent incidence angle effects in a CPC collector M L

A79-17452 Large-aperture radiant solar energy concentrators I V Baum (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1303-1307

The relation between the maximum concentration factor and the number and form of facets of a paraboloid mirror used for solar energy concentration is analyzed. The three-step approach begins by describing, in terms of differential geometry, the ray deflections associated with a facet system approximating an ideal paraboloid reflector. Then the formation of the receiver irradiation field is represented by a statistical model, and integration over the surface of a large number of facets is replaced by integration over the paraboloid surface, possible ray deflections are averaged in the procedure. Two effects can then be characterized. One involves the effect of the number of facets on the concentration factor, and the other is the effect of reflector aperture on approximation accuracy at a given number of facets. M L

A79-17453 Performance of solar concentrators - A theoretical study. M S Sodha, G Umesh, K Thyagarajan, B P Pal, and A K Ghatak (Indian Institute of Technology, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1309-1315

The paper reports a theoretical study on the performance of three types of solar energy concentrators, viz the compound parabolic, the cylindrical parabolic and the compound wedge concentrators. For fixed exit and entrance aperture widths, the relative energy distribution at the exit aperture of the concentrators, at different times of the day for three typical days of the year are calculated. The sun is assumed to be a moving point source and the collectors to be fixed on the ground at the equator. The energy distribution is calculated numerically by tracing a large number of rays. The results show that, whereas in the wedge type of concentrator the energy density is more or less uniform throughout the receiver plate, the other two types concentrate the light energy to an appreciable degree onto locally small regions. Also examined is the variation of the concentration efficiencies with the angle of incidence of the sun rays. Further, it is shown that the height of the compound parabolic concentrator can be decreased without any significant loss in the concentration efficiency. (Author)

A79-17454 Comparative performance of tracking type and non-tracking type solar collectors. M H Pajoja (Indian Institute of Technology, New Delhi, India) and S K Nanda In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1316-1320 6 refs

This paper reports some results of an experimental investigation on performance of four different types of collectors. These include the flat plate collector and the parabolic cylindrical, compound parabolic and conical concentrators. The flat plate collector with two glass covers was found to be best suited for use in Delhi, provided the required maximum temperature did not exceed 95 C. Among the concentrating collectors tested, the conical collector with conical absorber, gave significantly higher temperatures for the same concentration ratio. The conical reflector is also easier to fabricate as compared to parabolic reflectors. The requirement of high reflectivity and its continued maintenance for a concentrator, is a major drawback of a concentrating collector. (Author)

A79-17455 Solar concentrators. K S Salariya and E M Singh (Punjab Agricultural University, Ludhiana, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1322-1327 6 refs

Solar energy can be concentrated most efficiently by using lenses. Three types of cheap lenses have been developed in sizes 73 cm and 90 cm diameters in the forms of a double convex, plane-convex and concave-convex. These lenses are made from thin round acrylic sheets which are bolted together along their circumferences between two mild steel rings. Small thin cylindrical spacers of

acrylic are placed between the sheets at their center to give them the shape of the lenses. These hollow structures act like lenses when filled with clear water or any other transparent liquid. Their performances relating to solar energy are presented. (Author)

A79-17456 Design, construction and performance of Fresnel lens for solar energy collection. H P Garg (Central Arid Zone Research Institute, Jodhpur, India), M L Mathur, and V K Verma (Jodhpur, University, Jodhpur, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1328-1335 6 refs

This paper describes a study on circular type of Fresnel lens with steps on front for collection of solar energy. The effects of step width and plate thickness on design parameters have been analysed, and based on this, a design curve relating the radius to step angle has been drawn. The relationship between focal length and maximum attainable radius has been investigated. A method of manufacturing the Fresnel lens on a lathe is described. The experimental results with the lens manufactured are given. (Author)

A79-17457 A simple solar tracking system. K C Gupta, R K Mirakhur, and A P Sathe (Birla Institute of Technology and Science, Pilani, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1336-1340

A falling weight controlled by a pendulum drives a shaft which is parallel to the axis of the earth at a rate of one revolution per day. The concentrator (convex lens) is mounted on the shaft and it thereby tracks the sun. Changes in the declination of the sun are accounted for correctly when the device is adjusted manually to point towards the sun each morning. A method is presented for correctly aligning the rotating shaft parallel to the axis of the earth by making observations of the focal spot of the sun. (Author)

A79-17458 The design and evaluation of a hydraulic-solar powered tracking device. E A Farber, H A Ingley, C A Morrison, and N Cope (Florida, University, Gainesville, Fla) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1341-1348 7 refs

The design and construction of a self-contained heliostat are described. The heliostat operates without external conventional power and with minimal maintenance. The tracking device uses the pressure differential in irradiated sensors to produce the power to align a collector with the sun. Preliminary data suggest that the fluid-mechanical drive system provides adequate accuracy and minimal response time for highly efficient concentrating collectors. M L

A79-17459 Manufacture of curved glass mirrors for linear concentrators. J E Giutronich and D R Mills (New South Wales, University, Kensington, Australia) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1350-1352

A technique, based on heat sagging of glass components, is proposed for manufacturing glass cylindrical parabolic reflectors of good specularity, improved figure, and long life expectancy. The method is applicable to cylindrical shapes generally. It is readily adaptable to industrial applications. V P

A79-17460 Design of solar energy concentrators for power generation in residential and nonresidential areas. M Ibrahim (Indian Institute of Technology, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 2 Elmsford, N Y, Pergamon Press, Inc, 1978, p 1353-1356b

Two novel concentrators are described in this paper. The concentrators can be manufactured using existing technologies that are within the reach of underdeveloped and developing countries. A flat concentrator design using 'one-way mirrors' is suitable for collection of solar energy incident on the terrace of buildings. A modular design of a system of concentrators, mirrors, and lenses is proposed for use in thermal power plants with capacities of more than 100 MW. The solar concentrators do not track the sun's movement, and implement the concept of distributed focussing. (Author)

A79-17461 Comparison between simulation and experiment of solar heating. M Udagawa (Kogakuin University, Tokyo, Japan) and K-I Kimura (Waseda University, Tokyo, Japan). In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3. Elmsford, N Y, Pergamon Press, Inc., 1978, p 1364-1368. 5 refs.

A comparison between the measured and simulated results with one of the four solar heating systems set up at the experimental multi-family housing unit of Japan Housing Corporation is described. The floor panel heating system is combined with a water storage tank and an array of collectors mounted on the balcony and on the roof. Hour by hour simulation is made on unsteady state basis using the weather data obtained at the experiment site. The result of the comparison turned out satisfactorily for the solar heating system, though the total space heating load at the experiment was formed considerably higher than by simulation. (Author)

A79-17462 Design, operation and performance of the BBC Solar House. B Ziegenbein and H Birnbreier (Brown, Boveri et Cie. AG, Heidelberg, West Germany). In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3. Elmsford, N Y, Pergamon Press, Inc., 1978, p 1369-1373.

The BBC Solar House in Heidelberg, West Germany was completed in March 1976. Experimental performance data of nearly two years of operation are now available for the evaluation of cost-optimized solar heating systems for single family residential buildings and European weather conditions. A description of the solar system is presented and attention is given to such performance characteristics as instantaneous collector efficiency, monthly energy balances, and discharge of latent heat of fusion storage. B J

A79-17463 Analysis and design of solar buildings using the Cal-ERDA computer programs. R M Graven (Argonne National Laboratory, Argonne, Ill.), B D Hunn, M A Roschke (California, University, Los Alamos, N Mex.), A H Rosenfeld (California, University, Berkeley, Calif.), Z O Cumali (Consultants Computation Bureau, San Francisco, Calif.), and M Lokmanhekim (In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3. Elmsford, N Y, Pergamon Press, Inc., 1978, p 1374-1377. Research supported by the U.S. Department of Energy.

A79-17464 Experiments in solar space heating and cooling for moderately insulated regions. E Aranovitch, M Le Det, and C Roumengous (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerca, Ispra, Italy). In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3. Elmsford, N Y, Pergamon Press, Inc., 1978, p 1378-1386. 7 refs.

A solar laboratory has been constructed specifically for inter-comparisons between different solar heating and cooling systems under European insolation conditions. Various techniques for increasing solar system performance are described including high-efficiency collectors with selective surfaces, honeycomb structures, and V-corrugations, along with low operating temperatures, seasonal storage or combined heating and cooling systems in order to assure year-round utilization of the system. A model based on monthly

averages is used to extrapolate results to other climatic conditions or to perform parametric optimizations. B J

A79-17465 Solar heating performance of the Toshiba Solar House No. 1. H Koizumi, Y Kawada, H Murasaki, T Itoh, and K Matsui (Tokyo Shibaura Electric Co., Ltd., Toshiba Research and Development Center, Kawasaki, Japan). In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3. Elmsford, N Y, Pergamon Press, Inc., 1978, p 1387-1392. 5 refs.

Toshiba Solar House No. 1 is a two-story prefabricated residence, which was completed in October 1975 in Kawasaki, with a solar air heating system including a 48 sq m air-heating collector roof, a 17 ton rock-bed thermal storage and a forced-air distribution system, in addition to a solar water-heating system for hot water supply. In order to ascertain the feasibility of using the present solar heating systems, practical living tests were performed during the heating season of 1975-76, with a successful high heating performance. (Author)

A79-17466 The analysis by stochastic modelling of solar systems for space and water heating. J Haslett (Trinity College, Dublin, Ireland). In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3. Elmsford, N Y, Pergamon Press, Inc., 1978, p 1393-1397. 20 refs. Research supported by the National Science Council.

This paper discusses the use of methods of applied probability in the modeling of active systems for collecting, storing and distributing solar thermal energy. It is seen that these methods are particularly convenient for the calculation of the long term performance of such systems. In comparison with detailed hour-by-hour simulations the method is shown to yield adequate accuracy for economic calculations, except when the panel area/storage volume ratio is high. The required computational effort is however negligible, and the data base is compact. Further, being fully analytic, the method may be generalized to other systems. (Author)

A79-17467 Space heating with solar all-air systems - CSU Solar House II. S Karaki, G O G Lof, and P R Armstrong (Colorado State University, Fort Collins, Colo.). In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3. Elmsford, N Y, Pergamon Press, Inc., 1978, p 1398-1402. Research supported by the U.S. Department of Energy and Sheet Metal and Air Conditioning Industry.

Solar House II at Colorado State University is provided with a system comprising a 68.4-sq-m double-glazed, nonselective solar air heater, a 16.5-metric-ton pebble-bed heat storage bin, a solar hot water heat transfer coil, auxiliary natural gas heaters for space heating and hot water, an air distribution system, an evaporative cooler, an automatic control system, and fully instrumented data recording equipment. During the partial 1975-1976 heating season, the system provided 35,500 MJ of heat from the solar system, which was 71% of the total load for the period recorded. During the heating season from 3 November 1976 through 16 May 1977, the system provided 50,600 MJ of heat, which was 73% of the total load. B J

A79-17468 The interface with solar - Alternative auxiliary supply systems. J G Asbury, R F Giese, and R O Mueller (Argonne National Laboratory, Argonne, Ill.). In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3. Elmsford, N Y, Pergamon Press, Inc., 1978, p 1403-1410. 5 refs.

The total costs of solar space heating with different auxiliary energy supply technologies are calculated and compared. Instead of adopting the usual assumption of constant (time- and load independent) auxiliary energy costs, the study uses detailed cost allocation methods to calculate the marginal capital and variable

costs of electric resistance, natural gas, and fuel oil backup technologies. In terms of solar collection breakeven costs, the interface with the electric utility is the most difficult to justify (Author)

A79-17469 **Conceptual development of a solar town in Iran** M N Bahadori (Pahlavi University, Shiraz, Iran) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1411-1445 24 refs

Several methods of solar energy utilization are considered for a residential town of about 4000 people in Iran. The methods involve central generation of all energy needs, with parabolic concentrators used for power production and flat plate collectors for water vapor production and domestic hot water. Consideration is also given to the utilization of rejected heat from the power plant, the use of city wastes for the production of methane gas for high temperature cooking, and the use of waste water for the growing of an energy crop B J

A79-17470 **Some experimental investigations on solar space heating in Korea** J H Cha (Korea Atomic Energy Research Institute, Seoul, South Korea) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1446-1451 7 refs

Experiments performed to examine the technical feasibility of liquid-type and air type solar space heating systems in Korea are described. The liquid system resulted in a heating load capacity of up to 85% when the area between the solar collector unit and the heating space was the same. The air system was found to be very competitive with the liquid one in terms of performance and also favorable in terms of cost B J

A79-17471 **Design of a low-energy house in Denmark heated by a combination of solar and wind energy** T V Esbensen and F Strabo In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1454-1458

A79-17472 **Design problems of air source solar boosted heat pumps** L E Taylor (Ballarat College of Advanced Education, Ballarat, Victoria, Australia) and W W S Charters (Melbourne, University, Melbourne, Australia) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1459-1465 6 refs

In contrast to conventional air source heat pumps, the solar boosted version uses a solar collecting plate to absorb incident solar radiation in the heating mode. As compared to the conventional heat pump, the higher evaporating temperature of the solar boosted pump results in a smaller pressure ratio and hence lower compressor work. The coefficient of performance is thereby increased. A major fault with the solar boosted heat pump is compressor friction. Improved condenser heat exchange techniques and a design method to adequately include local wind patterns could also improve the performance of real installations B J

A79-17473 **Heattube, a universal electrical solar heat equipment for building, community and agricultural purposes** D Hoorn-Fréne (Daetwyler, Ltd., Altdorf, Switzerland) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1466-1469 5 refs

The design and principle of operation of a solar heat tube system for space heating are described. The tube is plastic, contains an electrical resistance element and has a black semiconductor coating, the tube is a blackbody which absorbs solar radiant energy leading to an increase in the temperature of the water circulating

through the tube. Possible applications of this system are considered B J

A79-17474 **Stochastic simulation experiments on solar air conditioning systems** D K Anand, E O Bazques, and R W Allen (Maryland, University, College Park, Md.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1498-1504 9 refs Contract No E(40-1) 4976

Real weather data and stochastic weather models are used to simulate the performance of solar powered air-cooled and water-cooled air conditioning systems. The simulations include various parametric models for the absorption flow rates. System coefficient of performance, total insolation, and useful energy delivered using the joint probability density approach are found to be in good agreement with real data on daily, monthly, and seasonal bases. The present scheme reduces the data necessary for simulations in a local region, resulting in considerable savings in system simulation both in terms of complexity and time. Any local region can be characterized by five or six constants and from nine to nineteen data sets B J

A79-17475 **Simulation and design of evacuated tubular solar residential air conditioning systems and comparison with actual performance** W S Duff and J A Leflar (Colorado State University, Fort Collins, Colo.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1509-1513 5 refs

The paper describes a simulation study of the Colorado State University Solar House I (SHI) which has concentrated on detailed modeling of the Corning evacuated tubular collector performance, the Arkla chiller performance, and the air conditioning load of the SHI. Several different operating system configurations were simulated including operation with and without cool storage and with and without solar service hot water production. Results of the design and simulation study indicate that the design of a solar heating LiBr absorption cooling system should be simple and straightforward and not include cool storage B J

A79-17476 **A Markov model of solar energy systems** G F Lameiro (Solar Energy Research Institute, Golden, Colo.) and W S Duff (Colorado State University, Fort Collins, Colo.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1514-1522 18 refs Research supported by the Colorado State University and NSF

This paper presents a Markov model approach to the generalized solar energy space heating performance analysis problem. Specifically, Markov chain models are developed to represent ambient temperature, insolation, hot water load and system performance. From the Markov transition probability matrices for these variables, long-term expected performance is calculated. The theoretical development is implemented in FORTRAN IV on a Control Data 6400 Computer System. Computational experience gained, using STOLAR 3.1 (STOchastic soLAR energy systems model), indicates the stochastic approach requires approximately five percent of the time necessary for standard dynamic simulation approaches with comparable performance results. The method also compared favorably with FCHART, a simplified design procedure (Author)

A79-17477 **Optimizing solar energy systems using continuous flow control** P R Herczfeld, R Fischl, and A Orbach (Drexel University, Philadelphia, Pa.) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1523-1530 8 refs Research supported by the U S Department of Energy

The optimization of the performance of solar heating and cooling systems employing continuous flow control is discussed with particular reference to the optimization of the useful heat gain by

the solar heat collection system. The problem of designing feedback control strategies to optimize the collection of solar energy is examined, and a continuous flow control strategy which increases collection efficiency and provides savings in collection time is outlined. V P

A79-17478 Performance of solar heating and cooling systems used in the national solar heating and cooling demonstration program. W L Corcoran (U.S. Department of Energy, Washington, D.C.) In *Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3*. Elmsford, N.Y., Pergamon Press, Inc., 1978, p. 1531-1534. 10 refs

The national demonstration program for the solar heating and cooling of commercial and residential buildings consists of a series of demonstration projects sponsored in whole or in part by the United States Department of Energy (DOE). The solar energy systems used in the demonstration projects include a wide range of designs and a variety of applications in various climatic regions. This paper describes the national demonstration program, including its objectives, history, and current status. The performance of solar energy systems in the demonstration program is also reviewed. (Author)

A79-17479 Theoretical basis and design for a residential size solar powered ammonia/water absorption air conditioning system. E A Farber, C A Morrison, H A Ingley, and D N Shearer (Florida, University, Gainesville, Fla.) In *Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3*. Elmsford, N.Y., Pergamon Press, Inc., 1978, p. 1535-1540. 10 refs

A79-17480 A solar heating and cooling system for an industrial plant located in southern Europe. R Minder (Electrowatt Engineering Services, Ltd., Zurich, Switzerland) In *Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3*. Elmsford, N.Y., Pergamon Press, Inc., 1978, p. 1544-1547

A79-17481 An experimental evaluation of an intermittent cycle solar-powered ammonia/water absorption air conditioning system. E A Farber, C A Morrison, H A Ingley, and J M Stanfield (Florida, University, Gainesville, Fla.) In *Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3*. Elmsford, N.Y., Pergamon Press, Inc., 1978, p. 1561-1566. 11 refs

The paper deals with research work carried out with a solar-powered intermittent cycle ammonia/water absorption air-conditioning system. It consists essentially of two heat exchanger vessels connected by a vapor line at the top. One heat exchanger functions as a generator/absorber for the intermittent-cycle unit, the other contains two tube bundles, one of which functions as a condenser and the other as an evaporator. The intermittent absorption system has demonstrated that solar-powered air-conditioning is feasible, using flat plate collectors for heat collection. V P

A79-17482 Performance predictions of a LiBr absorption air conditioner utilizing solar energy. R Lazzarin, E Rizzon, M Sovrano (Padova, Università, Padova, Italy), B Boldrin, and G Scalabrin (CNR, Laboratorio per la Tecnica del Freddo, Padova, Italy) In *Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3*. Elmsford, N.Y., Pergamon Press, Inc., 1978, p. 1572-1580

The paper examines the influence of the 'internal' temperature cycle on the coefficient of performance (COP) of a solar LiBr absorption air conditioner, with consideration of the limits imposed by the character of the LiBr-H₂O mixture. Consideration is also given to device performance for different temperatures of the 'external' fluids (heating, cooling, and refrigerated). The results are expressed as a function of 'external' parameters. It is shown that the COP is strongly affected by the cooling fluid temperature. B J

A79-17483 Integration of evacuated tubular solar collectors with lithium bromide absorption cooling systems. D S Ward, W S Duff, J C Ward, and G O G Lof (Colorado State University, Fort Collins, Colo.) In *Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3*. Elmsford, N.Y., Pergamon Press, Inc., 1978, p. 1581-1585. Research supported by the U.S. Department of Energy

By surrounding the absorber-heat exchanger component of a solar collector with a glass-enclosed evacuated space and by providing the absorber with a selective surface, solar collectors can operate at efficiencies exceeding 50% under conditions of $\Delta T/H$ sub T = 75 deg C-sq m/kW (ΔT = collector fluid outlet temperature minus ambient temperature, H sub T = incident solar radiation on a tilted surface). The high performance of these evacuated tubular collectors thus provides the required high temperature inputs (70-88 C) of lithium bromide absorption cooling units, while maintaining high collector efficiency. This paper deals with the performance and analysis of two types of evacuated tubular solar collectors integrated with the two distinct solar heating and cooling systems installed on CSU Solar Houses I and III. (Author)

A79-17484 Solar heated and cooled financial building. R M McChesney (Heart Federal Savings and Loan Association, Auburn, Calif.) In *Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3*. Elmsford, N.Y., Pergamon Press, Inc., 1978, p. 1586-1592. Research sponsored by the Heart Federal Savings and Loan Association

The paper deals with a completely automatic air-conditioning system devised for a 1100 sq m financial building. The system incorporates roof-top solar collectors, an Arkla water chiller, storage tanks for hot and chilled water, and a conventional air handler for distributing the conditioned air. Auxiliary energy is provided by a gas fired water heater. The system has the advantage of not requiring an anti-freeze material. V P

A79-17485 Solar retrofitting of existing residence with almost zero delta TE system. K W Boer (Delaware, University, SES, Inc., Newark, Del.) In *Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3*. Elmsford, N.Y., Pergamon Press, Inc., 1978, p. 1593-1602. 6 refs

The Solar One concept of simultaneous conversion of sunlight into heat and electricity with roof-top deployment of hybrid collectors and cost efficient utilization of these forms of energy in conjunction with auxiliary supply from conventional sources has been strengthened by experimental results obtained from two installations - the Solar One house and a private residence. In the present paper, it is shown that in economically reasonable installations, air as a heat transport medium would require a minimum collector plate (solar-cell) operational temperature of 60 and 70 C for summer and winter operation, respectively. When water is used as the transport fluid, a substantially lower operational temperature of typically 40 C can be maintained for the collector. V P

A79-17486 Design of solar heating system for winter heating of buildings /A case study/. J S Saini, R K Mehrotra, and C P Gupta (Roorkee, University, Roorkee, India) In *Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978. Volume 3*. Elmsford, N.Y., Pergamon Press, Inc., 1978, p. 1603-1606. 7 refs

This paper contains the complete design of a solar heating system for winter use for the administrative block of a large factory building. The building is to be heated only during the day time when solar radiant energy is available, also no provision for heating during long cloudy periods was made. Heating is accomplished with hot air coming from the collectors, then circulating through the rooms after the proper temperature attenuation. From the cost analysis, it was concluded that the solar heating system is technically feasible, although somewhat expensive in initial cost. (Author)

A79-17487 A heat operated mechanical device to control the temperature and flow of water entering a hot water storage tank in a solar water heating system J C Kapur (Kapur Solar Farms, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1612-1614

A79-17488 Dynamic response of a novel solar water heater A K Jain (Imperial College of Science and Technology, London, England) and T L S Rao (Regional Engineering College, Warangal, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1616-1620 10 refs Research supported by the Regional Engineering College

A solar water heater with a novel solar collector is described, and a method of predicting the thermal performance of this heater is presented The collector involves low boiling liquid at reduced pressure between two flat plates, vapor passes to the heat exchanger, releases heat to the water there, and drains back to the collector It is suggested that this collector does not suffer from the disadvantage of heat loss due to reversed flow at night The thermal performance model takes into account the geometry of the collector, the thermal capacity of the collector and the water tank, the transmissivity of the glass cover, and the absorptivity of the collector surface Tank water temperature is predicted as a function of time, and the theoretical and experimental results agree M L

A79-17489 Heat transfer analysis of flat plate type domestic solar water heater V K Gupta, N K Tiwari, and H R Tyagi (Jawaharlal Nehru Agricultural University, Jabalpur, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1625-1628 10 refs

A79-17490 Optimum insulation with internal and solar heat gains D L Hagen In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1657-1661 7 refs Research supported by the University of Minnesota

A generalized degree day method is developed which includes internal and solar heat gains by means of a variable balance temperature This requires only the expected solar energy and the means and standard deviations of the temperatures through the year Equations for the optimal insulation are formulated which fully incorporate solar collectors by the F-chart method Simpler equations which retain the gross effects are also developed Economic optimums are similar to conventional calculations, but two to three times greater than typical installations Auxiliary energy use however may be half or less than that expected from conventional calculations Energetic optimums are more than double current economic optimums Equations for optimal collector area are appended (Author)

A79-17491 Periodic heating/cooling by solar radiation S S Mathur, G Umesh, A K Seth, R P Sharma, and S C Kaushik (Indian Institute of Technology, New Delhi, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1662-1666

This paper presents a general theory of periodic heating/cooling of a thermally stratified slab due to the periodically changing (1) solar radiation and the (2) atmospheric temperature The solar temperature has been expanded as a Fourier series in time The heat conduction equation has been solved using the appropriate boundary conditions at the interfaces Numerical calculations for the heat flux through single and hollow concrete slabs have been made using the daily variation of the solar temperature for Kuwait It is found that the magnitude of the heat flux and the phase lag between the heat

flux and the solar temperature is a sensitive function of the solar conditions, thickness and nature of the material of the slabs The presence of the air gap in a hollow concrete slab considerably reduces the heat flux through the slab (Author)

A79-17492 Solar heating for a novel dwelling independent of servicing networks R B Thomas and J G F Littler (Cambridge University, Cambridge, England) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1667-1671 Research supported by the Science Research Council

The paper deals with the Autarkic House (constructed within the Autarkic Housing Project), which is disconnected from all servicing networks and which uses solar energy actively and passively for space and domestic hot water heating Simulations show that a collector area of 8 sq m on each of the east, west, and south roofs (slope of 30 deg) and of 10 sq m on the south wall (slope of 75 deg), combined with storage volumes of 20 cu m for space heating, 25 sq m for domestic hot water, and 0.5 cu m for domestic hot water preheating is adequate even for such 'poor' years as 1962-63 These volumes do not include the volume of insulation which is, however, approximately the same as the size of the store itself V P

A79-17493 An earth-wrapped solar greenhouse house J Cook (Arizona State University, Tempe, Ariz) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1672-1676 5 refs

In the solar house described in the present paper, the east and west walls and part of the north wall are completely buried by earth to provide thermal stability The south side of the house has the tempering advantage of a continuous greenhouse which provides an intermediate thermal zone The roof has a truss frame which provides another intermediate thermal layer It allows heat buildup to be vented through the eaves, as well as providing space for ducts Interior exposed concrete walls are also part of the passive methods of tempering the interior climate The design parameters are discussed and the design considerations and decision processes are outlined V P

A79-17494 Enhancement of intrinsic solar heating A O Converse (Dartmouth College, Hanover, N H) and J Kachadorian In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1677-1680 Research supported by the Central Vermont Public Service Corp and NSF

The Green Mountain Homes 'Solar-Slab' building's thermal performance is summarized for the period October 1976 to May 1977 Descriptions of the building, and monitoring and data processing procedures are also presented The measured heat loss for this 117.5 sq m building was 1.52 W/sq m-deg C of living space including insolation, or 0.95 for purchased energy only Thirty-seven percent of the heating energy came from the sun The monthly average of the maximum daily temperature ranged from 22.1 to 23.3 C The total cost of oil and electricity for heating was \$249 (Author)

A79-17495 Experimental investigation on solar house heating in northern India P Singh (Punjab Agricultural University, Ludhiana, India) and M A J Naseri In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1686-1691 6 refs

A79-17496 The attainable efficiency of the solar thermoelectric generators V A Baum and N O Ovezsokhatov (Akademiiya Nauk Turkmensoi SSR, Fiziko Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi,

India, January 16-21, 1978 Volume 2 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1692-1695

A method for calculating the maximum energy conversion efficiency for a solar thermoelectric generator is developed Theoretical and experimental results demonstrate that solar thermoelectric generators can be quite efficient and cheap if well-designed optical concentration systems are employed B J

A79-17497 **Exploitation of solar energy via modular power plants and multiple utilization of waste heat** J E Feustel and M Kraft (M A N Maschinenfabrik Augsburg-Nurnberg AG, Munich, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1696-1700

The paper describes the development of a solar farm plant of modular design and having ratings of 15 to approx 1000 kW Such plants lend themselves particularly to decentralized supply of power in countries with high rates of direct insolation - roughly up to 40 deg N and S of the equator An initial plant of 50 kW peak rating and 30 kW nominal rating also utilizing waste heat is presently being planned and built for a site in Almeria, southern Spain Sections of the plant will be put into operation in 1978 and the plant will be in full operation by 1979 First tests and optimization have been carried out at M A N 's solar test center in Munich since 1976

(Author)

A79-17498 **The French CNRS 1 MW solar power plant** B D'Utruy, D Blay (CNRS, Laboratoire d'Energetique Solaire, Poitiers, France), and M Coeytaux (Caliqua Co, Paris, France) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1701-1705

The Odeillo electrical solar power plant is described, and test results are presented The plant, built in 1976, operates on a Rankine cycle with steam production at 270 C under 27 bar Thermal fluid (hydrogen terphenyl) is stored at 335 C, and thermal energy of 2 MWh can be delivered The optics system, thermal fluid loop, conventional water steam loop, solar receiver, and storage tank are characterized, and information on heat losses and thermal efficiency is presented M L

A79-17499 **Preliminary results from the Georgia Tech 400 kWth Solar Thermal Test Facility** J D Walton, Jr, C T Brown, S H Bomar, Jr, and N E Poulos (Georgia Institute of Technology, Atlanta, Ga) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1706-1710

The Georgia Tech 400 kWth Solar Thermal Test Facility (GT/STTF) was constructed as a part of the ERDA central receiver solar thermal program The purpose of the GT/STTF is to provide a high temperature solar facility for test and evaluation of experimental receivers and for high temperature materials and component R&D This paper describes the initial operation and evaluation of the GT/STTF Operating characteristics of the facility are discussed with respect to (1) performance of the heliostat system, and (2) performance of the receiver (boiler-superheater), including steam temperatures and pressures provided by the thermal cycle set Specially designed and constructed calorimeters and real-time heat flux mapping equipment to be used in the evaluation of the facility are described Modifications to increase the capability of the facility are described Support capabilities such as instrumentation and data collection and analysis are also discussed Procedures for using the GT/STTF are summarized and the present operating schedule presented (Author)

A79-17500 **Cycle optimization for a solar turbopack** J J Isaac and P A Paranjpe (National Aeronautical Laboratory, Bangalore, India) In Sun Mankind's future source of energy, Proceedings

of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1712-1718 5 refs

A method of using an organic Rankine cycle solar power plant system employing flat plate collectors and a turbine to drive an irrigation pump has been proposed Optimization of the collector heat engine combination has been carried out and the best thermodynamic operating region and corresponding collector area determined Acetone and Freon 113 have been shown to be suitable working fluids for this application The complete Rankine plant, except for the collector array, has been constructed and preliminary tests with acetone have been successfully carried out with the collector heat supply being simulated by a hot air source (Author)

A79-17501 **A small solar power plant with a freon turbine** H Gehrke (Dornier System GmbH, Friedrichshafen, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1719-1721

The present paper deals with a project, the aim of which is to develop and test the prototype of a solar power plant with a capacity of 10 kWe, intended to supply electricity to small villages in sunny regions Successful results are reported for a plant in which thermal energy collected with flat plate collectors and parabolic troughs into mechanical and subsequently into electrical energy by means of a freon Rankine process V P

A79-17502 **Development of small solar power plants for rural areas in India** R K Suri, S Chandra (Bharat Heavy Electricals, Ltd, New Delhi, India), M V Krishnamurthy, S Srinivasamurthy (Indian Institute of Technology, Madras, India), K Berndorfer, H Hopmann, and D Wolf (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1722-1727

A79-17503 **Design and performance of 1/4 HP solar power unit** K D Mannan (Punjab Agricultural University, Ludhiana, India) and A Lal In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc , 1978, p 1728-1732

This paper describes the design, fabrication and performance evaluation of a 1/4 HP Solar Thermal Unit The mechanical power is produced using solar energy by operating a heat engine working on Rankine cycle Solar energy is collected at medium high temperatures (i.e., 140 C) using optimized compound wedge stationary concentrators having a concentration ratio of 3 Solar energy collected by these collectors is concentrated on tubular absorber covers, with two sheets of transparent covers, which acts as a boiler for the production of high pressure vapors A conventional 4-stroke petrol engine has been modified to operate on Rankine cycle with Freon-11 (Author)

A79-17504 **Application of turbopack in solar energy systems** S Sankaranarayanan and P A Paranjpe (National Aeronautical Laboratory, Bangalore, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y , Pergamon Press, Inc 1978, p 1733-1738

Selection, design features, and performance evaluation of a low-power turbopack unit of a solar thermodynamic power system are discussed The unit, which converts solar energy into shaft power, works on a low-temperature Rankine cycle and uses acetone The low-cost design of a partial admission impulse turbine with a spring-loaded graphite seal is outlined, and the performance of the unit as a drive for a centrifugal water pump is evaluated M L

A79-17505 **Alternative forms of energy transmission from OTEC plants** A Talib, A Konopka, N Biederman, C Blazek, and B

Yudow (Institute of Gas Technology, Chicago, Ill) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1744-1755 25 refs NSF Grants No C-1008, No AER-75-00033, Contract No E(49-18)-2426

In the present paper, the alternative forms of energy transmission from ocean thermal energy conversion (OTEC) plants are compared. The chemical energy carriers considered are gaseous and liquid hydrogen, liquid ammonia, methanol, gasoline, and methane. The analysis shows that the delivered cost of chemical energy obtained by using carbonaceous fuels (methane, methanol, and gasoline) is always higher than liquid ammonia transported by ocean-going barges. When comparing the delivered cost of carbonaceous fuels, it becomes apparent that for any distance over 161 km (100 miles), methanol transported by barges is always cheaper than methane by pipeline or gasoline by ocean going barge. V P

A79-17506 Heat exchangers for Ocean Thermal Energy Conversion plants S V Dighe, B C Chan, and R R Rothfus (Carnegie-Mellon University, Pittsburgh, Pa) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1756-1764 6 refs Contract No EY-76-5-02-2641

Heat transfer in vertical-tube condensers and evaporators such as projected for use in Ocean Thermal Energy Conversion can be enhanced by fine, axial flutes on the inside and outside surfaces of the tubes. Experiments with 1-inch aluminum tubes show that heat transfer coefficients in falling liquid layers of R-11 or ammonia are increased several times over by external flutes. Both heat transfer coefficients and friction factors for water flowing inside the tubes are increased by internal flutes up to a factor roughly equal to the fluted-to-smooth area ratio, even at moderate water velocities. (Author)

A79-17507 Medium capacity heliothermal power stations J-L Boy-Marcotte (Société Bertin et Cie, Plaisir, Yvelines, France) and B Devin (Commissariat à l'Énergie Atomique, Département de Transfer et Conversion d'Énergie, Gif-sur-Yvette, Essonne, France) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1771-1774

The potential development of solar thermal power stations in the 100-1000 MWe range is discussed. Construction requirements and user community characteristics are considered, and suggestions are presented as to choice of collectors, storage system and power conversion system. The use of an organic fluid instead of steam is urged. M L

A79-17508 Power plant systems based on solar energy C P Divakaran (P W D Electrical Wing, Palghat, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1777, 1778

When sea water is impounded in a shallow open reservoir the concentration of salt in it will increase due to the evaporation of solvent water on account of the effect of solar energy. If the water in the sea and in the reservoir are connected through a pipe with a semi-permeable membrane in between them an osmotic pressure head will develop between the two. The paper discusses how this pressure head developed could be utilized for running a low head reaction turbine thus producing mechanical energy from solar energy. (Author)

A79-17509 A reflector concentrator modified sterling engine unit and an aqua-ammonia absorber gas turbine unit for farm power needs. G G Puri, V K Sankhala, V C Bhavsar, and R C Jain (Resources Development Institute, Bhopal, India) In Sun Mankind's future source of energy, Proceedings of the International

Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1784-1789 7 refs

A79-17510 The Campbell Chinese Type Windmill J S Campbell In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1790-1795

A new vertical-axis windmill which uses an old basic operating principle, that of the Chinese windmills, has been developed. It has been engineered aiming principally at low costs and ability to utilize a wide range of wind velocities including lower velocity winds. A device for stopping the windmill operation, or rotation, while the wind is blowing is included. This new windmill has important distinctive advantages as follows: (1) Low total weight (2) No unusual size limitation (3) No strengthening limitation (4) High starting torque (5) Satisfactory efficiency (6) Ability to utilize lower velocity winds (7) Intercepted wind area is rectangular (8) Relatively low sail velocities (9) Similar type equipment can be used in flowing water such as tides and rivers (10) Low production cost per rated kilowatt. (Author)

A79-17511 Development of 1 kW vertical axis wind generator R P Gupta and S K Chandra (Bharat Electronics, Ltd, Hyderabad, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1803-1808

The design and development activities on 1 kW vertical axis wind generator are given. It is a two-bladed Darrieus type design with combination of vertical and inclined blades. Blades of fiberglass reinforced with mild steel strip have been used and they are analyzed theoretically for mechanical strength and tested experimentally in actual running condition for stress levels using photoelastic coating and reflection polariscope. The central rotating shaft has been designed to carry the buckling load and the blade shaft combination is analyzed for both torsional and bending modes of vibration. (Author)

A79-17512 Technical and economic feasibility of making fertilizer from wind energy, water, and air M Dubey (Lockheed-California Co, Burbank, Calif) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1812-1821 6 refs Research supported by the U S Department of Energy, NSF Grant No C-75-22186

In view of the shortage and rising costs of methane, wind energy, air, and water could be used in combination to produce anhydrous ammonia and ammonium nitrate (fertilizers). In the study described in the present paper, five systems of different size were built whose capacities ranged from 0.26 to 77 tons per day of ammonium nitrate. It is found that systems designed to produce more than 4 tons/day could economically compete with conventional fertilizer plants producing 1000 tons/day from natural gas feedstock, provided the cost of methane exceeds \$14 per 100 cubic meters. V P

A79-17513 Wind generation of electricity for a novel dwelling independent of servicing networks J G F Littler and R B Thomas (Cambridge University, Cambridge, England) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1822-1825 Research supported by the Science Research Council

The paper deals with the power supply for the prototype dwelling designed within the Autarkic House Project. Electricity is supplied by a vertical-axis wind turbine, generator, batteries, and inverter. The considerations which determine the system design are outlined. V P

A79-17514 A methodology for evaluating the worth of a new energy resource with particular reference to wind energy utilisation in rural areas L S Srinath (Indian Institute of Science, Bangalore, India) and S K Tewari (National Aeronautical Laboratory, Bangalore, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1826-1831 12 refs

A79-17515 Field testing of 5-kW commercial wind generator with an automatic load-matching device for utilizing its output D Pal (Civil Engineering Laboratory, Port Hueneme, Calif) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1833-1837 13 refs

A79-17516 Vertical axis wind turbine status G E Brandvold (Sandia Laboratories, Albuquerque, N Mex) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1843-1847 23 refs

Characteristics of the Darrieus vertical axis wind turbine (VAWT) are surveyed, and a 17-m turbine of this type is described. The turbine, which generates a maximum of 60 kilowatts of electrical power, may be operated with either two or three blades, each of which has a symmetrical airfoil cross section and is curved in the shape of a skipping rope when spun about a vertical axis. The peak coefficients of performance of the two-blade configuration ranged from 34% to 38% for rotational speeds from 34 to 52 rpm for power generation in excess of 40 kW. Construction costs are considered low. A parametric optimization study of utility grid VAWT systems is intended to provide estimates of energy costs and to establish system design guidelines for input to concept evaluation. M L

A79-17517 An evaluation of the strategy of low cost horizontal axis windmills S K Tewari (National Aeronautical Laboratory, Bangalore, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1848-1853 5 refs

An attempt is made to assess the relative cost effectiveness of three windmill designs with efficiencies above 5 percent. Two of the versions are low-cost technology windmills constructed from locally available materials. The third is an all metal windmill of factory production. The economics of these windmills are discussed. V P

A79-17518 A technique for longitudinal correlation of wind data - Theory and its application to siting of wind power plants. D Pal and C E Parker (Civil Engineering Laboratory, Port Hueneme, Calif) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1854-1857 6 refs

Accurate estimation of wind power potential at a perspective site is important to economically justify the installation of wind power generating equipment. The present paper deals with a method of obtaining such estimates. It is based on correlating long-term historical data for a region with measurements taken at the site in question over a relatively short period of time (on the order of six months). It is shown that by applying the statistical theory of turbulence to the surface layers in the atmosphere, a simple formula for the energy pattern factor (on the use of which the method is based) can be derived. V P

A79-17519 25 kilowatt photovoltaic powered irrigation and grain drying experiment R W Matlin, W R Romaine (MIT, Lexington, Mass), and P E Fischbach (Nebraska, University, Lincoln, Neb) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi,

India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1925-1929 Research sponsored by the U S Department of Energy

In the United States, the first step towards the realization of large scale agricultural systems utilizing photovoltaics was made during the summer of 1977 by the construction and operation of an experimental unit generating approximately 25 kW peak power. During the past summer this unit powered a 10 horsepower pump that was interconnected with an automatic gated pipe irrigation network and a reservoir of 2500 cubic meter capacity. It was designed to irrigate 32 hectares of corn, 12 hours a day at the rate of 3.8 cubic meters a minute. In early October, after the end of the irrigation season, the power was switched to nearby corn drying bins where a forced air drying technique is being tested utilizing photovoltaic powered circulation fans. Two grain bins, each with a 3.8 kilowatt fan, have been set up near the solar collector to dry the crop. Electricity generated by the solar unit is used to power the fan for in-bin drying of the grain. (Author)

A79-17520 Solar irrigation program status G E Brandvold (Sandia Laboratories, Albuquerque, N Mex) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1930-1934

The program discussed in the present paper is being pursued to develop solar energy as a practical power source for irrigation pumps. The specific objectives of the program are two-fold. First, to develop technically and economically feasible system designs, and second, to implement a commercialization program which will identify and assist industrial participation for the manufacture and marketing of solar irrigation systems. V P

A79-17521 Solar ammonia-water absorption system for cold storage application N K Giri and K M Barve (Jyoti, Ltd, Baroda, India) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1983-1987

The work described in the present paper was aimed at designing, constructing, and testing a 1-ton solar powered continuous ammonia-water absorption system for cold storage applications. Tests with ammonia-sodium thiocyanate also are planned. The results obtained with the system indicate that 10 to 20-ton capacity refrigeration plants (built on the basis of the present experience) may well be the answer to India's problem of rural food preservation facilities. V P

A79-17523 Design of a solar energy operated lithium-bromide water absorption refrigeration system for refrigeration storage S B Ghosh, H V Rao, G P Gupta (Indian Institute of Technology, Kharagpur, India), and G L Reddy In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 1997-2001

A79-17524 Use of solar energy for industrial process heat D K Anand (Maryland, University, College Park, Md) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N Y, Pergamon Press, Inc., 1978, p 2008-2015 Research supported by the U S Department of Energy

A survey of the use of solar energy in industrial process applications was conducted by Battelle Laboratories and independently by the InterTechnology Corporation. Since only broad requirements were given for the study, these organizations formulated their own assumptions and, as may be expected, arrived at their own (in part complementary and in part contradictory) conclusions. The purpose of the present paper is to review these surveys, first separately, and then to compare the results. V P

A79-17525 The development of a 37 kW solar-powered irrigation system S G Talbert, R D Fischer, G Alexander, D H Frieling, and J A Eibling (Battelle Columbus Laboratories, Columbus, Ohio) In Sun Mankind's future source of energy, Proceedings of the International Solar Energy Congress, New Delhi, India, January 16-21, 1978 Volume 3 Elmsford, N.Y., Pergamon Press, Inc., 1978, p 2138-2142 5 refs

The paper deals with the development and performance of the world's largest solar-powered irrigation system which is presently operating on the Gila River Ranch southwest of Phoenix, Arizona. The pump is capable of developing 36 kW (50 hp). It will pump 38 cu m (10,000 gallons) of irrigation water per minute at peak operation V P

A79-17530 Fracture research in Canada D J Burns and D M R Taplin (Waterloo, University, Waterloo, Ontario, Canada). In Fracture mechanics, Proceedings of the Tenth Symposium on Naval Structural Mechanics, Washington, D.C., September 11-13, 1978 Charlottesville, Va., University Press of Virginia, 1978, p 123-146 46 refs

A description is presented of fracture research which has been carried out in Canada to solve specific engineering problems in the energy and transportation industries. These problems are partly related to the Alaska highway pipeline project and the CANDU nuclear power reactor. Attention is also given to residual life prediction and high-temperature fracture, extensive fatigue and fail-safe studies carried out during the design and development of the Dash 7 aircraft, and fracture mechanics studies conducted in connection with the marine transportation of liquified natural gas. As measured by gross research expenditure normalized as a percentage of gross domestic product, research and development as a whole in Canada is at a remarkably low level. The conclusion is reached that a markedly increased research activity is needed in the industrial sector of the economy G R

A79-17576 International Instrumentation Symposium, 24th, Albuquerque, N Mex., May 1-5, 1978, Proceedings Parts 1 & 2 Symposium sponsored by the Instrument Society of America. Edited by K E Kissell (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio) Pittsburgh, Pa., Instrument Society of America (Instrumentation in the Aerospace Industry Volume 24, Advances in Test Measurement Volume 15), 1978 Pt 1, 353 p, pt 2, 338 p Price of two parts, \$75

The volumes treat such areas as automation of test facilities, telemetry, thermal measurements, digital instrumentation with microprocessor applications, wind tunnel testing, pressure and flow measurement, vibration measurement, flight testing, and nondestructive testing. Consideration is also given to acoustic emission testing, energy source instrumentation, reentry vehicle ground and flight testing, machinery instrumentation, and mass flow instrumentation for loss-of-fluid tests B J

A79-17599 Differential pressure measurements in high temperature environments J C Schneider (Kaman Sciences Corp., Colorado Springs, Colo.) In International Instrumentation Symposium, 24th, Albuquerque, N Mex., May 1-5, 1978, Proceedings Part 1 Pittsburgh, Pa., Instrument Society of America, 1978, p 281-288 14 refs

High temperature environments present in energy conversion processes are often the desired locations for a variety of measurements. Progress has been made in making such measurements through the use of eddy current technology. This progress is described as an introduction to the formidable task of making differential pressure measurements in high temperature corrosive surroundings. Different environments, media, and instruments are described that are typical of problems encountered in our energy conscious world (Author)

A79-17617 A minicomputer based data acquisition and analysis systems for vertical axis wind turbine testing B Stiefeld and R Tomlinson (Sandia Laboratories, Albuquerque, N Mex.) In International Instrumentation Symposium, 24th, Albuquerque, N

Mex., May 1-5, 1978, Proceedings Part 2 Pittsburgh, Pa., Instrument Society of America, 1978, p 469-474. Research supported by the US Department of Energy

An extensive program to develop wind turbines based on the Darrieus vertical axis concept is in progress. As part of this effort, a field wind laboratory has been instrumented which is capable of monitoring, controlling, and analyzing data from a number of vertical axis wind turbines (VAWT). This paper describes the computer based data acquisition system and instrumentation used to acquire environmental, structural, and performance data from the VAWT complex. An airborne type PCM encoder mounted on the turbine shaft is used to digitize much of the data, particularly the low-level strain information from the turbine blades and supporting structure (Author)

A79-17618 Solar Total Energy Control Data Acquisition System W W Shurtleff (Sandia Laboratories, Albuquerque, N Mex.) In International Instrumentation Symposium, 24th, Albuquerque, N Mex., May 1-5, 1978, Proceedings Part 2 Pittsburgh, Pa., Instrument Society of America, 1978, p 475-484

This report describes the control-data acquisition system for Sandia's Solar Total Energy facility. The system is versatile and easily used. It handles multiple tasks simultaneously and provides easy changeover to a less powerful control scheme if desired. The system consists of a minicomputer controlled general purpose data acquisition control system with an interface to a hardwired industrial plant controller. Control languages are FORTRAN and BASIC (Author)

A79-17619 Laser ray trace tester for parabolic trough solar collectors B D Hansche (Sandia Laboratories, Albuquerque, N Mex.) In International Instrumentation Symposium, 24th, Albuquerque, N Mex., May 1-5, 1978, Proceedings Part 2 Pittsburgh, Pa., Instrument Society of America, 1978, p 485-490

A laser ray trace tester is being developed to measure slope errors of parabolic trough solar collectors. We describe the design parameters, current status of the device, and some improvements which are necessary (Author)

A79-17620 Master control and data system for the 5MW Solar Thermal Test Facility D M Darsey (Sandia Laboratories, Albuquerque, N Mex.) In International Instrumentation Symposium, 24th, Albuquerque, N Mex., May 1-5, 1978, Proceedings Part 2 Pittsburgh, Pa., Instrument Society of America, 1978, p 491-496

The Solar Thermal Test Facility (STTF) requirements for control and evaluation data are best provided by a Master Control System (MCS), consisting of a modular network of minicomputers and associated equipment. Real-time data acquisition, analysis, and presentation and human-engineered software allow operator visibility and control of the experiment in progress. Preprogrammed test sequences assure repeatability, on-line modifications with transaction logging permit real-time changes as required. The present paper describes the design philosophy of the MCS and examines system control, operation, and data capabilities B J

A79-17621 Real time computer control of 5 megawatts of solar thermal energy E D Thalhammer (Sandia Laboratories, Albuquerque, N Mex.) In International Instrumentation Symposium, 24th, Albuquerque, N Mex., May 1-5, 1978, Proceedings Part 2 Pittsburgh, Pa., Instrument Society of America, 1978, p 497-502

The Solar Thermal Test Facility (STTF) operates under the control of a nine-machine distributed minicomputer network. The prime functions of this network are heliostat controls, heat rejection system controls, and data acquisition. This paper describes the control computer. This computer's main tasks are (1) the sun position calculation, (2) automatic heliostat command execution, (3) graphic display of heliostat status and selected items of tower and boiler control data, (4) operator control of the heliostat command cycle, (5) heliostat alarm handling, and (6) the permanent recording of all

test parameters necessary to fully describe the experiment performed. The control system is capable of directing 5 megawatts of thermal energy at any point within 327 meters of the solar receiver tower. Also described are the procedures and checking performed by the computers to insure personnel and facility safety. (Author)

A79-17631 Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volumes 1 & 2 Houston, Tex., Industrial Presentations, 1978 Vol 1, 487 p., vol 2, 470 p.

The current and future status of the coal industry is considered along with the impact of conversion to coal, a coal character analysis, low/intermediate Btu gasification, cogeneration, beneficiation, coal applications for the industrial user, high Btu gasification/liquefaction, direct combustion, transportation, ash and sludge handling, coal storage and handling, and aspects of research and development. Attention is given to feasibility studies of micronized coal-oil as an alternate fuel for Diesel engines and direct-fired gas turbines, MHD power generation, an atmospheric fluidized bed coal combustor for cogeneration, an assessment of current fuel gas desulfurization technology, the effect of coal properties on boiler design, air control permits and coal utilization, the handling and storage of lignite, pelletizing and drying of lignite, the disposal and potential uses of fly ash, and options for burning coal in industrial boilers. G R.

A79-17632 # Gasification Combined Cycle Test Facility at Pekin, Illinois. R F Beckman, M H Hashemi, and S F Kremenik (Fluor Engineers' and Constructors, Inc., Irvine, Calif.) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 1 Houston, Tex., Industrial Presentations, 1978, p 7-19
5 refs

The coal Gasification Combined Cycle Test Facility (GCCTF) will use commercial scale equipment to demonstrate the feasibility and economy of producing electric power from coal through low Btu gasification. A dynamic computer simulation of the process is being developed to assist in the plant design. Attention is given to aspects of plant design and operation, the project status, the test program, a dynamic simulation study, and simulation applications. The utility industry can make a commitment to use this new technology in large power stations when its reliability has been demonstrated in the GCCTF. It is pointed out that dynamic simulation is a new computational aid to process design. Its use is justified for unique or very complex design problems. G R.

A79-17633 # Advances in fluidized bed gasification process development. J B Yasinsky (Westinghouse Electric Corp., Pittsburgh, Pa.) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 1 Houston, Tex., Industrial Presentations, 1978, p 21-35 Contract No EY-77-C-01-1514

It would be highly desirable to have available a proven gasification process that is sufficiently flexible to process all types and forms of coal and be easily adaptable to the total spectrum of end-uses. The capabilities of an ideal gasifier are considered. A coal gasification process with the considered characteristics has been developed by a U.S. corporation. The feasibility of the process has been demonstrated through almost four years of successful operation of a 15-ton/day Process Development Unit. A process description is presented. In the single-stage process investigated, coal is fed directly to the gasifier where the processes of devolatilization, combustion, gasification, and ash agglomeration take place in a single fluidized bed. Attention is given to process development unit tests, tar formation experience, and a cleanup system that removes both gaseous and particulate contaminants to the degree required for the specific end-use. G R.

A79-17634 # The Koppelman process. E Koppelman, R C Phillips, and R G Murray (SRI International, Menlo Park, Calif.). In Coal technology '78, International Coal Utilization Convention,

Houston, Tex., October 17-19, 1978, Conference Papers Volume 1 Houston, Tex., Industrial Presentations, 1978, p 151-156

A description is presented of the development of a proprietary process for upgrading a variety of solid fuels at relatively low cost, so that they may be used to replace gas and oil in an environmentally acceptable manner. The process was originally conceived as a method for drying and treating lignite, so that it could be transported and stored economically and without danger of spontaneous combustion. Subsequent research proved that the process could also be used to upgrade subbituminous coal, to convert forest and agricultural wastes and peat to a high energy solid fuel, and to agglomerate coking coal fines. A wide range of cellulosic materials may be used as a feedstock to produce solid fuels by the Koppelman process. A table gives product compositions for forest wastes, agricultural wastes, wood scrap, and Canadian spagnum peat. G R.

A79-17635 # The H-Coal project. C D Hoertz (Ashland Oil, Inc., Ashland, Ky.) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 1 Houston, Tex., Industrial Presentations, 1978, p 235-246

The H-Coal process converts coal by catalytic hydrogenation to substitutes for petroleum ranging from an all distillate synthetic crude to a low sulfur fuel oil. The process is a related application to the H-Oil process which is used commercially for the desulfurization of residual oils from crude oil refining. The H-Coal process is primarily a liquefaction system but does produce significant quantities of substitute natural gas and liquefied petroleum gas. Briefly, coal is cleaned, dried, pulverized, and slurried with process-derived oil in the preparation section. It is then pumped to reactor pressure, mixed with hydrogen, heated, and charged to the reactor. There, the coal, recycle oil and hydrogen react in the presence of a catalyst at pressures up to 3500 psig and temperatures to 850 F. Depending on the severity selected the product slate can be an all distillate material or a liquefied residuum with only a small amount of distillate. G R.

A79-17636 # Synthetic fuels from coal. T J Pollaert. In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 1 Houston, Tex., Industrial Presentations, 1978, p 247-265

An analysis of the technology available to produce syn fuels shows that this technology is rather mature and developed to an extent that major economic breakthroughs should not be expected. Once the economic incentives and the regulatory climate are favorable, a synthetic fuels industry based on coal will establish itself. Coalgas, methanol, methanol-derived gasoline, and pyrolysis liquids will be the heart of this industry. Attention is given to the Lurgi gasifier, the advantages of a coal gasification plant, the catalytic conversion of methanol to gasoline, the Fischer-Tropsch conversion of coalgas, the hydrogenation of coal tars from low temperature pyrolysis, and the Lurgi-Ruhrgas Process. G R.

A79-17637 # Assessment of current flue gas desulfurization technology. R E Moser (Brown and Root, Inc., Houston, Tex.) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 1 Houston, Tex., Industrial Presentations, 1978, p 267-282 5 refs

An introductory overview is provided of those Flue Gas Desulfurization (FGD) processes and vendors which are currently available for U.S. utility applications. It is found that 88.7% of all the active FGD systems are calcium-based (lime and/or limestone), with sodium-based processes (sodium carbonate, Wellman-Lord, Double Alkali, and aqueous carbonate) accounting for 8.9% of the total, and magnesium oxide systems the remaining 2.4%. The processes are frequently classified as 'throwaway' or 'regenerable' depending on the ultimate utilization (or disposal) of the sulfur-bearing compound. The system complexity of the regenerable processes cause both initial capital and operating costs to far exceed

comparable throwaway processes. However, the production of a marketable by-product instead of a sludge requiring disposal is of significance. A number of developing FGD systems are considered, giving attention to the Saarberg-Holter process, the sodium citrate process, the ammonia process, the potassium thiosulfate process, dry activated carbon adsorption, the dry cupric oxide process, and the dry nahcolite process. G R

A79-17638 # MHD power generation F A Hals, D B Stickler, R Kessler, and R E Gannon (Avco Everett Research Laboratory, Inc., Everett, Mass.) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 1. Houston, Tex., Industrial Presentations, 1978, p 423-444. 13 refs.

In a magnetohydrodynamic (MHD) generator an electrically conducting gas replaces the rotating copper coil of the currently used electric generator. This substitution involves a principle which was recognized 150 years ago by Faraday. Development of the MHD process as an industrial method of generating electricity, however, had to wait until a better understanding of the dynamics and handling of hot gases in the range of 4000 to 5000 F was developed. Much of the necessary experience in dealing with such hot gases was gained in the aerospace industry in solving the ballistic missile reentry problem. The dominant position of coal in the future energy supply projections and the high temperatures attained in open-cycle operation make coal burning open cycle designs the most promising for future energy conversion systems. Aspects of technology development are discussed, giving attention to the MHD channel, the superconducting magnet, the coal combustor, a high temperature air preheater, and approaches for seed recovery. G R

A79-17639 # A summary of R&D programs J H Oxley, R H Poirier, and F G Dawson (Battelle Columbus Laboratories, Columbus, Ohio) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 1. Houston, Tex., Industrial Presentations, 1978, p 467-487.

In January of 1973 a study was authorized to examine the future technical efforts that would be required to accelerate the widespread use of coal in the US. Attention is given to the institution of widespread use of existing technology for coal washing, the development of stack gas treatment technology, the development of improved coal cleaning technology, the optimum development and reclamation of strip mines, the development of improved deep-mining technology, the development of viable synthetic fuel technology, the development of low-cost energy transmission systems, the use of coal in total energy or integrated utility systems, the development of low-cost fuel cells operating on coal-derived fuel, the development of the technology for the production of hydrogen, the development of viable coal-fired magnetohydrodynamic technology, the development of a substitute source of fuel and chemicals, the development of materials for implementation of new technology, and improvements of steam, gas turbine, and combined-cycle plants. G R

A79-17640 # Economic evaluation of the ATC/Wellman incandescent two-stage low Btu coal gas producer G E Brewer, F H Rucker (Applied Technology Corp., Houston, Tex.), and C K Moore (Creole Production Services, Inc., Houston, Tex.) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 2. Houston, Tex., Industrial Presentations, 1978, p 625-662.

It is pointed out that the basic design of the two-stage low Btu gas producer originated in the 1800's. Utilization of producer gas for industrial fuel gas requirements reached the height of its popularity in the US in the 1920's. Subsequent increased availability of low-cost natural gas and crude oil diminished the need for producer gas and as a result most of the coal gasification units were eventually abandoned. Essentially, low Btu producer gas is formed by the contact of water saturated air with coal in the incandescent zone of a

fixed bed furnace. The chief combustible elements in producer gas are hydrogen and carbon monoxide with some additional hydrocarbons such as methane. The thermal energy content of producer gas is approximately 150 to 180 Btu per cubic foot. Attention is given to producer gas application, a process description, a description of the analyzed systems, the evaluation data, the product gas prices, the effect of gasifier size, the effect of the rate of return, and the premium cost of low sulfur coal. G R

A79-17641 # Upgrading lignite by the Koppelman process R C Phillips, R G Murray (SRI International, Menlo Park, Calif.), and E Koppelman. In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 2. Houston, Tex., Industrial Presentations, 1978, p 681-696.

The US has large reserves of lignite. Difficulties concerning the utilization of lignite reserves in regions which are remote from prospective consumption areas are related to shipping problems on account of the high moisture content of the lignite and its propensity to self-ignite, especially after it has been dried conventionally. A description is presented of a novel approach for drying lignite. In the considered Koppelman process, lignite containing about 7000 Btu/lb is upgraded to a clean fuel with 12,000-13,000 Btu/lb. By processing lignite at high temperatures and pressures for short periods, water is removed irreversibly. Some of the oxygen is also removed, accounting for roughly 25% of the energy gain. The characteristics of the upgraded lignite product are discussed. G R

A79-17642 # Beneficiation of lignites L J Keller (Methacoal Corp., Dallas, Tex.) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 2. Houston, Tex., Industrial Presentations, 1978, p 697-708.

The lignites vary greatly in moisture content, ash content, heating value, and in virtually every other identifiable or quantifiable characteristic. Consequently, none of the conventional coal cleaning, or beneficiation, methods are broadly applicable to the field of lignite beneficiation. A description is presented of new lignite beneficiation methods, which are complete departures from the prior art, based on known and proven scientific, engineering and metallurgical principles. The new methods, in addition to providing practical means for beneficiation of most lignites, in one way or another, also provide beneficiation indirectly by producing from the lignites fuels which are more advantageously transportable, storable and burnable, and which can be handled and utilized with minimal adverse effects on the environment. G R

A79-17643 # Synthetic fuels from Gulf Coast lignite C V Philip and R G Anthony (Texas A & M University, College Station, Tex.) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 2. Houston, Tex., Industrial Presentations, 1978, p 709-724. 13 refs. Research supported by the Texas Engineering Experiment Station, Texas A & M University, and Dow Chemical Co.

The most likely fossil fuel source, which could be processed to meet the short fall in energy and chemical feed stock in Texas and neighboring states is lignite. Currently most of the lignite mined in Texas is used for electric power production. The deep basin lignite will probably have to be recovered by in situ mining methods. Two basic techniques, in situ gasification and in situ comminution of liquefaction, have potential for recovery of deep basin lignite. A bench scale lignite liquefaction experiment is discussed, taking into account aspects of gas production in lignite liquefaction, a low boiling liquid which was collected during the process of lignite liquefaction, high boiling point liquids, and a residue containing mostly minerals from lignite. It was found that Texas lignite could be liquefied at about 700 F, a temperature which is much lower than what is used for the liquefaction of bituminous and subbituminous coals. G R

A79-17644 # The Dow Chemical liquefaction process N G Moll and G J Quarderer (Dow Chemical Co., Midland, Mich.) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 2 Houston, Tex., Industrial Presentations, 1978, p 725-743

The considered process involves the use of unique patented expendable catalyst system, which is based on emulsion technology, and which generates a highly active, effective, expendable catalyst Hydroclones are employed to provide partial solids removal from the liquefaction reactor product and to provide partial recycle of the catalyst to the reactor A novel liquid-liquid extractor is used to produce an essentially solids-free, low sulfur product oil and a high solids concentrate suitable as a gasifier feedstock Run of mine coal is crushed, dried, pulverized, and classified The classified material is mixed with process derived recycle oil to make a 40% coal slurry Catalyst in the form of an emulsion is added to the slurry The resultant catalyst-oil-coal slurry is pumped to a short residence time preheater where it is combined with hydrogen at approximately 2000 psig The slurry is then preheated to approximately 420 C The major reaction occurs in the reactor The temperature in the reactor is maintained at about 450-460 C G R

A79-17645 # A survey of particulate collection devices for coal-fired boilers. J G Musgrove (Bechtel Power Corp., Houston, Tex.) In Coal technology '78, International Coal Utilization Convention, Houston, Tex., October 17-19, 1978, Conference Papers Volume 2 Houston, Tex., Industrial Presentations, 1978, p 853-939 25 refs

The recent resurgence of coal as a primary fuel for central station steam generation and more stringent environmental regulatory requirements have caused a simultaneous increase in the need for particulate control equipment and an increase in its required performance The fuel characteristics are considered, taking into account a coal analysis, an ash analysis, the collection parameters, and the requirements for an early selection The particulate collection requirements established on the basis of air quality criteria are discussed along with the particulate collection devices The electrostatic precipitators examined include weighted wire electrostatic precipitators, rigid frame electrostatic precipitators, and rigid mast electrode precipitators A second principal particulate collection device, called the fabric filter baghouse, is also described Attention is given to a recent study for a Southwestern utility in which budgetary pricing was requested for particulate collection equipment G R

A79-17646 Perspectives on energy Issues, ideas, and environmental dilemmas /2nd edition/ Edited by L C Ruedisili (Toledo, University, Toledo, Ohio) and M W Firebaugh (Wisconsin, University, Kenosha, Wis.) New York, Oxford University Press, Inc., 1978 603 p \$8.95

Fossil fuel energy sources are considered along with nuclear fission as an energy source, alternative energy sources, conservation, life-styles, and energy policy for the future Attention is given to boundary conditions in energy and ecology, health effects of energy production and conversion, energy use in the U S food system, the economics of the energy problem, a survey of world energy resources, coal conversion technology, the impact of technical advice on the choice for nuclear power, nuclear power generation, impacts of the nuclear energy industry on human health and safety, the toxicity of plutonium and some other actinides, security implications of alternative fission futures, cost escalation in nuclear power, the prospects for fusion, solar energy, solar heating and cooling, solar power from satellites, oil shale and the energy crisis, geothermal energy, and the potential for fuel conservation G R

A79-17647 Coal - Meeting the energy challenge C E Bagge (National Coal Association, Washington, D C.) In Perspectives on energy Issues, ideas, and environmental dilemmas /2nd edition/ New York, Oxford University Press, Inc., 1978, p 176-180 7 refs

Since it accounts for 80 per cent of the U S fossil fuel energy reserve, coal is the one reserve certain to be available to meet the nation's near-term energy needs President Carter emphasized this fact when he called for a two-thirds increase in annual coal production to 11 billion tons by 1985 The distribution of coal in the U S is examined About 80 per cent of the coal mined in the U S comes from fields east of the Mississippi, but eastern reserves make up only 45 per cent of the nation's total Western coal is currently in increasing demand because it allows utilities and industrial users to more easily meet U S government air quality standards, which limit sulfur emissions Attention is given to underground mining, surface mining, operations at the preparation plant, health and safety conditions, and the future of coal in the U S G R

A79-17648 Solar energy W W Eaton In Perspectives on energy Issues, ideas, and environmental dilemmas /2nd edition/ New York, Oxford University Press, Inc., 1978, p 418-436 19 refs

The amount of solar energy reaching the earth's surface is very large In the U S, the solar energy that reaches one-five hundredth of the country could, if converted at 20 per cent efficiency, satisfy all the present needs for electrical power Disadvantages of solar energy are related to its diffuse and intermittent character Basic information about the various applications is presented, taking into account solar energy research, development, and demonstration programs Attention is given to solar energy used as heat, the conversion of solar energy to electricity, the conversion of solar energy to plants and fossil fuels, and aspects of energy planning for the future Approaches for converting solar energy to electricity are related to a use of wind energy, solar thermal conversion, photovoltaic conversion, and the utilization of tropical ocean temperature differences G R

A79-17649 A low energy scenario for the United States - 1975-2050 J S Steinhart (Wisconsin, University, Madison, Wis.), R W Gates (Wisconsin, Dept of Natural Resources, Madison, Wis.), M Thornsjo (Northern States Power Co., Minneapolis, Minn.), M E Hanson, C C Dewinkel, K Briody, and S Kabala In Perspectives on energy Issues, ideas, and environmental dilemmas /2nd edition/ New York, Oxford University Press, Inc., 1978, p 553-580 59 refs

The reported investigation indicates that a 64 per cent reduction in U S energy use per capita from 1975 levels can be obtained a few decades into the 21st century To accomplish this end, major changes will be required, but these changes will not lead to a fall in the standard of living This contrasts with the assertion that further improvement or maintenance of the standard of living is inexorably linked to continued increase in energy use The considered analysis takes the traditional sectoral breakdown, residential, commercial, transportation, agricultural, and industrial, and examines each one for possible energy savings The depletion of petroleum and natural gas, the termination of nuclear power, as well as the implementation of alternative energy sources during the period are outlined G R

A79-17680 Procedure for flight guidance in the terminal maneuvering area for an experimental program employing a flying test device (Verfahren zur Flugführung im Flughafennahbereich für ein Experimentalprogramm unter Einsatz eines fliegenden Erprobungsträgers). A Modlinger (Vereingte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) In Modern methods to safeguard traffic at sea, in the air, and on land, National Meeting, Hamburg, West Germany, October 17-19, 1978, Reports. Volume 1 Dusseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1978 24 p In German Research supported by the Bundesministerium für Forschung und Technologie

It is desirable to obtain together with increasing safety a reduction in the cost of air transportation Boundary conditions are related to an increase in passenger comfort, a reduction of the stress to which the pilot is subjected in critical phases, and a reduction of the noise emitted by the aircraft An increase in operational economy with respect to fuel costs is, in the case of an automatically

conducted flight, obtained by means of an appropriate calculation of the flight path Two different approach procedures, TMA1 and TMA2, were developed in this connection The characteristics of these procedures are discussed, taking into account also their verification with the aid of a digital computer program The experimental program described uses the test device for certain investigations as a 'flying simulator' A computer with a word and instruction length of 16 bits is employed
G R

A79-17792 # Spatial oscillations of a solid body carrying a low-power flywheel motor (Prostorovi kolivaniia tverdogo tila, iake nese dvigun-makhovik obmezhenoi potuzhnosti) O M Papusha (Akademiia Nauk Ukrain's'koi RSR, Institut Mekhaniki, Kiev, Ukrainian SSR) Akademiia Nauk Ukrain's'koi RSR, Dopovidi, Seriia A - Fiziko-Matematichni ta Tekhnichni Nauki, Sept 1978, p 816-820 7 refs In Ukrainian

On the basis of a model of a dual spin spacecraft, the interaction of the rotational motions of the flywheel with the spatial oscillations of the solid body is analyzed by taking into account the statistical characteristics of the electric motor inside the flywheel The system is assumed to be moving in a Newtonian field in an elliptical orbit It is shown that the spatial motions of the spacecraft relative to its center of mass can be controlled through the internal angular momentum vector of the motor
P T H

A79-17822 # Optimal control of on-board and station flywheel storage for rail transit systems L M Sweet (Princeton University, Princeton, N J) and M J Keane ASME, Transactions, Journal of Dynamic Systems, Measurement, and Control, vol 100, Dec 1978, p 284-290 11 refs

The energy efficiency of rail transit systems using regenerative braking is enhanced by flywheel storage elements used to store energy not accepted by the wayside power rail In this paper three storage system control concepts are examined armature and field control of on-board flywheels, and field control of a station based storage device The energy recovery efficiency and performance characteristics of each system are determined subject to optimal control laws derived to minimize energy loss The resulting control systems are bilinear, due to the use of separately excited dc traction and fly-wheel motors as continuously variable transmissions The three systems yield similar energy recovery efficiencies for deceleration, with the advantages of each for practical applications discussed
(Author)

A79-17825 Regional analysis of potential water power B K Ferguson Energy Sources, vol 4, no 2, 1978, p 157-164 8 refs

A description of the quantity and distribution of a region's potential water power is useful to anyone interested in developing water supplies for hydropower plants This paper presents a method for such an analysis It is probably applicable to any stream in the world because it is a simple application of basic hydraulic principles Potential power per unit of stream length can be calculated at any point along a stream as a function of stream gradient and flow Gradient and flow can each be mapped at convenient intervals along the stream These two maps can then be combined to produce a map of potential (gross) power This map can be used to determine total power in the region of interest, to identify and evaluate concentrations of power within the region, or as a part of a more comprehensive planning process
(Author)

A79-17872 # Solar power satellites - An AIAA position paper Astronautics and Aeronautics, vol 17, Jan 1979, p 14-17

A79-17950 Reliability studies on MIS solar cells W A Anderson and J K Kim (Rutgers University, Piscataway, N J) Applied Physics, vol 17, Dec 1978, p 401-404 6 refs NSF supported research

Research on Cr/oxide/p-type Si solar cells has produced a 12.2% efficiency on 2 sq cm area Reliability studies have been conducted

to determine if degradation occurs during use in an extreme environment Several cells with A/R coatings and encapsulation have been tested with degradation occurring in some cases after 2 years of use One cell without an A/R coating was used for 1 + 1/2 years with degradation occurring only after a crack had appeared Dark I-V curves, photovoltaic data, and Auger analysis show a quite stable situation to exist A stable MIS solar cell depends on selection of the insulator, deposition rate of the metal, elimination of moisture, selection of the A/R coating, bonding techniques, and choice of encapsulant
(Author)

A79-17989 Progress in batteries and solar cells. Volume 1
Edited by A Kozawa, K V Kordes (Graz, Technische Universitat, Graz, Austria), E Voss (Varta Batterie AG, Kelkheim, West Germany), J P Gabano (Societe des Accumulateurs Fixes et de Traction, Romainville, Seine-Saint-Denis, France), K Fueki (Tokyo, University, Tokyo, Japan), H M Joseph (Union Carbide Corp., Battery Products Div., New York, N Y), H Ikeda (Sanyo Electric Co., Japan), and T Shirogami (Tokyo Shibaura Electric Co., Ltd., Toshiba Research and Development Center, Kawasaki, Japan)
Cleveland, Ohio, JEC Press, Inc., 1978 393 p \$36

Research on batteries, information on new devices, and sales data are presented Topics discussed include primary batteries, lead-acid batteries, electric vehicles and batteries, alkaline rechargeable batteries, solid state batteries, fuel cells, Na-S batteries, batteries for energy storage, photochemical cells, solar cells, and an MnO2 project Patents, events of 1977, new test methods, and production figures are considered
M L

A79-17992 Energy storage by the use of high temperature electrochemical systems S Yoshizawa (Kyoto University, Kyoto, Japan) In Progress in batteries and solar cells Volume 1
Cleveland, Ohio, JEC Press, Inc., 1978, p 183-186 6 refs

Li-CI2 secondary batteries, the sodium cycle, and water vapor electrolysis are examined with respect to their ability to function as high-temperature electrochemical systems for storing energy It is concluded that the systems are not yet practical A major problem involves the lack of suitably corrosion-resistant materials Data on the performance characteristics of alloy electrodes are presented
M L

A79-17994 Development of a 1 kW fuel cell aggregate with acid electrolyte H Boehm (Telefunken AG, Frankfurt am Main, West Germany) and K Maass (Telefunken AG, Wedel, West Germany) In Progress in batteries and solar cells Volume 1
Cleveland, Ohio, JEC Press, Inc., 1978, p 195-198

The paper proposes a 1-kW (net) fuel cell aggregate composed of 11 fuel cell modules containing 40 cells in each module The described fuel processor cracks methanol into a hydrogen-containing gas at approximately 300 C The described fuel cell battery uses tungsten carbide for the anode, since the catalytic activity of tungsten carbide is not destroyed by the carbon monoxide formed in the methanol-cracking process
M L

A79-17995 The development of photovoltaic conversion systems with sunlight concentration T Tsuji and S Mito (Sharp Corp., Engineering Div., Tenri, Nara, Japan) In Progress in batteries and solar cells Volume 1
Cleveland, Ohio, JEC Press, Inc., 1978, p 213-215

Three concentrators used in the photovoltaic conversion of sunlight are compared In order of measured optical efficiency, the concentrators are a parabolic cylinder-type concentrator, a compound concentrator (a combination of linear Fresnel lens and a side mirror), and a linear Fresnel lens type concentrator The compound concentrator is designed to operate without any tracking mechanism but the other two types were equipped with automatic tracking units
M L

A79-17996 **Solar cell modules for terrestrial use** In Progress in batteries and solar cells Volume 1 , Cleveland, Ohio, JEC Press, Inc., 1978, p 224-228

A solar cell module introduced for use in Japan is described Data on module and cell structure, absolute maximum ratings, electro-optical characteristics, solar battery power supply system, voltage-current relations, power voltage relations, temperature dependence, and spectral sensitivity are presented A smaller module is briefly characterized M L

A79-17997 **General view of low cost solar cell development in Japan** H Maeda and M Nakagawa (Tokyo Shibaura Electric Co., Ltd, Toshiba Research and Development Center, Kawasaki, Japan) In Progress in batteries and solar cells Volume 1 Cleveland, Ohio, JEC Press, Inc., 1978, p 232-235

Solar photovoltaic research programs in Japan are surveyed It is suggested that Japanese research, in comparison with US research, is more concerned with new crystal technology and less concerned with the development and demonstration of a conversion system made from conventional Czochralski wafers Attention is directed to vertical silicon ribbon crystal pulling technology A horizontal pulling method is characterized M L

A79-18009 **Solar fuels** J R Bolton (Western Ontario, University, London, Canada) *Science*, vol 202, Nov 17, 1978, p 705-711 31 refs

The paper is concerned with (1) the thermodynamic and kinetic limits for the photochemical conversion and storage of solar energy as it is received on the earth's surface, and (2) the evaluation of a number of possible photochemical reactions with particular emphasis on the production of solar hydrogen from water Procedures for generating hydrogen fuel are considered Topics examined include the general requirements for a fuel-generation reaction, the photochemical reaction, limits on the conversion of light energy to chemical energy, an estimate of chemical storage efficiency, and the water decomposition reaction M L

A79-18017 **Econometric analysis of concentrators for solar cells** A S Roy *Solar Energy*, vol 21, no 5, 1978, p 371-375 13 refs

The cost of electricity generated by photovoltaic solar cells in conjunction with concentrators is considered The paper presents a generalized model for correlating the electricity cost with some system parameters the annualized cost of the collector and other noncell components, the cell annualized cost, the concentration ratio, the orientation parameter, the insolation, the optical efficiency, and the cell efficiency The model can be applied to the economic assessment of concentrator-cell systems and the evaluation of the sensitivity of the cost of the produced electrical energy to various possible technological improvements As an example, the projected minima^oof generated electricity at concentration ratios between 4 and 400 are estimated M L

A79-18018 **Properties optimization for phase-change energy storage in air-based solar heating systems** J J Jurinak and S I Abdel-Khalik (Wisconsin, University, Madison, Wis) *Solar Energy*, vol 21, no 5, 1978, p 377-383 5 refs Contract No E(11-1)-2588

A parametric study has been conducted to determine the optimum physical properties of phase-change energy storage materials for solar air-heating systems Simulation techniques are used to determine the system performance over the entire heating season Variations of the solar fraction of the load with melting temperature, latent heat, load characteristics, and control strategy have been determined Air-heating systems with a wide range of hot water and space heating loads have been examined The effect of semicongruent melting of the phase change material on system performance has been investigated (Author)

A79-18019 **Optimal geometries for one- and two-faced symmetric side-wall booster mirrors** K D Mannan (Punjab Agricultural University, Ludhiana, India) and R B Bannerot (Houston, University, Houston, Tex) (*Flat-Plate Solar Collector Conference, Orlando, Fla., Feb 28-Mar 2, 1977*) *Solar Energy*, vol 21, no 5, 1978, p 385-391 11 refs Contract No E(40-1)-5100

Moderate concentration in east-west aligned nontracking, infinitely long, trough-like solar energy collectors is examined Two designs are evaluated in detail They are the one-facet and two-facet plane side-wall configurations The maximum performance designs are shown not to be the most practical designs since they tend to require disproportionately large reflectors A significant reduction in reflector area can be made with only a small degradation of performance At solstice a 9-deg acceptance angle is necessary for a minimum of eight hours of collection at optimum performance Under this restriction the practical concentration ratios are limited to about 2 and 2.6 for the one-facet and two facet designs, respectively (Author)

A79-18020 **Calculation of flat-plate collector utilizability** S A Klein (Wisconsin, University, Madison, Wis) *Solar Energy*, vol 21, no 5, 1978, p 393-402 21 refs Contract No E(11-1)-2588.

The 'utilizability' or phi-curve method developed by Whillier is reviewed, and a modified method, which uses daily charts of the average daily collector utilizability, rather than hourly phi-curves, is presented The daily charts can be processed easily on a programmable hand calculator, and their use greatly reduces the calculations required to determine flat plate collector utilizability An example showing the use of the daily-curve method is reported M L

A79-18021 **Model systems in photoelectrochemical energy conversion.** G W Murphy (Oklahoma, University, Norman, Okla) *Solar Energy*, vol 21, no 5, 1978, p 403-407 28 refs

Several model photoelectrochemical energy conversion systems are devised and analyzed, based on properties of liquid junction-solid state semiconductor photoactive 'membranes' The systems are classified in terms of the following output objectives electric power, short term chemical energy storage, desalted water from a saline source, acid-base production from a saline source, and hydrogen and oxygen from water Multicompartiment photoelectrochemical cells designed to achieve these objectives are made from various combinations of the photoactive component and ion selective membranes All of the objectives are projected as technically feasible, but only the electric power and desalting are projected as economically feasible based on state-of-the-art technology The properties of conceptual new solid state membranes needed to meet economic objectives in the other cases are analyzed (Author)

A79-18023 **Ideal prism solar concentrators** D R Mills and J E Giutronich (New South Wales, University, Kensington, Australia) *Solar Energy*, vol 21, no 5, 1978, p 423-430 12 refs

The paper is concerned with proposed nonimaging concentrators which use total internal reflection within a material of high refractive index to achieve concentration In both symmetrical and asymmetrical forms, the concentrators satisfy the maximum concentration limits for ideal radiation transformers for a given acceptance angle Exit-aperture light is restricted in angle, but irradiation of the exit aperture is much more uniform for a distant point source than in any other design For many designs, only flat surfaces are required Stationary concentrators with acceptance angles up to that of a flat plate are possible M L

A79-18024 **The place of extreme asymmetrical non-focusing concentrators in solar energy utilization** D R Mills (New South Wales, University, Kensington, Australia) *Solar Energy*, vol 21, no 5, 1978, p 431-434 6 refs

It is shown that asymmetrical nonfocusing ideal concentrators - in particular, the extreme asymmetrical forms - are often preferable to symmetrical concentrators such as the CPC in solar applications The significance of the 'tilt' of the acceptance angle of ideal trough concentrators is considered, and situations in which the use of asymmetric forms is preferable are discussed Three cases - com-

A79-18025

pletely stationary E-W trough concentrator systems, occasionally tilting systems, and frequently tilted systems - are examined M L

A79-18025 Shading and spacing in paraboloidal collector arrays B P Edwards (Australian National University, Canberra, Australia) *Solar Energy*, vol 21, no 5, 1978, p 435-439 8 refs

Variations in solar energy losses are calculated as a function of spacing for square arrays The system considered is a square array with 49 collectors with the shaded collector being the furthest from the sun in one corner of the array The fraction of the aperture illuminated is calculated at 40 points over each day, and for 20 equispaced days over the year It is shown that the cost per unit length of the links between collectors determines the optimum spacing M L

A79-18026 Total solar radiation in Mexico using sunshine hours and meteorological data R Almanza and S Lopez (Universidad Nacional Autonoma de Mexico, Mexico City, Mexico) *Solar Energy*, vol 21, no 5, 1978, p 441-448 13 refs

A79-18085 # Energy requirements of the rail mode A N Addie and B T Concannon (General Motors Corp, Detroit, Mich) (*American Society of Mechanical Engineers, Rail Transportation Conference, St Paul, Minn, Apr 11-13, 1978, Paper 78-RT-1*) *ASME, Transactions, Journal of Engineering for Industry*, vol 100, Nov 1978, p 475-482 5 refs

The results of computer simulations of railroad operations to determine the energy required to pull freight and passenger trains over mountainous and flat profiles is presented The effect of variations in average speed, profile and types of freight cars, is also determined The potential for recovering braking energy on mountainous grades and during passenger service with frequent stops is evaluated (Author)

A79-18091 # Two thermodynamic optima in the design of sensible heat units for energy storage A Bejan (Colorado, University, Boulder, Colo) *ASME, Transactions, Journal of Heat Transfer*, vol 100, Nov 1978, p 708-712 9 refs

The paper presents a treatment of sensible-heat energy storage units as systems intended to store useful work An analysis of the thermodynamic irreversibilities associated with storing energy from a hot gas source as sensible heat in huge liquid baths points out two important trade-offs First, there exists an optimum well-defined quantity of hot gas to be used in order to maximize the useful work stored in the liquid bath Using more than this optimum quantity in the hope of maximizing the amount of thermal energy stored as sensible heat leads to severe thermodynamics losses Second, there exists an optimum relationship among the gas-liquid heat-exchanger design parameters which minimizes the system irreversibility while maximizing its capability of storing useful work This relationship provides a procedure for estimating the heat-exchanger optimum number of transfer units The existence of the two optima demonstrates that designing sensible heat units for maximum thermal energy storage does not necessarily amount to thermodynamically optimizing such systems (Author)

A79-18092 # Thermosyphon models for downhole heat exchanger applications in shallow geothermal systems D B Kreitlow (Tektronix, Inc, Beaverton, Ore), G M Reistad (Oregon State University, Corvallis, Ore), G G Culver (Oregon Institute of Technology, Klamath Falls, Ore), and C R Miles *ASME, Transactions, Journal of Heat Transfer*, vol 100, Nov 1978, p 713-719 6 refs Contract No EY-76-S-06-2429

The analysis of downhole heat exchangers used to extract energy from relatively shallow geothermal wells leads to the consideration of several interesting problems of buoyancy-driven heat transfer in enclosures This paper considers thermosyphoning through and around the wellbore casing which is perforated at two or more depths Analytical models are developed for thermosyphoning in the cased well both with and without a heat exchanger installed Theoretical results are compared with experimental values These comparisons show that the observed energy extraction rates and flow

rates through the well casing are possible with thermosyphoning as the only circulation mechanism within the well bore The model with a heat exchanger installed is parametrically evaluated to illustrate the sensitivity of the model to estimated parameters and the effect of changes in design variables or constraints (Author)

A79-18097 # Emission control for SO₂ - An update A V Slack (SAS Corp, Sheffield, Ala) *ASME, IEEE, and ASCE, Power Generation Conference, Dallas, Tex, Sept 10-14, 1978, ASME Paper 78-JPGC-Pwr-11* 5 p Members, (ASME) \$1 50, nonmembers, \$3 00

A number of developments related to the emission standard of the Clean Air Act Amendments and the growing shortage of natural gas have increased requirements in the US to use a system for removing sulfur oxides from the combustion gas A review is presented of the current status of scrubber technology, taking into account problems resulting from the changing to the percentage removal standard The feasibility of bypassing gas is considered and aspects of process selection are discussed Attention is given to limestone scrubbing, fine grinding, the high slurry circulation rate, an efficiency increase possible in connection with a use of plug flow in the reaction tank, limestone selection, two-stage scrubbing, the use of additives, the advantage of double alkali methods, and the feasibility of using recovery processes The removal of a part of the sulfur by washing is also considered along with questions of system reliability G R

A79-18098 # Operating experience with three 20 MW prototype flue gas desulfurization processes R E Rush (Southern Company Services, Inc, Birmingham, Ala) *ASME, IEEE, and ASCE, Power Generation Conference, Dallas, Tex, Sept 10-14, 1978, ASME Paper 78-JPGC-Pwr-12* 23 p 15 refs Members, (ASME) \$1 50, nonmembers, \$3 00

A79-18099 # History and development of condensers at the Geysers geothermal power plant L L Forster (Ecolaire Condenser, Inc, Bethlehem, Pa) and J Pietruszkiewicz (Pacific Gas and Electric Co, San Francisco, Calif) *ASME, IEEE, and ASCE, Power Generation Conference, Dallas, Tex, Sept 10-14, 1978, ASME Paper 78-JPGC-Pwr-18* 10 p 8 refs Members, (ASME) \$1 50, nonmembers, \$3 00

Unique environmental and materials corrosion problems affecting equipment used, at the Geysers geothermal power plant are considered, and design characteristics of equipment, in particular of condensers, used at each of the 15 Geysers generating units are described The power plant cycle used with direct contact condensers and the cycle used with surface condensers are reported Improvements in condenser design and in the design of associated noncondensable gas-removal systems are surveyed M L

A79-18101 International Symposium on Wave and Tidal Energy, University of Kent, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Symposium sponsored by the British Hydromechanics Research Association Fluid Engineering Edited by H S Stephens and C A Stapleton Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978 231 p

Proposals for wave and tidal energy plants, economic analyses of plant operation and integration into existing power networks, and experimental results on pilot facilities are reported Topics studied include a theory of wave power absorption by two independently oscillating bodies, an 18-m long buoy with pneumatic chambers and eleven generators producing 1 25 MW for 3-m wave height, wave power systems for desalination, optimum sites for tidal power development in the Bay of Fundy, design and construction of marine structures for wave/tidal ocean thermal energy, and integrating wave power into the electricity supply system P T H

A79-18102 Tidal power plants - Sites, history and geographical distribution R H Charlier (Northeastern Illinois University, Chicago, Ill), Brussels, Free University, Brussels, Belgium) In International Symposium on Wave and Tidal Energy, Canterbury,

England, September 27-29, 1978, Proceedings Volume 1
Cranfield, Beds, England, British Hydromechanics
Research Association Fluid Engineering, 1978, p A1-1 to A16 6
refs

The paper takes a brief look at the principal forerunners of modern tidal power electric plants from classical times to the present Tide mills in England date from the 12th and 13th century, and some were still in operation in the 1940s In the U.S., Slade's mill, built in 1734, provided up to 375 kW Modern facilities include the French plant on the Rance River estuary, which takes advantages of tides of exceptional amplitude The only other operating tidal power plant is the Soviet 400 kW experimental plant built on the Kislogubskaya Promising sites for projects include the Valdez peninsula in Argentina, the Gulf of San Jorge, Santa Cruz Bay, sites in northwestern Australia, the coasts of Chile and southern Argentina, sites on the Arabian Sea, the Bay of Bengal, the Gulf of Kutch, and the Gulf of Cambay P T H

A79-18103 A theory for wave-power absorption by two independently oscillating bodies M A Srokosz and D V Evans (Bristol, University, Bristol, England) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p B1 1 to B1-34 21 refs Research supported by the Science Research Council

A theory is developed for predicting the efficiency of energy absorption of two independently oscillating cylinders The efficiency was shown to depend on generalized added mass and damping coefficients and on radiated potential amplitudes A simple approximate method for deriving these hydrodynamic coefficients from knowledge of corresponding coefficients for a single cylinder is given The results show that it is possible to absorb all the energy in a given incident wave at a given frequency when the system is tuned to that frequency Away from the tuned frequency, the efficiency of the system is low in the neighborhood of frequency values for which resonance occurs Resonance effects can be reduced by placing the barriers closer together or by submerging one or both of the cylinders P T H

A79-18104 A wave power machine using free floating vertical plates F J M Farley, P C Parks, and H Altmann (Royal Military College of Science, Shrivenham, Wilts, England) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p B2 35 to B2-46 5 refs Research supported by the Science Research Council

Vertical plates floating parallel to the wave crests move to and fro horizontally as a result of wave pressure They may be coupled to double acting pumps to produce hydraulic power A three-plate system with spacings of one-quarter wavelength and one-half wavelength can theoretically convert all the incoming power A detailed mathematical analysis shows a broad frequency response which is confirmed by model tests Design information is presented on the motion of the plates and on the matching of the hydraulics to the wave forces Sources of inefficiency are identified and discussed, overall theoretical and measured conversion efficiencies are reported (Author)

A79-18105 Experiences with a hydropneumatic wave power device T J T Whittaker (Queen's University, Belfast, Northern Ireland) and A A Wells (Welding Institute, Abington, Cambs, England) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p B4 57 to B4-72 Research supported by the Wolfson Foundation

Experimental results on a hydropneumatic device for extracting energy from waves are described The model consists of an axisymmetric pneumatic float 0.6 m in diameter The canopy is a

spherical dome open at the bottom and venting to the atmosphere through a Venturi neck Relative motion between the water column surface and canopy is achieved by providing the system with a large inertial component in the form of water-filled inertial containers attached to the skirt A toroid, flat plate, and sphere were tested as inertial components The effect of shape and position of the inertial system on extraction efficiency was determined A 4.5-m-diam prototype buoy was constructed and tested with a 45 kW alternator P T H

A79-18106 The theoretical analysis of an air turbine generation system A Hiramoto (Fuji Electric Co., Ltd., Kawasaki, Japan) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p B5-73 to B5-84

An analytical model of an air turbine generation system consisting of an 80-m long floating breakwater with 22 bottomless air chambers is presented A difference in the inner and outer water levels results in alternating positive and negative pressures, and air jets through the nozzle and rotates the turbine generator Equations for the nozzle air velocity, inner water level, air output power, turbine output power, and rotational speed of the synchronous generator are worked out Calculations for different wave conditions are given P T H

A79-18107 Wave power electric generation study in Japan Y Masuda and T Miyazaki (Japan Marine Science and Technology Centre, Japan) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p B6 85 to B6-92

The Kamei wave power facility is a boat-shaped buoy, 18 m long, 12 m wide, and 4.1-7.8 m in height It weighs 500 tons and houses 22 pneumatic chambers, each pair of chambers forming a single wave power collection system Eleven generators can be installed, and expected output is 2 MW peak, and 1.25 MW for 3-m wave height The turbine is a simple impulse turbine A hydropin anchor is to be used for permanent mooring on the sea bottom Wave power varies in strength, but if a number of wave power devices are used over a wide front, a smoothed output will be achieved Within a single unit, it is believed possible to cancel short-term power variations of periods less than one minute by a flywheel If the Kamei facility can generate 2 MW for 3000 hours annually over 15 years with an annual charge of 10%, the target of 3 p per kWh will be achieved P T H

A79-18108 The use of wave powered systems for desalination - A new opportunity C M Pleass (Delaware, University, Newark, Del.) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p D1-1 to D1-10 11 refs Grant No NOAA-04-7-158-44120

This paper describes the concept and engineering constraints on the use of wave powered high pressure seawater pumps for the provision of fresh water by reverse osmosis The significance of current wave power research is placed in context with the world need for fresh water An analysis of the device development logic which characterizes this end use is given and geographical regions of interest and high market potential are described A new international source of financial support for wave power device research and development is evident The level of equipment cost which will allow straight competition with existing electrical and diesel power sources is identified The primary problem of constructing a low cost long life seawater pumping system from passive materials will be addressed in detail This analysis will include the first detailed description of a novel high pressure seawater pump constructed entirely of inexpensive organic polymers Cost projections based on existing lifetime data from hollow fiber reverse osmosis modules will be given (Author)

A79-18109 OTEC in Europe W Griekspoor (Tebodin Consulting Engineers, Netherlands) and B J G Van Der Pot (Hollandsche Beton Maatschappij, Netherlands) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p D2-11 to D2-22

The European study group on ocean thermal energy conversion (OTEC) aims at a 25 MWe pilot demonstration plant before 1985. Their current objectives include (1) estimate the cost of electricity produced by a 100-MWe commercial off-shore OTEC plant, and (2) decide on a method of selecting, for a given site, the best combination of possible outlets of produced energy. A cost estimate is performed for a 100-MWe offshore OTEC plant on the basis of design data including (1) warm water at 25 C and cold water at 5 C at 600 m below sea level, (2) flows of order of 500 cu m/sec, (3) closed cycle turbine system with ammonia as working fluid, and (4) a floating structure. Economic analysis is based on 100 MW net output at the busbar, 30-year lifetime, and availability of 8000 hr/yr. P T H

A79-18110 Selection of optimum sites for tidal power development in the Bay of Fundy J G Warnock and R G Tanner (Acres Consulting Services, Ltd, Canada) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p E1-1 to E1-22 5 refs

A79-18111 Review of optimization and economic evaluation of potential tidal power developments in the Bay of Fundy G B Furst and M C Swales (Tidal Power Consultants, Ltd, Montreal, Canada) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p E2-23 to E2-40

A79-18112 The economics of Fundy tidal power R H Clark (Environment Canada, Inland Waters Directorate, Canada) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p E3-41 to E3-54 13 refs

The tidal range in Fundy coupled with favorable topography provides a potential for energy generation estimated to be in the billions of kilowatt-hours annually. Estimates of costs for plants of various capacities at different Fundy sites are provided. P T H

A79-18113 Prefabricated caissons for tidal power development B Severn (Engineering and Power Development Consultants, Ltd, England) and R O Campbell (William Halcrow and Partners, Tidal Energy Engineering Group, England) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p G1-1 to G1-12 7 refs

A79-18114 Principles of design and construction for marine structures for wave/tidal/ocean thermal energy J Derrington (Robert McAlpine and Sons, Ltd, England) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p G2-13 to G2-26 10 refs

A79-18115 Studies in retiming tidal energy R A Gibson (Engineering and Power Development Consultants, Ltd, England) and E M Wilson (Salford University, Salford, Lancs, England) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics

Research Association Fluid Engineering, 1978, p H1-1 to H1-10 6 refs

A study was conducted to determine how the benefits from an ebb-flow tidal power scheme were affected by retiming the off-peak tidal energy and how the effects varied with the scale of the installation. A plant on the Cumberland Basin in the Bay of Fundy linked to a pumped-storage facility at Dickey-Lincoln School Lakes was considered. Additional monetary benefit due to retiming is fundamentally dependent on the character of the electrical system and the pumping capacity available. P T H

A79-18116 The role of tidal power stations in future scenarios for electricity storage in UK T L Shaw (Bristol University, Bristol, England) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p H2 11 to H2-22 13 refs

The paper discusses the possibility of tidal energy integration into electrical nets. The case for associating a tidal power station with complementary storage capacity, both with regard to power and energy output, is strong. P T H

A79-18117 Integrating wave power into the electricity supply system D Vimukta, T M Baker, and B Plumpton (Open University, Bletchley, Bucks, England) In International Symposium on Wave and Tidal Energy, Canterbury, England, September 27-29, 1978, Proceedings Volume 1 Cranfield, Beds, England, British Hydromechanics Research Association Fluid Engineering, 1978, p H3-23 to H3-36 10 refs

The paper describes a preliminary analysis of the place that wave power might take in the electricity supply system. The analysis is based on two simple models, one of which is an hourly electricity demand model, and the other of which is an hourly wave power supply model. P T H

A79-18151 Lag damping in autorotation by a perturbation method F-S Wei and D A Peters (Washington University, St Louis, Mo) In American Helicopter Society, Annual National Forum, 34th, Washington, D C, May 15-17, 1978, Proceedings Washington, D C, American Helicopter Society, 1978 13 p 6 refs NSF Grant No ENG-76-84439 (AHS 78-25)

The effects of autorotation on lag damping are studied by a perturbation method. Closed-form expressions for the periodic equilibrium of trimmed or untrimmed rotors are derived from harmonic balance formulas and are simplified by neglecting reversed flow and other terms of fourth order in the advance ratio. The perturbation procedure provides considerable computational savings over Floquet theory and is uniformly convergent for advance ratios below 0.4. It is shown that the second harmonic coefficients have negligible effect on in-plane damping for advance ratios below 0.4. The autorotation flight condition is considerably less stable than the power flight condition, and instabilities can occur even for soft in-plane rotors. P T H

A79-18344 Emissions of nitrogen dioxide from a large gas-turbine power station. G M. Johnson and M Y Smith (Commonwealth Scientific and Industrial Research Organization, Div of Process Technology, North Ryde, New South Wales, Australia) *Combustion Science and Technology*, vol 19, no 1-2, 1978, p 67-70 12 refs. Research supported by the Electricity Trust of South Australia.

NO₂ and NO emitted by a gas-turbine power station burning natural gas have been measured as a function of operating conditions. The power station comprises three units, each rated at 50 MW full load. The NO₂ measurements were obtained by three different methods. At idle (about 15 MW per unit), the oxides of nitrogen in the exhaust gas are entirely in the form of NO₂ which has a concentration of 30 ppm. As the load is increased, the NO₂ concentration increases to a maximum of about 50 ppm at about 30 MW per unit and then decreases to about 25 ppm at full load. The NO concentration increases from zero at idle to 110 ppm at full load. (Author)

A79-18346 Wind power and other energy options. D R Inglis Ann Arbor, Mich, University of Michigan Press, 1978 308 p 191 refs \$16

Past experience with wind power is considered along with the mechanics of wind energy conversion, small wind-power installations, large wind-power machines and installations, other solar-related energy sources, geophysical energy sources, nuclear power from fission, nuclear power from fusion, a comparison of dollar costs of wind power and nuclear power, social costs of wind power and nuclear power, and the choice of options. Attention is given to the power of the wind, early wind power development, windmills, home electric power and home heating, the visual acceptability of home windmills, the siting of large wind dynamos, offshore floating wind dynamos, home heating and cooling by using direct solar energy, large solar steam-electric systems, nuclear reactor development, advantages and disadvantages of nuclear power, the present status of nuclear power, the containment problem in nuclear fusion, the costs of large wind dynamos, transmission line costs, and the need for energy storage G R

A79-18464 Energy storage - Economics and fuel conservation A A De Boer and J Smit (ECN-Netherlands Energy Research Foundation, Petten, Netherlands) *Energy Conversion*, vol 18, no 3, 1978, p 121-125

This article presents an analysis of the economic aspects of energy storage for an electric utility. It is shown that it is possible to optimize the storage economics. A relation between the efficiency of an energy storage device and the possible fuel saving is derived. Fuel savings are only obtainable with high efficiency energy storage systems (Author)

A79-18465 Modeling energy and power requirements of electric vehicles P D Blair (Pennsylvania, University, Philadelphia, Pa.) *Energy Conversion*, vol 18, no 3, 1978, p 127-134 22 refs

The paper describes the development of an electric vehicle performance model that can be used to estimate the energy and power requirements of vehicles in various driving environments. Coupled with a simple model of battery performance, the model is employed to estimate effective ranges of electric vehicles and hence the average amount of energy required per mile of operation, which can be compared with the performance of internal combustion engine or other vehicles under similar driving conditions. The discussion points out many restrictions placed on the model of electric vehicle performance by assuming that the number of acceleration-deceleration cycles per mile of vehicle operation acceptably describes the vehicle's driving cycle. Current work is centered around developing a simulation model of electric vehicle performance based on the expressions presented, that is flexible enough to examine alternative driving cycles. Results indicate that electric vehicles using current battery technology may be energy efficient in only urban environments S D

A79-18466 Some aspects of the transient response of a flat-plate solar energy collector D L Siebers and R Viskanta (Purdue University, West Lafayette, Ind.) *Energy Conversion*, vol 18, no 3, 1978, p 135-139 5 refs

The transient response of a flat-plate solar energy collector is analyzed. A two-dimensional transient heat transfer model is developed for this purpose. The parameters varied in the study are the absorber plate and working fluid heat capacities and the absorber plate to working fluid heat transfer coefficient. Both step input and diurnal cycle variations in insolation are considered. The results of the study indicate that flat-plate solar collector efficiency is not affected by increased heat capacity of the absorber plate or working fluid even though the collector response is slower and the peak working fluid outlet temperature over a diurnal cycle is lower. Energy required to heat a collector in the morning is regained in the afternoon. However, decreases in the absorber to working fluid heat transfer coefficient do cause a decrease in collector efficiency in addition to a slower collector response (Author)

A79-18467 The design and testing of a vertical-axis wind turbine using sails B G Newman (McGill University, Montreal, Canada) and T M Ngabo *Energy Conversion*, vol 18, no 3, 1978, p 141-154 13 refs National Research Council of Canada Grant No A 7096.

A vertical-axis wind turbine using sails rather than solid blades has been designed and tested at large model scale in a 15 ft diameter wind tunnel. The turbine has a relatively high solidity, three blades and an operating range of tip speed ratios from zero to about 2.5. Two types of sail have been tested - a double sail consisting of two layers of cloth wrapped round a circular leading edge dowel, and a jib sail consisting of a single layer of cloth with the leading edge held by a taut wire. The measured power outputs are about half those of a turbine with solid aerofoil blades running at tip speed ratios of 5 or 6. However, the cost and skill required for manufacture of the sail turbines are less and it is concluded that the present designs, which can be self starting if the trailing edge tension is appropriately set, may have application for 1 kW machines in developing countries (Author)

A79-18468 Effects of position of output electrodes in entrance region of open-cycle diagonal type MHD generator. M Ishikawa and Y Hattori (Kyoto University, Gokasho, Japan) *Energy Conversion*, vol 18, no 3, 1978, p 155-161 12 refs

Effects of position of output electrodes in open-cycle diagonal type MHD generators are investigated by a two-dimensional analysis with local nonequilibrium ionization. Arranging output electrodes where the magnetic field reduces to 10-40% decreases the current concentration on output electrodes, ballast resistance required, and eddy current in end-region. The output power in end-region varies with their position to some extent and has a peak at an attenuating point of magnetic field (Author)

A79-18469 Effect of finite boundary layer on the ionization instability in non-equilibrium MHD generators B K Gupta and R P Sharma (Indian Institute of Technology, New Delhi, India) *Energy Conversion*, vol 18, no 3, 1978, p 163-170 16 refs NSF-supported research

This paper presents an investigation of the effect of boundary layer on the ionization instability in non-equilibrium MHD plasmas. The Boltzmann transfer equation has been employed in the analysis. It is concluded that the effect of finite boundary layer thickness is to reduce the growth rate. Moreover, the growth rate is not constant across the channel cross-section, it is maximum on the axis and decreases away from the axis. These effects are more pronounced at higher Hall parameters. Further, it is shown that the effect of changing the flow velocity of the gas on the growth rate is more important than the effect of changing the wall temperature (Author)

A79-18470 * The advanced thermionic converter with microwave power as an auxiliary ionization source C N Manikopoulos, M Hatziprocopiou, H S Chiu, and D T Shaw (New York, State University, Buffalo, N.Y.) *Energy Conversion*, vol 18, no 3, 1978, p 171-178 6 refs NSF-NASA-ERDA-supported research

In the search for auxiliary sources of ionization for the advanced thermionic converter plasma, as required for terrestrial applications, the use of externally applied microwave power is considered. The present work is part of the advanced model thermionic converter development research currently performed at the laboratory for Power and Environmental Studies at SUNY Buffalo. Microwave power in the frequency range 1.3 GHz is used to externally pump a thermionic converter and the results are compared to the theoretical model proposed by Lam (1976) in describing the thermionic converter plasma. The electron temperature of the plasma is found to be raised considerably by effective microwave heating which results in the disappearance of the double sheath ordinarily erected in front of the emitter. The experimental data agree satisfactorily with theory in the low current region (Author)

A79-18471 Gas-cycle solar refrigeration system performance. L T Chen (National Tsing Hua University, Hsinchu, Na-

tionalist China) *Energy Conversion*, vol 18, no 3, 1978, p 179-187

The heat-driven Vuilleumier refrigerator is a small combined compressor-expander machine that is presently receiving great attention for use over the temperature range 5-80 K. Since it is driven by heat, it is expected to drive the machine by solar energy to produce refrigeration at not too low temperatures. In this paper, the performance of the idealized cycle is first reviewed and then extended to solar applications. Attention is given to investigation of the performance of the proposed solar refrigerator by taking the effects of adiabatic loss, regenerator effectiveness, and gas properties into account. It is shown that the cycle coefficient of performance can be over unity when a concentrating collector is used. In particular, the combined effect of adiabatic loss and regeneration loss has little dependence on pressure ratios. S D

A79-18472 Energy related mathematical models - Annotated bibliography. C R Deeter and A A J Hoffman (Texas Christian University, Fort Worth, Tex.) *Energy Conversion*, vol 18, no 4, 1978, p 189-227. 402 refs. NSF Grants No. MCS 76-23801. No. DCR-74 22044.

The evaluation of various options for energy sources, energy conversion, and efficient use of energy has led to the use of computer based mathematical models. To insure that these models are reasonably accurate representations of the situation being studied, it is desirable to have available information concerning the analysis of error propagation in mathematical models when implemented on computers. As an aid to energy model builders who seek methods of analysis for their own work, as well as to provide a helpful guide for the research computer scientists working on the development of methods for analysis of propagation of error, a classification scheme of error-propagation methods is presented. An annotated bibliography of energy-related mathematical models classified by validation and error-analysis methods is also provided. (Author)

A79-18479 Measurements of compressed core density of laser-imploded targets by x-ray continuum-edge shift. C M Lee and A Hauer (Rochester, University, Rochester, N Y.) *Applied Physics Letters*, vol 33, Oct 15, 1978, p 692-694. 9 refs. Research supported by the Exxon Research and Engineering Co., General Electric Co., Northeast Utilities Co., Empire State Electric Energy Research Corp., and New York State Energy Research and Development Administration.

The density of the compressed neon core in laser imploded neon-filled microballoons was measured by the shift to longer wavelengths of the free-bound X-ray continuum edges associated with the recombination processes $e(-) + Ne+9$ and $e(-) + Ne+10$. The results agree with results obtained by fitting Stark profiles to neon X-ray lines. It is suggested that the continuum method would be advantageous at higher densities since most spectral lines of the neon ion would disappear at higher densities due to pressure ionization. M L

A79-18480 Characterization of electron and ion current flow in very large aspect-ratio terawatt diodes employing heated and unheated anodes. R D Genuario and V L Bailey (Physics International Co., San Leandro, Calif.) *Applied Physics Letters*, vol 33, Oct 15, 1978, p 694-696. 5 refs. Research supported by the U.S. Defense Nuclear Agency and U.S. Department of Energy.

Electron-beam-focusing experiments using tapered hollow cathodes have been performed at power levels exceeding 1 terawatt and with diode aspect ratios (radius/anode-cathode spacing) of 24 and 45 (uncorrected for plasma motion). The spatial distributions of both the electron (using collimated p-i-n diodes) and ion currents (using quartz pressure gauges and Faraday cups) were measured simultaneously. Efficient electron-beam pinches were produced at large R/d (ratio approximately equal to 24) using a diode configuration that employed a small-diameter cathode and heated anode. (Author)

A79-18481 Effect of electrode shielding on beamlet-beamlet interaction in multiaperture sources. J H Whealton (Oak Ridge National Laboratory, Oak Ridge, Tenn.) *Applied Physics*

Letters, vol 33, Oct 15, 1978, p 697, 698. 7 refs. Contract No. W-7405-eng-26.

Extension of previous work on beamlet-beamlet interaction is made in two phases. The effect of beam space-charge truncation due to electrode shielding is considered. For a typical geometry multi-aperture source, the ion divergence is thus reduced by a factor of 30, assuming all the beamlets interact with each other, and by a factor of 5, assuming only nearest-neighbor beamlets interact. To account accurately for electrode shielding, a direct solution to the Poisson-Vlasov equation was made for a similar physical situation. For a typical circumstance it shows an additional decrease of a factor of 5 for both the global and nearest neighbor calculation. These results indicate that beamlet-beamlet interaction is small for typical ion sources. (Author)

A79-18487 Grain-boundary edge passivation of GaAs films by selective anodization. K P Pande, Y S Hsu, J M Borrego, and S K Ghandhi (Rensselaer Polytechnic Institute, Troy, N Y.) *Applied Physics Letters*, vol 33, Oct 15, 1978, p 717-719. 12 refs. Contract No. EG-77-S-01-4116.

Solar cells built on polycrystalline gallium arsenide usually have very leaky reverse characteristics and, consequently, low open circuit voltage. These problems arise from the effect of the Schottky diode made on the grain boundary, which behaves like n(+)-material. This diode shunts the active Schottky solar cell and leads to a deterioration of its performance characteristics. In this letter the use of selective-anodization techniques to provide an insulating barrier over the edge of the grain boundary in order to passivate it is described. Leakage current reduction of 5.6 decades has been achieved by this method, with both aqueous and nonaqueous anodization methods. (Author)

A79-18489 A high-efficiency GaAlAs double-heterostructure photovoltaic detector. R C Miller, B Schwartz, L A Koszi, and W R Wagner (Bell Telephone Laboratories, Inc., Murray Hill, N J.) *Applied Physics Letters*, vol 33, Oct 15, 1978, p 721-723. 12 refs.

An antireflection-coated GaAlAs double-heterostructure photovoltaic detector is described whose extrinsic power conversion efficiency is 56% when used with a focused 8075-micron wavelength laser beam. This is possibly the highest photovoltaic efficiency yet reported. A partially reflective rear contact provides extrinsic quantum efficiencies exceeding 0.90 with a relatively thin active region. By restricting the diameter of this contact to 50 microns and using high doping to reduce series resistance, open-circuit voltages of 1.15 V and fill factors up to 0.84 are obtained. The series resistance was 3.0 ohms with 1.0 ohm being attributable to the contacts. (Author)

A79-18503 Photoacoustic determination of photovoltaic energy conversion efficiency. D Cahen (Weizmann Institute of Science, Rehovot, Israel.) *Applied Physics Letters*, vol 33, Nov 1, 1978, p 810, 811. 7 refs.

Photoacoustic (i.e., photocalorimetric) measurements on photovoltaic devices can directly yield their energy conversion efficiency. This is illustrated for a Si solar cell, for which case excellent agreement is found with normal electrical measurements. In addition, the photoacoustic spectra under load and at open-circuit conditions are reported and compared with the cell's spectral response. Together, such measurements can provide information on the wavelength dependence of the cell performance as well. (Author)

A79-18504 /SN/x-GaAs polymer-semiconductor solar cells. M J Conen and J S Harris, Jr (Rockwell International Science Center, Thousand Oaks, Calif.) *Applied Physics Letters*, vol 33, Nov 1, 1978, p 812-814. 14 refs.

We report the first solar cell whose junction is formed by a polymer-semiconductor interface. Open-circuit voltages, V_{oc} greater than 0.7 V, have been observed on cells consisting of a thin film of polymeric sulfur nitride, (SN)_x, deposited on GaAs. This is an enhancement of more than 40% over the V_{oc} commonly measured

with metal-GaAs solar cells Initial efforts have resulted in efficiencies over 6% without antireflection coatings (Author)

A79-18519 Progress towards 100-knot nonconventional ocean ships II (Vers les navires océaniques non conventionnels à 100 noeuds II) A Grihangne *Navigation (Paris)*, vol 26, July 1978, p 275-288 In French

The performance capabilities of SES wing-in-ground concept ships are discussed Cargo size and fuel requirement characteristics are considered SES military applications surveyed include strategic operations, logistics support, and antisurface ship operations The use of sidewall ships as aircraft carriers is considered Technical decisions affecting SES cost are examined, and the abilities of SES are contrasted with limitations affecting the use of surface ships M L

A79-18521 Rule of fuel management (Règle de gestion carburant) R Cathodeau (Compagnie Nationale Air France, Paris, France) *Navigation (Paris)*, vol 26, July 1978, p 323-330 In French

A procedure for calculating flight fuel requirements and optimizing fuel use is described A slide rule-type device is used to correlate air distance and fuel use patterns Nomograph representations of the calculations are presented The changing weight of the unconsumed fuel is taken into account Examples of the use of the procedure are reported M L

A79-18560 # A cavity receiver design for solar heated gas turbine generating systems E le Grivès (ONERA, Châtillon-sous-Bagneux, Hauts de-Seine, France) (*University of Miami, Commercialization of Solar and Conservation Technologies Symposium Workshop, Miami, Fla, Dec 11-13, 1978*) ONERA, TP no 1978-137, 1978 28 p 9 refs

The computational evaluation of the thermal efficiency of a solar receiver is discussed The receiver, which is designed for use with gas turbine generators, is intended to produce a concentration in the order of 1000 suns Radiative interchange analysis was applied to the receiver, which has a cone frustrum and spherical zone geometry, and, by means of the Siegel and Howell (1972) procedure, values of the overall efficiency and of the energy fractions absorbed by the two surfaces were computed over a wide range of geometrical and optical characteristics for stated mean surface temperatures The analysis suggests that best performance would be achieved by using the reflector as part of the thermal absorber Emissivities, cavity geometry, and shape factors are considered M L

A79-18680 # Modern engine development test techniques. W J Crawford, III (General Electric Co, Aircraft Engine Group, Lynn, Mass) In *European Rotorcraft and Powered Lift Aircraft Forum, 4th, Stresa, Italy, September 13-15, 1978, Proceedings Volume 2* Gallarate, Italy, Costruzioni Aeronautiche Giovanni Agusta S p A, 1978, p 47 1 to 47-7

The shift in aircraft engine test philosophy is discussed by comparing the development of two GE engines the T58 and the T700 The T700 had undergone a four-year technology engine demonstrator program before its four-year development program began in 1972, when the first production engine was delivered in 1978, a total engine test time of 42,000 hours had been accomplished Consideration is given to modern engine development phases, factory tests, air vehicle fuel control assembly testing, air vehicle manufacturer tests, corrective actions, and the costs of not testing B J

A79-18681 # Technology evolution in the Allison Model 250 engine E C Stevens (General Motors Corp, Detroit Diesel Allison Div, Indianapolis, Ind) In *European Rotorcraft and Powered Lift Aircraft Forum, 4th, Stresa, Italy, September 13-15, 1978, Proceedings Volume 2* Gallarate, Italy, Costruzioni Aeronautiche Giovanni Agusta S p A., 1978, p 48-1 to 48-20

The evolution of compressor and turbine technology in the Allison Model 250 gas turbine engine can be largely attributed to the successful application of finite element analysis techniques The technology advances in the combustor resulted from the addition of a smaller-diameter prechamber upstream of the main chamber The combined effects of the component technology improvements on the advanced Model 250 engines are increased power, increased reliability, and improvements in both engine power-to-weight ratio and cruise SFC B J

A79-18794 Stimulated Raman scatter in laser fusion target chambers J J Thomson (California, University, Livermore, Calif) *Physics of Fluids*, vol 21, Nov 1978, p 2082-2085 9 refs Contract No W-7405-eng-48

The target chamber of a laser fusion reactor will contain small amounts of background gases As the beam is focused, it ionizes the gas and Raman scattering is induced Density limits on the background gas are found in order that the laser beam not become appreciably decollimated It is found that laser bandwidth efficiently decreases the scattering effect (Author)

A79-18830 Radially resolved measurements of 'q' on the adiabatic toroidal compressor tokamak R J Goldston (Princeton University, Princeton, N J) *Physics of Fluids*, vol 21, Dec 1978, p 2346-2353 33 refs Contract No EY-76-C-02-3073

A new technique for directly measuring the safety factor, or q, profile in a tokamak is described A tightly collimated neutral beam capable of injecting approximately 100 mA of 30-keV deuterium atoms was mounted on the Adiabatic Toroidal Compressor tokamak By proper tangential aiming of the beam a strong concentration of circulating fast ions was created at a chosen plasma minor radius Through examination of the orbits of these ions with a multi-sight-line charge-exchange detector, it was possible to measure the shifts of the orbits off magnetic surfaces, and thereby make local measurements of q This experiment showed that when q on axis reached unity, strong internal turbulence began, and further lowering of q at the outer edge of the plasma did not lower q(0) A second result was that the measured q(0) was approximately 1.8 times larger than the q(0) deduced from the radial electron-temperature profile, assuming effective ion charge to be independent of minor radius This suggests a significant peaking of effective ion charge on axis (Author)

A79-18846 Analysis of a cylindrical imploding shock wave E A Mishkin (New York, Polytechnic Institute, Brooklyn, N Y) and Y Fujimoto (New York, Polytechnic Institute, Brooklyn, N Y, Koyo Seiko Co, Ltd, Sueyoshi, Osaka, Japan) *Journal of Fluid Mechanics*, vol 89, Nov 14, 1978, p 61-78 14 refs

The implosion of a cylindrical shock wave in a perfect gas with constant ratio of specific heats is analyzed on the basis of the gasdynamic equation in a cylindrical coordinate system A self-similar solution is sought Postulation of a single maximum pressure behind the shock front leads to an analytic determination, in closed form, of the self-similarity coefficient For specific heat ratio less than 2 plus the square root of 3 the slight pressure maximum occurs behind the shock, approaching it as the specific heat ratio increases Solutions presented are both single-valued and nonsingular P T H

A79-18875 Performance testing of solar collectors. B Justin (Pilkington Brothers, Ltd, Lathom, Lancs, England) *Sunworld*, vol 2, Aug 1978, p 66-71

Lack of agreement on procedures for evaluating the thermal performance of solar collectors is considered Energy relationships and efficiency are discussed, and factors affecting collector efficiency are examined The type of test information needed for design purposes, characterization purposes, and development purposes is described The NBS testing procedure, its basis, and the interpretation of test data are reported M L

A79-18973 Heat transfer - A review of 1977 literature E R G Eckert, E M Sparrow, R J Goldstein, C J Scott, E Pfender, S V Patankar, and J W Ramsey (Minnesota, University, Minneapolis)

lis, Minn) *International Journal of Heat and Mass Transfer*, vol 21, Oct 1978, p 1269-1298 640 refs

Results published in various fields of heat transfer in 1977 are surveyed and classified into 21 categories. Research highlights include the analytical and numerical studies of heat conduction, especially in situations involving phase change. Another major research topic involves complex flow configurations in channel flow caused by corrugations, spherical and cylindrical blockages, and partially constricted inlets, as well as fluids containing additive and particulate materials. M L

A79-19083 Design of a D-shaped toroidal field coil. K Kuroda (Hitachi, Ltd., Research Laboratory, Hitachi, Ibaraki, Japan) *Journal of Applied Physics*, vol 49, Oct 1978, p 5146-5149 14 refs

A design method for making multilayer toroidal superconducting field coils completely free from the bending moment is developed. According to File's theory (1971), the shape of a multilayer toroidal field coil is determined so that the layers in the winding are in pure tension and, therefore, not subject to any bending moment, the shape of the resultant coil resembles the letter D. A toroidal field coil with a magnetomotive force of 18.8 MAT, a vertical bore of 1.51 m, and a horizontal bore of 1.07 m was designed with this method. B J

A79-19092 On the role of interface states in MOS solar cells. S Kar (Indian Institute of Technology, Kanpur, India) *Journal of Applied Physics*, vol 49, Oct 1978, p 5278-5283 21 refs

Interface states affect the performance of MOS solar cells in several ways. They affect the oxide voltage and the silicon band bending and cause an excess diode current to flow by recombination tunneling via interface states. The open-circuit voltage of the cell is determined by the zero-voltage silicon band bending, the oxide tunneling transmission factor at open circuit, and the change in the oxide voltage between short and open circuit. The most advantageous situation is that in which the interface-state density as well as its product with oxide thickness decrease with increasing oxide thickness. B J

A79-19098 Transport phenomena in MHD generators. Effect of boundary layers. B K Gupta and R P Sharma (Indian Institute of Technology, New Delhi, India) *Journal of Applied Physics*, vol 49, Nov 1978, p 5427-5434 15 refs. NSF-supported research

An investigation of the effect of velocity/temperature boundary layers on the conductivity and the power output of an MHD generator has been presented in this paper; the analysis is based on the Boltzmann transfer equation. It is seen that the conductivity and the mean power output per unit volume of an MHD generator becomes considerably reduced because of the presence of the velocity and temperature boundary layers. The power output is found to decrease sharply with boundary-layer thickness for low values of the thickness and levels off at larger thicknesses. (Author)

A79-19219 The measurement of the sulfuric acid and sulfate content of particulate matter resulting from the combustion of coal and oil. J B Homolya and C R Fortune (U.S. Environmental Protection Agency, Gaseous Emissions Research Section, Research Triangle Park, N.C.) *Atmospheric Environment*, vol 12, no 12, 1978, p 2511-2514 6 refs

A79-19359 Real-time, continuous measurement of automotive sulfuric acid emissions. M Beltzer (Exxon Research and Engineering Co., Linden, N.J.) *Air Pollution Control Association, Journal*, vol 29, Jan 1979, p 57-59 14 refs

A79-19401 Underground gasification of coal at deep levels - Perspectives and problems (Etudes préliminaires à la gazéification souterraine profonde des charbons - Perspectives et problèmes). M Pottier (Gaz de France, Paris, France), P Chaumet (Institut-Français

du Pétrole, Rueil-Malmaison, Hauts-de-Seine, France), and L. Lechevin (Charbonnages de France, Paris, France) *Association Technique de l'Industrie du Gaz en France, Congrès, Paris, France, Sept 12-15, 1978* Institut Français du Pétrole, *Revue*, vol 33, Sept-Oct 1978, p 729-746. In French.

Technical and economic factors involved in the gasification of deep coal (coal more than 800 m from the surface) are described. The problem of developing a connection between the two bore-holes required in a gasification process is examined, and the production of either a horizontal fracture or of a double vertical fracture by means of a hydraulic fracture technique is considered. Gasification schemes suitable for deep coal beds are discussed, and factors involved in the determination of the economic suitability of a gasification project are examined. It is estimated that in France there are more than 2 billion tons of coal more than 800 m deep in veins at least 2 m thick. M L

A79-19445 # On the flow of a conducting fluid between parallel disks with a transverse magnetic field I - A theoretical investigation on a nonequilibrium plasma flow as a compressible inviscid fluid. S Kamiyama and K Koike (Tohoku University, Sendai, Japan) *Tohoku University, Institute of High Speed Mechanics, Reports*, vol 38, 1978, p 13-26 13 refs

A79-19538 # Some effects of flow curvature on the performance of Darrieus wind turbines. P G Migliore and W P Wolfe (West Virginia University, Morgantown, W Va.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0112* 10 p 10 refs. Research sponsored by the U.S. Department of Energy and NSF.

A kinematic analysis was conducted which predicted disparate aerodynamic characteristics for airfoils in curvilinear versus rectilinear flow. This forecast was verified experimentally. Unusually large boundary layer radial pressure gradients and virtually altered camber and incidence were identified as casual phenomena. To facilitate future analyses, conformal mapping techniques were developed to transform geometric airfoils in curved flow to their virtual equivalents in rectilinear flow. It is argued that flow curvature is an important determinant of Darrieus turbine blade aerodynamic efficiency, and that its proper consideration will yield performance improvements. In this regard, variable blade camber is shown to have considerable promise. (Author)

A79-19539 # Wind turbine generator wakes. P M Sforza, W Stasi, M Smorto, and P Sheerin (New York, Polytechnic Institute, Farmingdale, N.Y.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0113* 10 p 40 refs

An experimental and theoretical investigation of the wake behind wind turbine generators is presented. The general features of such flows are reviewed and the applicability of past work on more conventional aerodynamic wakes is discussed. Modeling of the wind turbine and the atmospheric boundary layer in an environmental tunnel is described. Experimental results for such models are given. Theoretical modeling of the three-dimensional mixing process in the wake-boundary layer interaction region is performed and numerical solutions for such flows are discussed and compared to the experiments. (Author)

A79-19540 # Energy effectiveness of arbitrary arrays of wind turbines. P B S Lissaman (Aero Vironment, Inc., Pasadena, Calif.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0114* 8 p 9 refs

A computer model for an arbitrary array of wind turbines is presented, in which the power available to each wind turbine in the array is determined for that wind turbine as 'receptor', with each of the other wind turbines acting as a wake generator. The power of the entire array is determined by summing over all the receptors and then determining the average. The discussion covers wake profiles, wake growth and turbulent entrainment (wake development in a nonturbulent and a turbulent infinite medium), effect of ground

plane and neighboring wakes, and computer model. The basic equations employ basic fluid mechanical expressions related to drag conservation, wake growth due to turbulent entrainment, and a family of self-similar wake profiles obtained from experiment. This gives full definition of the wake velocity field and helps determine the velocity deficit for a given radius. Power output of selected arrays for all wind conditions is determined. Some typical results for various cases of interest are presented. S D

A79-19541 # The Madaras Rotor Power Plant - An alternate method for extracting large amounts of power from the wind. D H Whitford and J E Minardi (Dayton, University, Dayton, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0115* 12 p. Contract No. EY-76-S-01-2554

The Madaras Rotor Power Plant concept is discussed, and studies involving wind tunnel tests, electromechanical analysis, performance analysis, and cost analysis are reported. The Madaras concept uses rotating cylinders, vertically mounted on flat cars, to react with the wind like a sail and propel an endless train of connected cars around a closed track at constant speed. Electricity is generated at each car by alternators geared to the wheels. The analysis indicates that racetrack-shape plan-forms but not circular plan-forms of tracks might be economically attractive. Racetrack plants with capacities as high as 228 MW and annual energy outputs of 975,000,000 kW-hr/yr are considered. Energy costs of MOD-1 horizontal axis wind turbines and of Madaras plants are compared. M L

A79-19585 # Drop formation, evaporation modelling and environmental assessment of JP-4 fuel jettisoned from aircraft. R E Good (USAF, Geophysics Laboratory, Bedford, Mass.) and H J Clewell, III (USAF, Civil Engineering and Environmental Development Office, Tyndall AFB, Fla.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0186* 9 p. 13 refs.

The occasional jettison of unburned fuel from aircraft has raised the concern of environmentalists as to possible change in atmospheric composition or damage to crops. An experimental program was conducted consisting of flying a sampling aircraft directly through a fuel dump at selected altitudes to measure fuel drop size and number distributions. The measurement results of the sampling, fuel dump wake size and hydrocarbon vapor content are presented. A multi-component fuel drop model is used to predict the amount of drop vaporization and determine the initial drop size and number distribution. A description of the model will be presented with prediction of the dispersion and fall of the fuel drops. The observed drop size distribution is corrected for evaporation using the model to estimate the initial droplet formation size. For the KC-135 aircraft fuel venting procedures, the median drop diameter formed is 270 microns. It is determined that fuel jettisoned 5000 ft, or higher will evaporate before reaching the ground. Ground contamination can be avoided, eliminating any potential environmental damage. (Author)

A79-19587 # National program for the development of commercial MHD. R V Shanklin (U S Department of Energy, Washington, D C). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0188* 12 p.

Open-cycle MHD is important to the national energy plan because of its potential as a source of low-cost central-station electric power. It is the only advanced system available to an increasingly coal-dependent economy that burns coal directly to produce electricity. A mature coal-burning, utility-sized MHD steam power plant will achieve overall plant efficiency in the 50% range, meet all existing or proposed Federal standards for SO₂ and NO_x, and achieve a cost of electricity lower than competing systems. To realize these advantages, the objective of the MHD program is the commercialization of MHD by operating a coal-burning MHD steam power generating plant in a utility environment. This paper describes the Department of Energy's program for achieving this objective. It

discusses a baseline commercialization plan as well as two program options designed to establish MHD as a commercial technology at an earlier date. (Author)

A79-19588 # Slag deposition and its effect on the performance of MHD channels. E Doss and K Im (Argonne National Laboratory, Argonne, Ill.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0189* 8 p. 18 refs. Contract No. W 31-109-eng-38

A complete analytical slag-plasma interaction model is presented for evaluating the performance of MHD channels in the presence of surface slag coating. The flow inside the channel is described by a two-dimensional model, and the slag flow by a simple one-dimensional model for a viscous fluid film of very low Reynolds number. The effect of slag deposition on the channel performance is assessed by dividing the analysis into three interacting parts: calculation of the channel flow (heat, flux, shear stress, power output), calculation of the slag flow, and calculation of the slag deposition rate. The slag deposition calculation is described by a set of diffusion equations for the slag vapor species and particle species, with source terms included for both nucleation and vapor condensation on the particles formed. The analytical model described is successfully applied to determine the effect of surface temperature on the performance of the U S channel design for the Soviet U-25 facility. The result is improved channel power output, especially at low surface temperature. S D

A79-19589 # Recent developments in pressurized fluidized bed coal combustion research. V Zakkay, G Miller, and J Franceschi (New York University, New York, N Y). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0190* 15 p. 27 refs. Contract No. EF-75-C-01-2256

Atmospheric fluidized bed coal combustors are presently being considered by utilities for the production of electricity at present and in the near future. At the same time, research and development programs utilizing pressurized beds are being conducted at a number of industrial and university facilities in the US and abroad. Pressurized units will be more compact, attain higher sulfur retention, transfer heat more efficiently and can be utilized in higher efficiency combined cycle operations. Pressurized combustors may therefore make a significant impact in energy decisions by the late 1980's. This paper reviews some recent developments in pressurized fluidized bed research and discusses the technological areas to be investigated. (Author)

A79-19590 # The nuclear closed-cycle gas turbine /GT-HTGR/. A utility power plant for the year 2000. C F McDonald (General Atomic Co., San Diego, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0191* 12 p. 14 refs. Research supported by the U S Department of Energy and General Atomic Co.

The combining of a modern power conversion system such as the closed-cycle gas turbine (CCGT) with an advanced high-temperature gas-cooled reactor (HTGR) results in a power plant well suited to projected utility needs in the late 1990s and early decades of the 21st century. This paper discusses design aspects of the GT-HTGR plant in its present conceptual design stage. The established technology bases for the GT-HTGR power plant are outlined, and emphasis is placed on the design and development of the helium turbomachine. The benefits of the nuclear gas turbine power plant are presented, and it is concluded that the worldwide efforts to bring it into use should increase rapidly because the role it can have in meeting national energy goals is significant. (Author)

A79-19649 # Mathematical models of direct initiation of unconfined gas phase detonations. A A Boni and C W Wilson (Science Applications, Inc., La Jolla, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th,*

New Orleans, La., Jan 15-17, 1979, Paper 79-0299 6 p 6 refs

Previous worst case analyses have shown that the threshold for unconfined detonation of LNG/air clouds was attainable under certain idealized circumstances. Here the analyses are extended to more realistic situations to assess the implications of these worst-case results with respect to the detonation potential of natural gas/air clouds resulting from accidental spills of liquefied natural gas (LNG). We examine the effects of three distinct deviations from the worst case on the threshold for unconfined detonation. All three of these - cloud inhomogeneities, cloud temperature variations, and nonideal sources - are shown to significantly increase this threshold. (Author)

A79-19654 # Combustion of pulverized coal in high temperature preheated air D B Stickler, F E Becker, and S K Ubhayakar (Avco Everett Research Laboratory, Inc., Everett, Mass.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0298* 13 p 10 refs Contract No. ET-78-C-01-2712

An analytical model has been developed to simulate an MHD coal combustor. The model highlights the various physicochemical mechanisms which are of importance in a high-temperature pulverized-coal combustor using a hot oxidizing gas. The purpose of the model is to minimize exploratory experimental study and give a basis for the use of basic combustion information in combustor design without depending exclusively on empirical hardware testing. The model breaks down into three major conceptual blocks: fluid dynamics, particle processes, and gas chemistry. Each of these blocks, as well as the coupling between them, is discussed. The output behavior is illustrated by choosing a wide range of cases of interest to MHD combustor development. Also, the model is compared with experimental data from recent combustor tests. The versatility of the model in predicting behavior under different conditions is exemplified by a parametric study involving air preheat temperature, vitiated air temperature, size vs burnout, etc. Suggestions for improvement of the model are made. (Author)

A79-19687 # A characteristic time correlation for combustion inefficiency from alternative fuels D A Schmidt (Avco Corp., Avco Lycoming Div., Stratford, Conn.) and A M Mellor (Purdue University, West Lafayette, Ind.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0357* 11 p 24 refs Army-sponsored research

Gas turbine engines in tanks and helicopters should be capable of at least emergency service with any fuel. Long term operation of the same vehicles, as well as aircraft, will involve alternative fuels from non-petroleum sources. Non-aviation specification fuels however affect engine performance and in particular combustion efficiency. A characteristic time model correlation is examined with fuels representative of future alternatives with emphasis on viscosity and volatility effects upon efficiency. Results from heavier fuels as examined on a disc stabilized research combustor are compared with those from present day aviation fuels. A ratio of a chemical kinetic time to a turbulent mixing time in the shear layer surrounding the flame stabilizing recirculation zone correlates data for mixing controlled flames and a new characteristic time relevant to the fuel injection process is introduced which collapses geometry effects well for a given fuel but which fails to correlate individual fuel effects completely. Progress made to date with inclusion of heterogeneous effects in characteristic time correlations is detailed, and further requisite research is suggested. (Author)

A79-19735 # Operation and emission of a stoker-fired boiler while burning refuse derived fuel and coal mixtures J L Hall, G A Stevens, A W Joensen, D B Van Meter (Iowa State University of Science and Technology, Ames, Iowa), and H R Shanks (U.S. Department of Energy, Ames Laboratory, Ames, Iowa) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/APC-2* 12 p 13 refs Members, \$1 50, nonmembers, \$3 00 Research supported by the American Public Power Association, U.S. Department of Energy

and Iowa State University of Science and Technology, U.S. Environmental Protection Agency Grant No. R-803903010, Contract No. W-7405-eng-82

Results are presented of the emission evaluations of a stoker-fired boiler operating at the Ames, Iowa power plant while burning mixtures of refuse derived fuel (RDF) and coal. The facilities, test design, and sampling procedure are summarized and emission results are given. Emissions of uncontrolled particulates, chlorides, trace elements of copper, lead, and zinc all increase consistently with increases in RDF. Emissions of sulfur oxides and nitrogen oxides decrease with increases in RDF. No discernible trends, within the data scatter, were noted concerning formaldehyde, hydrocarbons C1 through C5, and many of the 17 different trace elements scanned during these experiments. Combustible and noncombustible characteristics of the boiler grate ash became more like the corresponding flyash characteristics as the amount of RDF was increased. Further studies are still in progress at the Ames facility. (Author)

A79-19736 # Modification of electrostatic precipitator performance by use of fly-ash conditioning agents T D Brown, G K Lee (Department of Energy, Mines and Resources, Canadian Combustion Research Laboratory, Ottawa, Canada), and N Sekhar (Ontario Hydro, Chemical Research Dept., Toronto, Canada) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/APC-3* 8 p Members, \$1 50, nonmembers, \$3 00

The effects of selected conditioning agents on the physicoelectrical characteristics of hot fly ash particles are evaluated in a pilot-scale low-sulfur-coal-fired boiler designed to accurately duplicate combustion conditions in full-scale boilers. The fly ash conditioning agents are SO₃, H₂SO₄, NH₂SO₂OH, NH₃, (NH₄)₂SO₄, (C₂H₅)₃N, and Na₂SO₄. It is shown that the electrical resistivity of fly ash decreases exponentially from a base level to a limiting value as the concentration of the conditioning agent increases, that SO₃ and H₂SO₄ produce a twofold increase in the precipitation rate parameter, and that NH₂SO₂OH and (C₂H₅)₃N give an increase of less than 50%. S D

A79-19738 # Combustion modifications for the control of air pollutant emissions from coal fired utility boilers W Bartok, A R Crawford (Exxon Research and Engineering Co., Government Research Laboratories, Linden, N.J.), E H Manny, and R E Hall (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Research Triangle Park, N.C.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/APC-7* 15 p 11 refs Members, \$1 50, nonmembers, \$3 00 Research supported by the Electric Power Research Institute, U.S. Environmental Protection Agency Contracts No. 68-02-0227, No. 68-02-1415

A field study concerning combustion modifications on utility boilers is considered, taking into account aspects of test program design, gaseous sampling and analysis, particulate and SO_x sampling, furnace fireside tube wall corrosion probe measurements, boiler efficiency, nitrogen oxide emissions, and sulfur oxide emissions. It is found that combustion modifications can significantly reduce NO_x emissions for all types of firing by about 40 percent, albeit with potential loss in boiler capacity if no special features are incorporated into the boiler system. Low excess air, staged firing mode of operation is at present the most effective combination of furnace combustion modifications for controlling NO_x emissions from coal-fired utility boilers. The optimum firing pattern generally established is the operation of the top burners on air only. G R

A79-19741 # Tests of various coals, coal-oil mixtures and refuse derived fuels in an experimental test facility R A Brown and C F Busch (Acurex Corp., Mountain View, Calif.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/APC-12* 11 p 17 refs Members, \$1 50, nonmembers, \$3 00

A small scale (293 to 879 kWt) experimental facility was designed and built to simulate the pollutant emissions from a front

wall-fired utility boiler, a tangentially fired utility boiler, and a small single burner package boiler. Results from baseline and NO_x control technology tests are presented for a variety of fuels including four coal types, two heavy oils, five coal-oil mixtures, and four refuse derived fuels co-fired with either coal or natural gas. These results show how a single versatile experimental facility can address a variety of air pollution and energy conservation problems. This facility is aiding the Environmental Protection Agency in evaluating emission levels for new fuels and in developing control technology for both new and conventional fuels (Author)

A79-19742 # Combustion modification pollutant control techniques for industrial boilers - The influence of fuel oil properties and atomization parameters M P Heap, G C England, J W Lee (Energy and Environmental Research Corp., Irvine, Calif.), D W Pershing (Utah, University, Salt Lake City, Utah), and G B Martin (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Research Triangle Park, NC) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/APC-13* 8 p Members, \$1 50, nonmembers, \$3 00 U.S. Environmental Protection Agency Contract No. 68-02-2624

A79-19765 # An optimal standard for solar heating systems. D M Auslander, M Tomizuka (California, University, Berkeley, Calif.), and H Lee *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/DSC-19* 15 p Members, \$1 50, nonmembers, \$3 00

Control problems in solar heating systems are studied. Using a load temperature regulation specification based on minimum temperature, an optimal control problem is formulated to compute a lower bound on the amount of auxiliary energy needed, over a given cycle, for a fixed solar heating system. In order to estimate the sophistication of control necessary for achieving higher performance, a comparative study is made among several simple controllers with both proportional and on-off actuation (Author)

A79-19766 # An air-modulated fluidic fuel-injection system. R L Woods (Texas, University, Arlington, Tex.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/DSC-21* 8 p 8 refs Members, \$1 50, nonmembers, \$3 00 U.S. Department of Transportation Contract No. OS-60152

This paper presents a unique approach to fuel management systems applicable to spark-ignition engines and discusses a fluidic implementation. The air-modulation system is opposite from conventional systems in that the driver selects the air consumption to the engine thereby providing many desirable functions that are inherent in its operation. Fluidic control was selected for its sensing and control compatibility with the fluid variables and for its cost and reliability potential. The design and bench tests of the fluidic controller are discussed. The results of the dynamometer and vehicle evaluation are encouraging (Author)

A79-19771 # Optimal control of on-board and station flywheel storage for rail transit systems L M Sweet (Princeton University, Princeton, N.J.) and M J Keane *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/DSC-32* 9 p 10 refs Members, \$1 50, nonmembers, \$3 00

The energy efficiency of rail transit systems using regenerative braking is enhanced by flywheel storage elements used to store energy not accepted by the wayside power rail. In this paper three storage system control concepts are examined: armature and field control of on-board flywheels, and field control of a station-based storage device. The energy recovery efficiency and performance characteristics of each system are determined subject to optimal control laws derived to minimize energy loss. The resulting control systems are bilinear, due to the use of separately excited DC traction and flywheel motors as continuously variable transmissions. The three systems yield similar energy recovery efficiencies for deceleration, with the advantages of each for practical applications discussed (Author)

A79-19775 # Floating dry cooling, a competitive alternative to evaporative cooling in a binary cycle geothermal power plant. H S Pines, M A Green, W L Pope, and P A Doyle (California, University, Berkeley, Calif.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Ener-2* 7 p 7 refs Members, \$1 50, nonmembers, \$3 00 Research supported by the U.S. Department of Energy.

The application of the floating cooling concept to non-evaporative and evaporative atmospheric heat rejection systems is studied as a method of improving the performance of geothermal powerplants operating upon medium temperature hydrothermal resources. The LBL thermodynamic process computer code GEOTHM is used in the case study of a 50 MWe isobutane binary cycle power plant at Heber, California. It is shown that operating a fixed capacity plant in the floating cooling mode can generate significantly more electrical energy at a higher thermodynamic efficiency and reduced bus bar cost for approximately the same capital investment. Floating cooling is shown to benefit a plant which is dry cooled to an even greater extent than the same plant operating with an evaporative heat rejection system. Results of the Heber case study indicate that a dry floating cooling geothermal binary cycle plant can produce energy at a bus bar cost which is competitive with the cost of energy associated with evaporatively cooled systems (Author)

A79-19776 # A comparison of the performance of steam turbine cycles using gas contaminated geothermal steam J H Eskesen, J W Mann, and A Whitehead (General Electric Co., Medium Steam Turbine Dept., Lynn, Mass.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Ener-3* 10 p Members, \$1 50, nonmembers, \$3 00 Contract No. EY-76-S-02-4051

The effect of carbon dioxide on steam turbine performance is examined. The performance of the conventional condensing cycle in which gas is removed from the main condenser is compared to that of three modified cycles in which gas contaminated steam is isolated from the turbine flow path. One modified cycle, called the Vent Cycle, takes advantage of the fact that only a small fraction of steam need be liberated from liquid brine to remove essentially all the CO₂. The gas can thus be vented from the system under pressure with relatively little steam loss and residual brine can be flashed in the usual manner to provide gas-free steam for a condensing unit. The other two cycles use the contaminated steam to generate gas-free steam from turbine condensate. The performance of the conventional cycle is shown to be slightly superior to that of the Vent Cycle and vastly superior to that of the other cycles and also flash binary cycles (Author)

A79-19777 # The Stirling engine, an energy converter for cogeneration applications D Lehrfeld and A Daniels (North American Philips Co., Inc., Philips Laboratories Div., Briarcliff Manor, N.Y.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Ener-4* 10 p 13 refs Members, \$1 50, nonmembers, \$3 00

A cogeneration system, in its broadest sense, is an on-site electric power generation plant fulfilling the site electrical requirements while utilizing the waste heat from the prime mover to supply the site heating and/or cooling demands. An investigation has been conducted regarding the application of Stirling cycle prime movers to cogeneration. The Stirling engine is a piston engine based on a closed cycle system. The characteristics of the Stirling engine make it suitable for a wide variety of heat sources without any essential modification of the engine being necessary. Attention is given to principles of operation, performance characteristics, and a Stirling total energy system study. The single most striking advantage of the Stirling prime mover is its multiple-fuel capability. The disadvantage of the Stirling prime mover is that it is not commercially available.

G R.

A79-19778 # Geothermal power and water production studies at the University of California A D K Laird, B W Tieimat (California, University, Berkeley, Calif.), J R Darnell (Bechtel National, Inc., San Francisco, Calif.), G J Smith (Exxon Research

and Engineering Co., Florham Park, N.J.), and F. V. Stickle (United Technologies Corp., Chemical Systems Div., Sunnyvale, Calif.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec. 10-15, 1978, Paper 78-WA/Ener-7* 10 p. 8 refs. Members, \$1.50, nonmembers, \$3.00

This paper summarizes results of studies on geothermal dual-purpose power and water production plants using geothermal and other working fluids. Combinations of heat exchanger and direct contact condensers with evaporative, dry and mixed cooling are considered. Effects of system parameters on production are given. Higher temperatures favor the use of open, or water, cycles, particularly when brines are low in dissolved solids, noxious gases and bicarbonates. At lower temperatures, either the water or the binary fluid cycle may be preferable, depending on conditions.

(Author)

A79-19787 # On the dynamics of electrostatically precipitated fly ash. D. Juricic and G. Herrmann (Stanford University, Stanford, Calif.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec. 10-15, 1978, Paper 78-WA/Fu-3* 8 p. 11 refs. Members, \$1.50, nonmembers, \$3.00. Research supported by the Electric Power Research Institute.

One of the factors influencing the efficiency of modern electrostatic precipitators is the proper cleaning of dust collecting plates, which is usually done by a periodic rapping. The rapping blow excites the plates, which in turn dislodge the accumulated dust layer. The paper analyzes the response of a deposited dust layer to an arbitrary out-of-plane motion of the plate to which it is held by the action of molecular and electrostatic adhesive forces. A simplified one-dimensional model of the precipitated dust-layer is assumed to have viscoelastic properties of the Kelvin solid. The results indicate that, in addition to the acceleration level, the frequency of excitation as well as the adhesive-force arrangement are decisive in defining how and when the dust layer will break off the plate.

(Author)

A79-19788 # Corrosion and deposits from combustion of solid waste VI - Processed refuse as a supplementary fuel in a stoker-fired boiler. H. H. Krause, D. A. Vaughan, P. W. Cover, W. K. Boyd (Battelle Columbus Laboratories, Columbus, Ohio), and R. A. Olexsey (U.S. Environmental Protection Agency, Industrial Environment Research Laboratory, Cincinnati, Ohio) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec. 10-15, 1978, Paper 78-WA/Fu-4* 9 p. 6 refs. Members, \$1.50, nonmembers, \$3.00.

The utilization of shredded and magnetically separated municipal refuse to supplement high-sulfur coal as fuel in a stoker-fired boiler was investigated, using the facilities of the Columbus, Ohio, Municipal Electric Plant. Corrosion probe exposures were used to show the effectiveness of cofiring with high-sulfur coal to reduce chloride corrosion of boiler tube metals by refuse. Reduced emissions of SO₂ from the high-sulfur coal also resulted from dilution of the coal with refuse and by action of alkaline components of the refuse. It was demonstrated that 700 hr corrosion rates with refuse and high-sulfur coal were 5-10 times less than those with bulk refuse burning, and approximated those from coal alone. In some runs sulfur dioxide emissions were reduced by about ten percent more than the refuse dilution factor. The cofiring with refuse had no significant effect on grate ash composition, but the ash fusion temperature was lowered about 100 F.

(Author)

A79-19789 # Trace element emissions from coal-fired power plants. F. B. Meserole, K. Schwitzgebel, R. A. Magee, and R. M. Mann (Radian Corp., Austin, Tex.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec. 10-15, 1978, Paper 78-WA/Fu-9* 12 p. 5 refs. Members, \$1.50, nonmembers, \$3.00.

The emission rates for 27 major, minor and trace elements from four coal-fired electrical generating stations are presented. The flow rates of each element in each process stream entering and leaving the power plant are given for three of the stations. The exit streams

include bottom ash, collected ash and fly ash and vapors in the exhausted flue gases. Elemental material balances were calculated to assess the reliability of the results. The elemental compositions of the particulates in the flue gas were determined as a function of particle size for two stations, one of which was included in the previous material balance study. The two stations studied during this phase used hot-side and cold-side electrostatic precipitators, respectively, to collect fly ash. The concentration effects were evaluated to determine whether the gas temperature during particulate collection affects the distribution characteristics of the elements enriched at the fly ash surfaces.

(Author)

A79-19790 # Thermophoresis - Enhanced deposition rates in combustion turbine blade passages. G. Vermes (Westinghouse Electric Corp., Combustion Turbine Systems Div., Eddystone, Pa.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec. 10-15, 1978, Paper 78-WA/GT-1* 5 p. 9 refs. Members, \$1.50, nonmembers, \$3.00.

Thermophoresis is proposed as an explanation of the finding that, in turbine cascades, the temperature difference between the cooled wall and the hot working gas significantly increases the deposited fraction of the solid material. Thermophoresis involves the movement of small particles toward colder regions under the influence of a thermal gradient in the continuum surrounding them, and a thermophoresis calculation procedure based on the Einstein/Epstein formula and simplified cascade considerations is presented. Results are compared with laboratory and field data. The percentage of material deposited is also referred to as the catch efficiency. Data from residual oil-burning turbines show that a 300 C temperature difference between gas and wall can cause a fifteenfold increase in deposition rate as compared with the case of the adiabatic cascade.

M. L.

A79-19791 # Design and development of a monorotor gas turbine auxiliary power unit. C. Rodgers *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec. 10-15, 1978, Paper 78-WA/GT-2* 13 p. Members, \$1.50, nonmembers, \$3.00.

A description is presented of the design and development phase of the T-62T-42 monorotor which was shown to fulfill all its design objectives and satisfactorily perform a 50-hour endurance run. The monorotor engine represents one possible solution to a high-temperature, low-cost, small gas turbine. In the monorotor engine a single-stage radial compressor and turbine are integrated back to back and the hot turbine is directly cooled by the cold compressor. A noncontact tip seal is provided to isolate the compressor and turbine flow paths through which a small fraction of throughflow leakage is intentionally directed to serve as additional turbine hub film cooling. Attention is given to aspects of compressor design and influence of heat transfer, questions of turbine design and heat transfer, the monostator design, tip seal considerations, a thermal analysis, a monorotor stress analysis, a T-62T-42 engine description, and a performance evaluation.

G. R.

A79-19796 # Program to establish ceramic technology readiness for large combustion turbine utility application. K. L. Rieke (Westinghouse Electric Corp., Combustion Turbine Systems Div., Crum Lynne, Pa.) and S. M. Wander (U.S. Department of Energy, Div. of Power Systems, Washington, D.C.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec. 10-15, 1978, Paper 78-WA/GT-8* 9 p. 20 refs. Members, \$1.50, nonmembers, \$3.00. Research supported by the U.S. Department of Energy.

The use of ceramic technology in combined cycle utility turbines shows the potential of realizing cycle efficiency of the order of 51% on coal-derived liquid fuels. Review of the available ceramic materials and their existing property data base show the need for materials development and characterization during a materials and design methodology development program to advance the current state-of-the-art in component design and life time prediction (reliability) for large utility turbine long time application. The conceptual

turbine design studies, based on limited short time fast fracture materials data show the feasibility of design using structural ceramics. Studies have shown that the use of combustor shell bleed is a feasible means of limiting shutdown transient stresses during the emergency shutdown to idle when loss of load occurs because of an unscheduled event opening the generator breaker G R

A79-19808 # Slag transport models for radiant heater of an MHD system L S H Chow, T R Johnson (Argonne National Laboratory, Argonne, Ill), and R Viskanta (Purdue University, Lafayette, Ind) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/HT-21* 10 p 13 refs Members, \$1 50, nonmembers, \$3 00 Research supported by the U S Department of Energy

The paper is concerned with the slag film flowing on a cooled vertical wall of a radiant heater through which combustion gases are passing. Two slag film models are used to predict the thermal performance and slag film characteristics in a radiant heater. Calculations for a specific combustion gas flow rate are reported, and the results show that the semitransparent model predicts a hot gas-to-cooled wall heat flux approximately 50% higher and a slag surface temperature approximately 250 K lower than does the opaque model. Radiation from entrained particles is considered, and the effects of semitransparency on NO_x decomposition and seed-slag interaction are discussed. The need for experimental data on optical properties, heat transport characteristics, and particle radiation is stressed M L

A79-19809 # Experimental measurements and correlations of Nusselt number for MHD high temperature air preheaters H W Townes, C J Mozer, T C Reihman, and T A Ameel (Montana State University, Bozeman, Mont) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/HT-22* 6 p 13 refs Members, \$1 50, nonmembers, \$3 00 Contract No EF-77 C-01-2524

A description is presented of the results obtained in an experimental program in which the pressure drop and heat transfer behavior of MHD high-temperature air preheaters is studied for clean and for slag-laden flows. A 19-flow hole sector representative of the central region of a 5.8 m long cored ceramic brick regenerative heat exchanger was used in the investigation. The air preheater is cycled between reheat and blow-down modes of operation. Typical cycle times are 6 minutes of reheat and 4 minutes of blowdown. The facility is instrumented to measure all pertinent flows, pressures, and temperatures for control and for fluid flow and heat transfer studies. The Nusselt number and Reynolds number were evaluated at 15 axial locations through the core. The Nusselt number-Reynolds number data pairs were stored in a reduced data matrix, plotted, and curve fitted with various functional forms G R

A79-19810 # Gas stream composition and temperature determination in a coal-fired MHD simulation facility R E Powe (Mississippi State University, Mississippi State, Miss) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/HT-23* 10 p 7 refs Members, \$1 50, nonmembers, \$3 00 Contract No EX-76-C-01-2246

A minicomputer controlled and monitored test stand for simulation of the gas stream conditions which will exist in various components of a coal-fired baseline MHD power plant and for evaluation of the substructures is described. Emphasis is devoted to the thermal aspects of the design and operation of this facility. A comprehensive thermal model of the system is described, and this model is employed in conjunction with an existing code for complex chemical equilibrium calculations to develop a sensitivity analysis for both temperature and chemical composition determination in the experimental facility (Author)

A79-19813 # Conceptual design of large heat exchangers for ocean thermal energy conversion B E Dawson (Foster Wheeler Energy Corp., Livingston, NJ) and C M Robidart (Lockheed

Missiles and Space Co., Inc., Sunnyvale, Calif) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/HT-32* 7 p Members, \$1 50, nonmembers, \$3 00

The closed cycle OTEC concept uses an ammonia working fluid in a Rankine cycle to produce power from the seawater temperature differential. A conceptual design study was made for state-of-the-art heat exchangers which would evaporate and condense the ammonia. The purpose of the study was to determine the most cost effective design for the horizontal, shell-and-tube type heat exchangers. The design variables included the design pressure which depended on whether the heat exchangers were mounted on a surface platform or were submerged, the size of each module, the shape of the shell, the material, and the tube size. The cost trade study is discussed, and weight and cost are shown as a function of the design variables. The selected design was an aluminum heat exchanger with a spherical shell and a 3.81 cm (1.50 in) diameter heat transfer tube with an extended surface (Author)

A79-19814 # The role of interfacial heat and mechanical energy transfers in a liquid-metal MHD generator G Fabris (Argonne National Laboratory, Argonne, Ill) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/HT-33* 8 p 5 refs Members, \$1 50, nonmembers, \$3 00 Research sponsored by the U S Department of Energy and U S Navy

A brief description of the two-phase liquid-metal MHD power generation cycle and its advantages is provided. The importance of good interfacial liquid to gas heat transfer is discussed, and data confirming that satisfactory heat transfer is indeed achieved in an experimental generator is presented. An expression for the effect of the velocity difference between the gas and the liquid on generator performance is derived. An 'equivalent turbine' efficiency is defined to characterize the generator as part of a heat engine and related to experimental data (Author)

A79-19815 # Development of compact heat exchangers for Ocean Thermal Energy Conversion (OTEC) systems J G McGowan, W E Heronemus, and R Braren (Massachusetts University, Amherst, Mass) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/HT-34* 14 p 31 refs Members, \$1 50, nonmembers, \$3 00 Contract No EG 77-S-02-4238

The concept of ocean thermal energy conversion has emerged as a large-scale solar driven alternative source of energy. Several investigators have considered various heat exchanger designs and overall systems designs and generally have concluded that the heat exchangers dominate OTEC system economics (approximately 50 percent of total capital costs). Developments regarding the use of compact heat exchangers in OTEC systems are considered. It is found that the successful development of compact heat exchangers, with lower capital costs per unit of power output, reduced physical size, and improved maintenance characteristics, is most important for the future success of the US OTEC program. A summary is provided regarding analytical and design studies conducted with respect to compact heat exchangers. An evaluation shows that evaporators and condensers based on compact panel assemblies are feasible from both a performance and manufacturing standpoint G R

A79-19824 # The analysis of heat transfer with and without condensation in a heat pipe heat exchanger R C Prager and T H Sun (Hughes Aircraft Co., Torrance, Calif) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/HT-59* 7 p 7 refs Members, \$1 50, nonmembers, \$3 00

In most heat pipe heat exchangers, the fluid streams will be in counterflow, and the inlet temperatures and the volume or mass flow rates of each stream are known. The simplest analysis under these conditions is provided by the effectiveness method reported by Kreith (1967). An expression for the effectiveness of a counterflow

heat exchanger is derived by Kays and London (1964) The effectiveness is used to determine the heat transfer performance of the unit In the case of the heat transfer with condensation involving the combined heat and mass transfer problem which occurs when condensation takes place, it was decided that the only scheme that would have any chance of success was some form of a numerical, iterative technique A three-node thermal model which characterizes flow through a single heat pipe module is shown A computer program using the considered analysis scheme was written and used to study sample cases G R

A79-19825 # The use of heat exchangers with THERMO-EXCEL's tubing in ocean thermal energy power plants T Torii, S Hirasawa, H Kuwahara, T Yanagida, and K Fujie (Hitachi, Ltd, Mechanical Engineering Research Laboratory, Tsuchiura, Ibaraki, Japan) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/HT-65* 8 p 12 refs Members, \$1 50, nonmembers, \$3 00

An experiment was conducted to check the performance of THERMOEXCEL's tubing using ammonia The characteristic feature of the tubing, that is a higher heat flux can be obtained even at a relatively small temperature difference, was confirmed Tentative calculation gave 2,710 W/sq m K for evaporator and 3,270 W/sq m K for condenser for the values of overall heat transfer coefficient These values show a promising future for the conventional shell and tube heat exchangers with THERMOEXCEL's tubing Other experimental results relevant to the design of the proposed heat exchangers are discussed (Author)

A79-19826 # Nuclear characteristics of D-D fusion reactor blankets - Technical data H Nakashima, M Ohta (Kyushu University, Fukuoka, Japan), and Y Nakao *Kyushu University, Faculty of Engineering, Memoirs, vol 38, Sept 1978, p 275-300* 14 refs

Technical data on the nuclear characteristics of D-D fusion reactor blankets are presented as a supplement to Nakashima and Ohta (1978) Topics considered include the internal spectral shifter and energy converter, effects of neutron source ratio, the molten salt blanket, and the B4C cooled blanket Bench-mark calculations of (H-T)B, (H-T)MG/(H-T)B, and phi-MG/phi-M are reported for an example of D-D blankets Some problem areas and research needs are examined, and it is suggested that higher-order approximation than P3-S4 should be used for deep penetration problems such as the problem involving the shielding design of a superconducting magnet The importance of finding a way of using the 'free' neutrons effectively is stressed M L

A79-19832 # Structural design of a superheater for a central solar receiver T V Narayanan, G D Gupta, and M S M Rao (Foster Wheeler Development Corp., Livingston, N J) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/PVP-1* 8 p 12 refs Members, \$1 50, nonmembers, \$3 00 Research supported by Martin Marietta Aerospace, Contract No E(04 3)-1110

The paper deals with the design analysis approach and the evaluation criteria used in a solar superheater regarded as a critical component of the receiver in a central solar thermal power system Attention is given to structural design considerations, where the effects of various parameters on the design of the superheater are assessed These parameters include heat flux, film coefficient, fluid temperature, tube geometry, and material properties The structural evaluation of the solar superheater is outlined, where the life prediction of the solar superheater is considered along with the ways in which creep, fatigue, and their interactive effects can be treated so that the superheater would withstand the thermal and cyclic loads for the desired lifetime However, the evaluation procedure needs validation through testing and operational experience S D

A79-19834 # Limitations of solar assisted heat pump systems D C Hopkins and C W Chiang (South Dakota School of Mines and Technology, Rapid City, S Dak) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif.,*

Dec 10-15, 1978, Paper 78-WA/Sol-1 7 p 17 refs Members, \$1 50, nonmembers, \$3 00 Research supported by the Spearfish School Board, Contract No EG-77-A 03-1509

A simulation study is conducted to determine if there is a combination of climate and heat-pump system design such that a solar-assisted heat pump would be more advantageous than the same heat pump used in a conventional manner as backup The analysis includes a steady-state simulation using variable climatic parameters and a transient simulation using real weather data for a typical year at Rapid City, S Dak (44 1 deg N) Both simulations indicate that it is very seldom that the series combination - the solar-assisted heat pump system - is more efficient than the parallel combination Similar results are found for a Carnot heat pump M L

A79-19835 # Parametric analysis of power conversion systems for central receiver solar power generation S C Kuo, T L O Horton, and H-T Shu (United Technologies Research Center, East Hartford, Conn) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec. 10-15, 1978, Paper 78-WA/Sol-2* 10 p 8 refs Members, \$1 50, nonmembers, \$3 00 Research supported by the U S Department of Energy

This paper presents the results of a comprehensive study to provide parametric performance and cost estimates for the power conversion systems (PCS) portion of an advanced solar central receiver power plant which is intended for operation in a 10-MWe pilot plant by 1985 and a 100-MWe demonstration plant by 1990 PCS system design-point performance, component size, and cost characteristics based on the closed-cycle gas turbine systems using air as the working fluid, were analyzed by variation of the principal system parameters identified The interface requirements for the PCS with the central receiver and the heat rejection system (i.e., cooling tower) were identified in terms of temperature, pressure, and flow rate, and the significance of parametric variation on the tradeoffs between efficiency and cost of the PCS and its potential impact on the overall solar plant economics are discussed (Author)

A79-19836 # Numerical computation of the loss coefficients for evacuated cylindrical collector receiver tubes M F Young and P E Jenkins (Texas A & M University, College Station, Tex) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Sol-3* 10 p Members, \$1 50, nonmembers, \$3 00

The numerical computation of the loss coefficients for evacuated cylindrical collectors, of one and two covers, are presented Wind speeds, receiver emissivities, ambient temperatures, collector area ratios, and receiver temperatures were varied in these computations The results are presented in terms of the loss coefficient ratios, i.e., evacuated to non-evacuated collector results The generalized loss coefficient is based on the outer-most surface area of the particular system under consideration, e.g., one or two cover systems The results show a significant reduction in the loss coefficients over the base non-evacuated configurations The decrease in the loss coefficient is more predominant in selective surface receiver tubes The importance of evacuation diminishes as receiver temperatures, wind effects, and ambient temperatures increase The calculation of the useful energy gain for evacuated cylindrical receiver collectors are made easier The tedious calculation process, for the loss coefficients under various conditions, has been performed and presented in tabular form for easy use (Author)

A79-19837 * # Efficiency degradation due to tracking errors for point focusing solar collectors R O Hughes (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Sol-4* 8 p Members, \$1 50, nonmembers, \$3 00 Research sponsored by the U S Department of Energy, Contract No NAS7-100

An important parameter in the design of point focusing solar collectors is the intercept factor which is a measure of efficiency and of energy available for use in the receiver Using statistical methods, an expression of the expected value of the intercept factor is derived for various configurations and control law implementations The

analysis assumes that a radially symmetric flux distribution (not necessarily Gaussian) is generated at the focal plane due to the sun's finite image and various reflector errors. The time-varying tracking errors are assumed to be uniformly distributed within the threshold limits and allows the expected value calculation (Author)

A79-19838 * # Solar receiver performance of point focusing collector system Y C Wu and L C Wen (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Sol-5* 10 p Members, \$1 50, nonmembers, \$3 00 Research sponsored by the U S Department of Energy

The solar receiver performance of cavity receivers and external receivers used in dispersed solar power systems was evaluated for the temperature range 300-1300 C. Several parameters of receiver and concentrator are examined. It was found that cavity receivers are generally more efficient than external receivers, especially at high temperatures which require a large heat transfer area. The effects of variation in the ratio of receiver area to aperture area are considered M L

A79-19839 # 1MW calorimetric receiver for Solar Thermal Test Facility L O Seamon, E E Rush (Sandia Laboratories, Albuquerque, N Mex.), and C E Moeller (Black and Veatch, Consulting Engineers, Kansas City, Mo.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Sol-7* 6 p Members, \$1 50, nonmembers, \$3 00 Research supported by the U S Department of Energy

A calorimetric solar receiver is described for measuring incident and absorbed solar radiation reflected from the heliostat field at the Department of Energy's 5MW Solar Thermal Test Facility, Sandia Laboratories, Albuquerque, New Mexico. The receiver consists of nine 1-meter (3 28-ft) square panels in a 3-meter (9 84-ft) square array. Each panel is capable of absorbing 0 5MW of power, but the total array is limited to 1MW. Each panel is cooled by an ethylene glycol/water solution entering at 61 C (142 F) in a flow circuit parallel to the other panels. Each panel is instrumented with a turbine flowmeter, inlet and outlet coolant thermocouples, and nine heat flux gages with integral thermocouples on one third-meter grid spacings. Details of mechanical, electrical power, instrumentation, data acquisition, and structural designs are presented. Results from initial tests of concentrating up to 1MW of thermal power on the receiver are presented (Author)

A79-19840 # Performance evaluation of the New Mexico State University Solar House R L Matzkanin and T R Mancini (New Mexico State University, Las Cruces, N Mex.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Sol-8* 9 p 8 refs Members, \$1 50, nonmembers, \$3 00 Research supported by the Energy Research Board of New Mexico

The design features, operating principles, and performance of the liquid-type solar heating/cooling system in the New Mexico State University Solar House are described. The performance is evaluated for part of the 1977-1978 heating season. The system components include collectors, storage tank, auxiliary water heater, heat exchangers, and pumps and controls, the control system includes manual overrides in all modes of operation. Operation of the heating system is initiated by the demand signal from a conventional thermostat set by the occupants of the house. Data on solar radiation and ambient temperature are presented. The heating loads, collector array performance, and the energy delivered to storage are plotted. Also discussed are the operational costs of pumps and fans, along with system operation at low storage temperatures S D

A79-19841 # A Thermic Controller for a thermic diode solar panel S M H Khandani and S B Buckley (MIT, Cambridge, Mass.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec. 10-15, 1978, Paper 78-WA/Sol-9* 6 p Members, \$1 50, nonmembers, \$3 00

The purpose of the study was to design a Thermic Controller using stored heat to warm the interior of the buildings. The controller operates to maintain the interior temperature of the building at an arbitrary set point. The controller design was theoretically investigated and modeled, a computer simulation verified the theoretical model. An experimental model was built which simulated the actual building-heating situation. The experimental model verified the assumption of the theoretical analysis. The accuracy of the controller allowed the simulated building's temperature to be held within + or - 3 F of the desired set point (Khandani, 1976) (Author)

A79-19842 # Cooling applications of thermic diode panels. J J Manzano and S B Buckley (MIT, Cambridge, Mass.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Sol-10* 10 p 11 refs. Members, \$1 50, nonmembers, \$3 00 Research supported by the U S Department of Energy

A theoretical study of the feasibility of using thermic diode panels to cool large buildings shows promising results. Semi-empirical correlations and heat transfer equations are combined to produce a mathematical model which is implemented into a computer program. Weather data, geometry and physical parameters are used as inputs to the model in order to simulate the system's performance. The data generated by the computer is correlated in terms of non-dimensional parameters which simplify the design task. Good performance was obtained for shopping centers in the American Southwest, where cooling is needed during much of the year (Author)

A79-19843 # A theoretical analysis of solar collector/storage panels D A Fender (Ecolaire Condenser, Inc., Lehigh Valley, Pa.) and J R Dunn (Texas Tech University, Lubbock, Tex.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Sol-11* 9 p 9 refs Members, \$1 50, nonmembers, \$3 00

A theoretical model for the evaluation of the transient performance of a thermosyphoning type solar energy collection and heat storage (CS) panel is derived and analyzed. Use is made of an analytical method developed by Ostrach for analyzing fully developed natural convection in a vertical, symmetrically heated channel that is extended for use with numerically implicit boundary conditions involving glazing convection and radiation and explicitly determined wall heat conduction. A numerical simulation is used to establish CS panel operating characteristics and design criteria for performance optimization assuming the storage wall is insulated. Results indicate that low solar thermal efficiencies and hourly panel operating factors for the insulated wall are obtainable only during mild, sunny weather. The strong effects of ambient air temperature indicate the importance of cover design for this system (Author)

A79-19844 # Solar collector storage panel L Graham (Illinois Institute of Technology, Chicago, Ill.) and J Stice (Kalwall Corp., Manchester, N H.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/SOL-12* 9 p Members, \$1 50, nonmembers, \$3 00

The solar collector storage panel is described. This rotating passive heating system combines thermal storage and insulation in a panel which resembles a large flat shutter or a Venetian blind. Materials that melt at temperatures slightly above room temperature are used for thermal energy storage. The panels are placed directly behind a window and within a room to be heated, and the procedures for controlling heat loss and room temperature by rotating, opening, and closing the panels are described. Test results for prototype panels and preliminary results of computer simulation are considered M L

A79-19845 # On the optimisation of Trombe wall solar collectors E Bilgen and R Jeldres (Ecole Polytechnique, Montreal, Canada) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Sol-13* 6 p 9 refs Members, \$1 50, nonmembers, \$3 00

A79-19847

In this study, the transfer of solar radiation in a Trombe wall solar collector-heat storage system is studied theoretically and the results are compared to the experimental measurements obtained in the 1967 prototype solar house of CNRS in Odeillo, France. The optimum thickness of the wall is found to be 0.40 m for the conditions of the prototype house (Author)

A79-19847 # Design of a freon jet pump for use in a solar cooling system F Zeren, R E Holmes, and P E Jenkins (Texas, A & M University, College Station, Tex.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec. 10-15, 1978, Paper 78-WA/Sol-15* 10 p 18 refs Members, \$1 50, nonmembers, \$3 00

The utilization of a solar energy to drive a vapor compression cooling system is considered. The compression is accomplished by use of a vapor jet pump. The functioning of a system using freon 12 in both the solar collector and in the cooling system is explained. Equations are presented for the design of the jet pump. As an example, a freon vapor jet pump is designed for a cooling load of 14,000 BTU/hr (3528 K cal/hr) (Author)

A79-19848 # Stochastic predictions of solar cooling system performance D K Anand, I N Deif, and R W Allen (Maryland, University, College Park, Md.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/Sol-16* 13 p Members, \$1 50, nonmembers, \$3 00 Contract No. EY 76-S-05-4976-A003

A two-part stochastic (probabilistic) method for generating synthetic weather profiles is described that takes a large base of weather data, and while retaining essentially the weather's history, compacts the information to a most convenient form for use in computer simulation. The first part is a purely statistical procedure in which a data base of weather is sorted out, and averages and standard deviations are calculated. The second part involves the development of an analytical model by using a least-squares error technique for the data base of weather. The method provides reconstruction of the data in the form of a single day's weather information. It is applied to five U.S. cities with diversity in climate and geography. Comparison of stochastic and real weather results show that the stochastic weather method compares well with the real weather approach, but at much reduced cost and data handling. S D

A79-19849 * # Accelerating the commercialization on new technologies T J Kuehn and P M Nawrocki (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *American Society of Mechanical Engineers, Winter Annual Meeting, San Francisco, Calif., Dec 10-15, 1978, Paper 78-WA/TS-4* 15 p 7 refs Members, \$1 50, nonmembers, \$3 00

It is suggested that federal programs for hastening the adoption of alternative energy sources must operate within the free market structure. Five phases of the free market commercialization process are described. Federal role possibilities include information dissemination and funding to stimulate private sector activities within these five phases, and federally sponsored procedures for accelerating commercialization of solar thermal small power systems are considered. M L

A79-19851 # Mass transfer in a current source during circulation of the mixture driven by gaseous reaction products (Massopereenos v istochnike toka pri tsirkulatsii rastvora za schet gazoobraznykh produktov reaktsii) N V Korovin, G N Maksimov, and A V Modestov (Moskovskii Energeticheskii Institut, Moscow, USSR) *Energetika*, vol 21, Oct 1978, p 86-91 9 refs In Russian

In the present paper, the problem of gas-driven circulation in a fuel cell is formulated for a bicyclic system of reagent supply. Relations are derived, using which the flow rate of the solution can be determined as a function of the gas removal rate and the design parameters of the system. The mass transfer of the reagent is calculated for an air/hydrazine fuel cell in which the circulation is driven by the gaseous products of reactions occurring in the cell. V P

A79-19896 How to tap NASA developed technology N Ruzic (National Space Institute, Arlington, Va.) *Research Management*, vol 21, Nov 1978, p 38-40

Information is presented on the means by which NASA facilitates the transferability of NASA developed technology to areas other than the space programs. Special attention is called to NASA's Technology Utilization Branch and its Application Centers, whose function is to provide technical assistance and literature retrieval and to interact, via a person-to-person approach, with industry to solve problems by hand-adapting available space technology. Also mentioned are NASA's library, covering documents and technical reports from all over the world and every field (begun in 1963), the NASTRAN computer programs (more than 1600) that have value outside of the space program, the biochemical and technology application teams, and NASA's patent licensing program. Also presented is a sample illustration of the successful spinoffs in the fields of energy, the environment, safety, health, industrial productivity, and recreation, particularly noting heat pipes, the rechargeable cardiac pacemaker, etc. A A

A79-19949 Effect of physical properties of a flat plate solar collector cover on efficiency calculations - Simplifying hypotheses (Influence des propriétés physiques de la couverture d'un capteur solaire plan sur la détermination de son rendement - Hypothèses simplificatrices) S Aikawa, P Gallet, and F Papin (Aix Marseille I, Université, Marseille, France) *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques*, vol 287, no 11, Oct 30, 1978, p 261-264 In French

Radiation efficiencies corresponding to different simplifying hypotheses regarding cover physical properties for calculating yield of flat plate solar collectors are compared. Results closest to experimental ones were obtained for calculation methods that took into account reflection and absorption and assumed (1) equal temperature at both sides of the cover, or (2) finite conductivity. P T H

A79-19975 Efficiency improvement by means of multi-component processes - Improvement of the efficiency of heat-power transformation by means of an employment of Clausius-Rankine sorption processes (Wirkungsgradverbesserung durch Mehrstoffprozesse - Verbesserung des Wirkungsgrades bei der Wärme-Kraft-Umwandlung durch Anwendung von Clausius-Rankine-Sorptionsprozessen) G Alefeld (München, Technische Universität, München, West Germany) *Energie*, vol 30, Nov 1978, p 398-409 31 refs In German

It is possible to enhance the efficiency of heat-power transformation procedures considerably without any significant increase in the values of the pressures and temperatures currently used in power generation. An approach for doing this is provided by the Clausius-Rankine sorption processes. Such processes are defined and discussed with the aid of diagrams. The diagrams can be used for a comparison of the considered processes of the absorption heat pump. A corresponding analysis provides, in addition, also a unified description of work-performing processes with multicomponent working fluids, the compression heat pump with solution cycle, and the absorption heat pump. G R

A79-20078 * # Fuel conservative aircraft engine technology D L Nored (NASA, Lewis Research Center, Cleveland, Ohio) In *International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings Volume 1* Cologne, International Council of the Aeronautical Sciences Secretariat (DGLR), 1978, p 11 26 22 refs

NASA's Aircraft Energy Efficiency Program, initiated in an effort to minimize the adverse impact of the worldwide fuel crisis, will develop technology for more fuel-efficient subsonic transport aircraft. The program includes three major propulsion projects: (1) Engine Component Improvement, directed at current engines, (2) Energy Efficient Engine, directed at new turbofan engines, and (3) Advanced Turboprops, directed at technology for advanced turboprop-powered aircraft. The present paper reviews the current

status of each of these projects and describes some of the technologies and recent accomplishments B J

A79-20084 # Drag reduction by cooling in hydrogen fueled aircraft E Reshotko (Case Western Reserve University, Cleveland, Ohio) In International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings Volume 1 Cologne, International Council of the Aeronautical Sciences Secretariat (DGLR), 1978, p 96-106 25 refs

Drag reductions are possible for cryo-fueled aircraft by using the fuel to cool selected aerodynamic surfaces on its way to the engines. This is because cooled laminar boundary layers in air at subsonic and low supersonic speeds are more stable than adiabatic boundary layers and therefore more resistant to transition to turbulent flow. Calculations for a $M = 0.85$ hydrogen-fueled transport show that drag reductions in cruise of about 20% are within reason. The weight of the fuel saved is well in excess of the weight of the required cooling system. These results suggest that the hydrogen-fueled aircraft employing surface cooling is quite attractive as an energy conservative aircraft and warrants more detailed study (Author)

A79-20085 # Ceramic materials for vehicular gas turbine applications. W Bunk (Deutsche Forschungs und Versuchsanstalt für Luft- und Raumfahrt, Institut für Werkstoff-Forschung, Cologne, West Germany) In International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings Volume 1 Cologne, International Council of the Aeronautical Sciences Secretariat (DGLR), 1978, p 107-114 15 refs

The paper focuses on the German R & D program in the field of ceramic components for vehicular gas turbine applications. The primary aims of the program are the attainment of (1) service temperatures of up to 1350 C in an effort to gain higher efficiency, and (2) low fuel consumption and more flexibility in the type of fuel used. The state of the art of ceramic material development for gas turbine engines is reviewed with reference to such advanced materials as reaction bonded silicon nitride, hot pressed silicon nitride, and silicon carbide, attention is also given to hot isostatic processing, the microstructure of new ceramics, and the creep properties at high temperature of such materials. The use of ceramics for such components as rotors, heat exchangers, and combustors is discussed B J

A79-20087 * # Recent advances in convectively cooled engine and airframe structures for hypersonic flight H N Kelly, A R Wieting, C P Shore, and R J Nowak (NASA, Langley Research Center, Hampton, Va) In International Council of the Aeronautical Sciences, Congress, 11th, Lisbon, Portugal, September 10-16, 1978, Proceedings Volume 1 Cologne, International Council of the Aeronautical Sciences Secretariat (DGLR), 1978, p 137-151 31 refs

Research over the past decade has identified critical thermal/structural design problems and has produced viable design concepts for a second generation experimental scramjet. The design concepts for the hydrogen fuel-cooled engine structure involve a variety of innovative features to accommodate the harsh aerothermal environment encountered within the engine. The baseline concept which has evolved has reasonable mass characteristics, and cooling requirements which permit engine operation to Mach 9-10 without additional hydrogen for engine cooling. Studies have identified fabrication techniques and coolant passage configurations that increase fatigue life of the structure an order of magnitude over previous configurations B J

A79-20139 Frequency distribution of wind speed near the surface D A Stewart and O M Essenwanger (US Army, Missile Research and Development Command, Redstone Arsenal, Ala) *Journal of Applied Meteorology*, vol 17, Nov 1978, p 1633-1642 24 refs

The purpose of this paper is to provide information about frequency distributions of wind speed near the surface of the earth

There has been a recent increased interest in this topic because of the potential for obtaining electrical energy from wind power. Frequency distributions of wind speed from a large collection of data are examined. Most distributions are skewed to the right and the mean is usually greater than the median. Experience has shown that the Weibull distribution provides a good analytical approximation to the cumulative distribution and is particularly useful for the 90-99% thresholds. Two methods of fitting a Weibull distribution with a nonzero location parameter are discussed. Both of these methods require less computational effort than the maximum likelihood solution for a three-parameter model and are suitable for practical use by the engineer. It is shown that the three parameter model is better than the two-parameter model for predicting extreme values (Author)

A79-20216 Merocyanine organic solar cells A K Ghosh and T Feng (Exxon Research and Engineering Co., Linden, N J) *Journal of Applied Physics*, vol 49, Dec 1978, p 5982-5989 25 refs

The high-efficiency Al/merocyanine/Ag organic solar cell is basically a Schottky barrier device except that an interfacial oxide layer between the barrier-forming metal and the merocyanine film increases the efficiency. The cell can therefore be considered as an MIS device. In this paper, a theoretical model is presented that accounts for the observed photovoltaic properties of the merocyanine dye. The model involves the generation, transport, and surface dissociation of excitons and field dependent quantum efficiency. One of the major limitations in the merocyanine cell is the field dependence of quantum efficiency. The quantum efficiency, and hence the sunlight engineering efficiency, can be increased by increasing the built-in diffusion potential. The model is believed to be applicable to other organic photovoltaic cells S D

A79-20244 The sodium/sulfur battery - A storage battery for peak load adjustment and electric traction (Die Natrium/Schwefel-Batterie - Ein Speicher für den Spitzenlastausgleich und die Elektrotraktion) W Fischer (Brown, Boveri et Cie AG, Heidelberg, West Germany) *Metall*, vol 33, Jan 1979, p 38-41 In German

The development, operation and prospects of sodium/sulfur batteries are described, and applications of improved sodium/sulfur batteries are considered. It is thought that future batteries of this type will be cheaper and longer lasting than lead batteries and will also outperform lead batteries by storing four times the amount of energy per unit weight. Possible applications of the sodium/sulfur batteries for peak load adjustment and for providing motive force for vehicles are discussed M L

A79-20273 # Rotating strength of glass carbon fiber-reinforced hybrid composite discs T Hattori (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Tsuchiura, Ibaraki, Japan), K Ikegami, and E Shiratori (Tokyo Institute of Technology, Yokohama, Japan) *JSME, Bulletin*, vol 21, Nov 1978, p 1595-1601 10 refs

The rotating strength of a circumferentially fiber-reinforced disk depends on the radial strength of disk material. Increasing the rotating strength of the disk of a given composite material requires to reduce the maximum radial stress as much as possible. The utilization of the hoop effect of the outer fiber layer of high elastic modulus, as a method of reducing the radial stress, is theoretically investigated and experimentally confirmed with glass-carbon fiber reinforced hybrid disks. Applicability of the circumferentially fiber reinforced disk as a flywheel is discussed (Author)

A79-20342 Selection of thermal operating regimes for fuel cell reactor-condenser systems E N Bukreev, A B Guliaenko, A I Kalinchak, and Iu L Tonkonogii (Odesskii Tekhnologicheskii Institut Pishchevoi i Kholodil'noi Promyshlennosti, Odessa, Ukrainian SSR) (*Inzhenerno-Fizicheskii Zhurnal*, vol 34, Apr 1978, p 642-647) *Journal of Engineering Physics*, vol 34, no 4, Oct. 1978, p 431-435 Translation

The paper deals with an investigation of the influence of the thermal mode of the reactor/condenser system on the efficiency of an electrochemical current generator. The mass transfer characteristics of the system are examined, and the permissible range of variation of the fluid temperature at the reactor and condenser inputs is determined. A system of equations describing the system parameter interaction is derived and solved. Analysis of the solution reveals the existence of an optimal fluid temperature at the condenser input, which depends on the temperature selected for the reactor, and also the existence of an optimal transverse water vapor mass flow. This makes it possible to determine the optimal condenser area. V P

A79-20346 **New models of solar cells and prospects for their optimization** N S Lidorenko, V M Evdokimov, A K Zaitseva, M M Koltun, S V Riabikov, and D S Strebkov (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, no 3, 1978, p 3-17) *Applied Solar Energy*, vol 14, no 3, 1978, p 1-12 34 refs Translation

Consideration is given to the theory of solar cells with 'built-in' electric fields. The development of a method for determining impurity concentration profiles which would optimize the accumulation of carriers from the doped layer is discussed. Attention is given to infrared-transparent solar cells and to cells with two-sided sensitivity. The use of solar concentration techniques to increase the efficiency of solar arrays is discussed. Different types of matrix multijunction cells with various p-n junction configurations are described. The possibility of producing solar cells on the basis of the volume photovoltaic effect is discussed. B J

A79-20347 **Photoelectric properties of pCdTe-nCdS film heterojunctions** S A Azimov, Sh A Mirsagatov, and D T Rasulov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 3, 1978, p 18-24) *Applied Solar Energy*, vol 14, no 3, 1978, p 13-17 13 refs Translation

A study was performed to evaluate the spectral distribution of the collection coefficient, Q , of the thin-film pCdTe-nCdS heterojunction (a possible solar cell element) for different thicknesses of the wideband upper layer of CdS, the photo-volt-ampere characteristics were also determined for different levels of illumination. It is found that Q increases with increase in thickness of the CdS layer, at 5 microns, a Q of 0.94-0.95 is obtained in the 0.56-0.8 micron wavelength region. An analysis of photoelectrical and electrophysical measurements has shown that there is an r -region in the pCdTe-nCdS heterojunction. This r -region appears to be due to the vaporization of cadmium from the surface of sublimated CdTe films during cooling. B J

A79-20348 **Optimization and design of radiative heat-discharge system for energy unit with Stirling engine** G Ia Umarov, L M Drabkin, and V S Trukhov (Tashkentskii Institut Zhelezno-dorozhnogo Transporta, Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 3, 1978, p 25-30) *Applied Solar Energy*, vol 14, no 3, 1978, p 18-22 Translation

The paper presents a method of specific-area optimization for the radiative cooling-fin system of a Stirling-engine solar energy unit in a planetary environment. An expression is obtained which enables optimization by means of the most easily obtainable experimental characteristics of the Stirling cycle. A method for the design and calculation of a one-dimensional radiator of tube-membrane type is developed on the basis of results of Stirling-cycle optimization. B J

A79-20349 **Characteristics of silicon photoconverters with inversion layer** B I Gil'man, V V Kasatkin, Iu V Sorokin, Iu B Skokov, and M B Zaks (*Geliotekhnika*, no 3, 1978, p 31-38) *Applied Solar Energy*, vol 14, no 3, 1978, p 23-28 9 refs Translation

Experiments were performed to investigate the output characteristics of silicon solar cells with doped inversion layers, the function of these layers is to collect minority carriers in the space charge region. Output current and the shape of the volt-ampere characteristics are studied as a function of initial voltage, intensity and wavelength of illumination, as well as the geometrical dimensions of inversion regions. Spreading of the photocurrent in the inversion layer plays a dominant role in the conversion process. Ways to raise the energy conversion efficiency of this type of solar cell are discussed. B J

A79-20350 **Composite heliostats of large solar plants.** R A Zakhidov and A Sh Khodzhaev (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR) (*Geliotekhnika*, no 3, 1978, p 39-44) *Applied Solar Energy*, vol 14, no 3, 1978, p 29-33 8 refs Translation

A mathematical model has been developed for investigating the mutual shading of individual heliostats in a paraboloidal multiheliostat system. On the basis of an analysis of shading effects, formulas are obtained for the optimization of the dimensions and mutual positioning of heliostats. Computer calculations are used to determine optimization relations which can be used to establish operational modes and possible power losses for the solar system. The model can be applied to the analysis and optimization of solar tower systems. B J

A79-20351 **Determination of thermal contact resistances.** Ch Agabaev and N Ovezsakhvatov (Akademiia Nauk Turkmenkoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) (*Geliotekhnika*, no 3, 1978, p 51-55) *Applied Solar Energy*, vol 14, no 3, 1978, p 39-42 Translation

An experiment was conducted to investigate heat transfer between copper plates for the following conditions: (1) plates in contact, (2) plates separated by thin air gaps (0.5-1.0 mm), (3) plates separated by electrical insulation, and (4) plates separated by layers of scale. The heat source was an electric furnace and the test temperature range was 300-1000 K. Values of specific heat flux and total thermal resistance are presented for the four schemes of contact and for different temperatures. Total thermal resistance and temperature jumps are obtained for a heat flux of 130,000 W/sq m. The types of plate contact examined here are such that may be encountered in different types of solar energy systems, and particularly in solar thermoelectric generators. B J

A79-20352 **Fundamentals of mathematical modeling of solar-radiation regime energy structure** R B Salieva (Tashkentskii Elektrotekhnicheskii Institut Sviazi, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 3, 1978, p 62-71) *Applied Solar Energy*, vol 14, no 3, 1978, p 48-55 11 refs Translation

A statistical modeling procedure is presented for studying solar radiation distribution on the earth surface. The procedure is based on periodic observations of normal-incidence insolation, but can also be used to construct models for other components of solar radiation, including total, scattered, and reflected. The approach is a probabilistic one, viewing the influx of solar radiation as a stationary stochastic temporal process. The procedure can be used to evaluate performance indices for various solar energy systems. B J

A79-20354 **Calculating the photocurrent and maximum efficiency of film p-CdTe-n-CdS photocells** N Iunusov, Sh A Mirsagatov, and D T Rasulov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 2, 1978, p 6-13) *Applied Solar Energy*, vol 14, no 2, 1978, p 3-8 Translation

A79-20355 **Thermal deformations of solar-energy concentrators** V M Korolev, Iu I Machuev, A Nazarov, E V Sokolov, L A Solodovnikova, and V G Fokin (Akademiia Nauk Turkmenkoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) (*Geliotekhnika*, no 2, 1978, p 20-28) *Applied Solar Energy*, vol 14, no 2, 1978, p 13-19 Translation

Solodovnikova, and V G Fokin (Akademiya Nauk Turkmensoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) *Geliotekhnika*, no 2, 1978, p 20-28 In Russian

An analysis is presented of the symmetrical and obliquely symmetrical thermal deformations of a paraboloid-mirror concentrator. The concentrator is treated as a shell of revolution reinforced by radial and annular ribs and the thermal deformation of the reinforced structure is described by the differential equation of bending of an isotropic shell of revolution. As an illustration, attention is given to the thermal deformation of a concentrator with a diameter of 4.7 m. B J

A79-20356 Solar-to-thermal energy converter based on coaxial evacuated tubular elements with multilayer and selective coatings. V B Eliseev, M M Koltun, O A Nevezhin, V P Matveev, I P Gavrillova, A V Romankevich, S V Riabikov, and E M Lurin (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, no 2, 1978, p 29-40) *Applied Solar Energy*, vol 14, no 2, 1978, p 20-27 9 refs Translation

A79-20357 Using N2O4 in a solar gas-turbine plant. V V Chikovani and M S Dzitov (Geliotekhnika, no 2, 1978, p 41-45) *Applied Solar Energy*, vol 14, no 2, 1978, p 28-32 8 refs Translation

The use of N2O4 as the working fluid in a solar gas-turbine power plant is evaluated experimentally. An analysis of the turbine cycle has shown that the optimal conditions of utilization of N2O4 are characterized by its dissociation in the compressor and heat supply with 'frozen' expansion at the turbine. The optimal utilization of N2O4 enables a significant reduction in temperature before the turbine without a reduction in the thermodynamic efficiency as compared with the utilization of a monatomic gas as working fluid. B J.

A79-20358 Experimental investigation of the joint operation of wind and solar plants. B I Lemasov, I G Savchenko, A N Smirnova, and B V Tarnizhevskii (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, no 2, 1978, p 46-49) *Applied Solar Energy*, vol 14, no 2, 1978, p 33-35 5 refs Translation

The paper presents results of a year-long investigation of wind-power and solar-photovoltaic plants (with nominal outputs of 140 and 200 W, respectively) operating on a common load. The aim of the study was to determine the capacity of storage equipment during independent and joint operation of the plants. It is found that joint operation is significantly better than independent operation if the yearly cycle is divided into three parts with different levels of daily energy consumption. This is because the required capacity and nonuniformity of user supply are significantly less than in the case of independent operation. B J

A79-20359 Study of the dynamics of the materials melting process for a solar furnace. M G Shekorian and V V Shakhparonian (*Geliotekhnika*, no 2, 1978, p 53-57) *Applied Solar Energy*, vol 14, no 2, 1978, p 38-40 Translation

The paper presents results of an experimental investigation of the initial stages of melting of aluminum-oxide powder in a solar furnace with automatic control of radiative flux. The effect on the melting process of having the radiative flux emitted from different annular zones of the solar-concentrator surface is investigated. Attention is also given to the effect of cylindrical shading devices (an integral part of the flux-control system) on the melting process. B J

A79-20360 Thermal calculations for the reactor of a solar-power unit to produce hydrogen by thermolysis of water. Sh D Shakhbazov and P F Rzaev (Azerbaijdzhanski Politeknicheskii Institut, Baku, Azerbaijdzhans SSR) (*Geliotekhnika*, no 2, 1978, p 69-73) *Applied Solar Energy*, vol 14, no 2, 1978, p 49-53 6 refs Translation

A79-20361 Analysis of the characteristics of silicon photoconverters in the 100-400 K temperature range. L I Gromovoi, L I Tikhonov, M V Sedik, V G Doroshenko, and M B Zaks (*Geliotekhnika*, no 2, 1978, p 74-81) *Applied Solar Energy*, vol 14, no 2, 1978, p 54-60 9 refs Translation

A79-20411 Vaporization of drops of a melt of potassium carbonate in a medium of combustion products. Iu A Zakharko, G V Nabatov, M S Pinkhasik, and V D Cherkas (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 16, Mar-Apr 1978, p 356-359) *High Temperature*, vol 16, no 2, Sept 1978, p 293-296 5 refs Translation

In the present paper, the evaporation of droplets of a K2CO3 ionizing addition in the combustion products of an MHD generator is analyzed for temperatures between 1800 and 3000 K with allowance for possible chemical reactions. A solution of the heat and mass transfer equations is obtained under the assumption that reactions occur at the surface of the droplets. A strong influence of the KOH forming reaction on the evaporation rate is demonstrated. V P

A79-20413 Subsonic flow in the channel of an MHD-generator. N P Isakova and S A Medin (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 16, Mar-Apr 1978, p 377-383) *High Temperature*, vol 16, no 2, Sept 1978, p 310-315 8 refs Translation

A79-20415 The electric conductivity of a plasma of combustion products of hydrocarbon fuels with alkali impurity. V A Atrazhev, B V Zelener, and I T Iakubov (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 16, Mar-Apr 1978, p 396-410) *High Temperature*, vol 16, no 2, Sept 1978, p 326-341 56 refs Translation

The conductivity of various combustion product plasmas in electric and magnetic fields is analyzed. The electron-molecule scattering cross sections required in the numerical calculations are taken from the literature. The reliability of these data for conductivity calculations at temperatures between 2000 and 3000 K is assessed. Universal formulas for the conductivity and the Hall parameter are proposed for systematizing extensive experimental and numerical conductivity data over a wide range of pressures, temperatures, and alkali contents of the fuels. The influence of various factors, in particular of the type of addition, of the conductivity and the Hall parameter is evaluated. V P

A79-20418 Mathematical model of interelectrode breakdown in MHD generator. L P Poberezhskii (VNIIPromprogress, USSR) (*Teplofizika Vysokikh Temperatur*, vol 16, Mar-Apr 1978, p 435-437) *High Temperature*, vol 16, no 2, Sept 1978, p 367-369 19 refs Translation

A79-20419 Effect of the properties of the working body on the selection of the temperature of the surface of the electrodes of the channel of an MHD generator. A V Bagdonas, V A Bashilov, V L Bobrov, and Iu V Makarov (NPO Energiya, USSR) (*Teplofizika Vysokikh Temperatur*, vol 16, Mar-Apr 1978, p 438, 439) *High Temperature*, vol 16, no 2, Sept 1978, p 370-372 6 refs Translation

A79-20438 Toward a materials-conservation ethic. H H Kellogg (Columbia University, New York, N Y) *Metallurgical Transactions A - Physical Metallurgy and Materials Science*, vol 9A, Dec 1978, p 1695-1704 14 refs

The recognition that material resources, energy resources, and the environment are inevitably interrelated provides a common framework for unifying these apparently diverse problems. It is now seen that environmental alteration and depletion of energy resources are unavoidable 'costs' associated with exploitation of material

A79-20447

resources, and that either or both of these 'costs' may prove so large as to deter or prevent the use of some material resources. These three aspects of the materials cycle are reviewed, as it pertains to achievement of a future in which adequate materials are available for a satisfying life for everyone. The necessary components of a well-grounded materials-conservation ethic are presented as an indispensable foundation for a stable future of materials. Returnable vs one-way beverage-container systems are discussed as an example of efficient vs inefficient use of materials, energy, and the environment.

S D

A79-20447 **The need for closed service areas in a supply economy based on line networks (Zur Notwendigkeit geschlossener Versorgungsgebiete in der leitungsgebundenen Versorgungswirtschaft)** U Budenbender. *Energiewirtschaftliche Tagesfragen*, vol. 28, Dec 1978, p 735-743. 24 refs. In German.

Critical comments are presented regarding an expert opinion provided by Emmerich. Emmerich had considered the question whether an exceptional case with respect to legal regulations concerning cartels would be justified for a supply economy based on line networks, taking into account competitive considerations. The conclusions reached by Emmerich are briefly summarized and evaluated. It is found that the very particular situation of the line network-based energy economy has not been adequately taken into account by Emmerich. It is pointed out that the German structure of the electric-power and gas-supply economy has been found to be very well adapted to the particular energy-related requirements of the national economy. It is concluded that the considered changes of this system should be rejected.

G.R.

A79-20448 **Gas turbine with waste heat utilization - Low investment costs and high fuel use efficiency (Gasturbine mit Abhitzeverwertung - Niedrige Investitionskosten und hohe Brennstoffnutzung)** M Gard and J Saronen. *Energiewirtschaftliche Tagesfragen*, vol 28, Dec 1978, p 751-758. In German.

Investments related to power generation for industrial projects require careful investigations to assure economical operation. In the case of a firm in Finland, electrical power and steam was needed in connection with the production of paper. It was found in a study of various possibilities for obtaining the required energy that a solution based on the use of a gas turbine and a waste-heat boiler with a supplementary heating system would provide an approach involving the lowest investment costs and an optimal fuel utilization. The new gas turbine-generator system is used in parallel operation with existing back-pressure steam-turbosets. Attention is given to electric power and steam requirements, details of installation design, the employment of air-filter systems, the anti-icing system, and operational details.

G R

STAR ENTRIES

N79-10095*# National Aeronautics and Space Administration Langley Research Center Hampton Va
FUTURE LARGE SPACE SYSTEMS OPPORTUNITIES A CASE FOR SPACE-TO-SPACE POWER?
 L B Garrett and W R Hook *In its Large Space Systems Technol* Vol 1 1978 p 507-531

Avail NTIS HC A23/MF A01 CSCL 22B

Applications and options for beaming power to near-earth space users from a central space power platform are examined. The cost effectiveness of on-board versus remote power transfer is examined for orbital transfer propulsion systems. Performance characteristics are projected for advanced power generation transmission and receiver systems for the 1990s. Major technological development needs are identified with particular emphasis on large space systems technology. A R H

N79-10113*# Boeing Aerospace Co Seattle, Wash Research and Engineering Div
ELECTRICAL POWER LOSS FROM HIGH-VOLTAGE POWER CIRCUITS THROUGH PLASMA LEAKAGE
 Henry Oman *In NASA Langley Res Center Large Space Systems Technol* Vol 2 1978 p 1057-1070

Avail NTIS HC A22/MF A01 CSCL 22B

Methods are proposed for constructing a solar power satellite system which would decrease electric current leakage through plasma. L S

N79-10122*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
FUTURE ORBITAL POWER SYSTEMS TECHNOLOGY REQUIREMENTS
 Sep 1978 195 p refs Symp held at Cleveland 31 May - 1 Jun 1978
 (NASA-CP-2058 E-9713) Avail NTIS HC A09/MF A01 CSCL 10A

NASA is actively involved in program planning for missions requiring several orders of magnitude more energy than in the past. Therefore a two-day symposium was held to review the technology requirements for future orbital power systems. The purpose of the meeting was to give leaders from government and industry a broad view of current government supported technology efforts and future program plans in space power. It provided a forum for discussion through workshops to comment on current and planned programs and to identify opportunities for technology investment. Several papers are presented to review the technology status and the planned programs.

N79-10123*# National Aeronautics and Space Administration, Washington D C
OAST SPACE POWER TECHNOLOGY PROGRAM
 Jerome P Mullin *In NASA Lewis Res Center Future Orbital Power Systems Technol Requirements* Sep 1978 p 1-16

Avail NTIS HC A09/MF A01 CSCL 10A

The current research and technology (R and T) base program is first described, then special attention is directed toward outlining a new system technology specifically oriented toward providing the utility power plant technology base for semi-permanent earth orbital facilities expected to be needed in the middle to late 1980's. The R and T program involves five areas of research: (1) photovoltaic energy conversion, (2) chemical energy conversion and storage, (3) thermal-to-electric conversion, (4) environment interactions, and (5) power systems management and distribution. The general objectives and planned direction of efforts in each of these areas is summarized. G Y

N79-10125*# Aerospace Corp El Segundo Calif
HISTORICAL AND PROJECTED POWER REQUIREMENTS
 Malcolm G Wolfe *In NASA Lewis Res Center Future Orbital Power Systems Technol Requirements* Sep 1978 p 41-69 refs

Avail NTIS HC A09/MF A01 CSCL 10A

Policy planning for projected space power requirements is discussed. Topics of discussion cover (1) historical space power trends (prime power requirements and power system costs) and (2) two approaches to future space power requirements (mission/traffic model approach and advanced system scenario approach). Graphs, tables, and flow charts are presented. G Y

N79-10127*# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio

MILITARY NEEDS FOR ORBITAL POWER

L D Massie, R R Barthelemy and E T Mahefkey *In NASA Lewis Res Center Future Orbital Power Systems Technol Requirements* Sep 1978 p 93-107 refs

Avail NTIS HC A09/MF A01 CSCL 10A

Results of the DoD/ERDA (now Department of Energy) Space Power Study completed in October 1977 are presented. The major new thrust of Air Force Advanced Technology Plans center on the development of military solar power systems which will extend capabilities to the 10 - 50 KW sub e power range for new classes of missions while maintaining technology applicability to the 0.5 - 10 KW sub e present mission class. The status of FY78 efforts for Project 682J (Air Force Space Power Advanced Development Program) are reported. Project 682J is divided into the following tasks: (1) high efficiency solar panel, (2) nickel-hydrogen battery, (3) gallium arsenide solar concentrator hardness study, and (4) new-start nuclear dynamic power system applications/integration study. G Y

N79-10128*# National Aeronautics and Space Administration, Washington D C

SATELLITE POWER SYSTEMS PROGRAM

Ralph J LaRock *In NASA Lewis Res Center Future Orbital Power Systems Technol Requirements* Sep 1978 p 107-111

Avail NTIS HC A09/MF A01 CSCL 10A

The Department of Energy and NASA are engaged in an intense three-year analysis to determine what course of action the Federal government should pursue relative to this nonconventional energy system. Information is presented in the form of charts for the following: (1) program organization, (2) major program milestones, (3) activity schedule for the program, (4) preliminary baseline comparison by two Systems Definition Centers, and (5) program definition plan (funding by agency management responsibility). G Y

N79-10129*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

ALTERNATIVE POWER-GENERATION SYSTEMS

Robert E English *In its Future Orbital Power Systems Technol Requirements* Sep 1978 p 113-131 refs

Avail NTIS HC A09/MF A01 CSCL 10A

The present state of the art of thermal power systems is surveyed. Because of the great potential variety of thermal power systems, the heat sources, the power conversion systems, and the integration of thermal power systems with missions are treated sequentially. G Y

N79-10131*# National Aeronautics and Space Administration Marshall Space Flight Center Huntsville Ala

SOLAR ARRAY SYSTEMS

William L Crabtree *In NASA Lewis Res Center Future Orbital Power Systems Technol Requirements* Sep 1978 p 147-155

Avail NTIS HC A09/MF A01 CSCL 10A

The recent past, present state-of-the-art, and future needs in the area of large photovoltaic solar arrays are discussed. In

the past most attention was focused upon performance whereas in the future most of the effort should go into cost reduction. Suggestions are made regarding possible approaches to reducing cost such as on-orbit maintenance, extended lifetime solar concentrators, and high-voltage modular concepts. G Y

N79-10132*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
TECHNOLOGY STATUS BATTERIES AND FUEL CELLS
J Stuart Fordyce *In its* Future Orbital Power Systems Technol Requirements Sep 1978 p 157-166 refs

Avail NTIS HC A09/MF A01 CSCL 10A
The current status of research and development programs on batteries and fuel cells and the technology goals being pursued are discussed. Emphasis is placed upon those technologies relevant to earth orbital electric energy storage applications. G Y

N79-10133*# National Aeronautics and Space Administration
Lyndon B Johnson Space Center, Houston, Tex
TECHNOLOGY STATUS FUEL CELLS AND ELECTROLYSIS CELLS
Hoyt McBryar *In* NASA Lewis Res Center Future Orbital Power Systems Technol Requirements Sep 1978 p 167-194 refs

Avail NTIS HC A09/MF A01 CSCL 10A
The status of the baselined shuttle fuel cell as well as the acid membrane fuel cell and space-oriented water electrolysis technologies are presented. The more recent advances in the alkaline fuel cell technology area are the subject of a companion paper. A preliminary plan for the focusing of these technologies towards regenerative energy storage applications in the multi-hundred kilowatt range is also discussed. G Y

N79-10134*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
POWER MANAGEMENT AND CONTROL FOR SPACE SYSTEMS
Robert C Finke, Ira T Myers, Fred F Terdan, and N John Stevens *In its* Future Orbital Power Systems Technol Requirements Sep 1978 p 195-207

Avail NTIS HC A09/MF A01 CSCL 10A
Power management and control technology for the large high-power spacecraft of the 1980s is discussed. Systems weight optimization that indicate a need for higher bus voltages are shown. Environmental interactions that are practical limits for the maximum potential on exposed surfaces are shown. A dual-voltage system is proposed that would provide the weight savings of a high-voltage distribution system and take into account the potential environmental interactions. The technology development of new components and circuits is also discussed. G Y

N79-10139*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
AN ECONOMICAL APPROACH TO SPACE POWER SYSTEMS
Fred Teren *In its* Future Orbital Power Systems Technol Requirements Sep 1978 p 265-270

Avail NTIS HC A09/MF A01 CSCL 10A
Projected energy demand for all NASA DoD and civil missions for the time span 1981 to 1995 are illustrated. Typical energy cost range from about \$300 to \$2000 per kW-hr, with an average of about \$800 per kW-hr for long-duration missions. At these levels, the cost of the required energy would be several billion dollars per year by about 1985 and might constrain the number and types of NASA programs to be carried out. NASA is extensively pursuing approaches for reducing nonrecurring costs. Two programs are presented for the development of an economical approach to space power systems. They are (1) Economical Orbital Power (ECOP) with the objective to demonstrate the applicability of a commercial approach to the development of a low cost photovoltaic space power system, and (2) Space Power Experiment (SPEX) which has the objective to demonstrate the application of industrial hardware for space power systems. G Y

N79-10141*# Spectrolab Inc, Sylmar, Calif
SOLAR CELL WORKSHOP
Eugene L Ralph *In* NASA Lewis Res Center Future Orbital Power Systems Technol Requirements Sep 1978 p 275-277

Avail NTIS HC A09/MF A01 CSCL 10A
The workshop addressed three issues in respect to the NASA solar cell technology requirements for future orbital missions. First, technology areas were identified that were considered most significant and the deficiencies and concerns that were had with each area are indicated. Second, the tasks that should be undertaken to reduce the costs and risks of future orbital power systems are recommended. Third, an attempt to identify the lowest priority items in the present program in terms of content and timing are made. G Y

N79-10142*# TRW Defense and Space Systems Group, Redondo Beach, Calif
SOLAR ARRAY WORKSHOP
Paul Goldsmith *In* NASA Lewis Res Center Future Orbital Power Systems Technol Requirements Sep 1978 p 279-282

Avail NTIS HC A09/MF A01 CSCL 10A
The solar workshop began with a review of the needs and objectives in this area as presented by the various government representatives during the preceding sessions. The major problem noted with respect to needs was the potentially conflicting requirements of low cost and low weight. Since the importance of weight and cost and relationship between them are strongly mission dependent, the workshop concluded that the requirements of military missions in synchronous orbit could be quite different from the requirements of NASA low-orbit missions and that an assignment of specific technology deficiencies could only be related to specific mission classes. G Y

N79-10143*# National Aeronautics and Space Administration
Goddard Space Flight Center, Greenbelt, Md
BATTERY WORKSHOP
Richard H Sparks (TRW Defense and Space Systems, Redondo Beach, Calif) and Floyd E Ford *In* NASA Lewis Res Center Future Orbital Power Systems Technol Requirements Sep 1978 p 283-287

Avail NTIS HC A09/MF A01 CSCL 10C
The workshop was attended by representatives from industry and government. The requirements for energy storage and the plans for battery development were reviewed. The workshop followed a debate format, with the objective of recommending improvements to the development plans presented by NASA and the Air Force. The issues addressed were (1) significant technology deficiencies which can be identified, (2) adequacy of current and proposed programs to resolve the technology deficiencies identified, (3) additional tasks which should be undertaken including benefits and timing, and (4) lowest priority items in the presently planned program, both in content and in timing. G Y

N79-10178# Chicago Univ, Ill
COAL ANION STRUCTURE AND CHEMISTRY OF COAL ALKYLATION *Quarterly Progress*, 1 Jun - 31 Aug 1977
L M Stock 1977 6 p
(Contract EF-77-S-02-4227)
(COO-4227-2 QPR-2) Avail NTIS HC A02/MF A01

Work is in progress concerning the proton and carbon nuclear magnetic resonance spectra of butylated coal samples. The synthesis of perdeuteriotetralin was completed. The control experiments using tetralin as a reagent for the conversion of Illinois 6 in tetralin were completed. DOE

N79-10179# Battelle Pacific Northwest Labs, Richland, Wash
CHEMICAL PRODUCTION FROM WASTE CARBON MONOXIDE ITS POTENTIAL FOR ENERGY CONSERVATION
C A Rohrmann, G F Schiefelbein, P M Molton, C T Li, D C Elliott, and E G Baker Nov 1977 289 p
(Contract EY-76-C-06-1830)
(BNWL-2137) Avail NTIS HC A13/MF A01

Results of a study of the potential for energy conservation by producing chemicals from by-product or waste carbon monoxide(CO) from industrial sources are summarized Extensive compilations of both industrial sources and uses for carbon monoxide were developed and included Reviews of carbon monoxide purification and concentration technology and preliminary economic evaluations of carbon monoxide concentration pipeline transportation and utilization of CO in the synthesis of ammonia and methanol are included Preliminary technical and economic feasibility studies were made of producing ammonia and methanol from the by-product CO produced by a typical elemental phosphorus plant Methanol synthesis appeared to be more attractive than ammonia synthesis when using CO feedstock because of reduced water gas shift and carbon dioxide removal requirements DOE

N79-10216# Southwest Research Inst , San Antonio Tex Army Fuels and Lubricants Research Lab
US ARMY/ENVIRONMENTAL PROJECTION AGENCY RE-REFINED ENGINE OIL PROGRAM Progress Report, Oct 1976 - May 1978

Edwin A Frame and Thomas C Bowen, Jr May 1978 34 p refs

(Contracts DAAK70-78-C-0001, DAAG53-76-C-0003) (AD-A056806 AFLRL-98) Avail NTIS HC A03/MF A01 CSCL 11/8

Re-refined base oils were obtained and analyzed Based on the analyses, six oils were formulated to MIL-L-46152 quality level using the same concentration of a single additive package The formulated oils were tested against the requirements of MIL-L-46152 One oil passed all the engine tests Vehicles from City of San Diego which operated on re-refined oil were disassembled and inspected for deposits Author (GRA)

N79-10237# Garrett Energy Research Engineering, Inc Claremont Calif
CONVERSION OF BIOMASS MATERIALS INTO GASEOUS PRODUCTS, PHASE 1 Final Technical Report, 25 May 1976 - 24 Jun 1977

Donald E Garrett Oct 1977 143 p refs (Contract E(04-3)-1241)

(SAN/1241-77/1) Avail NTIS HC A07/MF A01

A one year exploratory bench scale pilot plant and laboratory study was completed on proprietary double effect dryer-multiple hearth biomass pyrolysis process The results indicate that an initial vacuum drying stage is quite feasible and that an effective overall heat transfer coefficient of 4.5 Btu/hr x sq ft x F can be obtained for the flue gas-vacuum dryer Direct contact drying was also efficiently conducted in the hearths with an effective overall drying rate for manure of about 5 lbs water/hr x cu ft of hearth space Acceptably low solids entrainment and lack of hearth plugging occurred at a flue gas velocity of 0.1 ft/sec and 60 ft/sec through the base plate holes The 450 Btu/cu ft (dry carbon dioxide-free) product gas was obtained in about a 74% yield was low in carbon monoxide and should be blendable into natural gas pipelines Costs are estimated for constructing a 100 t/d manure processing plant producing a medium Btu gas for \$2.84/MMBtu, if manure is free with a 10% return on investment DOE

N79-10238# Rice Univ Houston Tex Dept of Chemical Engineering
PHASE EQUILIBRIA IN COAL HYDROGENATION SYSTEMS Quarterly Report, Jul - Sep 1977

Riki Kobayashi Nov 1977 23 p refs (Contract EX-76-S-01-2334)

(FE-2334-6) Avail NTIS HC A02/MF A01

Zone purification of organic compounds for eventual study is continued Samples thus far refined in large quantities include phenanthrene, naphthalene biphenyl dibenzofuran fluoranthene and alpha-methylnaphthalene Dew point/vapor pressure measurements of toluene at low temperature were completed The results are attached as an appendix The high temperature bath for the measurement of pure component dew points was completed and is expected to become operational during the coming quarter DOE

N79-10240# National Academy of Sciences - National Research Council Washington D C Board on Science and Technology for International Development

METHANE GENERATION FROM HUMAN, ANIMAL, AND AGRICULTURAL WASTES

1977 136 p refs

(Contract AID/CSD-2584)

(PB-276469/4 LC-77-92794) Avail NTIS HC A07/MF A01 CSCL 07A

The following topics are discussed (1) system description and economic feasibility of methane production (2) technology of anaerobic fermentation (3) engineering process design and (4) research and development needs GRA

N79-10241# Minnesota Univ Minneapolis Center for Study of the Physical Environment

BIOMASS UTILIZATION IN MINNESOTA Research Report, Mar 1975 - Sep 1977

Perry L Blackshear Jr Roger Aiken and Roger A Peterson Nov 1977 331 p refs Sponsored by Minnesota Pollution Control Agency

(PB-282531/3) Avail NTIS HC A15/MF A01 CSCL 21D

Contents pyrolysis crop residues as energy sources-assessing the cost and energy feasibility of direct firing cost and energy assessment of alternate uses of crop and timber residues in Minnesota anaerobic digestion of crop residues for methane generation as an adjunct to farming energy recovery on the farm by anaerobic digestion of animal manures ammonia volatilization from animal manures effect upon soil properties of utilization of plant residues for fuel energy and waste cellulose conversion to sugars by cellulose enzymes GRA

N79-10243# Science Applications Inc La Jolla Calif
PROCEEDINGS OF THE ENGINEERING FOUNDATION CONFERENCE ON CLEAN COMBUSTION OF COAL

Apr 1978 329 p refs Conf Held at Rindge, New Hampshire 1-5 Aug 1977 Sponsored in part by Bureau of Mines Pittsburgh Pa

(Grant EF-77-G-01-6003)

(PB-282949/7 EPA-600/7-78-073) Avail NTIS HC A15/MF A01 CSCL 21D

The proceedings document the 27 presentations made at a Conference concerning technical, economic environmental and policy aspects of clean combustion of coal The five Conference sessions dealt with problem definition precombustion processes, combustion processes postcombustion processes and future prospects The Conference was intended to provide an assessment of the status and trends of clean combustion of coal GRA

N79-10272*# General Dynamics/Convair San Diego Calif
ACHIEVABLE FLATNESS IN A LARGE MICROWAVE POWER ANTENNA STUDY Final Report

18 Aug 1978 220 p

(Contract NAS9-15423)

(NASA-CR-151831 CASD-NAS-78-011) Avail NTIS HC A10/MF A01 CSCL 20N

Achievable flatness for the microwave power transmission system antenna array was determined Two configurations were analyzed in detail and evaluated as to their net potential misalignment Manufacturing joint slack assembly alignment and environmental aspects were considered Approaches to each aspect were analyzed to minimize their contributions to distortions B B

N79-10363# National Technical Information Service Springfield, Va

ELECTRIC AUTOMOBILES CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Jul 1978

Audrey S Hundemann Aug 1978 220 p Supersedes NTIS/PS-77/0635 NTIS/PS-76/0560, NTIS/PS-75/490

(NTIS/PS-78/0880/1 NTIS/PS-77/0635 NTIS/PS-76/0560 NTIS/PS-75/490) Avail NTIS HC \$28 00/MF \$28 00 CSCL 13F

Abstracts of Federally-funded research pertaining to battery systems, costs, and evaluations of electric vehicles are presented Studies are included on nickel-zinc and lead-acid batteries, various

types of lithium cells and hybrid heat engine/electric systems This updated bibliography contains 212 abstracts 60 of which are new entries to the previous edition GR^A

N79-10364# National Technical Information Service Springfield Va

ELECTRIC AUTOMOBILES, VOLUME 2 CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1975 - Jul 1978

Audrey S Hundemann Aug 1978 210 p Supersedes NTIS/PS-77/0637 NTIS/PS-76/0561 (NTIS/PS-78/0881/9 NTIS/PS-77/0637 NTIS/PS-76/0561) Avail NTIS HC \$28 00/MF \$28 00 CSCL 13F

Citations from worldwide research cover the design of electric automobiles vans buses and hybrid vehicles Studies are included on lead acid, zinc air, lithium sulfur and nickel cadmium batteries fuel cells drive trains and chassis construction This updated bibliography contains 204 abstracts 41 of which are new entries to the previous edition GRA

N79-10422* National Aeronautics and Space Administration Marshall Space Flight Center Huntsville Ala

ROTATABLE MASS FOR A FLYWHEEL Patent

George M Weyler Jr inventor (to NASA) Issued 4 Jul 1978 4 p Filed 14 Nov 1975 Supersedes N76-13500 (14 - 04 p 0459)

(NASA-Case-MFS-23051-1, US-Patent-4,098,142 US-Patent-Appl-SN-632111 US-Patent-Class-74-572 US-Patent-Class-15-230 16 US-Patent-Class-15-230 17 US-Patent-Class-29-125 US-Patent-Class-428-133) Avail US Patent Office CSCL 13I

An improved rotatable mass for a flywheel characterized by a plurality of coaxially aligned, contiguous disks mounted on a spin shaft is presented Each disk of the plurality is formed by a plurality of woven fibers disposed in a plane transversely related to an axis of rotation with the fibers of alternate disks being continuous throughout their length The mid-portion of the fibers of the remaining disks of the plurality is removed for defining annular voids concentrically related to the spin shaft

Official Gazette of the U S Patent Office

N79-10435# Sandia Labs Livermore Calif

VARIABLE-DISPLACEMENT SPARK-IGNITION ENGINE Final Report

H N Pouliot, C W Robinson and W R Delameter May 1978 102 p refs (Contract EY-76-C-04-0789)

(SAND-77-8299) Avail NTIS HC A06/MF A01

A five-cylinder variable displacement research engine was designed built and tested Displacement was varied by changing the piston stroke using a four-bar linkage Before the engine was built its dynamics were thoroughly analyzed and a five-cylinder configuration was selected to minimize vibration Test data show that brake specific fuel consumption is less dependent on load than in conventional engines and averages less than 0.5 lb/bhp-hr over the load and speed range of ordinary automobile operation The impact of exhaust gas recirculation on emissions levels was studied experimentally Several methods for estimating urban fuel economy from dynamometer data predict a 20% to 25% improvement compared with conventional engines at the same emissions levels DOE

N79-10513* National Aeronautics and Space Administration Pasadena Office Calif

DUAL MEMBRANE HOLLOW FIBER FUEL CELL AND METHOD OF OPERATING SAME Patent

John D Ingham (JPL) and Daniel D Lawson inventors (to NASA) (JPL) Issued 11 Jul 1978 5 p Filed 3 Feb 1977 Supersedes N77-19581 (15 - 10 p 1336) Sponsored by NASA

(NASA-Case-NPO-13732-1, US-Patent-4 100,331 US-Patent-Appl-SN-765138 US-Patent-Class-429-13 US-Patent-Class-429-41 US-Patent-Class-429-42) Avail US Patent Office CSCL 10A

A gaseous fuel cell is described which includes a pair of electrodes formed by open-ended ion-exchange hollow fibers

each having a layer of metal catalyst deposited on the inner surface and large surface area current collectors such as braided metal mesh in contact with the metal catalyst layer A fuel cell results when the electrodes are immersed in electrolytes and electrically connected As hydrogen and oxygen flow through the bore of the fibers oxidation and reduction reactions develop an electrical potential Since the hollow fiber configuration provides large electrode area per unit volume and intimate contact between fuel and oxidizer at the interface and due to the low internal resistance of the electrolyte high power densities can be obtained Official Gazette of the U S Patent Office

N79-10514*# National Aeronautics and Space Administration Marshall Space Flight Center Huntsville, Ala

SOLAR TRACKING CONTROL SYSTEM SUN CHASER

D R Scott and P R White Aug 1978 17 p Prepared for DOE

(NASA-TM-78199) Avail NTIS HC A02/MF A01 CSCL 10A

The solar tracking control system Sun Chaser a method of tracking the Sun in all types of weather conditions is described The Sun Chaser follows the Sun from east to west in clear or cloudy weather and resets itself to the east position after sundown in readiness for the next sunrise J M S

N79-10515*# Wyle Labs, Inc Huntsville Ala Solar Energy Systems Div

INDOOR TEST FOR THERMAL PERFORMANCE EVALUATION ON THE NORTHRUP CONCENTRATING SOLAR COLLECTOR

Jul 1978 29 p Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150804, WYLE-TR-531-26) Avail NTIS HC A03/MF A01 CSCL 10A

The test procedure used and the results obtained from an evaluation test program conducted on a Northrup concentrating solar collector under simulated conditions are described The tests were made using the Marshall Space Flight Center's solar simulator A time constant test and incident angle modifier test were also conducted to determine the transient effect and the incident angle effect on the collector The Northrup concentrating solar collector is a water/glycol/working fluid type with a dipped galvanized steel housing transparent acrylic Fresnel lens cover copper absorber tube and fiber glass insulation It weighs approximately 98 pounds The gross collector area is about 29.4 sq ft per collector A collector assembly includes four collector units within a tracking mount array S B S

N79-10516*# General Electric Co, Philadelphia Pa

SOLAR HEATING AND COOLING SYSTEM DESIGN AND DEVELOPMENT Status Summary, Apr - Jun 1978

Jul 1978 43 p Prepared for DOE

(Contract NAS8-32092)

(NASA-CR-150803) Avail NTIS HC A03/MF A01 CSCL 10A

The development of eight prototype solar heating and combined heating and cooling systems is reported Manufacture test, installation maintenance problem resolution and monitoring the operation of prototype systems is included Heating and cooling equipment for single family residential and commercial applications and eight operational test sites (four heating and four heating and cooling) is described J M S

N79-10517*# Artech Corp Falls Church Va

THERMAL ENERGY STORAGE SUBSYSTEMS Quarterly Reports, 1 Jan - 30 Jun 1978

Jan 1978 17 p Prepared for DOE

(Contract NAS8-32254)

(NASA-CR-150812) Avail NTIS HC A02/MF A01 CSCL 10A

Progress made in the development fabrication and delivery of thermal energy storage are discussed J M S

N79-10518*# Rademaker (Richard L) Corp Louisville Kentucky

SOLAR SYSTEM INSTALLATION AT LOUISVILLE, KENTUCKY Final Report

7 Aug 1978 105 p
(Contract E(49-18)-2385)
(NASA-CR-150814) Avail NTIS HC A06/MF A01 CSDL
10A

The installation of a solar space heating and domestic hot water system is described. The overall philosophy used was to install both a liquid and a hot air system retrofitted to existing office and combined warehouse building. The 1080 sq ft office space is heated first and excess heat is dumped into the warehouse. The two systems offer a unique opportunity to measure the performance and compare results of both air and liquid at one site. J M S

**N79-10519*# National Aeronautics and Space Administration
Marshall Space Flight Center Huntsville Ala
COST ANALYSIS OF NEW AND RETROFIT HOT-AIR TYPE
SOLAR ASSISTED HEATING SYSTEMS**

Rodney D Stewart and Billy J Hawkins Aug 1978 33 p
refs; Sponsored in part by DOE
(NASA-TM-78186) Avail NTIS HC A03/MF A01 CSDL 10A

A detailed cost analysis/cost improvement study was performed on two Department of Energy/National Aeronautics and Space Administration operational test sites to determine actual costs and potential cost improvements of new and retrofit hot air type solar assisted heating and hot water systems for single family sized structures. This analysis concentrated on the first cost of a system which included procurement, installation, and integration of a solar assisted heating and hot water system on a new or retrofit basis. It also provided several cost projections which can be used as inputs to payback analyses depending upon the degree of optimism or future improvements assumed. Cost definitions were developed for five categories of cost and preliminary estimates were developed for each. The costing methodology approach and results together with several candidate low cost designs are described. Author

**N79-10520*# Colt Inc of Southern California, Rancho Mirage
Energy Systems Div
PRELIMINARY DESIGN PACKAGE FOR SOLAR HEATING
AND HOT WATER SYSTEM**

Dec 1976 69 p refs Prepared for DOE
(Contract NAS8-32242)
(NASA-CR-150619) Avail NTIS HC A04/MF A01 CSDL
10A

Two prototype solar heating and hot water systems for use in single-family dwellings or commercial buildings were designed. Subsystems included are collector storage transport, hot water auxiliary energy and government-furnished site data acquisition. The systems are designed for Yosemite California and Pueblo Colorado. The necessary information to evaluate the preliminary design for these solar heating and hot water systems is presented. Included are a proposed instrumentation plan, a training program, hazard analysis, preliminary design drawings, and other information about the design of the system. S B S

**N79-10521*# Wyle Labs Inc Huntsville Ala Solar Energy
Systems Div
THERMAL PERFORMANCE EVALUATION OF THE CALMAC
(LIQUID) SOLAR COLLECTOR**

H Usher 23 Jun 1978 28 p refs Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150819 WYLE-TR-531-25) Avail NTIS
HC A03/MF A01 CSDL 10A

The procedures used and the results obtained during the evaluation test program on the S N 1 (liquid) solar collector are presented. The flat plate collector uses water as the working fluid. The absorber plate is aluminum with plastic tubes coated with urethane black. The glazing consists of 040 in fiberglass reinforced polyester. The collector weight is 78.5 pounds with overall external dimensions of approximately 50.3 in x 98.3 in x 3.8 in. The following information is given: thermal performance data under simulated conditions, structural behavior under static loading, and the effects of long term exposure to natural weathering. These tests were conducted using the MSFC Solar Simulator. S B S

**N79-10522*# Alabama Univ University Dept of Physics
and Astronomy**

**DEVELOPMENT OF SURFACES OPTICALLY SUITABLE FOR
FLAT SOLAR PANELS Final Report**

Donald DeSmet and Andrew Jason [1978] 46 p refs
(Contract NAS8-32481)
(NASA-CR-150831) Avail NTIS HC A03/MF A01 CSDL
10A

Three areas of research in the development of flat solar panels are described: (1) A reflectometer which can separately evaluate the spectral and diffuse reflectivities of surfaces was developed. The reflectometer has a phase locked detection system. (2) A coating composed of strongly bound copper oxide that is formed by an etching process performed on an aluminum alloy with high copper content was also developed. Because of this one step fabrication process, fabrication costs are expected to be small. (3) A literature search was conducted and conclusions on the required optical properties of flat plate solar collectors are presented. S B S

**N79-10523*# Northrup Inc Hutchins Tex
DESIGN PACKAGE FOR CONCENTRATING SOLAR
COLLECTOR PANELS**

Aug 1978 228 p Prepared for DOE
(Contract NAS8-32251)
(NASA-CR-150788) Avail NTIS HC A11/MF A01 CSDL
10A

Information used to evaluate the design of the Northrup concentrating collector is presented. Included are the system performance specifications, the applications manual, and the detailed design drawings of the collector. The collector is a water/glycol/working fluid type with a dipped galvanized steel housing, transparent acrylic Fresnel lens cover, copper absorber tube, and fiber glass insulation. It weighs 98 pounds. A collector assembly includes four collector units within a tracking mount array. S B S

**N79-10524*# National Aeronautics and Space Administration
Marshall Space Flight Center Huntsville Ala
RANKINE CYCLE MACHINES FOR SOLAR COOLING**

Hoyt M Weathers Aug 1978 17 p Prepared for DOE
(NASA-TM-78196) Avail NTIS HC A02/MF A01 CSDL 10A

Research, development, and demonstration of Rankine cycle machines are outlined that use fluids heated by solar energy rather than by coal, petroleum, natural gas, or nuclear fuels. G G

**N79-10525*# United Technologies Corp Windsor Locks Conn
DESIGN, FABRICATION, AND TEST OF A COMPOSITE
MATERIAL WIND TURBINE ROTOR BLADE Final Report**

D G Griffie Jr, R E Gustafson, and E R More Nov 1977
185 p refs
(Contracts NAS3-19773 E(49-26)-1028)
(NASA-CR-135389, DOE/NASA/9773-78/1 HSER-7383)
Avail NTIS HC A09/MF A01 CSDL 10A

The aerodynamic design, structural design, fabrication, and structural testing is described for a 60 foot long filament wound fiberglass/epoxy resin matrix wind turbine rotor blade for a 125 foot diameter, 100 kW wind energy conversion system. One blade was fabricated which met all aerodynamic shape requirements and was structurally capable of operating under all specified design conditions. The feasibility of filament winding large rotor blades was demonstrated. Author

**N79-10526*# AiResearch Mfg Co Phoenix Ariz
MINI-BRU/BIPS 1300 W_e DYNAMIC POWER CONVERSION
SYSTEM DEVELOPMENT EXECUTIVE SUMMARY**

Sep 1978 25 p refs
(Contract NAS3-18517)
(NASA-CR-159440 AiResearch-31-2937) Avail NTIS
HC A02/MF A01 CSDL 10B

The status of the Brayton Isotope Power System (BIPS) is summarized. A 1200 watt sub-ground development unit was built and tested in a 0.000010 torr vacuum environment. Performance mapping and 1000 hours of proof of concept system testing were completed. Specific components, primarily turboc-

N79-10528

ompressor/alternator and recuperator performed according to predictions thus achieving the design goal of 25 percent net power conversion efficiency. The system was fabricated from superalloy (Hastelloy-X and Waspaloy) thus placing it entirely within current state-of-the-art technology. The system could be flyable in the early 1980s pending flight qualification. J M S

N79-10528# Levelton (B H) and Associates Ltd Vancouver (British Columbia)

AN EVALUATION OF WOOD-WASTE ENERGY CONVERSION SYSTEMS

B H Levelton Environ Canada Western Forest Products Lab 31 Mar 1978 199 p refs
Avail NTIS HC A09/MF A01 CSCL 10A

The British Columbia Wood Waste Energy Co-ordinating Commission was formed to evaluate the potential increased use of wood waste as an energy source in British Columbia. As part of this program the committee commissioned a study of the technology available for recovering energy from wood waste and evaluation of the merits of various systems available for energy recovery. The terms of reference of the study may be summarized as follows: (1) identify potential applications in the forest-products industry for wood-waste fuels to replace fossil fuels; (2) identify and assess the relative merits of the various classes of systems for wood energy conversion; and (3) identify and evaluate specific existing commercial and pilot-scale systems for wood-energy conversion with emphasis on all possible end uses of each system. G Y

N79-10532# Ecoview Napa Calif

DIRECT HEAT APPLICATIONS OF GEOTHERMAL ENERGY IN THE GEYSERS/CLEAR LAKE REGION, VOLUME 2 ENVIRONMENTAL ASSESSMENT Final Report

Aug 1977 266 p
(Contract EG-77-C-03-1326)
(SAN-1326-1/2) Avail NTIS HC A12/MF A01

Environmental assessments of each of the six study areas are presented under the following headings: general aspects, air resource status and quality, water resource-status, quality, vegetation resource, and faunal resource. The six areas are: (1) Borax Lake - Burns Valley Sulphur Bank Mine Valley and High Valley; (2) Mt Konociti - Thurston Lake; (3) Colloyma Valley - Ford Flat Area; (4) High Valley Creek - Glenbrook Area; (5) Calistoga Geothermal Area; and (6) Geysers Geothermal Field. DOE

N79-10533# West Virginia Univ Morgantown **DESIGN, INSTRUMENTATION, AND CALIBRATION OF A VERTICAL AXIS WIND TURBINE ROTOR M S Thesis**

D G Elko 1977 112 p refs
(Contract EY-76-C-05-5135)
(TID-27754) Avail NTIS HC A06/MF A01

A vertical axis wind turbine designed strictly for research purposes in order to confirm theoretical performance calculations is described. Aerodynamic performance and structural analysis are emphasized. DOE

N79-10534# Oak Ridge Associated Universities Tenn **NET ENERGY ANALYSIS OF FIVE ENERGY SYSTEMS**

A M Perry W D Devine, Jr A E Cameron G Marland H Plaza D B Reister N L Treat and C E Whittle Sep 1977 156 p refs
(Contract EY-76-C-05-0333)
(ORAU/IEA(R)-77-12) Avail NTIS HC A08/MF A01

Ocean thermal energy conversion, wind energy conversion, in-situ oil shale processing, fluidized-bed coal combustion, and municipal solid-waste utilization are analyzed. Energy expenditures required during construction and life-long operation and maintenance are estimated using input-output and process analyses. These expenditures including both direct and indirect consumption are classified as capital or operating expenditures and as expenditures for electric or nonelectric inputs to the systems. Various ratios that compare the anticipated energy product of a system to its estimated energy subsidy are defined. Dissimilar technologies cannot be compared on the basis of these performance indices. The indices indicate all of the systems

considered are net producers of energy and decisions to proceed with deployment and development should be based on other considerations. DOE

N79-10635# Institute of Gas Technology Chicago Ill **FEASIBILITY STUDY OF TRANSPORTING OFFSHORE OTEC-PRODUCED ENERGY TO SHORE BY THERMAL MEDIA PROJECT 8980 Topical Report, Nov 1976 - Jul 1977**

B Yudow A Konopka and N Biederman Oct 1977 112 p refs
(Contract EX-76-C-01-2426)
(DSE/2426-19) Avail NTIS HC A06/MF A01

Thermal-energy media were considered as both methods of storage and of transportation of OTEC-derived energy. Three types of thermal-energy storage media were considered for transport of OTEC energy: (1) sensible-heat media which depend upon the heat capacity of the material for energy storage; (2) latent heat of fusion materials; and (3) reversible chemical reactions which depend upon the change in energy content of certain compounds as chemical bonds are broken and other bonds are made. The characteristics of the storage medium configuration and materials, the system energy storage density, system thermal losses, heat-engine efficiency, and cycle temperature are specified. The unit capital costs of storage, transport ships, and heat engines are also discussed. The methodology for the economic evaluation of the thermal-energy transport system is also described. DOE

N79-10636# California Univ Berkeley Earth Sciences Div **GEOTHERMAL RESERVOIR ENGINEERING MANAGEMENT PROGRAM PLAN (GREMP PLAN)**

Oct 1977 142 p refs
(Contract W-7405-eng-48)
(LBL-7000) Avail NTIS HC A07/MF A01

A plan for the development of the geothermal resources of the United States is presented. Six major elements are identified to make up the research program structure. These are: properties of materials, definition of reservoir characteristics, description of example reservoirs, modeling the behavior of geothermal systems, exploitation strategies, and economics. The six elements yield twelve research categories and fifty research projects. These are discussed in detail and summarized in a table. DOE

N79-10637# Argonne National Lab Ill **NATIONAL COAL UTILIZATION ASSESSMENT AN INTEGRATED ASSESSMENT OF INCREASED COAL USE IN THE MIDWEST IMPACTS AND CONSTRAINTS, VOLUME 1**

Oct 1977 107 p
(Contract W-31-109-eng-38)
(ANL/AA-11-Vol-1-Draft) Avail NTIS HC A06/MF A01

The impacts of increased coal utilization in 14 northern midwestern states were examined to ensure that environmental and social concerns receive appropriate emphasis. Strategies to alleviate potential problems or constraints associated with coal utilization were identified. Areas examined were: technology characteristics, energy supply and demand trends, siting constraints on coal-related facilities, impacts of increased coal use on water availability, land use and coal reserves, impacts on air and water quality and ecosystem, effects of trace-element emissions from coal combustion/conversion, social and economic impacts, and health risks. Significant emphasis was placed on identifying the coal-related problems and risks that are of particular concern to state and regional agencies and commissions. DOE

N79-10638# Mitre Corp McLean, Va METREK Div **SYSTEM FOR PROJECTING THE UTILIZATION OF RENEWABLE RESOURCES SPURR METHODOLOGY**

K Rebibo, G Bennington, P Curto, P Spewak, and R Vitray Sep 1977 38 p refs
(Contract EY-76-C-01-2322)
(ERHQ/2322-77/4) Avail NTIS HC A03/MF A01

The program SPURR consists of a computer simulation model and an energy data base containing engineering cost data on solar and conventional technologies in heating and cooling of buildings process heat electric utility and production of synthetic fuels and products. The model simulates on a year by year basis the market decisions to purchase solar (or other new energy options) and conventional technologies in each of the four market sectors in each region of the U S to satisfy a given energy demand. The simulation accounts for regional differences in climate fuel costs and energy demand cost reductions on new technologies based on projected experience and certain interactions among the market sectors. Market decision algorithms were developed that incorporate probability of least cost technological substitution limited by an S-shaped curve market shares based on the relative value of competing technologies as well as the perceived risk of the new technology and a boom or bust phenomenon. DOE

N79-10539# Sandia Labs Albuquerque N Mex
SOLAR POWERED IRRIGATION PRESENT STATUS AND FUTURE OUTLOOK

L L Lukens R L Alvis and A M Perino 1978 8 p refs
 Presented at 4th Energy Symp Los Angeles, 23 May 1978
 (Contract EY-76-C-04-0789)
 (SAND-78-0016C Conf-780527-1) Avail NTIS
 HC A02/MF A01

Experiments in New Mexico and Arizona are described. The New Mexico experiment is constructed near Willard. New Mexico. It produce approximately 25 hp continuously during the irrigation season to direct drive a turbine-type well pump which delivers enough water to irrigate 100 acres. It utilizes 6720 sq ft (625 m sq) of distributive-type solar collectors to heat an oil heat transfer fluid. The hot fluid produced supplies a Rankine cycle engine and charges a unique design thermocline thermal storage system. Data from these experiments are utilized in a systems and application analysis. Optimal applications and designs for the important agricultural regions of the US are defined. The annualized costs of solar irrigation systems are compared to the annualized costs of conventional irrigation techniques. The economics of present systems are about a factor of four higher than conventional sources but future systems designed for mass production look better. DOE

N79-10540# Los Alamos Scientific Lab, N Mex

HOT DRY ROCK ENERGY PROJECT

R H Hendron 1977 26 p refs Presented at Alternative Energy Sources Symp Miami Beach Fla 5 Dec 1977
 (Contract W-7405-eng-36)
 (LA-UR-77-2744 Conf-771203-5) Avail NTIS
 HC A03/MF A01

A proof-of-concept experimental project to establish the feasibility of exploitation of the thermal energy contained in the earth's crust where such energy and a transporting fluid have not been juxtaposed in nature is described. A region of high heat flow and apparently unfaulted basement rock formation was selected. Two boreholes, drilled to a total depth of about 3 km (10 000 ft) and penetrating about 2.5 km (7500 ft) into the Precambrian formation to a rock temperature of 200 C, were connected at depth by a hydraulically fractured zone to form the heat extraction surface. Energy was extracted at a rate of 3.2 MW(t) with water temperature of 132 C during a 96-h preliminary circulating test run. The progress of the project, procedures salient events reports and specialized topics are presented. DOE

N79-10541# Oak Ridge National Lab Tenn Energy Div
ENERGY AVAILABILITIES FOR STATE AND LOCAL DEVELOPMENT 1973 DATA VOLUME

D P Vogt P L Rice and V P Pai Nov 1977 268 p refs
 (Contract W-7405-eng-26)
 (ORNL/TM-5890-S2) Avail NTIS HC A12/MF A01

The supply demand and net imports of seven fuel types for four final consuming sectors of BEAs states census regions, and the nation in 1974 is presented. The data were formatted

to present regional energy availability from primary extraction as well as from regional transformation processes. As constructed the tables depict energy balances between availability and use for each of the specific fuels. DOE

N79-10542# Oak Ridge National Lab Tenn Energy Div
ENERGY AVAILABILITIES FOR STATE AND LOCAL DEVELOPMENT 1974 DATA VOLUME

D P Vogt P L Rice and V P Pai Nov 1977 269 p refs
 (Contract W-7405-eng-26)
 (ORNL/TM-5890-S3) Avail NTIS HC A12/MF A01

Energy demand in 1973 for four final consuming sectors as well as domestic supply and net imports of seven fuel types are presented in the form of energy balance statements for each of these geographic regions. The regional energy statements developed present a consistent format for monitoring and reporting changes in historic and projected energy availability and consumption patterns. Marginal changes in energy availability were generally measured at the national level. B B

N79-10543# Department of Energy Morgantown W Va
 Morgantown Energy Research Center
FLUIDIZED-BED COMBUSTION TEST OF LOW-QUALITY FUELS TEXAS LIGNITE AND LIGNITE REFUSE

J S Mei U Grimm and J S Halow Apr 1978 48 p refs
 (MERC/RI-78/3) Avail NTIS HC A03/MF A01

Samples of Texas lignite from the Wilcox formation were investigated to assess this fuel as a potential feedstock for fluidized bed combustors. Combustion tests were performed over a wide range of operating conditions to develop fluidized bed combustion (FBC) engineering and emissions data on this low-quality fuel. Combustion characteristics observed include no clinker formation at bed temperature as high as 2000 F high sulfur retention capability of the mineral from lignite at bed temperature below 1600 F and freeboard burning of carryover less than expected. Results indicate that lignite may be a particularly attractive solid fuel for industrial FBC applications. One potential problem with the use of this fuel is the formation of very fine ash particles which are difficult to retain in the bed. Use of an attrition resistant bed material was required to maintain bed inventory. DOE

N79-10544# Department of Energy Washington D C Div
 of Energy Storage Systems
HYDROGEN ENERGY STORAGE PROGRAM FIVE-YEAR PLAN

Apr 1978 56 p refs
 (DOE/ET-0046) Avail NTIS HC A04/MF A01

Major topics discussed include production studies in electrolysis thermochemical cycles, and advanced concepts advancement of metal hydride and occluder material hydrogen storage methods both stationary and vehicular applications and underground hydrogen storage. Hydrogen use in the industrial residential and commercial and electric and natural gas utilities sectors is addressed along with containment materials for hydrogen and safety in hydrogen operations. DOE

N79-10545# Department of Energy Washington D C
ENVIRONMENTAL DEVELOPMENT PLAN (EDP) OIL SUPPLY, FY 1977

May 1978 178 p refs
 (DOE/EDP-0024) Avail NTIS HC A09/MF A01

This oil supply EDP briefly describes the petroleum technology. The environmental, health and safety issues and the environmental activities needed to resolve these issues are identified. An action plan for the evaluation and mitigation of environmental impacts, as well as a schedule for review and update of NEPA (National Environmental Policy Act) documents are presented. The coordination and management strategy for conducting the environmental research program is discussed. This is the first Oil Supply EDP and it will be updated annually to take into account the progress of the technologies toward commercialization, the environmental work accomplished by ERDA and other agencies, the resolution of outstanding environmental issues concerning the technologies and identification of decision points which require compliance with NEPA. DOE

N79-10546# Department of Energy Washington, D C Div of Energy Storage Systems
BATTERY AND ELECTROCHEMICAL SYSTEMS PROGRAM SUMMARY, FY 1977

W H Webster, ed Apr 1978 156 p
 (DOE/ET-0014) Avail NTIS HC A08/MF A01
 During FY 1977 STOR committed \$13.3 million of its funds to electrochemical programs and managed an additional \$5.6 million for the Division of Transportation Energy Conversion to develop near-term batteries for electric vehicles. This publication consists of summaries of all these programs including contractors major sub-contracts, names of program managers, funding, and a brief description of the objectives and status of each program.
 DOE

N79-10547# California Univ Berkeley Lawrence Berkeley Lab Energy and Environment Div
RELIABILITY OF WIND POWER FROM DISPERSED SITES A PRELIMINARY ASSESSMENT

Edward Kahn Apr 1978 46 p refs
 (Contract W-7405-eng-48)
 (LBL-6889) Avail NTIS HC A03/MF A01
 The reliability benefit of geographically dispersed wind turbine generators is analyzed. Electricity produced from wind machines experienced wide fluctuations of output at a given site. The conventional wisdom on wind power suggested that it is unrealistic to expect that wind generation will be sufficiently reliable to displace conventional capacity.
 DOE

N79-10550# Sandia Labs Albuquerque, N Mex
STATUS OF THE DOE PHOTOVOLTAIC CONCENTRATOR TECHNOLOGY DEVELOPMENT PROJECT

M W Edenburn D G Schueler, and E C Boes 1978 12 p refs
 Sponsored by DOE
 (SAND-78-0948C Conf-780619-4) Avail NTIS HC A02/MF A01

The project activities for the production of low-cost photovoltaic power by taking advantage of sunlight concentrators that replace high-cost photovoltaic cells with lower cost reflective or refractive optical surfaces are presented. The project includes developing solar cells designed for high-solar-intensity applications, finding and developing promising concentrator concepts, developing components for use in concentrators such as reflective and refractive optical devices, cell encapsulants, cell cooling mechanisms, and low-cost sun-tracking structures, testing and evaluating arrays and array components, studying various aspects of photovoltaic concentrators such as the effects of nonuniform illumination, shading, cell temperature gradients, and cell cooling, developing manufacturing techniques for large-scale array production, and supporting the fabrication of full-sized arrays.
 S B S

N79-10551# Department of Energy Washington, D C Div of Power Systems
IMPROVED CONVERSION EFFICIENCY WORKSHOP VOLUME 2 SUMMARY

Dominic J Monetta, ed 1977 41 p refs Workshop held at Pipestem, W Va 16-18 Oct 1977
 (CONF-771003-P2-Vol-2) Avail NTIS HC A03/MF A01

The proceedings of the workshop are given. Three major areas of discussion are engines, heating systems, and waste heat recovery. Summaries of the panel discussion on these topics are included. Conclusions and recommendations resulting from the workshop are outlined for research and development projects, federal involvement, funding, and indirect effects of conservation methods.
 S B S

N79-10552# National Technical Information Service, Springfield Va
ENERGY CONSERVATION POLICIES, PROGRAMS AND GENERAL STUDIES A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Jun 1978

Audrey S Hundemann Jul 1978 220 p Supersedes NTIS/PS-77/0506 updates NTIS/PS-75/214
 (NTIS/PS-78/0693/8, NTIS/PS-77/0506 NTIS/PS-75/214)

Avail NTIS HC \$28.00/MF \$28.00 CSCL 10A

National policies, programs, and general studies of ways to conserve energy are reviewed. Topic areas cover such subjects as electric load management, effects of price and taxation on energy conservation, public attitudes and behavior toward energy saving, energy savings through reduction in hot water consumption and telecommunications, substitutability for travel. This bibliography contains 216 abstracts.
 GRA

N79-10553# National Technical Information Service, Springfield, Va
SOLAR PONDS CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Jun 1978

Audrey S Hundemann Aug 1978 31 p Updates NTIS/PS-77/0458
 (NTIS/PS-78/0836/3, NTIS/PS-77/0458) Avail NTIS HC \$28.00/MF \$28.00 CSCL 10A

This bibliography contains 27 abstracts of federally-funded research reports on the design, performance, and use of solar ponds. Topic areas cover the use of solar ponds in industrial process heat production, roof ponds for passive solar buildings, and solar pond use in the production of biomass for renewable fuels.
 GRA

N79-10554# National Technical Information Service, Springfield, Va
SOLAR PONDS CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Jun 1978

Audrey S Hundemann Aug 1978 34 p Updates NTIS/PS-77/0459
 (NTIS/PS-78/0837/1, NTIS/PS-77/0459) Avail NTIS HC \$28.00/MF \$28.00 CSCL 10A

The design and use of solar ponds for industrial process heat production and in space heating applications are discussed in 25 abstracts from worldwide literature. A few citations pertain to solar pond stability and evaporation rates.
 GRA

N79-10555# AiResearch Mfg Co, Torrance Calif
STUDY OF FLYWHEEL ENERGY STORAGE VOLUME 1. EXECUTIVE SUMMARY Final Technical Report

L J Lawson A K Smith, and G D Davis 1 Sep 1977 123 p refs 5 Vol
 (Contract DOT-UT-60097T)
 (PB-282652/7, UMTA-CA-06-0106-77-1-Vol-1) Avail NTIS HC A06/MF A01, also available in set of 5 reports HC E14 as PB-282651-SET CSCL 13F

The practicality and viability of flywheel propulsion systems for urban mass transit vehicles was studied. The US transit properties requirements show that the most suitable vehicle for deployment of flywheel propulsion is the full-size transit bus. Several propulsion concepts were hypothesized and subjected to comparative analysis with present diesel buses, trolley coaches, and battery buses in regard to performance and life-cycle economics. The following basic concepts could provide high quality transit service: pure flywheel propelled bus, flywheel/diesel engine hybrid bus, flywheel-augmented trolley coach, and flywheel/battery hybrid bus. Design studies conducted for the four propulsion configurations show a high degree of commonality of components among the four concepts. Final life-cycle cost analyses show all four concepts to be in a competitive range with present transit vehicles.
 GRA

N79-10556# AiResearch Mfg Co, Torrance Calif
STUDY OF FLYWHEEL ENERGY STORAGE VOLUME 2. SYSTEMS ANALYSIS Final Technical Report

L J Lawson A K Smith, and G D Davis 1 Sep 1977 244 p refs 5 Vol
 (Contract DOT-UT-60097T)
 (PB-282653/5, UMTA-CA-06-0106-77-2-Vol-2) Avail NTIS HC A11/MF A01, also available in set of 5 reports HC E14 as PB-282651-SET CSCL 13F

The requirements for improved rubber-tired urban transit vehicles are reviewed and identified. Three baseline vehicles are described: a 40-ft diesel bus, a trolley coach, and a battery

ous The requirement needs of 11 transit properties are also discussed GRA

N79-10557# AiResearch Mfg Co, Torrance, Calif
**STUDY OF FLYWHEEL ENERGY STORAGE. VOLUME 3
 SYSTEM MECHANIZATION Final Technical Report**
 L J Lawson, A K Smith, and G D Davis 1 Sep 1977
 157 p refs 5 Vol
 (Contract DOT-UT-60097T)
 (PB-282654/3, UMTA-CA-06-0106-77-3-Vol-3) Avail NTIS
 HC A08/MF A01, also available in set of 5 reports HC E14 as
 PB-282651-SET CSCL 13F

The practicality and viability of flywheel propulsion systems for urban mass transit vehicles was studied Several propulsion concepts were hypothesized and subjected to comparative analysis with present diesel buses, trolley coaches, and battery buses in regard to performance and life-cycle economics The results of the system mechanization are presented for the four flywheel propulsion configurations that scored highest in the screening pure flywheel drive, flywheel/battery hybrid drive, flywheel/diesel engine hybrid drive, and flywheel-augmented trolley coach drive GRA

N79-10558# AiResearch Mfg Co, Torrance, Calif
**STUDY OF FLYWHEEL ENERGY STORAGE. VOLUME 4:
 LIFE-CYCLE COSTS Final Technical Report**
 L J Lawson, A K Smith, and G D Davis 1 Sep 1977
 110 p refs 5 Vol
 (Contract DOT-UT-60097T)
 (PB-282655/0, UMTA-CA-06-0106-77-4-Vol-4) Avail NTIS
 HC A06/MF A01, also available in set of 5 reports HC E14 as
 PB-282651-SET CSCL 13F

Four flywheel vehicles were studied to determine the practicality and viability of flywheel propulsion systems for urban mass transit The vehicles were a pure flywheel propelled bus, a flywheel/diesel engine hybrid bus, a flywheel-augmented trolley coach, and a flywheel/battery hybrid bus The methodology developed to guide the life cycle cost analysis of the flywheel vehicles as compared with three baseline vehicles is described GRA

N79-10559# AiResearch Mfg Co, Torrance, Calif
**STUDY OF FLYWHEEL ENERGY STORAGE. VOLUME 5:
 VEHICLE TESTS Final Technical Report**
 L J Lawson, A K Smith, and G D Davis 1 Sep 1977
 91 p refs 5 Vol
 (Contract DOT-UT-60097T)
 (PB-282656/8, UMTA-CA-06-0106-77-5-Vol-5) Avail NTIS
 HC A05/MF A01 also available in set of 5 reports HC E14 as
 PB-282651-SET CSCL 13F

The major results of tests performed on a 40-foot diesel bus and a trolley coach as related to determining the practicality and viability of flywheel propulsion systems for urban mass transit vehicles are presented Test data from the 20-vehicle MAN Electrobus demonstration program in Germany are included GRA

N79-10560# Energy and Environmental Analysis, Inc., Arlington, Va
**END USE ENERGY CONSUMPTION DATA BASE. SERIES
 1 TABLES**
 Washington DOE Jun 1978 219 p refs Prepared in cooperation with Faucett (Jack) Associates, Inc., Chevy Chase, Md, and Ultrasystems, Inc McLean, Va
 (Contract DOE-CO-03-60412-00, DOE-CO-03-50346-00, DOE-CO-03-60410)
 (PB-281817/7 DOE/EIA-0014, DOE/CRN-780106-00003)
 Avail NTIS HC A10/MF A01 CSCL 10A

A series of tables are presented which categorize national energy consumption in 1974 by economic sector, by major industries within certain sectors, by end use, by fuel and by geographic area For the transportation sector, there is a breakout by mode of transportation For the residential sector, there are breakouts by type of housing structure and by the income level of the residents GRA

N79-10561# Department of Transportation Washington, D C
 Research and Special Programs Administration
ENERGY IN TRANSPORTATION
 May 1978 44 p refs
 (PB-282928/1, DOT-RSPA-DPB-20-78-13) Avail NTIS
 HC A03/MF A01 CSCL 10A

Near-term transportation energy demand vehicle design considerations, and transportation energy conservation opportunities are presented Current and projected energy demand in the transportation modes and their relative energy efficiencies are given Various vehicle and propulsion systems are described along with several examples of potentially more efficient propulsion technologies that are in development The estimated effectiveness of various energy conservation opportunities are summarized GRA

N79-10562# Illinois Energy Resources Commission Springfield
**SOLID WASTE AND BIOMASS THEIR POTENTIAL AS
 ENERGY SOURCES IN ILLINOIS, 1977**
 Harold L Koenig 1977 54 p refs
 (PB-281649/4) Avail NTIS HC A04/MF A01 CSCL 13B

The Solid Waste and Biomass Study Panel was established in April 1976, to prepare a comprehensive report describing current programs, problems and recent technical developments pertaining to the conversion to fuel of solid waste and biomass The panel was also directed to recommend legislative action as well as educational and research programs that could be undertaken by the state to encourage the development of solid waste and biomass as sources of energy for the state The panel's recommendations are described in this report GRA

N79-10563# General Electric Co, Schenectady, N Y
**A STUDY OF FLYWHEEL ENERGY STORAGE FOR URBAN
 TRANSIT VEHICLES Final Report**
 Sep 1977 213 p refs
 (Contract DOT-UT-60096T)
 (PB-282929/9, UMTA-NY-06-0062-77-1) Avail NTIS
 HC A10/MF A01 CSCL 13F

The use of flywheel storage as applied to fixed-route multistop, and rubber-tired urban transit vehicles was studied The application of flywheel energy storage to a broad spectrum of electrically powered urban transit vehicles was also studied Charts, tables, major conclusions and recommendations are provided System requirements flywheel/motor energy storage packages life-cycle cost analysis, methodology, and worksheets modularity in design and a list of references are included GRA

N79-10564# Florida Agricultural and Mechanical Univ.,
 Tallahassee
**ENERGY THE NEW ECONOMIC DEVELOPMENT WILD-
 CARD Final Report**
 Shirley P Burgraff Jan 1978 59 p refs Presented at White House Conf on Balanced Natl Growth and Economic Development
 (Grants EDA-99-7-13426, EDA-PF-612)
 (PB-282494/4, EDA/OER-78-024) Avail NTIS
 HC A04/MF A01 CSCL 10A

Contrary to the general impression that energy is a specifically national issue emerging evidence indicates that energy is a function of geography to a surprising degree The purpose of this report is to address such topics as (1) the possibility of forecasting the effect of energy on the national economy, (2) the likelihood of energy causing serious economic dislocations by becoming a significant factor in location and survival of firms and (3) the size of the interregional income transfers due to energy, the probability of energy causing the economically advantaged states or regions of the country to get richer and the disadvantaged poorer, or the opposite influence GRA

N79-10565# Department of Energy Washington, D C
 Energy Information Administration
**COMPREHENSIVE OVERVIEW OF WINTER ENERGY DATA
 BULLETINS Annual Report, Nov 1977 - Mar 1978**
 Jun 1978 413 p
 (PB-282787/1, DOE/EIA-0058, CRN-780531-00226) Avail
 NTIS HC A18/MF A01 CSCL 10A

N79-10566

Winter Energy Data Bulletins (WEDB) provide information concerning energy related problems that affect the public throughout the winter. The WEDBs contain demand and supply information for coal natural gas, and refined petroleum products, as well as temperature accumulations and weather forecasts
GRA

N79-10566# National Technical Information Service Springfield Va

SOLAR ENERGY CONCENTRATOR DESIGN AND OPERATION CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Jun 1978

Audrey S Hundemann Aug 1978 104 p Updates NTIS/PS-77/0458

(NTIS/PS-78/0838/9 NTIS/PS-77/0458) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10A

Government-funded research on the design and operation of various types of solar energy concentrators is discussed. Abstracts cover the efficiency and optimization of Fresnel lenses, V-trough concentrators flat plate and parabolic reflectors compound parabolic concentrators used in solar photovoltaic conversion and heliostat systems. A few abstracts deal with heat loss and cost studies. This bibliography contains 97 abstracts
GRA

N79-10572# Department of Energy, Washington, D C Div of Environmental Control Technology

ENVIRONMENTAL CONTROL TECHNOLOGY ACTIVITIES OF THE DEPARTMENT OF ENERGY IN FY 1977

Nov 1977 88 p refs

(DOE/EV-0030) Avail NTIS HC A05/MF A01

Activities to balance energy goals with environmental requirements to protect and enhance the general health safety, and welfare of the nation are described. Environmental effects and mitigating measures that can be taken are considered. Only ERDA research funding development and demonstration activities are covered
DOE

N79-10574# Stanford Research Inst Menlo Park, Calif

PRELIMINARY ENVIRONMENTAL ASSESSMENT OF ENERGY CONVERSION PROCESSES FOR AGRICULTURAL AND FOREST PRODUCT RESIDUES, VOLUME 1 Final Report

Benjamin J Gikis, F Alan Ferguson, Jerry L Jones, M C T Kuo, and Clyde L Witham Mar 1978 181 p refs

(Contract EPA-68-01-2940)

(PB-281189/1, EPA-600/7-78-047-Vol-1) Avail NTIS HC A09/MF A01 CSCL 13B

The environmental impacts of several types of conversion processes for producing energy or fuels from agricultural and forestry residues were assessed. Fifteen examples were selected to represent various combinations of agricultural residues and conversion processes available in various geographic regions. The conversion processes included gasification-pyrolysis, liquefaction-pyrolysis, combustion (direct firing both large and small scale), co-combustion with coal, and anaerobic digestion. Residues included animal manure, forestry and field crops, including sugar cane. Special attention was given to pesticide and herbicide residues in conversion processes
GRA

N79-10591# PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio

PARTICULATE AND SULFUR DIOXIDE EMISSION CONTROL COSTS FOR LARGE COAL-FIRED BOILERS Final Report

Larry L Gibbs Duane S Rorste and Yatendra M Shah Feb 1978 168 p refs

(Contract EPA-68-02-2535)

(PB-281271/7 EPA-450/3-78-007) Avail NTIS HC A08/MF A01 CSCL 13B

Cost cases developed included five processes lime, limestone, mag-ox double alkali, and Wellman-Load. Also included are five plant sizes from 25-1000 MW three SO₂ control levels, current 90% efficiency 0.5 lbs SO₂/million Btu, three particulate levels current (43 ng/j) 22 ng/j, and 13 ng/j, and coals of varying sulfur heating value and ash content. Averaging times,

redundancy sludge disposal and energy penalties are also studied
GRA

N79-10595# Hittman Associates Inc Columbia Md

STANDARDS OF PRACTICE MANUAL FOR THE SOLVENT REFINED COAL LIQUEFACTION PROCESS Final Report, Apr - Nov 1977

P J Rogoszewski P A Koester C S Koralek R S Wetzel and K J Shields Jun 1978 372 p refs

(Contract EPA-68-02-2162)

(PB-283028/9, EPA-600/7-78-091) Avail NTIS HC A16/MF A01 CSCL 07A

The manual gives an integrated multimedia assessment of control/disposal options emissions and environmental requirements associated with a hypothetical 50,000 bbl/day Solvent Refined Coal (SRC) facility producing gaseous and liquid fuels. It gives an overall outline of the basic system including module descriptions and summaries on pollution concurrently available and developing control/disposal practices that may be applicable to waste streams from coal liquefaction technologies. In the detailed definition of the basic system it describes modules in detail and quantities input and output streams
GRA

N79-10603# Monsanto Research Corp Dayton Ohio

PARTICULATE CONTROL MOBILE TEST UNITS THIRD YEAR'S OPERATION Annual Report, Jun 1976 - Jun 1977

Donald L Zanders Jun 1978 29 p refs

(Contract EPA-68-02-1816)

(PB-283657/5 MRC-DA-783 EPA-600/7-78-098) Avail NTIS HC A03/MF A01 CSCL 13B

The operation of EPA-owned mobile test units is summarized. Three field units (the baghouse wet scrubber, and electrostatic precipitator) were designed to be used for studying the applicability of different methods for controlling fine particulate emitted from a wide variety of sources. The fourth unit (an energy van) was designed to demonstrate the feasibility of unconventional energy supply systems to support residential and commercial buildings
GRA

N79-10604# Industrial Environmental Research Lab Cincinnati, Ohio

POLLUTION CONTROL GUIDANCE FOR GEOTHERMAL ENERGY DEVELOPMENT

Robert P Hartley Jun 1978 149 p refs

(PB-282546/1 EPA-600/7-78-101) Avail NTIS HC A07/MF A01 CSCL 13B

The EPA regulatory approach toward geothermal energy development is summarized. The state of knowledge is described with respect to the constituents of geothermal effluents and emissions including water air solid wastes, and noise. Pollutant effects are discussed. Pollution control technologies that may be applicable are described along with preliminary cost estimates for their application. Finally, discharge and emission limitations are suggested that may serve as interim guidance for pollution control during early geothermal development
GRA

N79-10610# Energy and Environmental Research Corp, Santa Ana Calif

LOW NO_x COMBUSTION CONCEPTS FOR ADVANCED POWER GENERATION SYSTEMS FIRING LOW-BTU GAS Final Report, Jun 1973 - Mar 1977

T J Tyson, M P Heap, C J Kau, B A Folsom, and N D Brown (Combustion Engineering, Inc., Windsor Conn) Nov 1977 37 p refs

(Contract EPA-68-02-1361)

(PB-282983/6, EPA-600/2-77-235) Avail NTIS HC A03/MF A01 CSCL 13B

Several advanced power generating concepts were analyzed. A combined gas-turbine/steam-cycle power plant with integrated gasifier was the most promising from fuel utilization and economic viewpoints. Two representative combined cycle systems were chosen for detailed NO_x emission and analysis: an advanced-technology high-temperature gas turbine with a waste heat boiler, and a supercharged boiler with a current-technology gas

turbine NOx emissions were investigated using a kinetic model which was validated by comparison with best available experimental data and then applied to idealized combustor configurations. Calculations indicate that staged combustion involving rich primary zones and controlled mixing secondary zones minimizes thermal NOx and NOx produced from ammonia in the fuel gas. Minimum calculated NOx levels were 150 ppm for the high temperature turbine with a 0.45 equivalence ratio and 4000 ppm of fuel ammonia, and 125 ppm for the supercharged boiler, with 5% excess air and 500 ppm of fuel ammonia. GRA

N79-10636* National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt, Md
THE NATURAL AND PERTURBED TROPOSPHERE
 Richard W Stewart, Sultan Hameed (State Univ of New York at Stony Brook), and Joseph Pinto (State Univ of New York at Stony Brook) / In NASA Langley Res Center Man's Impact on the Troposphere Sep 1978 p 27-64 refs

Avail NTIS HC A16/MF A01 CSCL 04A

The processes important in establishing the concentrations of a number of tropospheric species were reviewed and gaps in current understanding of these processes. The points at which man may intervene in the major cycles of atmospheric gases were identified and the possible consequences of such interventions are described. Pollutants released into the troposphere may adversely affect the environment by virtue of their chemical interactions with other atmospheric species, their radiative properties or both. Problems discussed include the growth of atmospheric carbon dioxide (CO₂) resulting from the burning of fossil fuels and its possible climatic effects, the consequences of increased levels of carbon monoxide (CO) emission on the self-cleaning ability of the troposphere and on the radiation budget, and possible changes in the stratospheric odd nitrogen and ozone amounts due to increased use of fertilizers in agriculture. The magnitude of the perturbations predicted by various model studies were reviewed with particular attention to uncertainties which may affect the results. B B

N79-10679* National Center for Atmospheric Research Boulder Colo

MULTIDISCIPLINARY RESEARCH RELATED TO THE ATMOSPHERIC SCIENCES

Michael H Glantz, Harry VanLoon and Elmer Armstrong Jun 1978 330 p refs Sponsored in part of NSF (PB-283076/8 NCAR-3141-78/1) Avail NTIS HC A15/MF A01 CSCL 04B

The publication contains the papers presented at a Conference on Multidisciplinary Research related to the atmospheric sciences, held at the National Center for Atmospheric Research. The specific topics cover a wide range of disciplines with a potential relationship to the atmospheric sciences and to each other such as (1) the value of agro-meteorological information (2) fisheries management, (3) aquaculture (4) global climatic changes due to energy conversion systems (5) energy utilization (6) problems in the CO₂ balance (7) ocean thermal energy conversion systems (8) environmental economics (9) the economics of natural hazards (10) inadvertent weather modification and the law (11) modeling of climatological forecasts for agricultural models and ecological aspects of the chemistry of atmospheric precipitation. GRA

N79-10951* National Technical Information Service Springfield, Va
TECHNOLOGY ASSESSMENT, VOLUME 2 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, Jul 1976 - Jul 1977

Carolyn Shonyo Aug 1978 244 p (NTIS/PS-78/0830/6) Avail NTIS HC \$28 00/MF \$28 00 CSCL 05A

The bibliography cites references concerning the assessment of technology in a wide variety of fields from social to the physical sciences. Theoretical and applied studies are covered. This updated bibliography contains 237 abstracts, none of which are new entries to the previous edition. GRA

N79-10988* Stone (Ralph) and Co Inc, Los Angeles Calif
ENVIRONMENTAL ASSESSMENT OF SOLID RESIDUES FROM FLUIDIZED-BED FUEL PROCESSING Final Report, Nov 1976

Ralph Stone and Richard L Kahle Jun 1978 342 p refs (Contract EPA-68-03-2347) (PB-282940/6 EPA-600/7-78-107) Avail NTIS HC A15/MF A01 CSCL 21B

The results of a 2 year study of the environmental assessment of solid residues generated by fluidized-bed combustion (FBC) of coal and gasification of oil are given. A literature search, chemical and physical residue characterization laboratory leaching studies and testing of residues in various materials and agricultural applications is included. The data were used to assess the potential for impact on water quality, and the capacity of the disposal environment to attenuate degradation. Residue use was considered for concrete, asphalt, soil cement and lime/flyash aggregate. GRA

N79-11011* Old Dominion Univ Norfolk Va
PUBLIC POLICY

In its Air Cargo An Integrated Systems View 1978 Summer Pac Fellowship Program in Eng Systems Design Sep 1978 p 213-274 refs

Avail NTIS HC A15/MF A01 CSCL 01C

Public policy issues which relate to the air cargo integrated system are basically issues of energy economics and politics. The energy picture must be displayed, the economic considerations must be explicated, and the political ambience in which decisions occur must be defined in order to comprehend the global significance of the ACIS (air cargo integrated system). The following topics are addressed: (1) American political culture as it relates to the ACIS (2) the economics of materials and energy, (3) the concerns of topic (4) to policy issues (5) capital formation (6) military needs and foreign policy and (7) futures and impacts of the ACIS. G Y

N79-11150 Wyoming Univ Laramie
KINETIC MODELING OF PYROLYSIS AND HYDROGASIFICATION OF CARBONACEOUS MATERIALS Ph D Thesis

Dung Quoc Tran 1978 309 p Avail Univ Microfilms Order No 7818947

A thermogravimetric analyzer was used to determine kinetic parameters of catalyzed and noncatalyzed samples of various wood wastes. Catalyzed samples were prepared by impregnating 20 wt% of potassium carbonate on the sample particles. A one inch diameter fixed bed flow reactor was used to investigate the effect of various operating variables such as temperature, steam rate, catalyst and particle size of the sample on pyrolysis and gasification. For the pyrolysis step, the apparent activation energy is found to be a linear function of conversion. However, for the hydrogasification step, the apparent activation energy varies as a second degree polynomial with respect to conversion. A proposed pyrolysis model is used to predict conversion as a function of time. The prediction shows good agreement with fluidized bed data obtained by other investigators. Dissert Abstr

N79-11152* National Aeronautics and Space Administration Pasadena Office Calif

SURFACTANT-ASSISTED LIQUEFACTION OF PARTICULATE CARBONACEOUS SUBSTANCES Patent

George C Hsu inventor (to NASA) (JPL) Issued 24 Oct 1978 8 p Filed 7 Oct 1976 Supersedes N78-25237 (16 - 16 p 2097) Sponsored by NASA (NASA-Case-NPO-13904 1 US-Patent-4 121 995 US-Patent-Appl-SN-730468 US-Patent-Class-208-8 US-Patent-Class-208-10 US-Patent-Class-44-51 US-Patent-Class-302-66) Avail US Patent Office CSCL 07D

A slurry of carbonaceous particles such as coal containing an oil soluble polar substituted oleophilic surfactant suitably an amine substituted long chain hydrocarbon is liquefied at high temperature and high hydrogen presence. The pressure of surfactant results in an increase in yield and the conversion product contains a higher proportion of light and heavy oils and less asphaltene than products from other liquefaction processes. Official Gazette of the U S Patent Office

N79-11166

N79-11166# Dow Chemical Co Midland Mich Hydrocarbons and Energy Research Lab

CHEMICALS FROM COAL REPORT BASED ON HRI H-COAL PRODUCT Final Report

Bruce C Peters 25 Oct 1977 32 p

(Contract EX-76 C-01-1534)

(FE-1534-50 DOW-FR-363) Avail NTIS HC A03/MF A01

The final results of an investigation to determine the suitability of the COED H-COAL SYNTHOIL and SRC II syncrudes as petrochemical feedstocks are reported. Based on the results of laboratory investigations conversions of the liquid products to petrochemical feedstocks per ton of coal fed to each liquefaction process was 15.0 percent, 33.9 percent, 26.9 percent and 23.0 percent respectively. While it is recognized that the samples obtained were from liquefaction runs that were not necessarily representative based on the samples that were furnished, the H-COAL process produces the maximum yield of feedstocks and was chosen as the basis for the preliminary design and economics for a commercial chemical refinery. From a chemical refinery sized to process 50,000 barrels per stream day of H-COAL derived syncrude yields of 653 anti-M lb/year of ethylene and 245 anti-M gal/year of benzene were calculated. DOE

N79-11223# Air Research Mfg Co Phoenix Ariz

CERAMIC TECHNOLOGY READINESS PROGRAM Monthly Technical Progress Report, 3-30 Apr 1978

10 May 1978 38 p refs

(Contract EF-77-C-01-2664)

(FE-2664-7 MTPR-17) Avail NTIS HC A03/MF A01

Progress is reported on work performed to (1) provide convincing evidence of the ability of ceramic components to survive for lifetimes adequate for utility applications in an environment of high temperature combustion products from coal derived fuels and (2) to develop and demonstrate technology readiness for the application of ceramic materials technology to advanced gas turbines operating on coal derived fuels in utility base load and intermediate load service. Author

N79-11236# Los Alamos Scientific Lab N Mex

THERMOCHEMICAL PRODUCTION OF HYDROGEN FROM WATER

K E Cox and Melvin G Bowman 1977 21 p refs Presented at the Workshop on Supply and Demand of Hydrogen as a Chemical Feed Stock Houston Tex 12-14 Dec 1977

(Contract W-7405 eng-36)

(LA-UR-78-652 Conf-771246 1)

Avail NTIS

HC A02/MF A01

After a brief discussion of thermochemical efficiency and step wise decomposition of water, some of the more promising thermochemical hydrogen cycles under investigation are described. (Author) DOE

N79-11237# Mueller Associates Inc Baltimore Md

DENATURANTS FOR ETHANOL/GASOLINE BLENDS

Apr 1978 19 p refs

(HCP/M2098-01) Avail NTIS HC A02/MF A01

A major source of revenue for the Federal Government is the tax placed on ethyl alcohol used for human consumption. If ethyl alcohol (ethanol) is used as an automotive fuel, it will be necessary to deter any potential public damage or attempts at avoiding the taxation of potable ethanol, both of which could occur through uncontrolled distribution of bootleg alcohol products. A study assesses (1) if the ordinary methods denaturing ethyl alcohol are satisfactory to prevent the recovery of potable ethanol from any future ethanol/gasoline fuel blends and (2) if there is a need for the development of a more effective denaturant. The effects that any government tax credit programs (designed to encourage the use of alcohol as a gasoline extender) may have on the possible recovery of potable ethanol from ethanol/gasoline fuel blends were considered. DOE

N79-11238# Fluor Engineers and Constructors Inc Irvine Calif
ECONOMICS OF FUEL GAS FROM COAL AN UPDATE INCLUDING THE BRITISH GAS CORPORATION'S SLAGGING GASIFIER Final Report

K Chandra B McElmurry and S Smelser May 1978 100 p refs

(EPRI Proj 239)

(EPRI-AF-782) Avail NTIS HC A05/MF A01

The results of an economic screening study for oxygen blown slagging coal gasification process to produce intermediate Btu fuel gas are presented. All of the processes investigated produce fuel gas which could be used in fossil fired power plants. The evaluation was based on a complete grass roots facility sized to conform to electric utility practice of building units of approximately 1000 MW capacity. The conclusion reached is that within the accuracy of the study, fuel gas costs projected for the moving bed process using the BGC slagging gasifier are competitive with costs projected based on fluidized bed and entrained processes. The major assumption underlying the conclusion is that the BGC slagging gasifier operates successfully on a commercial scale in exactly the same manner as is represented by the performance estimates used. DOE

N79-11239# TRW Defense and Space Systems Group Redondo Beach Calif Chemistry and Chemical Engineering Lab

CATALYTIC CONVERSION OF COAL ENERGY TO HYDROGEN Project Final Report

John A Starkovich, James D Pinkerton and Ethelyn Motley Oct 1977 154 p refs

(Contract EX-76-C-01-2206)

(FE 2206-14) Avail NTIS HC A08/MF A01

The catalytic gasification of coal char with the use of alkali salt based catalyst systems for promoting the char-lime-steam char-steam and char-oxygen-steam gasification reactions was studied. The activity and recyclability performance of selected alkali catalyst systems were evaluated using both fixed and fluid bed reactors. It was established in both fixed and fluid bed reactor tests that all char gasification reactions could be made to rapidly occur at 650 C with steam using alkali catalysts such as sodium and potassium carbonate. The reaction temperature is approximately 150 to 200 deg lower than the temperature at which rapid reaction can be effected for uncatalyzed char gasification reactions. It was shown in reactions carried out in fluidized bed reactors that a 95 percent pure hydrogen product is obtainable from catalyzed char-acceptor-steam reactions at 650 C and for 3 to 6 atmosphere reaction pressures. DOE

N79-11242# Department of Energy Washington D C Alcohol Fuels Program

ALCOHOL FUELS PROGRAM PLAN

Mar 1978 59 p

(DOE/US-0001/2) Avail NTIS HC A04/MF A01

The Department of Energy has considered the production and use of ethanol and methanol as liquid fuels. The task force on alcohol fuels has reviewed the status of alcohol-related activities within DOE and elsewhere and has formulated a plan of action to (1) help resolve uncertainties and (2) provide options supportive of potential national decisions in this area. DOE is currently conducting a Fuels Supply Strategy Study which will consider all candidate alternative fuels and emphasize contingency planning to ensure an acceptable balance between supply and demand under future contingency cases. The special studies included in the immediate action element will provide analyses of key-issue areas for alcohol fuels to support the fuels supply strategy study. These special studies will examine the following aspects of alcohol fuels use: (1) resource availability, (2) economic, environmental and social impacts, (3) end-use applications, (4) Federal fiscal consequences, (5) industry incentives and (6) policy instruments for price control, market assurance and import control. DOE

N79-11312 Toledo Univ Ohio

TRANSIENT RESPONSE TO THREE-PHASE FAULTS ON A WIND TURBINE GENERATOR Ph D Thesis

Leonard Joseph Gilbert 1978 143 p

Avail Univ Microfilms Order No 7818530

In order to obtain a measure of its response to short circuits, a large horizontal axis wind turbine generator is modeled and its performance is simulated on a digital computer. The baseline

model for the simulation is the DOE/NASA 100 kW wind turbine generator Simulation of short circuit faults on the synchronous alternator of a wind turbine generator indicates that maximum clearing times for the system tied to an infinite bus are longer than the typical clearing times for equivalent capacity conventional machines Also maximum clearing times are independent of tower shadow and wind shear Variation of circuit conditions produce the modifications in the transient response predicted by analysis The model and simulation are applicable for more extensive investigations of power systems involving wind turbine generators
Dissert Abstr

N79-11406*# Ford Motor Co Dearborn Mich
AUTOMOTIVE STIRLING ENGINE DEVELOPMENT PROGRAM Quarterly Technical Progress Report, Apr 1978 - Jun 1978

Jun 1978 96 p Sponsored by NASA
(Contract EC-77-C-02 4396)
(NASA-CR-159436 CONS/4396-3) Avail NTIS
HC A05/MF A01 CSCL 13F

The third quarter (April-June 1978) effort of the Ford/DOE Automotive Stirling Engine Development Program is reported specifically Task 1 of that effort which is Fuel Economy Assessment At the end of this quarter the total fourth generation fuel economy projection was 26.12 MPG (gasoline) with a confidence level of 44% This represents an improvement of 66.4% over the baseline M-H fuel economy of 15.7 MPG The confidence level for the original 20.6 MPG goal has been increased from 53% to 57% Engine 3X17 has accumulated a total of 213 hours of variable speed running A summary of the individual sub-tasks of Task 1 are given The sub-tasks are grouped into two categories Category 1 consists of those sub-tasks which are directly related to fuel economy and Category 2 consists of those sub-tasks which are not directly related to fuel economy but are an integral part of the Task 1 effort
G Y

N79-11412# California Univ Livermore Lawrence Livermore Lab

COMPUTER MODELING OF AUTOMOTIVE ENGINE COMBUSTION

C K Westbrook and L C Haselman Dec 1977 26 p refs
Presented at Natl Computing Conf Anaheim Calif 5-8 Jun 1978

(Contract W-7405-eng-48)
(UCRL 80451 Conf-780615-2) Avail NTIS
HC A03/MF A01

A general outline of the physical and chemical events which occur in an automobile combustion chamber during a complete engine cycle is used in discussing some of the achievements and some of the limitations of computer modeling of automotive engine combustion This type of modeling is often limited by lack of physical knowledge and by computer software and hardware restrictions Still within these constraints many types of combustion models were able to make important contributions to present understanding of automobile engine combustion DOE

N79-11446# ASL Engineering Goleta Calif
ENVIRONMENTALLY INDUCED CRACKING OF NATURAL GAS AND LIQUID PIPELINES VOLUME 2 APPENDICES A AND B Final Report

J A Bartol C H Wells R P Wei et al Dec 1977 150 p refs

(Contract DOT-OS-60519)
(PB-282924/O DOT-MTB-OPSP-78-02) Avail NTIS
HC A07/MF A01 CSCL 13K

The Office of Pipeline Safety Operations was provided with an appraisal of the seriousness of certain types of environmentally induced cracking problems in natural gas and liquid petroleum pipelines Measures for locating and identifying such cracks or for identifying conditions leading to their occurrence are identified Predictions of future incidence probability are formulated and recommendations made for needed research and action GRA

N79-11447# ASL Engineering Goleta Calif
ENVIRONMENTALLY INDUCED CRACKING OF NATURAL

GAS AND LIQUID PIPELINES VOLUME 1 TECHNICAL REPORT Final Report

J A Bartol C H Wells and R P Wei Dec 1977 146 p refs

(Contract DOT-OS-60519)
(PB-282923/2 DOT-MTB-OPSP-78 01) Avail NTIS
HC A07/MF A01 CSCL 13K

An appraisal of the seriousness of certain types of environmentally induced cracking problems in natural gas and liquid petroleum pipelines is provided for the Office of Pipeline Safety Operations Measures for locating and identifying such cracks or for identifying conditions leading to their occurrence are identified Predictions of future incidence probability are formulated and recommendations made for needed research and action GRA

N79-11454# Petroleum Industry Research Foundation Inc New York

OUTLOOK FOR WORLD OIL INTO THE 21ST CENTURY WITH EMPHASIS ON THE PERIOD TO 1990 Final Report

John H Lichtblau and H J Frank May 1978 180 p refs

Sponsored by Electric Power Research Inst Prepared in cooperation with Arizona Univ
(EPRI-EA-745 SOA-76-328) Avail NTIS HC A09/MF A01

A forecast is presented of oil supply and demand in the non-Communist world for two periods 1976 to 1990 and 1990 to 2005 Oil is treated as the energy supply of last resort the balancing item with special emphasis on oil from the Organization of Petroleum Exporting Countries (OPEC) Energy demand based on forecast economic growths and energy/economic growth relationships is projected This demand is assumed to be met to the maximum feasible extent from non-oil energy supplies (coal gas nuclear power hydro and geothermal power and other sources) The resultant total oil demand is then met first from non-OPEC oil supplies in order to test the demand for and adequacy of OPEC oil supplies under different energy demand scenarios The findings are that a gradual transition to non-oil sources of energy over the next 25 to 30 years is more likely than an extended oil shortage of crisis proportions DOE

N79-11462 Virginia Polytechnic Inst and State Univ Blacksburg
ANALYTICAL METHODS FOR EVALUATING TWO-DIMENSIONAL EFFECTS IN FLAT-PLATE SOLAR COLLECTORS Ph D Thesis

Clifford Keith Rice 1978 202 p
Avail Univ Microfilms Order No 7818557

Two methods of absorber plate thermal analysis which can be used within the framework of existing theory were developed The first method used the separation of variables technique in a unique manner to solve exactly for the coupled axial and transverse temperature distributions in an absorber plate-tube assembly The conventional assumption of an overall uniform loss coefficient $U_{sub L}$ was used in the analysis The first method is practical only for the parallel-flow collectors The second method used two sectionally uniform loss coefficients $U_{sub Li}$ for internal collector sections and $U_{sub Le}$ for edge sections to evaluate collector performance The second method is applicable for both parallel flow and serpentine configurations The solution technique developed in the first method has potential applications to a number of conduction-convection problems The second method has the inherent capability to better evaluate performance and design questions related to edge effects
Dissert Abstr

N79-11464 Texas Univ at Austin
SOLID DESICCANT AIR CONDITIONING WITH SILICA GEL USING SOLAR ENERGY Ph D Thesis

Fernando Enrique Pla Barby 1978 223 p
Avail Univ Microfilms Order No 7817695

A solid desiccant air dryer was modeled numerically and checked against experimental data and other analytical and experimental models The parameters that control the air dryer performance were determined and the performance data for the silica gel system were presented in terms of these parameters based on the modeling results The numerical model was used in an investigation of solid desiccant air conditioning using silica gel as the desiccant and solar energy at low temperature (150 F) to regenerate the desiccant Several combinations of air dryers heat exchangers and evaporative coolers were analyzed and their

N79-11465

performance calculated. It was determined that although solid desiccant air conditioning is feasible a regeneration temperature of 150 F is really the lowest that may be used and should be increased as much as possible to improve the performance of the air dryer
Dissert Abstr

N79-11465 Georgia Inst of Tech Atlanta
THERMAL ANALYSIS OF RECEIVERS FOR SOLAR CONCENTRATORS AND OPTIMIZATION PROCEDURE FOR POWER PRODUCTION Ph D Thesis
Prakash Rao Damshala 1978 193 p
Avail Univ Microfilms Order No 7819520

The particular linear concentrator used is the 540 sq ft prototype faceted fixed mirror concentrator at Georgia Tech which utilizes the fixed mirror moving receiver. The thermal analysis of the collector utilizing an evacuated receiver is described which predicts the thermal efficiency of the receiver and exit temperature of the collector fluid. Therminol 66 is the heat transfer fluid. A linear equation is obtained for the thermal efficiency of the receiver for arbitrary values of solar intensity inlet temperature and ambient temperature. A solar/fossil power plant of 100MW was designed to illustrate the procedure for optimizing the system for the least cost unit power produced. A Rankin cycle using toluene as the working fluid is coupled to the collector circuit. Pertinent component models and heat balance equations are included. A procedure is outlined to optimize the entire system.
Dissert Abstr

N79-11467* National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio
SOLAR CELLS HAVING INTEGRAL COLLECTOR GRIDS
Patent
John C Evans Jr inventor (to NASA) Issued 1 Aug 1978
7 p Filed 6 Jun 1977 Supersedes N77-24593 (15 - 15 p 2011)
(NASA-Case-LEW-12819-1 US-Patent-4 104 084
US-Patent-Appl-SN-803823 US-Patent-Class-136-89CC
US-Patent-Class-136-89SJ US-Patent-Class-357-15
US-Patent-Class-357-16 US-Patent-Class-357-30
US-Patent-Class-357-65 US-Patent-Class-357-67) Avail US
Patent Office CSCL 10A

A heterojunction or Schottky barrier photovoltaic device is described comprising a conductive base metal layer. A back surface field region was formed at the interface between the device and the base metal layer. A transparent conductive mixed metal oxide layer in integral contact with the n-type layer of the heterojunction or Schottky barrier device. A metal alloy grid network was included. An insulating layer prevented electrical contact between the conductive metal base layer and the transparent conductive metal oxide layer.
Official Gazette of the U S Patent Office

N79-11469* National Aeronautics and Space Administration
Marshall Space Flight Center Huntsville Ala
METHOD FOR MAKING AN ALUMINUM OR COPPER SUBSTRATE PANEL FOR SELECTIVE ABSORPTION OF SOLAR ENERGY Patent
Marion L Roberts Max H Sharpe and Albert C Krupnick inventors (to NASA) Issued 1 Aug 1978 7 p Filed 31 Aug 1977 Supersedes N77-31610 (15 - 22 p 2960)
(NASA-Case-MFS 23518-1 US-Patent-4 104 134
US-Patent-Appl SN-829390 US-Patent-Class-204-37R
US Patent Class-204 32 US-Patent-Class-204-33
US-Patent-Class-204-38B) Avail US Patent Office CSCL 10A

A panel is described for selectively absorbing solar energy comprising an aluminum substrate. A zinc layer was covered by a layer of nickel and an outer layer of solar energy absorbing nickel oxide or a copper substrate with a nickel layer. A layer of solar energy absorbing nickel oxide distal from the copper substrate was included. A method for making these panels is disclosed.
Official Gazette of the U S Patent Office

N79-11470* National Aeronautics and Space Administration
Pasadena Office Calif
SOLAR PHOTOLYSIS OF WATER Patent
Porter R Ryason inventor (to NASA) (JPL) Issued 8 Aug 1978
7 p Filed 30 Sep 1977 Supersedes N78-11500 (16 - 02 p 0212) Sponsored by NASA
(NASA-Case-NPO-14126-1 US-Patent-4 105 517
US-Patent-Appl-SN-838336 US-Patent-Class-204-157 1R
US-Patent-Class-250-527) Avail US Patent Office CSCL 10A

A cyclic process is described for the solar photolysis of water including a first stage in which water is reduced in the presence of a Eu^{+2} photooxidizable reagent producing hydrogen and spent oxidized Eu^{+3} reagent. The spent reagent Eu^{+3} is reduced by means of a transition metal ligand complex reductant RuL^{+3} in a photoexcited state such as a ruthenium pyridyl complex. Due to competing reactions between the photolysis and regeneration products the photooxidation reaction must be separated from the regeneration in space and time by supporting the reagent and/or the reductant on solid supports and utilizing pH wavelength and flow control to maximize hydrogen and oxygen production.
Official Gazette of the U S Patent Office

N79-11471* National Aeronautics and Space Administration
Pasadena Office Calif
NON-TRACKING SOLAR ENERGY COLLECTOR SYSTEM
Patent
M Kudret Selcuk inventor to NASA (JPL) Issued 31 Oct 1978
8 p Filed 27 May 1977 Supersedes N77-28583 (15 - 19 p 2550) Continuation-in-part of US Patent Appl SN-765139
filed 3 Feb 1977 US Patent 4,091 798 Sponsored by NASA
(NASA-Case-NPO-13817-1, US-Patent-4,122 833
US-Patent-Appl-SN-801452 US-Patent-Class-126-271,
US-Patent-Class-126-270, US-Patent-Class-350-288,
US-Patent-Class-350-299, US-Patent-4,091,798, US-Patent-Appl-SN-765139) Avail US Patent Office CSCL 10A

A solar energy collector system is described characterized by an improved concentrator for directing incident rays of solar energy on parallel strip-like segments of a flatplate receiver. Individually mounted reflector modules of a common asymmetrical triangular cross-sectional configuration supported for independent orientation are asymmetric included with vee-trough concentrators for deflecting incident solar energy toward the receiver.
Official Gazette of the U S Patent Office

N79-11472* National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio
SOLAR CELL COLLECTOR AND METHOD FOR PRODUCING SAME Patent
John C Evans Jr inventor (to NASA) Issued 24 Oct 1978
5 p Filed 21 Oct 1977 Division of US Patent Appl SN-770869
Filed 22 Feb 1977 US Patent-4 082 569
(NASA-Case-LEW-12552-2 US-Patent-4 122 214
US-Patent-Appl-SN-844346 US-Patent-Class-427-75
US-Patent-Class-427-84 US-Patent-Class-427-123
US-Patent-Class-427-126 US-Patent-Class-427-261
US-Patent-Class-427-343 US-Patent-Class-427-398A
US-Patent-Class-427-399 US-Patent-Class-29-572
US-Patent-4 082 569 US-Patent-Appl-SN-770869) Avail US
Patent Office CSCL 10A

A transparent conductive collector layer containing conductive metal channels is formed as a layer on a photovoltaic substrate by coating a photovoltaic substrate with a conductive mixed metal layer. A heat sink having portions protruding from one of its surfaces is attached. These protruding portions define a continuous pattern in combination with recessed regions among them such that they are in contact with the conductive layer of the photovoltaic substrate. Heating the substrate while simultaneously oxidizing the portions of the conductive layer exposed to a gaseous oxidizing substance forced into the recessed regions of the heat sink creates a transparent metal oxide layer on the substrate. A continuous pattern of highly conductive metal channels is contained in the metal oxide layer.
Official Gazette of the U S Patent Office

N79-11473*# Rocket Research Corp Redmond Wash
**APPLICATIONS OF THERMAL ENERGY STORAGE TO
 PROCESS HEAT AND WASTE HEAT RECOVERY IN THE
 IRON AND STEEL INDUSTRY Final Report, Sep 1977 -
 Sep 1978**

Lincoln B Katter and Daniel J Peterson Oct 1978 136 p
 refs Sponsored by NASA
 (Contracts EC-77-C-01-5081 EC-77-A-31-1034)
 (NASA-CR 159397 RRC 78-R 607 CONS/5081-1) Avail
 NTIS HC A07/MF A01 CSCL 10A

The system identified operates from the primary arc furnace
 evacuation system as a heat source Energy from the fume stream
 is stored as sensible energy in a solid medium (packed bed) A
 steam-driven turbine is arranged to generate power for peak
 shaving A parametric design approach is presented since the
 overall system design at optimum payback is strongly dependent
 upon the nature of the electric pricing structure The scope of
 the project was limited to consideration of available technology
 so that industry-wide application could be achieved by 1985 A
 search of the literature coupled with interviews with representa-
 tives of major steel producers served as the means whereby
 the techniques and technologies indicated for the specific site
 are extrapolated to the industry as a whole and to the 1985
 time frame The conclusion of the study is that by 1985 a
 national yearly savings of 19 million barrels of oil could be
 realized through recovery of waste heat from primary arc furnace
 fume gases on an industry-wide basis Economic studies indicate
 that the proposed system has a plant payback time of ap-
 proximately 5 years LS

N79-11474*# National Aeronautics and Space Administration
 Washington D C
**PROGRAM THEK ENERGY PRODUCTION UNITS OF
 AVERAGE POWER AND USING THERMAL CONVERSION
 OF SOLAR RADIATION**

Nov 1978 16 p refs Transl into ENGLISH of Programme
 Thek Unites de Production d'Energie de Moyenne Puissance
 par Conversion Thermique du Rayonnement Solaire Centre
 National de la Recherche Marseilles Sep 1977 6 p Transl
 by Scientific Translation Service Santa Barbara Calif
 (Contract NASw-3198)

(NASA-TM-75369) Avail NTIS HC A02/MF A01 CSCL 10A
 General studies undertaken by the CNRS in the field of
 solar power plants have generated the problem of building energy
 production units in the medium range of electrical power in the
 order of 100 kW Among the possible solutions the principle of
 the use of distributed heliothermal converters has been selected
 as being with the current status of things the most advantageous
 solution This principle consists of obtaining the conversion of
 concentrated radiation into heat by using a series of heliothermal
 conversion modules scattered over the ground the produced
 heat is collected by a heat-carrying fluid circulating inside a
 thermal loop leading to a device for both regulation and
 storage LS

N79-11475*# Rockwell International Corp Downey Calif
 Satellite Systems Div
**SATELLITE POWER SYSTEMS (SPS) CONCEPT DEFINITION
 STUDY (EXHIBIT C) Quarterly Review No 2**

G M Hanley Sep 1978 446 p
 (Contract NAS8-32475)
 (NASA-CR-150827 SD 78-AP-0115) Avail NTIS
 HC A19/MF A01 CSCL 10A

A coplanar satellite conceptual approach was defined This
 effort included several trade studies related to satellite design
 and also construction approaches for this satellite A transportation
 system consistent with this concept was also studied including
 an electric orbit transfer vehicle and a parallel-burn heavy lift
 launch vehicle Work on a solid state microwave concept continued
 and several alternative approaches were evaluated Computer
 determination of an optimized transistor and circuit design was
 also continued Experiment/verification planning resulted in the
 development of a total solar array and microwave technology
 development plan as well as definition of near-term research to
 evaluate key technology issues G Y

N79-11477*# National Aeronautics and Space Administration
 Lewis Research Center Cleveland Ohio
**OPTIMUM DRY COOLING SUB-SYSTEMS FOR A SOLAR
 AIR CONDITIONER**

James L S Chen and David Namkoong Oct 1978 41 p
 refs
 (NASA-TM-79007 E-9788) Avail NTIS HC A03/MF A01
 CSCL 10A

Dry-cooling sub-systems for residential solar powered Rankine
 compression air conditioners were economically optimized and
 compared with the cost of a wet cooling tower Results in terms
 of yearly incremental busbar cost due to the use of dry-cooling
 were presented for Philadelphia and Miami With input data
 corresponding to local weather energy rate and capital costs
condenser surface designs and performance the computerized
 optimization program yields design specifications of the sub-
 system which has the lowest annual incremental cost Author

N79-11478*# National Aeronautics and Space Administration
 Lewis Research Center Cleveland Ohio
**PRELIMINARY SUMMARY OF THE ETF CONCEPTUAL
 STUDIES**

George R Seikel Robert W Bercaw C Victor Pearson (Argonne
 Natl Lab) and William R Owens (Gilbert Assoc Inc) 1978
 20 p refs Presented at the 4th US-USSR Colloq on MHD
 Elec Power Generation Washington D C 5-6 Oct 1978
 (Contract EF-77-A-01-2674)

(NASA-TM-78999 E-9783 DOE/NASA/2674 78/1) Avail
 NTIS HC A02/MF A01 CSCL 10A

Power plant studies have shown the attractiveness of MHD
 topped steam power plants for baseload utility applications To
 realize these advantages a three-phase development program
 was initiated In the first phase the engineering data and
 experience were developed for the design and construction of a
 pilot plant the Engineering Test Facility (ETF) Results of the
 ETF studies are reviewed These three parallel independent studies
 were conducted by industrial teams led by the AVCO Everett
 Research Laboratory the General Electric Corporation and the
 Westinghouse Corporation A preliminary analysis and the status
 of the critical evaluation of these results are presented LS

N79-11479*# National Aeronautics and Space Administration
 Lewis Research Center Cleveland Ohio
**SUPPLY OF REACTANTS FOR REDOX BULK ENERGY
 STORAGE SYSTEMS Final Report**

Randall F Gahr Sep 1978 12 p refs
 (Contract E(49 28)-1002)
 (NASA-TM-78995 E-9779 DOE/NASA/1002-78/1) Avail
 NTIS HC A02/MF A01 CSCL 10A

World resources reserves production and costs of reactant
 materials iron chromium titanium and bromine for proposed
 redox cell bulk energy storage systems are reviewed Supplying
 required materials for multimegawatt hour systems appears to
 be feasible even at current production levels Iron and chromium
 ores are the most abundant and lowest cost of four reactants
Chromium is not a domestic reserve but redox system installations
 would represent a small fraction of U S imports Vast quantities
 of bromine are available but present production is low and
 therefore cost is high Titanium is currently available at reasonable
 cost with ample reserves available for the next fifty years
 S B S

N79-11481*# National Aeronautics and Space Administration
 Lewis Research Center Cleveland Ohio
**THERMAL STORAGE FOR INDUSTRIAL PROCESS AND
 REJECT HEAT**

R A Duscha and W J Masica 1978 14 p refs Presented
 at the 2d Conf on Waste Heat Management and Util Miami
 Beach Fla 4-6 Dec 1978
 (Contract EC-77-A-31-1034)

(NASA-TM-78994 E-9777 DOE/NASA/1034-78/3) Avail
 NTIS HC A02/MF A01 CSCL 10A

Industrial production uses about 40 percent of the total energy
 consumed in the United States The major share of this is derived

from fossil fuel Potential savings of scarce fuel is possible through the use of thermal energy storage (TES) of reject or process heat for subsequent use Three especially significant industries where high temperature TES appears attractive - paper and pulp iron and steel and cement are discussed Potential annual fuel savings with large scale implementation of near-term TES systems for these three industries is nearly 9 000 000 bbl of oil
SBS

N79-11483# American Univ Washington D C
THE PREPARATION OF SOME NOVEL ELECTROLYTES SYNTHESIS OF PARTIALLY FLUORINATED ALKANE SULFONIC ACIDS AS POTENTIAL FUEL CELL ELECTROLYTES Interim Technical Report

Chaiyun Bunyagidj and M H Aldridge Mar 1978 29 p refs (Contract DAAK70-77-C-0047 DA Proj 1L1-61102-A-H51) (AD-A056278 TR-1) Avail NTIS HC A03/MF A01 CSCL 10/2

The objective of this research was to prepare some strong acids for evaluation by Fort Belvoir as potential fuel cell electrolytes The only acid other than phosphoric H3PO4 currently under investigation by Fort Belvoir as a fuel cell electrolyte is TFMSA CF3SO3H H2O trifluoromethanesulfonic acid monohydrate aqueous solutions and sodium salt mixtures TFMSA has been found to be superior to H3PO4 from the standpoint of electrode kinetics but certain undesirable characteristics (volatility wetting of Teflon) led to this search for a better fuel cell electrolyte The following acids were prepared Methanedisulfonic acid Ethanesulfonic acid Ethane-1,2-disulfonic acid Propane-1,3-disulfonic acid Propane-1,2,3-trisulfonic acid Chlorotrifluoroethanesulfonic acid and 1,2,2-trifluoroethane-1,1,2-trisulfonic acid Yields were low because of purification difficulties and future work will be concerned with scaling up the preparations GRA

N79-11485# Army Mobility Equipment Research and Development Command Fort Belvoir Va

HIGH ENERGY METAL HYDRIDE FUEL CELL POWER SOURCE

Walter G Taschek and Cornelius E Bailey Jr Jun 1978 14 p refs (AD-A056491) Avail NTIS HC A02/MF A01 CSCL 10/2

A fuel cell is a device which produces electricity cleanly silently and efficiently Like the familiar dry cells and lead acid batteries fuel cells work by virtue of electrochemical reactions in which the energy of a fuel and an oxidant are directly transformed into direct current electricity Unlike batteries however fuel cells do not consume the chemicals that are part of or stored within their structure The reactant chemicals used by fuel cells are supplied from an external source This feature in principle allows the fuel cell to operate as long as fuel and oxidant are supplied and reaction products removed GRA

N79-11486# Naval Postgraduate School Monterey Calif
PRELIMINARY DESIGN AND ANALYSIS OF A TOTAL ENERGY SYSTEM FOR MASSACHUSETTS INSTITUTE OF TECHNOLOGY M S Thesis

Webster Lance Benham Sep 1977 219 p refs (AD-A057289) Avail NTIS HC A10/MF A01 CSCL 10/3

The total energy system concept has been proposed as a possible means of reducing the cost of providing electricity at MIT An overview of key factors influencing the possible shift to a total energy system approach is presented Campus steam and electrical load profiles are defined and the dependence of load upon ambient temperature is analyzed Load growth and the future impact of conservation measures at MIT are addressed in relation to the relative sizing of a proposed total energy plant A demand model is constructed for use in simulating the operation of alternative total energy designs on a computer A comparison of 1976 consumption data at MIT with that predicted by the load model is made establishing the validity of the model for further use in total energy system simulation Methods of modeling different equipment configurations are discussed for the purpose of devising computer programs to aid in comparative cost studies
Author (GRA)

N79-11487# Oak Ridge National Lab Tenn
TRANSPORTATION ENERGY CONSERVATION DATA BOOK, EDITION 2

D B Shonka A S Loebel and P D Patterson Oct 1977 567 p refs (Contract W-7405-eng-26)

(ORNL-5320) Avail NTIS HC A24/MF A01

Energy data are presented for the various characteristics of transportation Areas covered include projected transportation technologies government impacts district heating utilization of waste heat from electric power generation and on-site generation of electricity
DOE

N79-11488# Department of Energy Oak Ridge Tenn
ENERGY INFORMATION DATA BASE GUIDE TO ABSTRACTING AND INDEXING

Feb 1978 110 p

(TID-4583-R1) Avail NTIS HC A06/MF A01

The guidelines used in abstract writing and editing and in subject descriptor selection for five data bases are presented The associated acquisition and subject categorization functions are also addressed Three major data bases maintained are the Energy Information Data Base containing scientific and technical information covering all areas of energy as well as quasi-technical information in the area of energy policy and management the General and Practical Information Base containing mass-distribution information on energy how-to information primarily in the areas of energy conservation and solar energy utilization and information on energy-related legislation and standards and the Research in Progress Information Base which describes current research and development programs in the field of energy Two smaller classified data bases are also produced one on weapons data and the second containing other information that must be given limited distribution
DOE

N79-11489# National Association of Counties, Washington, D C
GUIDE TO REDUCING ENERGY-USE BUDGET COSTS

Apr 1978 101 p refs Prepared in cooperation with Natl League of Cities Washington D C

(Contract EM-75-C-01-8516)

(HCP/U60505-01) Avail NTIS HC A06/MF A01

Improved buildings and vehicle fleets were studied as a means of energy conservation A 48.1 percent saving in school buildings and a 59.7 percent saving in office buildings can be achieved with modifications of insulation wiring ventilation and lighting systems An average 30 percent saving can be achieved by lowering driving speeds from 70 to 50 mph Energy-saving driving habits can cut fuel consumption by as much as 20 percent Chapters included are The Commitment to Energy Management Employee Programs Vehicle Fleets New Buildings and Existing Buildings
DOE

N79-11490# Public Service Electric and Gas Co., Newark, N J
BATTERY ENERGY STORAGE TEST (BEST) FACILITY PHENOMENOLOGICAL CELL MODELING A TOOL FOR PLANNING AND ANALYZING BATTERY TESTING AT THE BEST FACILITY

E A Hyman 21 Oct 1977 101 p refs Prepared in cooperation with Public Serv Elec and Gas Res Corp Maplewood N J (COO-2857-1) Avail NTIS HC A06/MF A01

Phenomenological cell modeling a tool for battery testing is presented The uses of modeling in the battery cycling test program are described The modeling and modeling needs are discussed in more general terms Areas in which modeling would be useful are listed Succeeding sections are critical Surveys of available technical information in each area are included
DOE

N79-11491# Department of Energy Oak Ridge Tenn
ELECTRIC BATTERIES A BIBLIOGRAPHY

1978 780 p

(TID-3361) Avail NTIS HC A99/MF A01

This bibliography cites 5422 foreign and U S research reports patents articles conference proceedings and books relating to

the electric batteries Aspects covered include design and development performance and testing materials components and auxiliaries and research in progress Abstracts are included when available If no abstract is provided the subject descriptors used for computer storage and retrieval are given Corporate author personal author subject and report number indexes are included DOE

N79-11493# ArResearch Mfg Co Los Angeles Calif
STUDY OF HEAT ENGINE/FLYWHEEL HYBRID PROPULSION CONFIGURATION WITH ELECTRICAL TRANSMISSION SYSTEM PHASE 2 DESIGN DEFINITION Final Report
 Apr 1978 28 p
 (Contract EY-76-C-04-0789)
 (ALO-41/2) Avail NTIS HC A03/MF A01

Transmission options were evaluated and ranked according to cost weight and fuel economy The vehicle used for the evaluation was a five-passenger family sedan The primary use of this transmission system is to augment the heat engine with energy from the flywheel in such a manner as to level engine loads and improve the overall vehicle efficiency It was determined that the ac-ac transmission system was the most attractive for vehicular applications in the weight range investigated A comparison was made between a conventionally propelled (heat engine/automatic transmission) vehicle and the same vehicle configured with the hybrid propulsion arrangement that utilized the selected ac-ac transmission system The results of this comparison were shown The conventional vehicle had a curb weight of 3000 lb whereas the same vehicle configured with the hybrid arrangement had a curb weight of 2866 lb Both vehicles had the same acceleration and pass maneuver performance The hybrid's fuel consumption was 39.5 mpg compared to 15 mpg projected for the conventional vehicle DOE

N79-11494# Los Alamos Scientific Lab N Mex
AUGMENTED SOLAR ENERGY COLLECTION USING VARIOUS PLANAR REFLECTIVE SURFACES THEORETICAL CALCULATIONS AND EXPERIMENTAL RESULTS
 D P Grimmer K G Zinn K C Herr, and B E Wood Apr 1978 39 p
 (Contract W-7405-eng-36)
 (LA-7041) Avail NTIS HC A03/MF A01

The use of different types of flat reflective surfaces to increase the collection of solar energy by flat collectors was investigated Specular diffuse and combination specular/diffuse reflective surfaces are discussed An attempt was made to describe the reflective properties of surfaces in more generalized terms than simple direct or simple diffuse Most real surfaces possess a combination of specular-like and diffuse-like reflective properties A computer model was generated to describe surfaces as a combination of specular- and diffuse-like reflectivities The reflective properties of a given surface can be measured in the laboratory as a function of incident and reflected angles and these measured reflective properties can be used in the computer model to predict the increase in collector performance with such a reflector Predictions of system performance were made for various collector/reflector configurations and compared with the performance of an optimally oriented collector without a reflector DOE

N79-11496# Sandia Labs Albuquerque N Mex
SENSITIVITY OF SLOPE MEASUREMENTS ON PARABOLIC SOLAR MIRRORS TO POSITIONING AND ALIGNMENT OF THE LASER SCANNER
 L Rear Apr 1978 28 p refs
 (Contract EY-76-C-04-0789)
 (SAND-78-0700) Avail NTIS HC A03/MF A01

Distinctive patterns of apparent error in the collector surface geometry are introduced by inaccuracies in three apparatus set up parameters vertical position angular alignment and horizontal position The studies allowed recognition of the subsequent compensation for the effects introduced by errors in the vertical position and the angular alignment but the similarity between patterns generated by errors in the horizontal position and those

due to deviations in parabola focal length precluded the use of pattern recognition techniques This ambiguity between error sources introduces an uncertainty in the best fit focal length estimated from scanning data which is equal to 0.42 times the uncertainty in horizontal positioning In addition the practical lower bounds for all three set-up tolerances are dependent on the resolution of the system detector Analysis of worst case error combinations indicate the need for yet closer positioning and alignment tolerances DOE

N79-11497# California Univ Livermore Lawrence Livermore Lab
DESIGN GUIDE FOR SHALLOW SOLAR PONDS
 A B Casamajor and R E Parsons 6 Jan 1978 74 p refs
 (Contract W-7405-eng-48)
 (UCRL-52385) Avail NTIS HC A04/MF A01

The Solar Energy Group at LLI developed shallow solar ponds to supply solar-heated water for industrial and commercial use at a cost that is competitive with conventional energy sources Three aspects of the SSP technology are discussed (1) an introduction to SSP technology potential and limitations (2) a detailed description of the design and operation of an SSP system including component drawings and specifications and (3) planning information so that an SSP system can be used for a particular application and the cost can be estimated DOE

N79-11498# Fluor Engineers and Constructors Inc Irvine Calif
ECONOMICS OF TEXACO GASIFICATION COMBINED CYCLE SYSTEMS ECONOMIC STUDIES OF COAL GASIFICATION COMBINED CYCLE SYSTEMS FOR ELECTRIC POWER GENERATION
 B McElmurry and S Smelser Apr 1978 126 p
 (EPRI-AF-753) Avail NTIS HC A07/MF A01

Air blown coal gasification coupled with combined cycle power generation was investigated to determine whether an air blown gasifier had economic incentives greater than oxygen blown gasification Gasification processes were integrated with combined cycle plants based on advanced gas turbine technology (2400 F combustion outlet) estimated to be available in the 1981-1985 time period The evaluations were based on complete grass-roots facilities sized to conform to the present electric utility practice of building units of approximately 1000 MW capacity Results show that the process with air blown gasification is economically equivalent to oxygen blow gasification Also development emphasis should be placed on power generation rotating machinery heat transfer equipment and further gasification pilot plant experiments to maximize the overall thermal efficiency of air blown gasification Both processes have the potential for commercialization in the mid to late 1980s DOE

N79-11499# Brookhaven National Lab Upton N Y
ANNUAL HIGHLIGHTS OF THE ENERGY TECHNOLOGY PROGRAMS
 Dec 1977 31 p
 (Contract EY-76-C-02-0016)
 (BNL-50799) Avail NTIS HC A03/MF A01

The objective scope significant accomplishments in 1977 principal activities planned for 1978 and publications are presented for each program The energy storage and conversion division programs are in two broad areas electrolysis-based hydrogen energy storage systems and related technologies and conservator in buildings and community systems The engineering division programs include work in solar energy fossil energy and combustion technology areas The conservation program management group has responsibilities of national scope involving R and D projects carried out in coordination with industry and universities DOE

N79-11500# Brookhaven National Lab Upton N Y
ENERGY NEEDS USES, AND RESOURCES IN DEVELOPING COUNTRIES
 P F Palmedo R Nathans E Beardsworth and S Hale Jr
 Mar 1978 158 p refs
 (Contract EY-76-C-02-0016)
 (BNL-50784) Avail NTIS HC A08/MF A01

N79-11501

If traditional patterns of development are to continue oil consumption in the non-OPEC LDCs will grow steadily to become comparable with current U S consumption between 2000 and 2020 in the absence of major actions to replace noncommercial fuels or to increase the effectiveness with which they are used a large fraction of the 3 to 4 billion LDC rural population in the year 2000 will not be able to raise their energy usage above subsistence levels There is a variety of solutions to these problems many of them emerging directly from the changed economics of energy For example most LDCs have not adequately explored and developed their own indigenous resources in virtually all energy conversion and utilization processes there are opportunities for improvements in efficiency and substitution of renewable energy forms In virtually all these areas there are opportunities for effective assistance activities

DOE

N79-11501# ESB Inc Yardley Pa ESB Technology Center
SODIUM-ANTIMONY TRICHLORIDE BATTERY DEVELOPMENT PROGRAM FOR LOAD LEVELING Interim Report
A M Chreitzberg Apr 1978 143 p refs
(EPRI-EM 751) Avail NTIS HC A07/MF A01

Cell tests on 2- 20- 55 and 80-Wh cells provided data for the projection of performance for 200 Wh single-tube cells of 181 Wh/l and 88 Wh/kg at the 5-hour rate Twenty-watt-hour cells deliver up to 500 100% depth cycles at 3 cycles per day Ceramic processes--formerly magnesium-doped beta -were converted to lithia-doped beta with a reduction in specific resistivity and an increase in Na/Na test life to greater than 1500 Ah/cm²beta A complete cost analysis is presented for beta tubes and an estimate for a 100-MWh load-leveling battery yields \$39/kWh Major concerns are the unpredictable life of beta alumina solid electrolyte positive current collector corrosion short seal life and the low probability of achieving load-leveling-battery cost targets

DOE

N79-11502# General Electric Co Schenectady N Y Corporate Research and Development Dept

DEVELOPMENT OF SODIUM-SULFUR BATTERIES FOR UTILITY APPLICATION Interim Report
S P Mitoff and D Chatterji May 1978 312 p
(EPRI-EM-683) Avail NTIS HC A14/MF A01

Over 150 small (16-Ah) cells were placed on test Lifetimes up to 12 000 hours and up to 1 150 Ah/cm² were obtained Cell capacities of over 80% were achieved and sustained for over 250 cycles The most common failure mode involved degradation of the glass seal between the beta-alumina tube and the alpha-alumina header Thermocompression bonding of steel containers to the alpha alumina insulator was chosen as the first choice for the exterior seals The basic unit of the system is a module which is a thermally self-sufficient package It consists of 360 cells (300 Wh each) The cells within the module are arranged in nine bundles in series each bundle consisting of forty cells connected in parallel Manufacturing cost studies were presented A cost projection for a battery system of commercial size 100 megawatt-hours is projected to be about \$38/kWh The effect of the ceramic electrolyte tube size on the system selling price was also investigated A summary of supporting research activities was given

DOE

N79-11503# Department of Energy Washington D C Div of Solar Applications

SOLAR HEATING AND COOLING DEMONSTRATION PROJECT SUMMARIES
May 1978 270 p

(DOE/CS-0009) Avail NTIS HC A12/MF A01

The design and operating characteristics of all commercial and federal residential solar heating and cooling systems and the structures themselves are described Also included are available pictures of the buildings and simplified solar system diagrams A list of non-federal residential installations is provided

DOE

N79-11506# Argonne National Lab Ill
BIOMIMETIC APPROACH TO SOLAR ENERGY CONVERSION ARTIFICIAL PHOTOSYNTHESIS

J J Katz 1978 16 p refs Presented at 5th Energy Technol Conf., Wash D C 27 Feb 1978

(Contract W-31-109-eng-38)

(CONF-780222-5) Avail NTIS HC A02/MF A01

Results of efforts to devise apparatus and systems for using solar energy for chemical purposes by methods that mimic those used by photosynthetic organisms are reported Sufficient progress has been made in the understanding of plant photosynthesis to make artificial photosynthesis a reasonable goal Artificial photoreaction centers the apparatus used by photosynthetic organisms for light energy conversion to chemical oxidizing and reducing capacity have been made in the laboratory The synthetic reaction centers mimic with remarkable fidelity the properties of their in vivo prototypes Some of the formidable problems that must still be solved and the future prospects for biomimetic devices for solar energy conversion are discussed

DOE

N79-11508# Argonne National Lab Ill Chemical Engineering Div

ADVANCED SECONDARY BATTERIES FOR ELECTRIC VEHICLE PROPULSION

N P Yao 1978 20 p refs Presented at the Advan Transit Assoc Intern Conf Indianapolis 25 28 Apr 1978

(Contract W-31-109-eng-38)

(CONF 780426-2) Avail NTIS HC A02/MF A01

Contemplated battery applications and requirements for electric vehicles are summarized Development goals for the applications and the technological status of near-term state-of-the-art and long-term advanced batteries are reviewed Among the near-term batteries for electric vehicles are the improved lead-acid nickel-iron and nickel-zinc systems Zinc-chlorine sodium-sulfur and lithium-metal sulfide systems are the most promising advanced batteries under development Batteries are modular in construction nearly pollution-free in operation and can be custom-tailored in principle to almost all power and energy levels shapes and environmental conditions

DOE

N79-11510# Energy Research and Development Administration Washington D C

NEED FOR AND DEPLOYMENT OF INEXHAUSTIBLE ENERGY RESOURCE TECHNOLOGIES REPORT OF TECHNOLOGY STUDY PANEL INEXHAUSTIBLE ENERGY RESOURCES STUDY

Sep 1977 470 p refs

(TID-28202) Avail NTIS HC A20/MF A01

The technical state-of-the-art timing and cost barriers of the various inexhaustible technologies and their relationships to the nation's needs are assessed Principal summary observations and results are included The eleven sections are entitled executive summary introduction energy demand and exhaustible supply projections exhaustible energy sources inexhaustible energy resource technologies impact of energy market place engineering solution results and recommendations IERS technology study panel commentary technology study panel fact sheets and energy production cost data and equations

DOE

N79-11511# Oak Ridge National Lab Tenn
ENERGY AVAILABILITIES FOR STATE AND LOCAL DEVELOPMENT PROJECTED ENERGY PATTERNS FOR 1980 AND 1985

D P Vogt P L Rice and V P Pai Jun 1978 536 p refs Sponsored in part by Dept of Commerce

(Contract W-7405-eng-26)

(ORNL/TM-5890/54) Avail NTIS HC A23/MF A01

Projections of the supply demand and net imports of seven fuel types and four final consuming sectors for the nation for 1980 and 1985 are presented The data are formatted to present regional energy availability from primary extraction as well as from regional transformation processes The tables depict energy balances between availability and use for each of the specific fuels A consistent base of historic and projected energy information within a standard format is provided It should aid regional policymakers in their consideration of regional growth issues that may be influenced by the regional energy system This basic data must be supplemented by region-specific

information which only the local policy analyst can bring to bear in his assessment of the energy conditions which characterize each region DOE

N79-11512# Recon Systems Inc Princeton N J
FUNDAMENTAL DATA NEEDS FOR COAL CONVERSION TECHNOLOGY APPENDICES

7 Oct 1977 437 p refs
(Contract EY 76-C-02-4059)
(TID 28152-App) Avail NTIS HC A19/MF A01

Eleven coal conversion processes including major liquefaction and gasification processes were studied Emphasis was placed on thermodynamic data Analysis of the conversion processes including contact with developers and designers resulted in compilations of data needs in the following categories physical properties thermodynamic properties chemical properties transport properties and engineering data Temperature and pressure ranges are specified for each of the data needs DOE

N79-11513# Canterbury Univ Christchurch (New Zealand)
ENERGY ANALYSIS

R G Pearson Dec 1977 17 p refs Prepared in cooperation with Lincoln Coll Canterbury New Zealand
(NP 23145 Rept 30 ISSN-0110 1692) Avail NTIS (US Sales Only) HC A02/MF A01 DOE Depository Libraries

A discipline called Energy Analysis (EA) formalizes the calculation of the energy requirements of any product or process These requirements include not only the fuel and electricity consumed directly by the particular process in question but also the fuel and power used indirectly to produce the goods and services associated with the process Thus the energy requirements of a kilogram of potatoes includes the fuel and power used on the farm in trucks and by green grocers and also that used to make the fertilizer the tractors the trucks and so on The development of EA is described and its potential applications in New Zealand are examined by evaluating the arguments for and against its adoption DOE

N79-11515# California Univ Berkeley Lawrence Berkeley Lab Energy and Environment Div
NATIONAL GEOTHERMAL INFORMATION RESOURCE Annual Report, 1977

S L Phillips 19 Apr 1978 72 p refs
(Contract W-7405-eng-48)
(LBL-7803) Avail NTIS HC A04/MF A01

Critically evaluated data and other information for the development and utilization of geothermal energy are represented Included are both site dependent and site independent information related to resource evaluation electrical and direct utilization environmental aspects and the basic properties of aqueous electrolytes The information is organized into four principal areas (1) basic geothermal energy data (2) site-dependent data for both electrical and direct utilization (3) environmental aspects and (4) data handling development DOE

N79-11516# Sandia Labs Albuquerque N Mex
STRUCTURAL PERFORMANCE OF THE DOE/SANDIA 17 METER VERTICAL AXIS WIND TURBINE

W N Sullivan 1978 7 p refs Presented at the 23rd Natl SAMPE Symp Anaheim Calif 2 May 1978
(Contract EY-76-C-04-0789)
(SAND-78-0880C Conf-780502-7) Avail NTIS HC A02/MF A01

The structural performance of the 17 meter turbine blades was satisfactory during the two-blade test series The strut because of the high steady stresses from centrifugal loads is the highest stressed structural member on the blade Fatigue life consumption begins in the strut for wind speeds above 40 MPH Considering the frequency of such winds at typical sites the annual fatigue life consumption is still very small on the order of 2% DOE

N79-11517# Sandia Labs Albuquerque N Mex
DATA ACQUISITION AND SIGNAL PROCESSING FOR A VERTICAL AXIS WIND ENERGY CONVERSION SYSTEM

B Stiefeld and R N Tomlinson 1978 8 p refs Presented at the Seminar on Testing Solar Energy Mater and Systems Washington D C 22 May 1978
(Contract EY-76-C-04-0789)
(SAND-78-1000C Conf-780550-4) Avail NTIS HC A02/MF A01

The data acquisition and analyses system developed to meet the needs of the 17 meter VAWT is described The system employs a minicomputer-based data acquisition system with special peripheral equipment Statistical methods described are employed to evaluate the performance of the system from both a structural and performance viewpoint DOE

N79-11521# Varian Associates Palo Alto Calif
HIGH PERFORMANCE GaAs PHOTOVOLTAIC CELLS FOR CONCENTRATOR APPLICATIONS Final Report, 13 Oct 1976 - 13 Oct 1977

L W James H A Vanderplas and R L Moon Dec 1977 87 p refs
(Contract EY-76-C 04-0789)
(SAND-78-7018) Avail NTIS HC A05/MF A01

The AlGaAs/GaAs cell went from a workable design to an optimized design and cell construction procedures advanced to the point where the predicted optimized efficiency 23% AM 2 of 1000 suns was obtained for a number of cells The yield of cells exceeding some minimum efficiency increased steadily with one temporary setback due to an uncontrolled thermal alloying cycle The experimental results for best cells agree quite well with predicted efficiency vs air mass concentration and temperature As a result of the work done the AlGaAs/GaAs concentrator cell is ready for pilot-line production using some degree of automation and incorporation into application experiments DOE

N79-11522# Department of Energy Washington D C
ENVIRONMENTAL DEVELOPMENT PLAN (EDP) SOLAR THERMAL POWER SYSTEMS 1977

Mar 1978 61 p refs
(DOE/EDP-0004) Avail NTIS HC A04/MF A01

The plan (EDP) briefly describes the goals of the program and identifies potential environmental health safety and socioeconomic impacts relevant to solar thermal power systems particularly those sited in the southwest These impacts are screened for key issues i.e. those which are considered to be most serious in nature which have near term importance to the program and for which current knowledge of effects and control is inadequate A management plan is then presented for conducting and coordinating environmental research in concert with the technology development effort This will ensure that identified environmental issues are resolved prior to significant public deployment of the technology Seven key issues related to solar thermal power systems are identified in this EDP handling and disposal of system fluids and wastes potable water contamination heliostat reflection ecological impacts of the heliostat field alteration of the microclimate land use and utility-consumer interface DOE

N79-11525# Sandia Labs Albuquerque N Mex
SOLAR IRRIGATION PROGRAM PLAN SECOND REVISION

R L Alvis and L L Lukens May 1978 28 p refs Revised
(Contract EY-76-C-04-0789)
(SAND-78-0308-Rev) Avail NTIS HC A03/MF A01

Program goals are listed participants named and their responsibilities outlined Program efforts are divided into the following design analysis and system experimentation system application analysis and market definitions and analysis A deep-well experiment the Gila-Bend experiment and a shallow-wall experiment are analyzed Irrigation experiments are planned and their analyses are described DOE

N79-11526# General Atomic Co San Diego Calif
FIXED MIRROR SOLAR CONCENTRATOR FOR POWER GENERATION

N79-11527

J R Schuster J L Russell Jr G H Eggers and S V Shelton
Mar 1978 25 p Presented at Symp on Solar Thermal Power
Stations Cologne (Germany) 12 Apr 1978
(Contract EY-76 C 04-0789)

(GA A-14883 Conf 780425 3) Avail NTIS HC A02/MF A01

The concentrator employs a fixed mirror trough that produces a sharp line focus regardless of sun position. The heat receiver which employs a compound parabolic secondary concentrator is moved in a circular arc to track the focal line. With secondary concentration a theoretical upper concentration limit of 206 suns is possible. The secondary concentrator makes possible the design of a practical concentrator to efficiently generate steam at modern steam plant operating conditions. Because the mirror trough is stationary it can be made using low-cost type construction approaches. Modules of precast concrete and glass mirrors were fabricated to supply a collector field to Sandia Laboratories for their Solar Total Energy Demonstration Facility. These modules were constructed on-site at Sandia using local labor. The combination of concrete substrate and glass mirrors yields a rugged low-maintenance concentrator that has good potential for low-cost high volume on-site construction. Another construction approach based on supporting the glass mirrors with inexpensive metal stamping has also been developed. These structures can be quickly assembled in the field. S B S

N79-11527# Sandia Labs Albuquerque N Mex EFFECT OF SOLAR CELL PARAMETER VARIATION ON ARRAY POWER OUTPUT

J L Watkins and E L Burgess 1978 6 p refs Presented at
IEEE Photovoltaic Specialists Conf Washington DC 5 Jun
1978

(Contract EY-76-C-04-0789)

(SAND-78-0917C Conf-780619 7) Avail NTIS
HC A02/MF A01

Variations in cell series resistance cell photon generated current and cell temperature were considered independent and the effect of their variation on array performance was investigated using a combination of analysis techniques and a computer circuit simulation program SPICE. Results indicate that for series connected arrays variations around a mean of cell series resistance and cell operating temperature insignificantly affect array maximum power. However variations in cell photon generated current significantly affects power output as array current is limited by the weakest cell. Universal curves are presented which allow these results to be applied to a variety of arrays. DOE

N79-11528# Brookhaven National Lab Upton N Y Policy Analysis Div

ENERGY SITUATION IN THE MID-ATLANTIC REGION

James S Munson and Joel P Brainard Aug 1977 263 p
refs

(Contract EY-76 C-02-0016)

(BNL 50703) Avail NTIS HC A12/MF A01

The patterns of energy production supply and demand are described by the state. These patterns are compared to national and regional averages. A picture of existing energy and environmental interactions and a view of potential energy and environmental conflicts are presented. The major issues are reviewed by energy sector as a description of the existing energy actors and major energy programs for Ohio West Virginia Virginia Pennsylvania New Jersey New York Delaware Maryland Puerto Rico Virgin Islands and Washington DC. DOE

N79-11529# Sandia Labs Albuquerque N Mex DEVELOPMENT OF HIGH-EFFICIENCY P()-N() BACK-SURFACE-FIELD SILICON SOLAR CELLS

J G Fossum R D Nasby and E L Burgess 1978 6 p refs
Presented at the IEEE Photovoltaic Specialists Conf Washington
DC 5 Jun 1978

(Contract EY 76-C 04 0789)

(SAND-78 1156C Conf 780619-2) Avail NTIS
HC A02/MF A01

Primary physical mechanisms that can limit solar cell performance were identified and characterized by an analytical study. From the study results near optimum back-surface field

solar cells were designed and fabricated. Power conversion efficiencies of nearly 17% at AM1 and greater than 18% at illuminations near 50 suns have been measured at 27 C. The cell fabrication process is straightforward and is characterized by exceptionally high yield. DOE

N79-11531# Department of Energy Washington D C ENVIRONMENTAL DEVELOPMENT PLAN (EDP) OCEAN THERMAL ENERGY CONVERSION, 1977

Mar 1978 48 p refs

(DOE/EDP 006) Avail NTIS HC A03/MF A01

The status and goals of the OTEC program are described. Potential environmental health safety and socioeconomic impacts relevant to OTEC are identified. These impacts are screened for key issues i.e. those which are considered to be most serious in nature which have near-term importance to the program and for which current knowledge of effects and control strategies is inadequate. A management plan is presented for conducting and coordinating environmental research in concert with the technology development effort. This will ensure that identified environmental issues are resolved prior to significant public utilization of OTEC systems. The nine key issues associated with OTEC deployment are: ocean water mixing, metallic discharges, impingement/entrainment, use of biocides, working fluid leaks, climatological impacts, worker safety, international law, and secondary impacts. DOE

N79-11533# Waterloo Univ (Ontario)

METHODS FOR REDUCING HEAT LOSSES FROM FLAT PLATE SOLAR COLLECTORS, PHASE 2 Final Report, 1 Feb 1976 - 31 Aug 1977

K G T Hollands G D Raithby and T E Unny Mar 1978
84 p refs

(Grant EY-76-G 02 2597)

(COO-2597 4) Avail NTIS HC A05/MF A01

Improvements to flat plate solar collectors for heating and cooling of buildings were investigated through two parallel studies. The first study which deals with the free convective heat loss from V-corrugated absorber plate to a plane glass cover shows that for the same average spacing the free convective heat loss is greater for a V-corrugated absorber plate than for a plane absorber plate. However provided the average spacing is large enough the amount of increase is slight. The second study which deals with the free convective heat loss in a honeycomb solar collector in which the honeycomb consists of a set of horizontal partitions or slits shows that provided the solar collector is tilted to near vertical such a honeycomb gives equivalent or superior free convective loss suppression than does a square-celled honeycomb having the same amount of material. Correlation equations for the free convective heat loss are given for both studies. DOE

N79-11534# California Univ Berkeley Lawrence Berkeley Lab

DEFINITION OF ENGINEERING DEVELOPMENT AND RESEARCH PROBLEMS RELATING TO THE USE OF GEOTHERMAL FLUIDS FOR ELECTRIC POWER GENERATION AND NONELECTRIC HEATING

J A Apps Nov 1977 63 p refs

(Contract W-7405-eng-48)

(LBL-7025) Avail NTIS HC A04/MF A01

The use of geothermal fluids for electric power generation and nonelectric purposes causes problems not normally encountered when pure water is used for similar purposes. These problems must be identified and means developed to overcome them before geothermal energy resources can become an important source of electric power or thermal energy in the United States. Research and development projects aimed at solving problems arising from the use of geothermal fluids from known sources in the United States are listed. Problem areas covered are: impact on engineering design caused by chemical thermodynamic and transport properties of geothermal fluids, scaling and sludge formation, gases, volatile brine constituents, condensate chemistry, and environmental problems. The research projects identified are general in nature and are not site specific. DOE

N79-1.535# General Electric Co Philadelphia Pa Space Div

APPLIED RESEARCH ON ENERGY STORAGE AND CONVERSION FOR PHOTOVOLTAIC AND WIND ENERGY SYSTEMS VOLUME 3 WIND CONVERSION SYSTEMS WITH ENERGY STORAGE Final Report

Jan 1978 330 p refs Sponsored in part by DOE (Contract NSF C-75-22221-01)

(HCP/T22221-01/3) Avail NTIS HC A15/MF A01

Energy storage technologies deemed best suited for use in conjunction with a wind energy conversion system in utility residential and intermediate applications were evaluated. Break-even cost goals are presented for several storage technologies in each application. These break-even costs are compared with cost projections to show technologies and time frames of potential economic viability. Results, conclusions and recommendations pertaining to use of energy storage with wind energy conversion systems are included. DOE

N79-11536# California Univ Livermore Lawrence Livermore Lab

EVALUATED PHYSICAL PROPERTIES DATA FOR MATERIALS USED IN ENERGY STORAGE SYSTEMS

V E Hampel and L H Gevantman (NBS Washington D C) May 1978 25 p Presented at the 6th Intern CODATA Conf Palermo Italy 22-25 May 1978

(Contract W-7405-eng-48)

(UCRL-81159 Conf 780587-1) Avail NTIS HC A02/MF A01

The Lawrence Livermore Laboratory under contract to the Division of Energy Storage Systems of the U.S. Department of Energy (DOE/STOR) identifies materials and properties required for batteries, flywheels and for thermal or chemical systems. The users of these data set the priorities for evaluation. Requests are forwarded to the Office of Standard Reference Data of the National Bureau of Standards (NBS/OSRD) which selects and engages other sources of expertise. In addition OSRD manages and monitors the output of data evaluations prior to their being published as part of the NSRD/NBS series and prior to their being stored on a PDP-11/70 mini-computer for subsequent access through the Integrated Information System at LLL. Administrators of DOE/STOR researchers, engineers and DOE

N79-11537# Sandia Labs Livermore Calif
SPECIFIC HEAT VARIATIONS IN OIL ENERGY STORAGE MEDIA AND THEIR ECONOMIC IMPLICATIONS

R W Carling and L G Radosevich Jun 1978 25 p refs

(Contract EY-76-C-04-0789)

(SAND-78-8672) Avail NTIS HC A02/MF A01

Hydrocarbon oils were investigated for use as thermal energy storage media in solar thermal electric systems. In systems storing the energy as sensible heat the energy storage capacity is determined by the specific heat of the oil. Among the oils studied is Caloria HT-43. Previously reported specific heat data on Caloria HT 43 show values differing by as much as 25 percent. An attempt was made to resolve this discrepancy by measuring the specific heat from 77 to 327 C. Results show values from four samples varying by as much as 11 percent. The variations are correlated with differences in average molecular weights and inhomogeneity of the samples. The impact on cost of an 11 percent variation in specific heat is less than 1 percent for oil/rock systems and less than 2 percent for an all-oil system. DOE

N79-11538# California Univ Livermore Lawrence Livermore Lab

MECHANICALLY RECHARGEABLE METAL-AIR BATTERIES FOR AUTOMOTIVE PROPULSION

John F Cooper and E L Littauer 26 May 1978 8 p refs Presented at the 13th Intersoc Energy Conversion Eng Conf San Diego Calif 20-25 Aug 1978 Prepared in cooperation with Lockheed Missiles and Space Co Palo Alto Calif

(Contract W-7405-eng-48)

(UCRL-81178 Conf-780801-8) Avail NTIS HC A02/MF A01

The batteries are refueled by the addition of anode plates and water while the reaction product is withdrawn to be recycled at fixed industrial sites. Aluminum is most attractive for this application because of the large domestic industry expected in the 1980s. Battery performance is projected from reported cell data for a hardware designed for rapid addition of electrodes. The reaction product is processed in the battery to form a purified dry powder of trihydrated alumina-a feedstock of the current aluminum industry. For a 30 kW peak battery weighing 220 to 250 kg ranges of 500 to 750 km are estimated for a one-ton vehicle. Costs of recycled aluminum and air-cathode modules comprise 85 percent of the total cost (ca 5 cents/km) of battery ownership and operation. DOE

N79-11539# Stanford Univ Calif Inst for Energy Studies
ENERGY AND THE ECONOMY Final Report

William W Hogan Jan 1978 40 p refs

(EPRI-EA-620-Vol-1) Avail NTIS HC A03/MF A01

Six models of energy and the economy were compared. The comparison illuminates the structure of the models and identifies the importance of a few key elements in determining the nature of the feedback from the energy sector to the remainder of the economy: the value share of energy, the potential for the substitution of capital and labor for energy, and the interaction between energy availability and capital formation. The strengths and weaknesses of the models in application to the study of energy and the economy are discussed with emphasis on the contribution to improved communication between decision makers and energy modelers. DOE

N79-11540# California Univ Berkeley Lawrence Berkeley Lab

URBANISM AND ENERGY IN DEVELOPING REGIONS

Richard L Meier, S Berman and D Dowell 1 Mar 1978 100 p refs

(Contract W-7405-eng-48)

(LBL-7808) Avail NTIS HC A05/MF A01

Population growth assessments for Sao Paulo-Rio de Janeiro, Calcutta, Cairo-Alexandria, Mexico City and Seoul are presented. This analysis-from-a-distance is insufficient to judge how much extra installed electrical generating capacity is required before 1995: the added refining capability for liquid fuels or the uses for new LNG and coal imports due to be arranged. Results indicate that energy (and perhaps also water in most regions) planning is the major determinant of the manner in which these urban areas will adapt to the extraordinary pressures for new settlement. Energy supplies must be planned to meet requirements set by locally dominant values regarding human services and the environment. DOE

N79-11541# Argonne National Lab Ill
INTEGRATING TECHNOLOGIES TO PRODUCE ENERGY CONSERVATION

Robert E Holtz and Thomas J Marciniak 1978 19 p refs

Presented at the 2d Natl Conf and Exhibition on Technol for Energy Conservation Albuquerque N Mex 24-27 Jan 1978

(Contract W-31-109-eng-38)

(CONF-780109-6) Avail NTIS HC A02/MF A01

Urban energy systems are essentially designed to meet the electrical heating, cooling and miscellaneous energy demands of the community they serve. This paper briefly reviews each of the more prominent of the past, present and perhaps the future technologies. The systems are discussed in the order of the time frame of their commercial availability. An analysis of a fuel cell based system, a heat pump centered system and a Diesel engine based system is also presented. The addition of a pyrolysis unit which employs the refuse from the site with the Diesel engine based system is also examined. DOE

N79-11542# Department of Energy Washington D C Div of Consumption Data Studies

FEDERAL ENERGY DATA SYSTEM (FEDS) TECHNICAL DOCUMENTATION

Raymond F Fuller Jun 1978 117 p refs

N79-11543

(PB-281815/1 DOE/EIA-0031/1 CRN-780301-00087) Avail
NTIS HC A06/MF A01 CSCL 10A

Data system areas covered are (1) an explicit definition of each data series including source methodology naming conventions and idiosyncrasies which do not follow directly from the published source (2) table of contents and description for the on-line FEDS (3) an explicit detailed description of the FEDS computer tape (4) completed summary of conversion factors and scalars (5) glossary of energy terms
GRA

N79-11543# National Bureau of Standards Washington D C **PLAN FOR THE DEVELOPMENT AND IMPLEMENTATION OF STANDARDS FOR SOLAR HEATING AND COOLING APPLICATIONS**

D Waksman J H Pielert R D Dikkers E R Streed and W J Niessing Jun 1978 58 p refs Supersedes NBSIR-76-1143

(Contract EA-77-A-1-6010)

(PB-283237/6 NBSIR-78-1143A NBSIR-76-1143) Avail
NTIS HC A04/MF A01 CSCL 13A

Overviews of the building regulatory system in the United States are given along with a listing of the various standards which will be required for the various solar systems subsystems components and materials A list of training activities and manuals of accepted practice is presented The development of standards for solar applications by the Federal Government is outlined as well as the potential interface and utilization of the existing consensus standards generating organizations
GRA

N79-11544# National Bureau of Standards Washington D C Center for Building Technology **INTERNATIONAL PROJECT CATALOG OF MODULAR INTEGRATED UTILITY SYSTEMS**

M H Nimmo and C W Phillips Jul 1978 458 p
(PB 283477/8 NBS-SP-515 LC-78-600056) Avail NTIS
HC A20/MF A01 CSCL 13A

Project descriptions on more than 200 modular integrated utility systems type projects being conducted in the participating countries are presented Each summary form includes a description of the project its status the approach expected results some technical data the principal investigator an indication whether or not data is/or will be available and other miscellaneous project information
GRA

N79-11546# General Accounting Office Washington D C
Energy and Minerals Div

THE FEDERAL GOVERNMENT SHOULD ESTABLISH AND MEET ENERGY CONSERVATION GOALS Report to Congress

30 Jun 1978 121 p
(PB-283066/9 EMD-78-38) Avail NTIS HC A06/MF A01
CSCL 10A

The following policies are evaluated (1) energy conservation activity in the Nation (2) Federal energy conservation programs directed at the private sector (3) opportunities to achieve greater energy conservation and (4) additional actions which could be taken by the Congress and the Department of Energy
GRA

N79-11547# Bureau of Mines Washington D C **PROJECTS TO EXPAND ENERGY SOURCES IN THE WESTERN STATES**

Charles H Rich Jr 1978 210 p
(PB-283706/0 BM-IC-8772) Avail NTIS HC A10/MF A01
CSCL 10A

A survey was made of 808 fuel-related facilities ranging from coal and uranium mines and electric powerplants to storage and transportation projects planned proposed or under construction in all states west of the Mississippi River It covers new construction as well as expansion of existing coal mines electric powerplants coal conversion and waste-to-fuel plants oil shale projects tar sands projects geothermal facilities coal slurry petroleum and natural gas pipelines railroads needed for fuels development terminal facilities uranium mines mills and enrichment facilities oil refineries and natural gas processing plants and storage facilities Projects are listed by category and

by state and the probable location of each is plotted on state maps
GRA

N79-11548# Office of Technology Assessment Washington
D C

APPLICATION OF SOLAR TECHNOLOGY TO TODAY'S ENERGY NEEDS, VOLUME 1

Jun 1978 522 p
(PB-283770/6 OTA-E-66-Vol-1) Avail NTIS
HC A22/MF A01 CSCL 10A

A range of solar energy systems designed to produce thermal and electrical energy directly from sunlight with units small enough to be located on or near the buildings they are designed to serve are reviewed The state-of-the-art technology the circumstances under which such systems could be economically attractive and the problems encountered in integrating these devices into existing energy generation and delivery systems are examined The impact that widespread use of decentralized solar energy equipment could have on the United States is assessed
GRA

N79-11549# National Bureau of Standards Washington D C Center for Mechanical Engineering and Process Technology **COMMITTEE ON THE CHALLENGES OF MODERN SOCIETY RATIONAL USE OF ENERGY PILOT STUDY MODULAR INTEGRATED UTILITY SYSTEMS PROJECT VOLUME 1 DESCRIPTION ACTIVITIES, AND PRODUCTS Final Report**

M H Nimmo and C W Phillips 1978 105 p Sponsored in part by HUD
(PB-283428/1 NBSIR 78-1-1468 1 NATO/CCMS 74/1)
Avail NTIS HC A06/MF A01 CSCL 13A

The project its objectives chronology activities and products are described Copies of its products and minutes of its meetings are included The progress of each activity and product is discussed
GRA

N79-11550# National Technical Information Service Springfield
Va

DESIGN AND APPLICATIONS OF FLYWHEELS CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Aug 1978

Guy E Habercom Jr Sep 1978 263 p Supersedes
NTIS/PS-77/0882 NTIS/PS-76/0767 NTIS/PS-75/743
NTIS/PS-75/070
(NTIS/PS-78/0997/3 NTIS/PS-77/0882 NTIS/PS-76/0767
NTIS/PS-75/743 NTIS/PS-75/070) Avail NTIS
HC \$28 00/MF \$28 00 CSCL 131

The design and varied applications of flywheels and reaction wheels are investigated Such diversified applications as satellite stabilization surface vehicle propulsion energy transfer devices and inertial or friction welding are reviewed This updated bibliography contains 258 abstracts 74 of which are new entries to the previous edition
GRA

N79-11551# National Technical Information Service Springfield
Va

DESIGN AND APPLICATIONS OF FLYWHEELS CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Sep 1978

Guy E Habercom Jr Sep 1978 228 p Supersedes
NTIS/PS-77/0883 NTIS/PS-76/0768
(NTIS/PS-78/0998/1 NTIS/PS-77/0883 NTIS/PS-76/0768)
Avail NTIS HC \$28 00/MF \$28 00 CSCL 131

A worldwide literature survey was conducted to obtain information on the design and varied applications of flywheels and reaction wheels Such diversified applications as satellite stabilization surface vehicle propulsion energy transfer devices and inertia or friction welding are reviewed This updated bibliography contains 222 abstracts 42 of which are new entries to the previous edition
GRA

N79-11552# National Technical Information Service Springfield Va

**ENERGY POLICY AND RESEARCH PLANNING, VOLUME 2
A BIBLIOGRAPHY WITH ABSTRACTS Progress Report,
1976 - Sep 1977**

Audrey S Hundemann Sep 1978 240 p
(NTIS/PS-78/0961/9) Avail NTIS HC \$28 00/MF \$28 00
CSCL 10A

Energy planning for future U S energy needs on both national and state government levels is discussed The history and development of national and state legislation and regulations Project Independence studies and assessment of the effects of deregulation are presented Technical economic and environmental considerations in energy planning are also covered This updated bibliography contains 233 abstracts none of which are new entries to the previous edition GRA

N79-11553# National Techn.cal Information Service Springfield Va

**ENERGY POLICY AND RESEARCH PLANNING, VOLUME 3
A BIBLIOGRAPHY WITH ABSTRACTS Progress Report,
Oct 1977 - Sep 1978**

Audrey S Hundemann Sep 1978 91 p Supersedes NTIS/PS-77/0839 NTIS/PS-76/0710 NTIS/PS-75/630
(NTIS/PS-78/0962/7 NTIS/PS-77/0839 NTIS/PS-76/0710 NTIS/PS 75/630) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10A

Citations relative to planning for future U S energy needs on both national and state government levels are presented The history and development of national and state legislation and regulations Project Independence studies and assessment of the effects of deregulation are included Technical economic and environmental considerations in energy planning are also covered This updated bibliography contains 85 abstracts 83 of which are new entries to the previous edition GRA

N79-11554# Johns Hopkins Univ Laurel Md

**ENERGY PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY Quarterly Report,
Jan - Mar 1978**

Mar 1978 42 p refs 2 Vol
(PB-283171/7 APL/JHU-EQR/78-1) Avail NTIS
HC A03/MF A01 CSCL 10A

The first section of the report contains short descriptions of meetings trips presentations and other limited tasks of note performed in connection with the major program tasks The second section contains articles on the following subjects (1) scenarios for the use of energy available from hot dry rock and for geothermal energy use in South Dakota and in the eastern Gulf coastal plain (2) progress monitoring and reporting system and data base for Geothermal Region 5 (3) a study of geothermal energy applications in the Atlantic coastal plain (4) institutional problems for low-head hydroelectric power development in New England (5) an insurance modeling project (6) storage of electrical energy by flywheel and battery at small hydroelectric sites (7) a Community Annual Storage Energy System (CASES) (8) development and demonstration plan for a low cost flywheel and (9) multiple-objective modeling of power plant locations GRA

N79-11555# Johns Hopkins Univ Laurel Md

**ENERGY PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY Quarterly Report,
Oct - Dec 1977**

Dec 1977 43 p refs Sponsored by DOE 2 Vol
(PB-283170/9 APL/JHU-EQR/77-4) Avail NTIS
HC A03/MF A01 CSCL 10A

The first section of the report contains short descriptions of meetings trips presentations and other limited tasks of note performed in connection with the major program tasks The second section contains articles on the following subjects (1) scenarios for geothermal energy use in South Dakota the Atlantic coastal plain the eastern Gulf coastal plain and Arkansas (2) use of the energy available from hot dry rock (3) a progress monitoring and reporting system and data base for DOE Geothermal Region 5 (4) a fact sheet on the redevelopment of old hydroelectric power dams in New England (5) institutional problems for

low-head hydroelectric power development in New England (6) storage of electrical energy by the electrolysis of water (7) an insurance modeling project (8) a Community Annual Storage Energy System (9) and a development and demonstration plan for a low-cost flywheel GRA

N79-11556# Office of Technology Assessment Washington D C

**RENEWABLE OCEAN ENERGY SOURCES PART 1 OCEAN
THERMAL ENERGY CONVERSION**

May 1978 50 p refs
(PB-283104/8 OTA-0-62 LC-78-600053) Avail NTIS
HC A03/MF A01 CSCL 10B

The current status of OTEC technology is reported with particular attention to areas in which significant problems exist The economic considerations which are pertinent to an OTEC system are discussed and economic problems facing some of the products most often suggested for OTEC production are outlined The present and possible future Government role in funding OTEC research is reported GRA

N79-11557# Office of Technology Assessment Washington D C

**RENEWABLE OCEAN ENERGY SOURCES PART 1
WORKING PAPERS OCEAN THERMAL ENERGY CONVERSION**

May 1978 127 p refs
(PB-283103/0 OTA-0-63) Avail NTIS HC A07/MF A01
CSCL 10B

The discussions of the historical development of the OTEC concept (including the open- closed- and low temperature difference- cycles) the resource potential of ocean thermal gradients markets and products for OTEC development status and technical problem areas are reported Economic factors and environmental concerns are also treated The shore-based and open-ocean OTEC sites are presented GRA

N79-11558# National Bureau of Standards Washington D C
Center for Mechanical Engineering and Process Technology

**COMMITTEE ON THE CHALLENGES OF MODERN SOCIETY
RATIONAL USE OF ENERGY PILOT STUDY MODULAR
INTEGRATED UTILITY SYSTEM PROJECT VOLUME 2
MINUTES OF PROJECT MEETING Final Report**

M H Nimmo and C W Phillips Jun 1978 147 p Sponsored
in part by Dept of Housing and Urban Development Wash
D C

(PB-283429/9 NBSIR-78-1468-2-Vol-2 Nato/CCMS-74/2)
Avail NTIS HC A07/MF A01 CSCL 13A

A description of the project its objectives the chronology of the project a description of its activities and products copies of its products and minutes of its meetings are reported The progress of each activity and product is discussed the committee's recommendations are given GRA

N79-11560*# National Aeronautics and Space Administration
Langley Research Center Hampton Va

**ELEMENTAL CHARACTERISTICS OF AEROSOLS EMITTED
FROM A COAL-FIRED HEATING PLANT**

Jag J Singh and G S Khandelwal (Old Dominion Univ Norfolk
Va) Nov 1978 21 p refs
(NASA-TM-78749 L-12427) Avail NTIS HC A02/MF A01
CSCL 13B

Size differentiated aerosols were collected downstream from a heating plant fueled with eastern coal and analyzed using particle induced X-ray emission technique Based on aerosol masses collected in various size ranges the aerosol size distribution is determined to be trimodal with the three peaks centered at 0.54 microns 4.0 microns and 11.0 microns respectively Of the various trace elements present in the aerosols sulphur is the only element that shows very strong concentration in the smallest size group Iron is strongly concentrated in the 4.0 micron group Potassium calcium and titanium also exhibit stronger concentration in the 4.0 micron group than any other group Other trace elements - vanadium chromium manganese nickel copper and barium - are equally divided between the

N79-11568

0.54 microns and the 4.0 microns groups. Apparently all of the trace elements - except S - enter aerosols during the initial formation and subsequent condensation phases in the combustion process. Excess concentration of sulphur in the 0.54 microns group can only be accounted for by recondensation of sulphur vapors on the combustion aerosols and gas-to-particle phase conversion of sulfate vapors at the stack top. Author

N79-11568# Oak Ridge National Lab Tenn ENERGY-RELATED POLLUTANTS IN THE ENVIRONMENT THE USE OF SHORT-TERM FOR MUTAGENICITY IN THE ISOLATION AND IDENTIFICATION OF BIOHAZARDS

J L Epler F W Larimer T K Rao C E Nix and T Ho
1978 31 p refs Presented at the Higher Plant Systems as
Monitors of Environ Mutagens Marineland Fla 16 Jan 1978
Sponsored in part by EPA

(Contract W-7405-eng-26)

(CONF-780121-2) Avail NTIS HC A03/MF A01

The potential genetic hazards of existing or proposed energy generating or conversion systems were investigated. To approach the problems of dealing with and the testing of large numbers of compounds a form of the tier system was used. Operating units utilizing *Salmonella E coli* yeast human leukocytes mammalian cells and *Drosophila* were initiated. Various liquid-liquid extraction methods and column chromatographic separations were applied to crude products and effluents from oil shale coal liquefaction and coal gasification processes. Mutagenicity of the various fractions was assayed using reversion of histidine-requiring auxotrophs of *Salmonella typhimurium* and comparative studies were carried out with the other genetic systems. In order to incorporate metabolic activation of these fractions and compounds rat liver homogenates were used in the various assays. Results implicate chemicals occurring in the basic and the neutral fractions as potential genetic hazards. Chemical constituents of these fractions (identified or predicted) were tested individually for their mutagenic activity and correlated with the genetic monitoring. DOE

N79-11569# Department of Energy Washington D C ENVIRONMENTAL DEVELOPMENT PLAN (EDP) UNDER- GROUND COAL CONVERSION PROGRAM, FY 1977

Mar 1978 170 p refs

(DOE/EDP-0011) Avail NTIS HC A08/MF A01

Underground Coal Gasification (UCG) is one of several coal gasification technologies which when commercialized will allow for greater utilization of the nation's vast coal resources. There are certain environmental impacts unique to UCG processes that must be assessed before commercialization can occur. The most significant impacts are potential ground-water pollution subsidence and disruption of aquifers. These impacts are discussed more fully in this EDP. Most of the environmental research performed to date has addressed the characterization of the raw product gas hydrocarbon liquids and groundwater contamination. These EDPs are being distributed so that all having interests and responsibilities may assist in a planned revision and update. DOE

N79-11570# Oak Ridge National Lab Tenn NONPROLIFERATION ALTERNATIVE SYSTEMS ASSES- SMENT PROGRAM (NASAP) PRELIMINARY ENVIRONMEN- TAL ASSESSMENT OF THORIUM/URANIUM FUEL CYCLE SYSTEMS

H R Meyer J E Till and E A Bondietti Jun 1978 29 p
refs

(Contract W-7405-eng-26)

(ORNL/TM-6069) Avail NTIS HC A03/MF A01

A preliminary assessment is presented of the quality of existing information available for the evaluation of potential environmental impacts resulting from large-scale implementation of a thorium-based fuel cycle. The report's purpose includes (1) assistance in the development of a hazard assessment policy for the Nonproliferation Alternative Systems Assessments Program (NASAP) sponsored by the Department of Energy and (2) identification of areas in which further research is necessary to allow detailed evaluation of the environmental hazards

associated with thorium fuel cycles in general. Both the hazard assessment data base and the available assessment methodology are evaluated. DOE

N79-11607# Gulf Universities Research Consortium Bellaire Tex

POTENTIAL PRODUCIBILITY AND RECOVERY OF NAT- URAL GAS FROM GEOPRESSURED AQUIFERS OF THE CENOZOIC SEDIMENTS OF THE GULF COAST BASIN Final Report

Chapman Cronquist J P Malott N H Olsen P E Purser and
F W Zimmerman 30 Oct 1977 39 p refs

(Contract EX-76-C-01-2025)

(FE-2025-3) Avail NTIS HC A03/MF A01

The geothermal geopressured gas resource of the Texas-Louisiana Gulf Coast area was studied. It appears to offer a reasonable chance of developing into an energy resource of considerable magnitude. It has the additional advantage that the gas and electricity can be fed into existing transportation systems at minimal investments and it would supplement declining production from other sources as it was brought on stream. No fundamental technical problems are foreseen and there appears to be no radically new technology development required. Four areas discussed are the economics of individual reservoir size, extended well productivity, brine saturation of the natural gas, and an economical and environmentally satisfactory means of brine disposal. DOE

N79-11613# World Meteorological Organization Geneva (Switzerland)

RADIATION REGIME OF INCLINED SURFACES

K Y Kondratyev 1977 95 p refs Sponsored by UNESCO
(WMO-467 TN-152 ISBN-92-63-10467-0) Avail NTIS
HC A05/MF A01 WMO Geneva Sw Fr 18

The importance of understanding the radiation regime of inclined surfaces in any attempt to make direct use of solar radiation as a source of energy is stressed. The approach suggested is to make use of available data on incoming direct scattered and global radiation from stations which relate to horizontal surfaces and from this deduce the corresponding radiation component fluxes on inclined surfaces. ESA

N79-11641# Brookhaven National Lab Upton N Y ERDA'S OCEANOGRAPHIC PROGRAM FOR THE MID- ATLANTIC COASTAL REGION

F W Barvenik ed 1977 137 p refs Presented at Workshop
on Mid-Atlantic Coastal Oceanographic Res Upton N Y
3-7 Jan 1977

(Contract EY-76-C-02-0016)

(BNL-24016) Avail NTIS HC A07/MF A01

The impact of natural resources development on the Mid-Atlantic continental shelf itself or within the region and the location of energy facilities upon or adjacent to the shelf are discussed as part of an ERDA program to optimize energy development while minimizing deleterious environmental effects. The principal stresses and how they may be transferred in the ecosystem or to man are assessed. Contractor capabilities and research facilities are reviewed and the potential for multi-group or multi-agency research coordination is asserted. The appendix contains research summaries from the present contractors. DOE

N79-11686# Franklin Inst Research Labs, Rockville Md Dept of Science Information Services

A LITERATURE REVIEW-PROBLEM DEFINITION STUDIES ON SELECTED TOXIC CHEMICALS VOLUME 1 OC- CUPATIONAL HEALTH AND SAFETY ASPECTS OF DIESEL FUEL AND WHITE SMOKE GENERATED FROM IT Final Report, Mar 1977 - Apr 1978

Deborah Liss-Suter and Richard Mason Apr 1978 66 p refs
(Contract DAMD17-77-C-7020, DA Proj 3E7-62720-A-835)
(AD-A056018) Avail NTIS HC A04/MF A01 CSCL 08/20

Literature is reviewed (75 references) covering analysis physical and chemical properties human and animal toxicology, mammalian pharmacokinetics industrial standards and occupational hazards of diesel fuel and white smoke (an aerosol mixture of diesel fuel additives diesel engine exhaust and pyrolysis products) Diesel fuel is an aliphatic and aromatic hydrocarbon mixture obtained from the straight-run distillation of petroleum and often blended with cracked fuels Composition is controlled only by physical properties (boiling range flash point viscosity cetane number) additives improve combustibility reduce corrosiveness and reduce gum formation The smoke is generated by feeding diesel fuel into the exhaust manifold of a diesel engine creating a vapor which condenses into an opaque mass of microdroplets which may be useful in screening military equipment and personnel The health hazards of exposure to white smoke have not been studied although pure diesel fuel aerosols do not appear to be irritating to the respiratory tract or skin of humans during acute exposures to relatively low concentrations Dermatitis following direct contact with diesel fuel is reportedly due to a combination of poor occupational hygiene and constitutional factors Ingestion of diesel fuel results in gastritis and patchy destruction of the gastric mucosa GRA

N79-11688# Franklin Inst Research Labs Rockville Md Dept of Science Information Services
A LITERATURE REVIEW-PROBLEM DEFINITION STUDIES ON SELECTED TOXIC CHEMICALS VOLUME 8 ENVIRONMENTAL ASPECTS OF DIESEL FUEL AND FOG OILS SGF NUMBER 1 AND SGF NUMBER 2 AND SMOKE SCREENS GENERATED FROM THEM Final Report
 Deborah Liss-Suter Apr 1978 132 p refs
 (Contract DAMD17-77 C-7020 DA Proj 3E7-62720-A-835) (AD-A056021) Avail NTIS HC A07/MF A01 CSCL 06/20

In this literature review (117 references) on the environmental aspects of fog oils and diesel fuel and the smoke screens or fogs generated from them the topics which are investigated include the effects of petroleum fuels and lubricants on waterfowl and birds insects plants soil nematodes fish marine worms molluscs crustaceans and other marine species phytoplankton microorganisms and zooplankton In addition to acute toxicity of these petroleum oils in most species adverse effects on reproduction carcinogenicity chemically-mediated behavior disruption and inhibition of photosynthesis among others are reported for various organisms Factors influencing the atmospheric dispersion of the oil smokes and the dispersion and persistence of the oil films on soil water and vegetation resulting from the settling of the oil smoke to ground level are reviewed as well as pathways by which these petroleum oils are chemically and biologically degraded and their uptake and accumulation in species ranging from algae through fish and shellfish to humans Current techniques for sampling and analysis of fog oils and diesel fuel in water soil and biological media are presented GRA

N79-11859# RAND Corp Santa Monica Calif
PULSED-POWER RESEARCH AND DEVELOPMENT IN THE USSR Interim Report
 Simon Kassel May 1978 160 p refs
 (Contract MDA903-78-C-0189 ARPA Order 3520) (AD-A056635, RAND/R-2212-ARPA) Avail NTIS HC A08/MF A01 CSCL 20/7

Part of a continuing study of Soviet R and D of high-current high-energy charged-particle beams and their scientific and technological applications this report discusses pulsed-power devices and elements the basic means of energy delivery to all charged-particle beam systems Specifically it treats pulsed-power generation storage and switching Soviet technical literature since 1960 was examined for data detailing both the organization and planning of Soviet pulsed-power R and D and the theory testing and operation of pulsed-power equipment The author concludes that the USSR is engaged in a major effort to develop pulsed-power systems for controlled thermonuclear reactions as a national energy source and military applications Appendixes list pulsed-power facilities and published staff authors by research area and alphabetical order Author (GRA)

N79-11887# Department of Energy Washington D C Office of Magnetic Fusion Energy
OVERVIEW OF THE MAGNETIC FUSION ENERGY DEVELOPMENT AND TECHNOLOGY PROGRAM
 Mar 1978 31 p
 (HCP/T3073-01) Avail NTIS HC A03/MF A01

Controlled fusion research is discussed with emphasis on (1) fusion system engineering and advanced design (2) plasma engineering, (3) magnetic systems (4) materials (5) environment and safety and (6) alternate energy applications DOE

N79-11889# Westinghouse Electric Corp Pittsburgh Pa Fusion Power Systems Dept
FOUR IGNITION TNS TOKAMAK REACTOR SYSTEMS DESIGN SUMMARY
 C A Flanagan ed Oct 1977 178 p refs
 (Contract W-7405-eng-26) (ORNL/Sub-7117/25 WFPS-TME-071) Avail NTIS HC A09/MF A01

Principal TNS objectives assumed included (1) demonstration of ignition and burning dynamics and (2) reactor technology forcing The selection of an overall design approach for TNS is described The choice of ignition plasma design conditions (principally size and confining field of axis) and the choice of toroidal field coil technology (resistive or superconducting windings) are discussed Four TF coil types were examined, these included copper NbTi/Nb3Sn and a hybrid design employing nested coils of copper and NbTi The four reference concepts using decision modeling techniques as a mechanism for selecting a preferred design approach for the TNS mission are compared DOE

N79-11890# ECON Inc Princeton N J
ECONOMICS OF FUSION RESEARCH
 George A Hazelrigg Jr 15 Oct 1977 288 p refs
 (Contract EG-77-C-02-4181) (COO-4181- ECON-77-158-2) Avail NTIS HC A13/MF A01

The study recognized that a hierarchy of economic analyses of research programs exists standard benefit-cost analysis expected value of R and D information and expected utility analysis It was shown that standard benefit-cost analysis as commonly applied to research programs was inadequate for the evaluation of a high technology research effort such as fusion research A methodology for performing an expected value analysis was developed and demonstrated An overview of an approach to perform an expected utility analysis of fusion research is presented In addition a potential benefit of fusion research, not previously identified is discussed and rough estimates of its magnitude are presented This benefit deals with the effect of a fusion research program on optimal fossil fuel consumption patterns The results of this study indicated that it was both appropriate and possible to perform an expected value analysis of fusion research in order to assess the economics of a fusion research program DOE

N79-11956# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
FUEL CELL ON-SITE INTEGRATED ENERGY SYSTEM PARAMETRIC ANALYSIS OF A RESIDENTIAL COMPLEX
 Stephen N Simons [1977] 25 p refs Presented at the Fuel Cell Workshop Sarasota Fla 14 17 Nov 1977 sponsored by DOE (NASA-TM-78996 E-9780) Avail NTIS HC A02/MF A01 CSCL 10B

A parametric energy-use analysis was performed for a large apartment complex served by a fuel cell on-site integrated energy system (OS/IES) The variables parameterized include operating characteristics for four phosphoric acid fuel cells eight OS/IES energy recovery systems and four climatic locations The annual fuel consumption for selected parametric combinations are presented and a breakeven economic analysis is presented for one parametric combination The results show fuel cell electrical efficiency and system component choice have the greatest effect on annual fuel consumption fuel cell thermal efficiency and geographic location have less of an effect Author

N79-12084*# Pratt and Whitney Aircraft Group East Hartford, Conn Commercial Products Div
ENERGY EFFICIENT ENGINE PRELIMINARY DESIGN AND INTEGRATION STUDY

D E Gray et al Nov 1978 362 p
 (Contract NAS3-20628)
 (NASA-CR-135396, PWA-5500-18) Avail NTIS
 HC A16/MF A01 CSCL 21E

The technology and configurational requirements of an all new 1990's energy efficient turbofan engine having a twin spool arrangement with a directly coupled fan and low-pressure turbine, a mixed exhaust nacelle and a high 38.6:1 overall pressure ratio were studied. Major advanced technology design features required to provide the overall benefits were a high pressure ratio compression system, a thermally actuated advanced clearance control system, lightweight shroudless fan blades a low maintenance cost one-stage high pressure turbine a short efficient mixer and structurally integrated engine and nacelle. A conceptual design analysis was followed by integration and performance analyses of geared and direct-drive fan engines with separate or mixed exhaust nacelles to refine previously designed engine cycles. Preliminary design and more detailed engine-aircraft integration analysis were then conducted on the more promising configurations. Engine and aircraft sizing, fuel burned and airframe noise studies on projected 1990's domestic and international aircraft produced sufficient definition of configurational and advanced technology requirements to allow immediate initiation of component technology development.

A R H

N79-12086*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
NASA RESEARCH ON GENERAL AVIATION POWER PLANTS

Warner L Stewart Richard J Weber Edward A Willis and Gilbert K Sievers 1978 14 p refs Proposed for presentation at the 15th Ann Meeting and Tech Display, Washington D C, 6-8 Feb 1979 sponsored by AIAA
 (NASA-TM-79031 E-9828) Avail NTIS HC A02/MF A01 CSCL 21A

Propulsion systems are key factors in the design and performance of general aviation airplanes. NASA research programs that are intended to support improvements in these engines are described. Reciprocating engines are by far the most numerous powerplants in the aviation fleet. Near-term efforts are being made to lower their fuel consumption and emissions. Longer-term work includes advanced alternatives such as rotary and lightweight diesel engines. Work is underway on improved turbofans and turboprops.

Author

N79-12130*# LinCom Corp, Pasadena, Calif
AUTOMATIC PHASE CONTROL IN SOLAR POWER SATELLITE SYSTEMS Final Report

W C Lindsey and A V Kantak 15 Feb 1978 130 p refs
 (Contract NAS9-15237)
 (NASA-CR-151856 TR-7802-0977) Avail NTIS
 HC A07/MF A01 CSCL 22B

Various approaches to the problem of generating, maintaining and distributing a coherent, reference phase signal over a large area are suggested, mathematically modeled and analyzed with respect to their ability to minimize phase build-up, beam diffusion and beam steering phase jitter, cable length and maximize power transfer efficiency. In addition, phase control configurations are suggested which alleviate the need for layout symmetry.

J M S

N79-12138*# Lockheed Missiles and Space Co Sunnyvale Calif Space Systems Div
ASSESSMENT OF SEPS SOLAR ARRAY TECHNOLOGY FOR ORBITAL SERVICE MODULE APPLICATION Final Topical Report

30 Oct 1978 153 p refs
 (Contract NAS9-15595)
 (NASA-CR-151859 LMSC-D665410) Avail NTIS
 HC A08/MF A01 CSCL 22B

Work performed in the following assessment areas on the SEPS solar array is reported: (1) requirements definition

(2) electrical design evaluation (3) mechanical design evaluation and (4) design modification analysis. General overall assessment conclusions are summarized. There are no known serious design limitations involved in the implementation of the recommended design modifications. A section of orbiter and array engineering drawings is included. S B S

N79-12239# Forest Products Lab Madison, Wis
METHANOL FROM WOOD WASTE A TECHNICAL AND ECONOMIC STUDY

A E Hokanson (Raphael Katzen Assoc Cincinnati) and R M Rowell Jun 1977 21 p refs
 (FPL-12) Avail NTIS HC A02/MF A01

A methanol-from-wood waste facility having a capacity of 50 million gallons per year requires 1,500 oven-dry tons (ODT) of wood waste per day. The yield of methanol from wood is about 38 percent, or about 100 gallons per ODT of wood. This yield is based on all process energy required coming from the wood waste. At a wood waste cost of \$15/ODT, the selling price of methanol is estimated at \$0.77/gal, at \$34/ODT the selling price is \$0.96/gal.

Author

N79-12249# Southwest Research Inst San Antonio Tex
IDENTIFICATION OF PROBABLE AUTOMOTIVE FUELS CONSUMPTION 1985-2000, EXECUTIVE SUMMARY

May 1978 50 p Prepared in cooperation with SOHIO Petrol Co, Cleveland, Standard Oil Co of Ind Whiting, and Cameron Engineers Inc, Denver
 (Contract EY-76-C-04-3684)
 (HCP/W3684-01/2) Avail NTIS HC A03/MF A01

The principal factors and activities in the production of automotive fuels which have synthetic hydrocarbon constituents and alcohol fuels derived from coal are traced and discussed in detail. These include selection of reference raw materials, syncrude compositions for a variety of candidate conversion processes and finished automotive fuels composition based upon domestic fuel demand projections for the time frame 1985-2000. In addition, those fuel-engine relationships pertinent to developing optimized automotive systems are discussed in relation to anticipated developments in propulsion systems technology. Projected compositions and performance of finished specification-quality automotive fuels for this time frame are not expected to differ significantly from those for today's fuels. Consequently, excessive undesirable compounds can be diluted to acceptable specifications levels by proportionate blending with petroleum feedstocks. DOE

N79-12250# Minnesota Legislature Science and Technology Project, St Paul

PARAMETERS FOR LEGISLATIVE CONSIDERATION OF BIOCONVERSION TECHNOLOGIES

Tom P Abeles and Janna R King Feb 1978 45 p refs
 (Grant NSF ISP-76-02379)
 (PB-284742/4 NSF/RA-780196) Avail NTIS
 HC A03/MF A01 CSCL 21D

Conclusions and recommendations are reported that evolved from the examination of various models of biomass production of nonpetroleum fuels. It was determined that it was neither economically nor energetically wise at this time for Minnesota to commit itself to a gasohol program modeled after Nebraska's program. Instead of adopting the single source, large scale Nebraska model, it was concluded that Minnesota should do the pilot and demonstration plants for the production of ethanol on the small scale (farm or local co-op size), and encourage the utilization of a variety of feedstocks such as, sugar beets, grains and cellulosic residues. GRA

N79-12251# Environmental Protection Agency, Research Triangle Park NC Office of Air Quality Planning and Standards

NATIONAL EMISSIONS DATA SYSTEM (NEDS) FUEL USE REPORT (1974) Final Report

Apr 1978 128 p
 (PB-284658/2 EPA-450/2-77-031) Avail NTIS
 HC A01/MF A01 CSCL 21D

Annual estimates of total consumption of major fuels such as coal, fuel oil natural gas, gasoline, diesel fuel and a number of other comparatively minor fuels are summarized. The data are distributed according to major categories of air pollutant emissions sources and are reported for the nation as a whole and for individual states, territories, and the District of Columbia. GRA

N79-12256# R and D Associates Marina Del Rey, Calif
LIQUEFIED NATURAL GAS WIND TUNNEL SIMULATION AND INSTRUMENTATION ASSESSMENTS
 Apr 1978 366 p refs Prepared in cooperation with Colorado State Univ., Fort Collins
 (Contract EE-77-C-03-1364)
 (SAN-W1364-01) Avail NTIS HC A16/MF A01

An evaluation of selected aspects of Liquefied Natural Gas (LNG) safety research is presented. Findings are reported on LNG flame radiation data criteria for test site selection, wind tunnel modeling, wind tunnel tests, instrumentation and Salton Sea meteorological data. Recommendations are made for methods of studying LNG vapor dispersion. DOE

N79-12424# Aerotherm Acurex Corp Mountain View Calif
MEASUREMENT OF HIGH-TEMPERATURE, HIGH-PRESSURE PROCESSES Annual Report, Apr 1976 - Jul 1977

Larry Cooper Jan 1978 265 p refs
 (Contract EPA-68-02-2153)
 (PB-284041/1 EPA-600/7-78-011) Avail NTIS
 HC A12/MF A01 CSCL 14B

The first year's efforts under a planned 3 year program to develop measurement techniques for high-temperature, high-pressure (HTP) processes are reviewed. Several related topics are discussed in detail. GRA

N79-12439# California Univ Livermore Lawrence Livermore Lab
CIVILIAN APPLICATIONS OF LASER FUSION
 J Maniscalco, J Blink R Buntzen, J Hovingh W Meir, M Monsler and P Walker 17 Nov 1977 104 p refs
 (Contract W-7405-eng-48)
 (UCRL-52349) Avail NTIS HC A06/MF A01

The commercial aspects of laser fusion were evaluated in an attempt to relate the end products (neutrons and energy) to significant commercial applications. It was found that by far the largest markets and highest payoffs for laser fusion are associated with electric power production. The prospects of producing commercial electricity with laser fusion was examined. A laser fusion concept, the liquid lithium waterfall reactor is described in detail. It was concluded that all three sources of electrical energy should be developed to the point where the final selections are primarily based on economic competitiveness. The other potential applications of laser fusion (fissile fuel production, synthetic fuel production, actinide burning, and propulsion) are also discussed and a preliminary plan for the engineering development of laser fusion is presented. DOE

N79-12450# Little (Arthur D.), Inc. Cambridge, Mass
RECOMMENDED PERFORMANCE STANDARDS FOR ELECTRIC AND HYBRID VEHICLES
 B Underhill, P Gott and D Hurter Sep 1977 156 p
 (EY-76-C-03-1335)
 (SAN/1335-1) Avail NTIS HC A08/MF A01

Minimum performance standards for electric and hybrid vehicles were developed. The standards cover passenger cars and commercial vehicles with the latter having possible agricultural uses. The primary results cover performance parameters such as payload, acceleration time, top speed, range (both constant and on an SAE J227a schedule C cycle), maximum energy consumption, gradability, battery life, battery recharge time, safety standards, handling, weatherproofing, audio and radiation noise and maintainability. DOE

N79-12542*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
NONLINEAR DYNAMIC RESPONSE OF WIND TURBINE ROTORS Ph D Thesis - MIT
 Inderjit Chopra Feb 1977 233 p refs
 (Grant NSF AER-75 00826)
 (NASA-TM-78324) Avail NTIS HC A11/MF A01 CSCL 10A

The nonlinear equations of motion for a rigid rotor restrained by three flexible springs representing the flapping, lagging and feathering motions are derived using Lagrange's equations for arbitrary angular rotations. These are reduced to a consistent set of nonlinear equations using nonlinear terms up to third order. Author

N79-12543*# Jet Propulsion Lab Calif Inst of Tech Pasadena
CHARACTERIZATION OF SOLAR CELLS FOR SPACE APPLICATIONS VOLUME 4 ELECTRICAL CHARACTERISTICS OF SPECTROLAB BSF 200-MICRON HELIOS CELLS AS A FUNCTION OF INTENSITY AND TEMPERATURE
 R G Downing and R S Weiss 1 Nov 1978 38 p refs
 (Contract NAS7-100)
 (NASA-CR-157934 JPL-Pub-78-15-Vol-4) Avail NTIS
 HC A03/MF A01 CSCL 10A

Electrical characteristics of Spectrolab BSF 200 micron Helios N/P silicon solar cells are presented in graphical and tabular format as a function of solar illumination intensity and temperature. Author

N79-12544*# Springborn Labs Inc Enfield, Conn
ENCAPSULATION TASK OF THE LOW-COST SILICON SOLAR ARRAY PROJECT INVESTIGATION OF TEST METHODS, MATERIAL PROPERTIES, AND PROCESSES FOR SOLAR CELL ENCAPSULANTS Annual Report
 P B Willis B Baum and R A White Jun 1978 161 p
 Prepared for DOE
 (Contracts NAS7-100 JPL-954527)
 (NASA-CR-157939 DOE/JPL-954527-78/8) Avail NTIS
 HC A08/MF A01 CSCL 10A

The results of an investigation of solar module encapsulation systems applicable to the Low-Cost Solar Array Project 1986 cost and performance goals are presented. Six basic construction elements were identified and their specific uses in module construction defined. A uniform coating basis was established for each element. The survey results were also useful in revealing price ranges for classes of materials and estimating the cost allocation for each element within the encapsulating cost goal. The six construction elements were considered to be substrates, superstrates, potting, adhesives, outer covers and back covers. GY

N79-12547*# National Aeronautics and Space Administration, Washington, D C
THE STIRLING ENGINE FOR VEHICLE PROPULSION
 P Kuhlman Nov 1978 14 p refs Transl into ENGLISH from VDI-Berichte (West Germany), no 224, 1974 p 87-91
 Original language document was announced as A75-23509
 Transl by Kanner (Leo) Associates Redwood City, Calif
 (Contract NASw-3199)
 (NASA-TM-75442) Avail NTIS HC A02/MF A01 CSCL 10A

The performance data of experimental Stirling engines are considered along with questions of exhaust-gas composition, engine noise, engine volume and weight, engine control, and the engine-starting process. The Stirling engine can use practically any liquid or gaseous fuel for its operation. It is found that technically a use of the Stirling engine in motor vehicles is feasible. Economic questions related to an introduction of the Stirling engine are discussed along with possible new developments which could improve the economic situation in favor of a use of Stirling engine. Author

N79-12548*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
MICROPROCESSOR CONTROL OF A WIND TURBINE GENERATOR
 Arthur J Gnecco and Gary T Whitehead 1978 17 p Presented at the Conf on Ind Appl of Microprocessors, Philadelphia, 20-22

Mar 1978, sponsored by IEEE
(Contract E(49-26)-1028)
(NASA-TM-79021 E-9818 DOE/NASA/1028-78/20) Avail
NTIS HC A02/MF A01 CSCL 10B

A microprocessor based system was used to control the unattended operation of a wind turbine generator. The turbine and its microcomputer system are fully described with special emphasis on the wide variety of tasks performed by the microprocessor for the safe and efficient operation of the turbine. The flexibility, cost and reliability of the microprocessor were major factors in its selection. A A

N79-12552*# AiResearch Mfg Co, Torrance Calif
PROTOTYPE SOLAR HEATING AND COOLING SYSTEMS
Monthly Progress Reports, 1 Jan 1978 - 31 Mar 1978

Apr 1978 25 p Prepared for DOE
(Contract NAS8-32091)
(NASA-CR-150828) Avail NTIS HC A02/MF A01 CSCL
10A

Eight prototype systems were developed. The systems are 3 25, and 75-ton size units. The manufacture, test, installation, maintenance, problem resolution and performance evaluation of the systems is described. Size activities for the various systems are included. S B S

N79-12553*# United Technologies Corp, East Hartford Conn
Power Systems Div
DEVELOPMENT OF ADVANCED FUEL CELL SYSTEM Final
Report, 25 Feb - 31 Dec 1976

B Gitlow, A P Meyer, W F Bell, and R E Martin 6 Jun
1978 74 p refs
(Contract NAS3-19778)
(NASA-CR-159443, FCR-0398) Avail NTIS
HC A04/MF A01 CSCL 10A

An experimental program was conducted continuing the development effort to improve the weight, life and performance characteristics of hydrogen-oxygen alkaline fuel cells for advanced power systems. These advanced technology cells operate with passive water removal which contributes to a lower system weight and extended operating life. Endurance evaluation of two single cells and two two-cell plaques was continued. Three new test articles were fabricated and tested. A single cell completed 7038 hours of endurance testing. This cell incorporated a Fybex matrix hybrid-frame PPF anode and a 90 Au/10 Pt cathode. This configuration was developed to extend cell life. Two cell plaques with dedicated flow fields and manifolds for all fluids did not exhibit the cell-to-cell electrolyte transfer that limited the operating life of earlier multicell plaques. Author

N79-12554*# General Electric Co, Philadelphia Pa
Space Div

MINI-BRAYTON HEAT SOURCE ASSEMBLY DEVELOP-
MENT Final Report, 27 Jun 1974 - 1 Oct 1978

D Wein and W F Zimmerman 1 Nov 1978 306 p refs
(Contract NAS3-18541)
(NASA-CR-159447, Doc-78SDS4252) Avail NTIS
HC A14/MF A01 CSCL 10A

The work accomplished on the Mini-Brayton Heat Source Assembly program is summarized. Required technologies to design, fabricate and assemble components for a high temperature Heat Source Assembly (HSA) which would generate and transfer the thermal energy for a spaceborne Brayton Isotope Power System (BIPS) were developed. B B

N79-12555# National Aviation Facilities Experimental Center
Atlantic City, N J

ALTERNATIVE ENERGY SOURCES FOR FEDERAL AVIA-
TION ADMINISTRATION FACILITIES Final Report, May
1976 - Jan 1978

Lane G Hinkley, George C Apostolakis and Arthur H Bonello
Aug 1978 121 p refs
(FAA Proj 081-431-100)
(AD-A058681, FAA-NA-77-17 FAA-RD-78-87) Avail NTIS
HC A06/MF A01 CSCL 10/2

The feasibility of using photovoltaics, wind, fuel cells and thermoelectric/thermionic generators to provide electrical energy at Federal Aviation Administration facilities was investigated. As

the result of a literature and industry/government search and two questionnaires, it was recommended that the agency (1) proceed to establish alternative energy demonstration sites in order to gain experience in the design, implementation, and operation of such systems, (2) expend some level of effort in continuing the literature/industry/government search initiated under this project in order to remain current on the subject and (3) establish a centralized data collection and tabulation point for energy requirements/consumption/cost data on a facility basis. A R H

N79-12556*# National Aeronautics and Space Administration
Marshall Space Flight Center, Huntsville Ala

MSFC HOT AIR COLLECTORS Final Report
Kenneth Anthony Oct 1978 32 p refs
(NASA-TM-78206) Avail NTIS HC A03/MF A01 CSCL 10A

A description of the hot air collector is given that includes a history of development, a history of the materials development and a program summary. The major portion of the solar energy system cost is the collector. Since the collector is the heart of the system and the most costly subsystem, reducing the cost of producing collectors in large quantities is a major goal. This solar collector is designed to heat air and/or water cheaply and efficiently through the use of solar energy. G G

N79-12557*# Jet Propulsion Lab, Calif Inst of Tech, Pasadena
SATELLITE POWER SYSTEM (SPS) ENVIRONMENTAL
IMPACTS, PRELIMINARY ASSESSMENT

Floyd R Livingston 1 Apr 1978 26 p refs
Sponsored by NASA
(NASA-CR-157952, JPL-900-822) Avail NTIS
HC A03/MF A01 CSCL 10A

Present power plant assessment factors are used to present satellite power system (SPS) impacts. In contrast to oil, gas, nuclear and coal fueled power plants, the SPS and hydroelectric power plants produce air, water and solid waste emissions only during the construction phase. Land use impacts result from the placement of rectennas used for microwave receiving and rectifying. Air quality impacts of the SPS resulting from the construction phase amount to 0.405 metric tons per megawatt year. Solid waste impacts are 0.108 metric tons per year of operation. Other impacts such as those caused by heavy lift launch vehicle sites are also discussed. S B S

N79-12558*# Jet Propulsion Lab, Calif Inst of Tech, Pasadena
SATELLITE POWER SYSTEM (SPS) MICROWAVE SUB-
SYSTEM IMPACTS AND BENEFITS

Richard M Dickinson 28 Sep 1977 104 p refs
Sponsored by NASA
(NASA-CR-157951, JPL-900-800) Avail NTIS
HC A06/MF A01 CSCL 10A

The impacts and benefits to society of the microwave subsystem resulting from the developing construction and operating of a space solar power to earth, electric power delivery system are presented and discussed. The primary benefit (usable energy) is conveyed mainly in the fundamental frequency portion of the RF radiation beam that is intercepted and converted to electric power output. The small fraction of the microwave and other electromagnetic energy that does not end up in the electric utility grid yields most of the subsystem impacts. The impacts range from harmonics and noise radiated by the transmitting antenna through potential interference with ionospheric communications and navigation caused by the power beam heating the ionosphere, to the potential large land area requirements for the rectennas and low level microwave radiation around the rectennas. Additional benefits range from a very low level of waste heat liberated and lack of atmospheric emissions including noise while operating to having no residual ionizing radiation from the rectenna when it is deactivated. S B S

N79-12559# Dayton Univ Research Inst, Ohio
A FEASIBILITY STUDY OF INORGANIC OXIDE-FLUORIDE
COMPOSITIONS FOR THERMAL ENERGY STORAGE
APPLICATIONS Final Report

J E Davison Apr 1978 56 p refs
(Grant AF-AFOSR-3117-77, AF Proj 2301)

(AD-A059001 UDRI-TR-78-41 AFOSR-78-1145TR) Avail
NTIS HC A04/MF A01 CSCL 10/3

The purpose of this present investigation was to review the liquid-solid transformations of chemical compositions intermediate between pure inorganic fluorides and pure inorganic oxides. The liquid-solid transformations of seventy oxide-fluoride systems were reviewed. Five of these oxide-fluoride systems were identified which have liquid-solid transformations in the desired temperature interval. The values of the enthalpy of the liquid-solid transformation, the eutectic temperature, the thermal diffusivity, and the density of the liquid and solid phases were measured. These measured values were compared to the values which had been measured on inorganic eutectic fluorides. As a result of this comparison, the LiF-MgF₂-KF eutectic composition is recommended for thermal energy storage application because of the larger value for the enthalpy of transformation. Author (GRA)

N79-12560# Tetra Tech Inc Arlington Va
US NAVY ENERGY PLAN AND PROGRAM, 1978

Jun 1978 209 p
(Contract N00014-78-C-0097)
(AD-A058054 TETRAT-A-6053-02-78-368 OPAV-41-P4)
Avail NTIS HC A10/MF A01 CSCL 05/1

The 1978 U.S. Navy Energy Plan and Program is intended to keep the CNO apprised of the Navy energy situation and to update Navy energy program goals in light of presidential executive orders and DOD directives. The plan and program includes a brief overview of the world national and Navy energy situations, Navy energy objectives and goals, a summary of program accomplishments, a description of the approved FYDP (POM-79) Navy energy program, and a description of an expanded energy program required to meet federally mandated goals.

Author (GRA)

N79-12562# Unified Industries Inc Alexandria Va
ARMY ENERGY PLAN

Richard J Boas 22 Feb 1978 176 p refs
(Contract DAAG39-77-C-0164)
(AD-A057987 UII-70101) Avail NTIS HC A09/MF A01 CSCL 05/1

The Plan identifies the Army's organization, goals, objectives, and policies with respect to energy. It projects energy consumption and costs to the year 2000 and summarizes the programs required to support the long range goals. A summary of current and needed energy related legislation is included. Author (GRA)

N79-12563# Army Command and General Staff Coll Fort Leavenworth Kansas

THE DEPARTMENT OF DEFENSE'S ALTERNATE ENERGY POLICY M S Thesis Final Report

William J Lucas 9 Jun 1978 81 p refs
(AD-A058200) Avail NTIS HC A05/MF A01 CSCL 21/4

This thesis examines the question of the scarcity of petroleum-based fuels early in the Twenty-First Century and the DOD policy and programs to meet this shortage. Based on the fact that petroleum fuels as we know them will not be available early in the Twenty-First Century, this study examines the uniqueness of the DOD's world-wide mission and its dependence on petroleum fuels for its main weapon systems. Because of this uniqueness, it was concluded that the DOD needs an alternative fuels policy independent of other governmental agencies to meet the national security requirements. The current DOD policy on alternative fuels for the future is examined. This investigation revealed that as of January 1978, the DOD did not have a comprehensive policy for alternative fuels. Further, the direction of Research and Development efforts has suffered as a result of this lack of policy. Lastly, the study offers a proposed policy for consideration. Recommendations for both short- and long-range goals are proposed. Conclusions were that an alternative fuels policy is absolutely necessary and that a policy needs to be established as soon as possible. Author (GRA)

N79-12564# Argonne National Lab Ill Engineering Div
EXPERIMENTAL TWO-PHASE LIQUID-METAL MAGNETOHYDRODYNAMIC GENERATOR PROGRAM Annual Report

M Petrick G Fabris E S Pierson A K Fischer and C E Johnson May 1978 104 p refs
(Contract N00014-77-F-0006 NR Proj 099-404)
(AD-A059240 ANL-MHD-78-2) Avail NTIS HC A06/MF A01 CSCL 10/2

Testing of the second diverging-channel generator with the revised ambient-temperature NaK-N₂ facility has been completed. The primary goal of the revised facility, demonstrating reduced slip ratio (ratio of gas velocity to liquid velocity) with higher liquid velocity (flow rate), was accomplished. The reduction in slip ratio was dramatically demonstrated by a series of consecutive runs with varying flow rate (from 6 kg/s to 12 kg/s for the liquid). Substantial increases in generator efficiency were obtained with higher liquid flow rates. Experiments to demonstrate that good liquid-to-gas heat transfer exists in the generator were successfully completed. Good heat transfer is essential because it is the almost constant temperature expansion of the gas (vapor) in the generator that yields higher system efficiencies for liquid-metal MHD power cycles. The feasibility of generating relatively-stable bubbles, hence a foam in liquid metals, has been demonstrated. Photographic documentation of these phenomena, both motion and still pictures, was made. Surface tension measurements and foaming experiments have shown that viscosity is also a factor in promoting bubble formation and persistence. Wetting and contact angle measurements have been made for stainless steel and carbon steel immersed in eutectic NaK. GRA

N79-12565# Sandia Labs Albuquerque N Mex
SOLAR TOTAL ENERGY TEST FACILITY PROJECT TEST RESULTS HIGH-TEMPERATURE THERMOCLINE STORAGE SUBSYSTEM

T D Harrison C E Hickox A Ortega and K Wally Apr 1978 41 p refs
(Contract EY-76-C-04-0789)
(SAND-77-1528) Avail NTIS HC A03/MF A01

The results of tests conducted on the Sandia Laboratories High-Temperature Thermocline Storage Subsystem (HTTSS) from August 1976 through June 1977 are summarized and analyzed. A thermocline storage system has certain theoretical thermodynamic and economic advantages that make it an attractive thermal energy storage concept. The studies described were performed to determine to what extent these theoretical advantages could be realized in practice. The objectives of the tests described were to measure thermal losses from the tank to determine the stability of the thermocline and to estimate the costs associated with the thermocline thermal energy storage option. Results of tests performed with the thermocline storage system associated with the New Mexico/DOE Solar Irrigation Project at Willard, New Mexico, are included for comparison. DOE

N79-12566# Department of Energy Oak Ridge Tenn Technical Information Center

ENERGY INFORMATION DATA BASE SERIAL TITLES

Feb 1978 568 p
(TID-4579-R10) Avail NTIS HC A24/MF A01

This publication is the authority list for serial titles as used by the DOE Technical Information Center. Title abbreviations are with few exceptions in accordance with the International Organization for Standardization. Entries are arranged alphabetically, letter-by-letter, according to the abbreviated form of the title. The complete title entry is based on the International Serial Data System and generally appears in the form as given on the publication. DOE

N79-12567# Department of Energy Washington D C Div of Solar Technology

NATIONAL PHOTOVOLTAIC PROGRAM PLAN

Mar 1978 34 p
(DOE/ET-0035(78)) Avail NTIS HC A03/MF A01

The federal government's Photovoltaic Program is described. The program is designed to expand the commercial use of photovoltaic systems as rapidly as possible through a program of research, process development, in support of the manufacturing industry, test, and applications. DOE

N79-12568# Los Alamos Scientific Lab N Mex
THERMAL STRESS CRACKING AND THE ENHANCEMENT OF HEAT EXTRACTION FROM FRACTURED GEOTHERMAL RESERVOIRS

Apr 1978 19 p refs
 (Contract W-7405-eng-36)
 (LA-7235-MS) Avail NTIS HC A02/MF A01

The extraction of heat from geothermal reservoirs formed by the hydraulic fracturing of competent rock will eventually result in the formation of thermal stress cracks in the reservoir. These cracks penetrate the rock in a manner such that the penetration-to-spacing ratio is approximately one. The penetration depends upon the extent of cooling and the square root of time. Initially then the cracks are closely spaced and penetrate but little so that a crazing pattern is apparent but with increasing time some of these cracks now more widely spaced grow deeper. Eventually these larger cracks attain a critical aperture such that significant rates of water flow can be established within them and thus the newly created heat transfer area becomes useful for heat extraction. At the same time that cracks are forming within the main reservoir, thermal cracking also occurs in the wellbores that communicate with the reservoir. These cracks eventually convey water to and from the reservoir thus leading to a decrease in the flow impedances that are often concentrated in the wellbore regions. DOE

N79-12569# Department of Energy Washington D C
ENVIRONMENTAL DEVELOPMENT PLAN (EDP) PHOTO-VOLTAICS, 1977

Mar 1978 53 p refs
 (DOE/EDP-0003) Avail NTIS HC A04/MF A01

The status program goals and potential applications of photovoltaic technologies are reviewed. Potential areas of environmental concern relevant to both system production and use are identified. Among these concerns are occupational exposure to hazardous substances, environmental effects and possible subsequent public health problems and socioeconomic impacts. Screening of identified possible impacts resulted in delineation of those of the most serious, irreversible and cumulative nature which have near-term importance to the program and for which current knowledge of effects and control technologies are inadequate. A management plan coordinating studies in necessary environmental research areas with the technology development schedule is presented. The principal concerns involve worker exposure to hazardous substances during preparation of semiconductor materials and photovoltaic cells. DOE

N79-12570# Sandia Labs Albuquerque N Mex
COMBINED PHOTOVOLTAIC THERMAL COLLECTOR TESTING

D R Smith K L Biringer and D A Pritchard 1978 6 p refs
 Presented at IEEE Photovoltaic Specialists Conf Wash D C 5 Jun 1978
 (Contract EY-76-C-04-0789)
 (SAND-78-1191C Conf-780619-8) Avail NTIS
 HC A02/MF A01

A commercially available liquid-cooled thermal flat-plate collector was modified by the addition of 104 silicon cells in four parallel strings extending almost the entire length of the collector front surface. The electrical efficiency of the cell array was measured as a function of temperature for three different flow rates corresponding to temperature differences between inlet and outlet coolant ranging from 4 C to 38 C. The data showed a linear decrease in electrical efficiency with the temperature of the panel surface measured halfway between inlet and outlet ports. The efficiency-temperature relationship was independent of the temperature gradient. The thermal efficiency also exhibited a linear decrease with increasing difference between inlet coolant temperature and ambient temperature. The measured array efficiency (8.1 percent at 27 C) was comparable to the measured efficiency of a single cell from the same lot. DOE

N79-12571# National Bureau of Standards Washington D C
PROVISIONAL FLAT PLATE SOLAR COLLECTOR TESTING PROCEDURES Intern Report

David Waksman Elmer R Streed Thomas Reichard and Louis E Cattaneo Jun 1978 66 p refs Revised supersedes NBSIR-78-1305
 (Contract DOE-EA-77-01-6010)
 (PB-283721/9 NBSIR-78-1305A-Rev-1) Avail NTIS
 HC A04/MF A01 CSCL 13A

The test methods contained in this report and the provisional rating criteria presented in an appendix are intended for use in determining the thermal performance and to aid in the assessment of the safety and durability/reliability of flat plate solar collectors. GRA

N79-12572# Rutgers - The State Univ Piscataway N J
SILICON SCHOTTKY PHOTOVOLTAIC DIODES FOR SOLAR ENERGY CONVERSION Final Report, 1 Jun 1975 - 31 May 1978

Wayne A Anderson Jul 1978 72 p refs Prepared in cooperation with DOE
 (Grant NSF AER-73-03197)
 (PB-283998/3 NSF/RANN/SE/AER73-03197/FR/78) Avail
 NTIS HC A04/MF A01 CSCL 10B

A 12.2% Cr-MIS solar cell was fabricated on (100) p-type single-crystal Si. An efficiency of 8.8% was recorded on Wacker polycrystalline Si. Surface-state density values range from 1.5×10^{10} to the 11th power/sw cm-eV to 1.5×10^{13} to the 13th power/sq cm-eV for MIS diodes on (100) singlecrystal Wacker polycrystalline IBM ribbon and EFG ribbon Si. These data correspond to $V_{sub\ oc} = 0.25-0.60$ V on similar photovoltaic cells. Columnar 5-micrometer crystallites obtained on e-beam-deposited Si films having a 20-30 micrometer thickness. Rectification and photovoltaic response observed. GRA

N79-12573# Energy Inc Idaho Falls Idaho
ENERGY SUPPLY AND ENVIRONMENTAL IMPACTS- CONVENTIONAL SOURCES, STUDY MODULE 3-A, TECHNICAL APPENDIX Final Code Users Manual

James H McFadden 1978 122 p refs Sponsored by Pacific Northwest Regional Comm Vancouver Wash
 (PB-283787/0 NEPP-3-A-APP) Avail NTIS
 HC A06/MF A01 CSCL 10A

The future supplies and prices of all forms of energy consumed in the Pacific Northwest (electricity, natural gas, petroleum and coal) through the year 2000 are examined. Sets of alternative assumptions on the availability, price and use of these forms of energy are used to develop scenarios leading to low, moderate and high rates of growth in supply and demand. Quantified estimates of the environmental impacts likely to occur at each rate of growth are given. This technical appendix contains the code users manual, the environmental impact coefficients and sample problems in natural gas, petroleum, coal and electricity. GRA

N79-12574# Kentucky Univ Lexington Inst for Mining and Minerals Research
A KENTUCKY ENERGY RESOURCE UTILIZATION PROGRAM Semiannual Report, 1 Jul - 31 Dec 1977

Jun 1978 66 p refs
 (PB-283796/1 IMMR37-PR6-78) Avail NTIS
 HC A04/MF A01 CSCL 081

Research and education projects being conducted by the IMMR, several University of Kentucky departments, the University of Louisville and eight other Kentucky educational institutions are reported. These projects are assigned to one of three technical divisions: materials, process development or resources recovery and reclamation. A summary of progress for each division is included. These projects include analytical methods development, research in catalysis, coal preparation, reclamation and improved mining techniques. GRA

N79-12575# Illinois Univ at Urbana-Champaign Urbana Inst of Government and Public Affairs
ENERGY AND ENVIRONMENT AN INTERGOVERNMENTAL PERSPECTIVE Final Report

Boyd R Keenan Jan 1978 155 p refs Papers presented at Ohio River Valley Assembly College Corner Ohio 10-12 Oct 1977
 (Contract EE-77-C-02-4310 Grant EPA-R-805615-01)

(PB-28473/4) Avail NTIS HC A08/MF A01 CSCL 10A

The background papers written for the Ohio River Valley meeting and the text of oral presentations, each focusing on different aspects of the intergovernmental character of regional energy and environmental problems are presented. Topics discussed include the Ohio River Valley at the center of the American energy dilemma, intergovernmental energy and environmental challenges in the Ohio River Valley-the view from Washington, intergovernmental energy and environmental challenges in the Ohio River Valley-the view from the states, regionalism in the Ohio River Valley-the river basin planning perspective, challenges of intergovernmental cooperation in waterway management in the Ohio River Valley, intergovernmental cooperation in waterway management in the Ohio River Valley, intergovernmental cooperation in 'up-valley' pollution transport management and a region's energy and environmental future-organizational options. GRA

N79-12576# RPC International, Inc., Austin Tex
MANAGING OIL AND GAS ACTIVITIES IN COASTAL ENVIRONMENTS

William L Longley, Rodney Jackson, and Bruce Snyder Jun 1978 75 p
 (Contract DI-14-16-0008-2152)
 (PB-283677/3, FWS/OBS-78/54) Avail NTIS
 HC A04/MF A01 CSCL 10A

Coastal ecosystems are grouped into uplands, seasonally flooded wetlands, saturated wetlands, and open water, characteristic vegetation, animals, water regimes, and management practices are described. The impacts of petroleum development activities ranging from pre-exploration surveys through termination of production are viewed in various ecosystems, comments and suggestions are included to help mitigate the effects. GRA

N79-12577# Martin Marietta Labs., Baltimore Md
BIOLOGICAL SOLAR ENERGY CONVERSION APPROACHES TO OVERCOME YIELD STABILITY AND PRODUCT LIMITATIONS Progress Report, 1 Oct 1977 - 31 Mar 1978

Bessel Kok, C F Fowler, R J Radmer, and B V Velthuis 1978 37 p refs
 (Grant NSF AER-73-03291)
 (PB-284823/2, MML-TR-78-18 NSF/RA-780065, PR-6) Avail
 NTIS HC A03/MF A01 CSCL 06A

A series of experiments was performed in which chlorophyll fluorescence was monitored in parallel with the mass spectrometer gas exchange measurements. It was observed that the fluorescence yield is not significantly altered when O₂, rather than CO₂ was the terminal electron acceptor and it was concluded that the state of the photosynthetic apparatus is not strongly affected by a changeover from CO₂ fixation to O₂ reduction, or vice-versa. The study of photosynthetic activities in chloroplasts and particles of corn leaves was continued. The feasibility of measuring the relative contents of system 1 and system 2 photoreceptors in spinach and maize chloroplasts was examined. GRA

N79-12578# Northwest Energy Policy Project, Portland, Ore
ENERGY FUTURE NORTHWEST NORTHWEST ENERGY POLICY PROJECT Final Report

May 1978 187 p
 (PB-284697/0) Avail NTIS HC A09/MF A01 CSCL 10A

Regional, state and local policy options which might influence future patterns of energy production and energy consumption in the Northwest states of Idaho, Oregon and Washington are highlighted. The Project also evaluated the social, environmental and economic consequences of exercising the various state and local energy policy choices. GRA

N79-12579# Maryland State Dept of Legislative Reference
 Annapolis Scientific Div
THE ENERGY DILEMMA A CHALLENGE FOR MARYLAND PROCEEDINGS MARYLAND GENERAL ASSEMBLY/AISLE CONFERENCE

Myron Miller, Diane Chapman Willis and Eleanor D Musk Jul 1978 151 p. Conf held at Annapolis 1-3 Dec 1977. Sponsored in part by NSF

(PB-284703/6, NSF/RA-770583) Avail NTIS
 HC A08/MF A01 CSCL 10A

Topic areas cover energy resources management, National Energy Act - application to Maryland, energy conservation buildings and homes, water resources management - energy implications, energy and air quality management and alternate energy resources. GRA

N79-12581 California Univ Los Angeles
TECHNICAL AND ENVIRONMENTAL ASPECTS OF OIL SHALE PROCESSING Ph D Thesis

Jay Douglass White 1978 296 p
 Avail Univ Microfilms Order No 7820299

Oil shale processing techniques currently being considered for application to United States oil shale deposits include (1) aboveground or surface retorting, (2) modified in situ retorting, and (3) true in situ retorting techniques. The candidate oil shale technologies within each of these categories were identified and described. A representative retorting technology from each category was studied as an example of the current state-of-the-art. The analysis included a description of process operations, a technical evaluation of the process, and a scenario of a commercial scale operation using the retorting technology selected for analysis. The environmental aspects of commercial scale development activities, the ecological effects of large scale land disruption, potential health risks to oil shale industry workers, and socio-economic impacts to communities in the oil shale region are discussed. Dissert Abstr

N79-12591# National Technical Information Service, Springfield Va

NITROGEN OXIDE AIR POLLUTION VOLUME 2, PART 1 CONTROL TECHNOLOGY A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1975 - Aug 1978

Diane M Cavagnaro Sep 1978 305 p. Supersedes NTIS/PS-77/0850
 (NTIS/PS-78/0971/8, NTIS/PS-77/0850) Avail NTIS
 HC \$28 00/MF \$28 00 CSCL 13B

Nitrogen oxide air pollution control is covered from both mobile and stationary sources. Fluidized bed combustion boiler combustion modification and engine design are discussed as they relate to emissions reduction. This updated bibliography contains 299 abstracts, 106 of which are new entries to the previous edition. GRA

N79-12593# National Technical Information Service, Springfield Va

NITROGEN OXIDE AIR POLLUTION PART 3 ATMOSPHERIC CHEMISTRY A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Aug 1978

Diane M Cavagnaro Sep 1978 230 p. Supersedes NTIS/PS-77/0853
 (NTIS/PS-78/0973/4, NTIS/PS-77/0853) Avail NTIS
 HC \$28 00/MF \$28 00 CSCL 04A

Photochemical air pollution models, smog chemistry and reactivity, and SST exhaust effects are covered in the bibliography. Auroral and upper atmospheric chemistry and photochemistry of naturally occurring nitrogen oxides are excluded. This updated bibliography contains 224 abstracts, 52 of which are new entries to the previous edition. GRA

N79-12601# Southern Research Inst Birmingham Ala
EVALUATIONS OF NOVEL PARTICULATE CONTROL DEVICES Final Report, Jun 1974 - Jan 1978

Joseph D McCain Jun 1978 179 p. refs
 (Contract EPA-68-02-1480)
 (PB-283973/6 EPA-600/7-78-093
 SORI-EAS-78-347-3344F) Avail NTIS HC A09/MF A01 CSCL 13B

Fractional and overall mass efficiency tests of four particulate control devices are described. Three were wet scrubbers: an Aronetics two-phase jet scrubber, an Entoleter centrifugal scrubber, and a CEA variable-throat venturi scrubber. The fourth was a rexord gravel-bed filter. The devices were used for

controlling emissions from a submerged-arc ferroalloy furnace an asphalt batching plant a pulverized-coal-fired utility boiler and a portland cement clinker cooler respectively Total flue gas particulate mass concentrations and emission rates were determined at device inlets and outlets by conventional techniques Inlet and outlet emission rates as functions of particle size were determined on a mass basis using cascade impactors for sizes from about 0.5 to 5 micrometers and on a number basis for sizes smaller than 1 micrometer using optical and diffusional and/or electrical mobility methods Brief descriptions are included of the control devices and the process on which each was utilized the measurement methods inlet and outlet size distributions and overall and fractional efficiencies GRA

N79-12602# Rockwell International Corp Creve Couer Mo Air Monitoring Center
REGIONAL AIR POLLUTION STUDY HEAT EMISSION INVENTORY Final Report
F E Littman R W Griscom and E Puronen Jun 1978 67 p refs
(Contract EPA-68-02-2093)
(PB-284081/7 EPA-600/4-78-029) Avail NTIS
HC A04/MF A01 CSCL 13B

Heat emissions to the atmosphere originating directly or indirectly from the combustion of fossil fuels in the St Louis Missouri area were studied With the exception of a small amount of energy radiated into space as light and the energy carried out of the area by cooling water (primarily the Mississippi River) all of the energy released by the combustion of fuels is sooner or later released to the atmosphere as heat either at the point of production (the power stations) or where it is consumed Heat emissions from point sources as well as area sources were considered Heat emissions from point sources account for about 11 percent in the area Point source emissions are however in the form of concentrated plumes while other heat emissions are diffused Thus the meteorological dispersion behavior of these sources is quite different GRA

N79-12606# PEDCO-Environmental Specialists Inc, Cincinnati, Ohio
FLUE GAS DESULFURIZATION SYSTEM CAPABILITIES FOR COAL-FIRED STREAM GENERATORS, VOLUME 1 EXECUTIVE SUMMARY Final Task Report, Apr - Dec 1977

T Devitt R Gerstle L Gibbs, S Hartman and R Klier Mar 1978 44 p
(Contract EPA-68-02-2603)
(PB-284045/2 EPA-600/7-78-032A) Avail NTIS
HC A03/MF A01 CSCL 07A

The availability of technology for reducing SO₂ emissions from coal-fired steam generators using flue gas desulfurization (FGD) systems is discussed Foreign and domestic lime, limestone double alkali magnesium slurry, and Wellman-Lord FGD systems are described, and the design parameters and operating experiences are discussed Steps that have been taken to achieve high system operability are covered along with disposal of FGD system wastes GRA

N79-12970*# Gnostic Concepts, Inc, Menlo Park Calif
INDUSTRIALIZATION STUDY Final Report

28 Aug 1978 194 p
(Contracts NAS7-100 JPL-954899)
(NASA-CR-157953 DOE/JPL-954899-78/3) Avail NTIS
HC A09/MF A01 CSCL 05A

The investment process in US industries was studied in order to characterize the critical elements in major high risk investment decisions Because motivation was determined to be the greatest single factor force in inducing a company to invest in a high risk venture the relative impact of alternative government programs and policies on personal and financial motivations were analyzed qualitatively and quantitatively to ascertain the effect on these programs and policies on photovoltaic industrialization The government alternatives are ranked on the basis of their ease of implementation and their probable effect The recommended sequence in which government policies would be applied to maximize the industrialization of the photovoltaic venture is discussed A R H

N79-13026*# General Dynamics/Convair, San Diego, Calif
VEHICLE DESIGN EVALUATION PROGRAM (VDEP) A COMPUTER PROGRAM FOR WEIGHT SIZING, ECONOMIC, PERFORMANCE AND MISSION ANALYSIS OF FUEL-CONSERVATIVE AIRCRAFT, MULTIBODIED AIRCRAFT AND LARGE CARGO AIRCRAFT USING BOTH JP AND ALTERNATIVE FUELS

B H Oman Jan 1977 426 p refs
(Contract NAS1-13285)
(NASA-CR-145070) Avail NTIS HC A19/MF A01 CSCL 01C

The NASA Langley Research Center vehicle design evaluation program (VDEP-2) was expanded by (1) incorporating into the program a capability to conduct preliminary design studies on subsonic commercial transport type aircraft using both JP and such alternate fuels as hydrogen and methane (2) incorporating an aircraft detailed mission and performance analysis capability, and (3) developing and incorporating an external loads analysis capability The resulting computer program (VDEP-3) provides a preliminary design tool that enables the user to perform integrated sizing, structural analysis, and cost studies on subsonic commercial transport aircraft Both versions of the VDEP-3 Program which are designated preliminary Analysis VDEP-3 and detailed Analysis VDEP utilize the same vehicle sizing subprogram which includes a detailed mission analysis capability, as well as a geometry and weight analysis for multibodied configurations A R H

N79-13060*# Pratt and Whitney Aircraft Group East Hartford, Conn Commercial Products Div
ANALYTICAL EVALUATION OF THE IMPACT OF BROAD SPECIFICATION FUELS ON HIGH BYPASS TURBOFAN ENGINE COMBUSTORS Final Report

R P Lohmann, E J Szetela, and A Vranos Dec 1978 161 p refs
(Contract NAS3-20802)
(NASA-CR-159454, PWA-5565-15) Avail NTIS
HC A08/MF A01 CSCL 21E

The impact of the use of broad specification fuels on the design, performance durability, emissions and operational characteristics of combustors for commercial aircraft gas turbine engines was assessed Single stage, vortex and lean premixed prevaporized combustors, in the JT9D and an advanced engine efficient engine cycle were evaluated when operating on Jet A and ERBS (Experimental Referee Broad Specification) fuels Design modifications, based on criteria evolved from a literature survey, were introduced and their effectiveness at offsetting projected deficiencies resulting from the use of ERBS was estimated The results indicate that the use of a broad specification fuel such as ERBS will necessitate significant technology improvements and redesign if deteriorated performance durability and emissions are to be avoided Higher radiant heat loads are projected to seriously compromise liner life while the reduced thermal stability of ERBS will require revisions to the engine-airframe fuel system to reduce the thermal stress on the fuel Smoke and emissions output are projected to increase with the use of broad specification fuels While the basic geometry of the single stage and vortex combustors are compatible with the use of ERBS, extensive redesign of the front end of the lean premixed prevaporized burner will be required to achieve satisfactory operation and optimum emissions G G

N79-13140# Battelle Columbus Labs, Ohio
STATE OF THE ART AND SCIENCE REPORT ON DESIGN OF ALLOYS RESISTANT TO HIGH-TEMPERATURE CORROSION-EROSION IN COAL CONVERSION ENVIRONMENTS Interim Report

I G Wright and C W Price Apr 1978 140 p refs Sponsored by Electric Power Research Inst
(EPRI-FP-557) Avail NTIS HC A07/MF A01

It is concluded that the state of the art of the use of wear-resistant alloys in a large number of corrosive environments is good There is no acceptable correlation of alloy erosion behavior with alloy properties or microstructure, and there are very available descriptions of the mode of erosion of alloys DOE

N70-19162/ Little (Arthur D), Inc Cambridge, Mass
ENERGY USE PATTERNS FOR METAL RECYCLING
 Charles L Kusik and Charles B Kenahan 1978 196 p refs
 (PB-284855/4. BUMINES-IC-8781) Avail NTIS MF A01.
 HC SOD CSCL 11F

Data were collected on energy requirements to recycle prompt industrial and obsolete scrap for nine metal commodities iron and steel, aluminum, copper zinc, lead, stainless steel, titanium, tin, and nickel and nickel alloys Major process routes for recycling were considered, starting from the first collection point through scrap preparation transportation, smelting and/or refining to the molten metal, ingot, or other semi-finished form approximately equivalent to a primary metal of a similar composition Available data for 1976 were collected on the amounts of each metal commodity recycled by major scrap categories GRA

N70-13102/ Naval Research Lab, Washington D C Combustion and Fuels Branch
FURTHER STUDIES OF FUELS FROM ALTERNATE SOURCES. FIRE EXTINGUISHMENT EXPERIMENTS WITH JP-5 JET TURBINE FUEL DERIVED FROM SHALE
 Robert N Hazlett, Wilbur A Affens G W McLaren and Clement S Butler May 1978 13 p refs
 (WF57571301)

(AD-A058586, AD-E000199, NRL-MR-3780) Avail NTIS HC A02/MF A01 CSCL 21/4

Fire extinguishment experiments with JP-5 jet fuels derived from shale crude oil and also from petroleum (for comparison) were conducted at NRL's Chesapeake Bay facility The experiments were conducted in a 40-foot diameter circular pool using Aqueous Film Forming Foam (AFFF) as the fire extinguishing agent The results with both types of fuel were similar, and it was concluded that the techniques and agents for AFFF application, which have been developed for petroleum fuel fires, can also be used for shale derived jet fuel Author (GRA)

N70-19100/ Department of Energy, Washington D C
COMPARATIVE AUTOMOTIVE ENGINE OPERATION WHEN FUELED WITH ETHANOL AND METHANOL
 E E Ecklund May 1978 59 p refs Prepared in cooperation with Santa Clara Univ and Miami Univ, Coral Gables
 (Contracts EC-78-C-03-1737, EY-78-S-05-5216)
 (HCP/W1737-01) Avail NTIS HC A04/MF A01

An experimental investigation of Q spark ignition multicylinder engine operation on pure ethanol was undertaken to contrast the engine performance and exhaust emissions with indolene and pure methanol Equivalence ratio (normalized F/A ratio) was chosen as the principal independent variable Fuel economy, the regulated exhaust emissions and exhaust aldehydes and maldistribution were taken as dependent variables Both steady state engine results and simulated driving cycle (the Federal Emission Test Procedure FTP and the Highway Fuel Economy Test Procedure-HFETP) results are presented and discussed The findings show, in general that ethanol gives results in fuel economy on the basis of miles per millions Btu which lie between the results obtained using gasoline and methanol i.e. better fuel economy than gasoline and poorer fuel economy than methanol DOE

N70-19100/ Mueller Associates, Inc, Baltimore, Md
STATUS OF ALCOHOL FUELS UTILIZATION TECHNOLOGY FOR HIGHWAY TRANSPORTATION
 Jun 1978 159 p refs
 (Contract EC-77-X-01-2923)
 (HCP/M2923-01) Avail NTIS HC A08/MF A01

The current status of the technology(ies) of alcohol utilization in highway transportation is reviewed Methanol, ethanol, and certain of their derivatives are treated The results of engine, vehicle, and fuels testing are summarized The topics of exhaust emissions, performance, and fuel economy, vehicle drive-ability, fuel systems materials compatibility, engine and vehicle design, fuels characterization, and environmental consideration are discussed in depth, based upon the most recent data available at the time of this writing The status of the technology at the time of the last comprehensive surveys (1974) is summarized

and discussed in greater detail in an appendix to this report Significant advances made since that time are delineated, as are remaining information gaps and areas in which more extensive investigation is still needed An appendix is provided which describes the salient properties of selected alcohols and alcohol-derived fuels DOE

N70-19101/ Southwest Research Inst San Antonio, Tex
IDENTIFICATION OF PROBABLE AUTOMOTIVE FUEL COMPOSITION: 1000-2000
 May 1978 225 p refs
 (Contract EY-76-C-04-3884)
 (HCP/W3884-01/1) Avail NTIS HC A10/MF A01

The principal factors and activities in the production of automotive fuels which have synthetic hydrocarbon constituents and alcohol fuels derived from coal are traced and discussed These include selection of reference raw materials, syncrude compositions for a variety of candidate conversion processes, and finished automotive fuels composition based upon domestic fuel demand projections for the time frame 1985 to 2000 Those fuel-engine relationships pertinent to developing optimized automotive systems are considered in relation to anticipated developments in propulsion systems technology Projected compositions and performance of finished specification-quality automotive fuels for this time frame are not expected to differ significantly from those for today's fuels since it is anticipated that coal- or shale-derived syncrudes will be blended with dominant petroleum crudes at conventional petroleum refineries rather than at plants dedicated to the exclusive refining of synthetic crudes DOE

N70-13102/ Advisory Group for Aerospace Research and Development, Paris (France)
AIRCRAFT ENGINE FUTURE FUELS AND ENERGY CONSERVATION
 Sep 1978 188 p refs Lecture Series held at Munich, 16-17 Oct 1978 and London, 19-20 Oct 1978
 (AGARD-LS-96 ISBN-92-835-1297-9) Avail NTIS HC A09/MF A01

Current and forecasted world energy demands, growth, and supply are reviewed in perspective to the status and outlook for future aviation fuels to meet NATO needs The special problems associated with the refining of aviation fuels from lower quality feedstocks (including fuel refined from coal, oil shale and tar sands) and techniques for reducing energy consumption in refining processes are examined Special attention is given to the chemistry and combustion characteristics of future hydrocarbon fuels and the impact of using these fuels in aircraft engines and fuel systems An assessment is made as to what technology advancements are currently underway and what other advancements are needed with reference to engine components engine systems aircraft designs and operational procedures to help conserve fuel resources

N70-13103/ Imperial Coll of Science and Technology London (England) Dept of Mechanical Engineering
FUTURE FUELS FOR AVIATION
 J J MacFarlane In AGARD Aircraft Eng Future Fuels and Energy Conserv Sep 1978 12 p refs

Avail NTIS HC A09/MF A01

The historical background of the current aviation gas turbine fuel specification is described Current local supply difficulties are discussed in relation to crude oil availability and the pattern of regional demand for petroleum products The consensus of expert opinion on the effects of predicted future petroleum resource availability and of various trade and economic factors on future rates of production are described Recent data on the demand for petroleum products and the crucial importance of future demand control are discussed The prospects for petroleum based aviation fuel are evaluated The long term sources of aviation fuel are described and the problem areas enumerated The need for a research program on alternative fuels is demonstrated Previous work using model flames on the effects of fuel

N79-13194

composition on rich flame chemistry is reviewed and the potential contribution of fundamental research in the alternative aviation fuels program is outlined
J M S

N79-13194# Shell Research Ltd., Chester (England) Thornton Research Centre

FUTURE AVIATION FUELS FUEL SUPPLIERS VIEWS

A Lewis *In* AGARD Aircraft Eng Future Fuels and Energy Conserv Sep 1978 22 p refs

Avail NTIS HC A09/MF A01

Developments in the potential future availability of aviation fuels from petroleum crude oils shale oils, and coal are reviewed on the basis of published data. Much of the data were derived from statistics of the Organization for Economic Cooperation and Development and the Workshop on Alternative Energy Strategies
J M S

N79-13195# Imperial Coll of Science and Technology, London (England) Dept of Mechanical Engineering

THE ROLE OF FUNDAMENTAL COMBUSTION IN THE FUTURE AVIATION FUELS PROGRAM

J J MacFarlane *In* AGARD Aircraft Eng Future Fuels and Energy Conserv Sep 1978 6 p refs

Avail NTIS HC A09/MF A01

Alternative fuels research using can type engine combustors is briefly summarized. This research stressed the overall response of the system to fairly arbitrary changes in fuel properties and fuel preparation observing such quantities as carbon deposit formation, wall temperature combustor outlet temperature distribution and combustion efficiency. Flame research undertaken to study the way in which carbon is formed in gas turbine primary zones was described. This research utilized experimental model combustors prevaporized and premixed C5 and C6 hydrocarbons and kerosene, and sprayed kerosene. Contour maps of soot formation as a function of pressure and equivalence ratios were presented. The mechanism of carbon formation in spray flames was discussed
J M S

N79-13196* National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

CHARACTERISTICS AND COMBUSTION OF FUTURE HYDROCARBON FUELS

R A Rudey and J S Grobman *In* AGARD Aircraft Eng Future Fuels and Energy Conserv Sep 1978 23 p refs

Avail NTIS HC A09/MF A01 CSCL 21D

Changes in fuel properties that are expected in future hydrocarbon fuels for aircraft are discussed along with the principal properties of syncrudes' and the fuels that can be derived from them. The impact that the resultant potential changes in fuel properties may have on combustion and thermal stability characteristics is illustrated and discussed in terms of ignition soot formation carbon deposition flame radiation and emissions
J M S

N79-13197* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

IMPACT OF FUTURE FUEL PROPERTIES ON AIRCRAFT ENGINES AND FUEL SYSTEMS

R A Rudey and J S Grobman *In* AGARD Aircraft Eng Future Fuels and Energy Conserv Sep 1978 29 p refs

Avail NTIS HC A09/MF A01 CSCL 21D

The effect of modifications in hydrocarbon jet fuels specifications on engine performance, component durability and maintenance, and aircraft fuel system performance is discussed. Specific topics covered include specific fuel consumption ignition at relight limits, exhaust emissions, combustor liner temperatures carbon deposition, gum formation in fuel nozzles, erosion and corrosion of turbine blades and vanes deposits in fuel system heat exchangers and pumpability and flowability of the fuel. Data that evaluate the ability of current technology aircraft to accept fuel specification changes are presented and selected technology-

cal advances that can reduce the severity of the problems are described and discussed
J M S

N79-13198# Pratt and Whitney Aircraft Group, East Hartford Conn

ENGINE COMPONENT IMPROVEMENT AND PERFORMANCE RETENTION

William H Sens *In* AGARD Aircraft Eng Future Fuels and Energy Conserv Sep 1978 12 p

Avail NTIS HC A09/MF A01

The importance of improving the fuel consumption of current engines and their derivatives is addressed in terms of making significant savings in aircraft fuel consumption in this century. Methods of reducing fuel consumption of current engines considered include (1) cycle improvement incorporated in growth and derivative engine models by changes in bypass ratio, overall pressure ratio, and turbine inlet temperature, (2) component performance improvements through design refinements incorporated into the existing engines during routine overhaul and (3) improved engine performance retention through revised maintenance procedures and improved design
J M S

N79-13199# Pratt and Whitney Aircraft Group East Hartford, Conn

LOW ENERGY CONSUMPTION ENGINES

William H Sens *In* AGARD Aircraft Eng Future Fuels and Energy Conserv Sep 1978 13 p refs

Avail NTIS HC A09/MF A01

Improvements in aircraft gas turbine engine economy over four decades are briefly reviewed. Possibilities for the evolution of the turbofan cycle to give improved engine performance are discussed with emphasis on the Energy Efficient Engine Program. Alternative cycles are also considered. These include Brayton cycle, regenerative cycle, compound fan shrouded propeller and the prop-fan. The prop-fan is considered the most promising
J M S

N79-13200# Office National d Etudes et de Recherches Aerospatiales, Paris (France)

ENERGY CONSERVATION AIRCRAFT DESIGN AND OPERATIONAL PROCEDURES

Philippe Poisson-Quinton *In* AGARD Aircraft Eng Future Fuels and Energy Conserv Sep 1978 47 p refs

Avail NTIS HC A09/MF A01

A review is given of studies and applications leading to improved fuel efficiency in the air transportation system. Major technological progress in aerodynamics structures/materials, propulsion integration and avionics is quantified for the subsonic transport aircraft as well as future VTOL STOL and SST. It is shown that improvements on flight and ground operational procedures are in the developmental stage and that these improvements must strongly reduce the energy waste of the current civil and military air transportation system
J M S

N79-13252# Battelle Pacific Northwest Labs., Richland Wash
INITIAL ASSESSMENT ELECTROMAGNETIC COMPATIBILITY ASPECTS OF PROPOSED SPS MICROWAVE POWER TRANSMISSION SYSTEM (MPTS) OPERATIONS

Feb 1978 139 p refs

(Contract EY-76-C-1830)

(PNL-2482) Avail NTIS HC A07/MF A01

An analysis of major concerns with regard to the effects on radio and electronic systems by the proposed Microwave Power Transmission System for transmitting power from a satellite solar power station to earth is presented
Author (DOE)

N79-13263* Jet Propulsion Lab., Calif Inst of Tech Pasadena
MICROWAVE POWER TRANSMITTING PHASED ARRAY ANTENNA RESEARCH PROJECT Summary Report

Richard M Dickinson 15 Dec 1978 94 p refs

(Contract NAS7-100)

(NASA-CR-157843 JPL-Pub-78-28) Avail NTIS
HC A05/MF A01 CSCL 09C

An initial design study and the development results of an S band RF power transmitting phased array antenna experiment system are presented. The array was to be designed, constructed and instrumented to permit wireless power transmission technology evaluation measurements. The planned measurements were to provide data relative to the achievable performance in the state of the art of flexible surface, retrodirective arrays, as a step in technically evaluating the satellite power system concept for importing to earth, via microwave beams, the nearly continuous solar power available in geosynchronous orbit. Details of the microwave power transmitting phased array design, instrumentation approaches, system block diagrams and measured component and breadboard characteristics achieved are presented. B B

N79-13290# Stone and Webster Engineering Corp., N Y
TECHNICAL NOTES FOR THE CONCEPTUAL DESIGN FOR AN ATMOSPHERIC FLUIDIZED-BED DIRECT COMBUSTION POWER GENERATING PLANT

Apr 1978 664 p

(Contract EF-77-C-01-2583)

(HCP/T2583-01/2) Avail NTIS HC A99/MF A01

The design, arrangement, thermodynamics and economics of a 592 MW(e) (nominal) gross electric power generating plant equipped with a Babcock and Wilcox Company (B and W) atmospheric fluidized bed (AFB) boiler are described. Information is included on capital and operating costs, process systems, electrical systems, control and instrumentation and environmental systems. This document represents a portion of an overall report describing the conceptual designs of two atmospheric fluidized bed boilers and balance of plants for the generation of electric power and the analysis and comparison of these conceptual designs to a conventional pulverized coal-fired electric power generation plant equipped with a wet limestone flue gas desulfurization system. DOE

N79-13281# Mathtech Inc., Princeton, N J
IMPACT OF ELECTRIC PASSENGER AUTOMOBILES ON UTILITY SYSTEM LOADS, 1985 - 2000

E P Marisi, C W Upton, and C E Agnew. Jul 1978 443 p
refs

(EPRI-EA-623) Avail NTIS HC A19/MF A01

A supply model is described which includes an Electric Vehicle Design Model and calculates factors such as weight, battery size, and cost of a vehicle from user-supplied design characteristics. In the next stage of the analysis, calculation of electric vehicle sales and stocks, the hedonic approach is adopted which states that consumers demand for a good is a derived demand for a bundle of characteristics (comfort, cost, performance, and the like) provided by the vehicle. Using this approach, a demand model was developed that forecasts the future stock and sales of electric vehicles and their competitors--internal combustion engine (ICE) vehicles. The final step in the analysis is the calculation of electricity loads and air quality impacts on a national basis for the period 1985 to 2000 and also for New York, Chicago, Los Angeles, and Washington, D C. By end of the century, the models predict that approximately 141 million passenger vehicles will be on the road, and that 11 to 13 million of these will be electric vehicles, incorporating an advanced battery. DOE

N79-13322# Battelle Pacific Northwest Labs., Richland, Wash
PRELIMINARY RESULTS OF A FIELD EXPERIMENT TO CHARACTERIZE WIND FLOW THROUGH A VERTICAL PLANE

M Gary Verholek. Apr 1978 42 p

(Contract EY-76-C-06-1830)

(PNL-2518) Avail NTIS HC A03/MF A01

Preliminary results are presented of a field experiment to study the turbulent structure in the wind flow through a simulated disc of rotation of a large, horizontal-axis wind turbine blade. The wind flow impinging on the hypothetical turbine blade was simulated by a nine-element circular array of three component anemometers in a single vertical plane. The wind data were

analyzed as a single point, hub height measurement (at the center of the array) an arithmetic average of all sensors, and a synthesis of the data records assumed to represent measurement locations on a hypothetical, rotating turbine blade. The effects of areal averaging were examined using the arithmetic mean over the array. Similarly, the effects of averaging over the blade pair were examined by arithmetically averaging opposing data points representing the air flow past the rotating blade. DOE

N79-13343 Washington Univ., Seattle
BLACKBODY OPTICAL PUMPING OF CARBON DIOXIDE LASER MIXTURES Ph D Thesis

Okta Y Yesil. 1978 180 p

Avail Univ Microfilms Order No 7820789

The concept of blackbody radiation pumping of CO₂ laser mixtures as a step toward utilization of solar radiation as a pumping source is illustrated. An attractive method whereby solar energy can be converted to laser energy very efficiently is to use an intermediate blackbody cavity. An experiment was performed in which laser gas mixtures were exposed to intense thermal radiation for brief periods of time. Gain has been measured at 10.6 microns in a CO₂-He gas mixture. The gas mixture at a temperature of 400 K with pressures on the order of 1 torr is enclosed in a sapphire tube and pumped by blackbody radiation. An electrically heated oven in the temperature range of 1500 K supplies the radiation. A CW CO₂ probe laser is used to detect the optical gain. A simplified model is used to describe the rate of change of energy of the vibrational modes of CO₂.

Dissert Abstr

N79-13370# Jet Propulsion Lab., Calif Inst of Tech., Pasadena
THE OTTO-ENGINE-EQUIVALENT VEHICLE CONCEPT

M W Dowdy and M D Couch. 15 Dec 1978 36 p refs
Prepared for DOE

(Contract NAS7-100)

(NASA-CR-157840 JPL-Pub-78-101)

Avail NTIS

HC A03/MF A01

A vehicle comparison methodology based on the Otto-Engine Equivalent (OEE) vehicle concept is described. As an illustration of this methodology, the concept is used to make projections of the fuel economy potential of passenger cars using various alternative power systems. Sensitivities of OEE vehicle results to assumptions made in the calculational procedure are discussed. Factors considered include engine torque boundary, rear axle ratio, performance criteria, engine transient response and transmission shift logic. Author

N79-13376# Transportation Systems Center, Cambridge, Mass
THE EMISSIONS AND FUEL ECONOMY OF A DETROIT DIESEL 6-71 ENGINE BURNING A 10-PERCENT WATER-IN-FUEL EMULSION Final Report, Mar - Jun 1976

Robert A Walter. Jul 1978 81 p

(AD-A058550, TSC-USCG-78-1, USCG-D-10-78) Avail NTIS
HC A05/MF A01 CSCL 21/4

Initial efforts with water/fuel emulsions in diesel engines were directed toward the control of NO_x. More recent studies emphasized the use of emulsions to improve fuel economy. It is believed that in a diesel engine combustion process emulsified fuel droplets would undergo micro-explosions that would decrease the heterogeneity of the injector spray pattern and thus increase the efficiency and fuel economy. Although all data in the literature indicate that emulsions do lower the levels of NO_x and smoke, carbon monoxide (CO) and hydrocarbons (HC) generally increase, depending on the amount of water in the emulsion, and the engine type, speed, and load. Reported fuel economy either decreases or increases, again dependent on the water content, engine type and design, and engine speed and load. Other possible effects, such as increased fuel injector corrosion, water dilution of the lubricating oil and the possibility of increased combustion chamber deposits have not been studied. The task reported here is a preliminary investigation of water/fuel emulsions in a GM6-71 engine. Surface active agents (surfactants), were used to produce the emulsions for this task. The purposes of this preliminary effort were to resolve the conflicting results in the

literature, assess potential problem areas and aid in formulating future efforts GRA

N79-13378# McDonnell Aircraft Co., St Louis Mo
GIROMILL WIND TUNNEL TEST AND ANALYSIS, VOLUME 2 TECHNICAL DISCUSSION Final Report, Jun 1976 - Oct. 1977

W A Moran Oct 1977 96 p refs

(Contract EY-76-C-02-2617)

(COO-2617-4/2) Avail NTIS HC A05/MF A01

A wind tunnel test of a Giromill rotor was conducted. A three bladed Giromill rotor having a diameter of 2.13 m (7 ft) and a span of 1.52 m (5 ft) was tested. The blade modulations were accomplished through use of a cam and push rod arrangement. Replaceable cams provided the desired blade modulation at the various operating points. Various operating conditions were achieved by adjusting the rotor RPM and tunnel speed. The results show that the Giromill has good performance equal to or much better than that predicted by theory, and outperforms the other types of vertical axis wind turbines tested. DOE

N79-13472*# National Aeronautics and Space Administration
 Lewis Research Center Cleveland Ohio

APPLICATION OF MULTISPECTRAL SCANNER DATA TO THE STUDY OF AN ABANDONED SURFACE COAL MINE

Ernie W Spisz Nov 1978 80 p refs Original contains color illustrations

(NASA-TM-78912 E-9647) Avail NTIS HC A05/MF A01 CSDL 081

The utility of aircraft multispectral scanner data for describing the land cover features of an abandoned contour-mined coal mine is considered. The data were obtained with an 11 band multispectral scanner at an altitude of 1.2 kilometers. Supervised, maximum-likelihood statistical classifications of the data were made to establish land-cover classes and also to describe in more detail the barren surface features as they may pertain to the reclamation or restoration of the area. The scanner data for the surface-water areas were studied to establish the variability and range of the spectral signatures. Both day and night thermal images of the area are presented. The results of the study show that a high degree of statistical separation can be obtained from the multispectral scanner data for the various land-cover features. G G

N79-13474*# Jet Propulsion Lab Calif Inst of Tech, Pasadena
A SYNOPTIC DESCRIPTION OF COAL BASINS VIA IMAGE PROCESSING Interim Technical Report

K Winslow Farrell, Jr and David B Wherry Sep 1978 38 p refs

(Contracts NAS7-100 ET-76-01-9036)

(NASA-CR-157970 JPL-Pub-78-82 FE/9036-3) Avail NTIS HC A03/MF A01 CSDL 08G

An existing image processing system is adapted to describe the geologic attributes of a regional coal basin. This scheme handles a map as if it were a matrix in contrast to more conventional approaches which represent map information in terms of linked polygons. The utility of the image processing approach is demonstrated by a multiattribute analysis of the Herrin No. 6 coal seam in Illinois. Findings include the location of a resource and estimation of tonnage corresponding to constraints on seam thickness, overburden and Btu value which are illustrative of the need for new mining technology. Author

N79-13478# Virginia Polytechnic Inst and State Univ, Blacksburg Dept of Geological Sciences
EVALUATION AND TARGETING OF GEOTHERMAL ENERGY RESOURCES IN THE SOUTHEASTERN UNITED STATES Progress Report, 1 Oct - 31 Dec 1977

J K Costain L Glover III and Sinha A Krishna 1977 174 p refs

(Contract ET-78-C-05-5648)

(VPI-SU-5648-1) Avail NTIS HC A08/MF A01

Progress in the evaluation of low-temperature geothermal resources in the eastern United States utilizing geological, geochemical, and geophysical data is reported. Primary programmatic emphasis is now being placed on the confirmation of radiogenic resources beneath sediments of the Atlantic Coastal Plain. The purpose of this study is to determine the relationship of the Rolesville, N C batholith to the surrounding country rocks, and to provide a geologic base for the geophysical interpretation of Piedmont stratigraphy underlying Atlantic Coastal Plain sediments to the east. DOE

N79-13480# California Univ Berkeley Lawrence Berkeley Lab

GEOTHERMAL EMISSIONS DATA BASE CERRO PRIETO GEOTHERMAL FIELD

S R Schwartz comp Apr 1978 298 p

(Contract W-7405-eng-48)

(UCID-4033) Avail NTIS HC A13/MF A01

A new data base subset on the gaseous emissions from the Cerro Prieto geothermal field is presented. Properties and states of the reservoir fluid such as flow rates, wellhead pressure, and enthalpy are included in the file along with the well name and constituent measurement. This subset is the result of an initial screening of the data covering 1967 to 1969, and new additions will be appended periodically to the file. The data are accessed by a data base management system as are all other subsets in the file. Data output is available in the form of numerical compilations or graphical displays disposed to paper, film, or magnetic tape. DOE

N79-13491*# Copper Development Association, Inc New York, N Y

INSTRUMENTATION AT THE DECADE 80 SOLAR HOUSE IN TUCSON, ARIZONA Collation of Monthly Reports, May - Sep 1978

Oct 1978 8 p

(Contract NAS8-32244)

(NASA-CR-150851) Avail NTIS HC A02/MF A01 CSDL 10A

Modifications problems and solutions for the instrumentation system that occurred during the period from May through September 1978 are described. The solar house was built to show the use of copper in home building and to demonstrate the use of solar energy to provide space heating and cooling and domestic hot water. The auxiliary energy sources are electrical resistance heating for the domestic hot water and a gas-fired boiler for space heating and operation of the adsorption air conditioning units. G G

N79-13492*# Wyle Labs, Inc, Huntsville Ala Solar Energy Systems Div

LARGO HOT WATER SYSTEM LONG RANGE THERMAL PERFORMANCE TEST REPORT, ADDENDUM

Nov 1978 19 p refs Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150842) Avail NTIS HC A02/MF A01 CSDL 10A

The test procedure used and the test results obtained during the long range thermal performance tests of the LARGO Solar Hot Water System under natural environmental conditions are presented. Objectives of these tests were to determine the amount of energy collected, the amount of power required for system operation, system efficiency, temperature distribution and system performance degradation. S B S

N79-13493*# Wyle Labs, Inc Huntsville, Ala Solar Energy Systems Div

LONG-TERM WEATHERING EFFECTS ON THE THERMAL PERFORMANCE OF THE LENNOX/HONEYWELL (LIQUID) SOLAR COLLECTOR

Nov 1978 13 p refs Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150818) Avail NTIS HC A02/MF A01 CSDL 10A

The test procedures used and the results obtained during the evaluation test program of the Lennox/Honeywell double covered liquid solar collector. The tests were performed under simulated conditions, following long-term exposure to natural weathering conditions. The Lennox/Honeywell collector is a flat-plate solar collector. The absorber plate is steel with copper tubes bonded on the upper surface and is coated with black chrome. Visual inspection of the collector indicated slight discoloration of the absorber plate. Results indicate that performance degradation had occurred. Absorptivity and/or transmissivity decreased as a result of the weathering. S B S

N79-13494*# Wyle Labs Inc Huntsville Ala Solar Energy Systems Div

LIBBEY-OWENS-FORD SOLAR COLLECTOR STATIC LOAD TEST

Dec 1978 6 p Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150852) Avail NTIS HC A02/MF A01 CSCL 10A

The test article is a flat plate solar collector that uses liquid as the heat transfer medium. The absorber plate is copper and has a double tempered glass cover. Test requirements and procedures are described and results are presented in a table. Results demonstrate that the collector performed satisfactorily. S B S

N79-13495*# Elcam, Inc Santa Barbara Calif

PROTOTYPE SOLAR-HEATED HOT WATER SYSTEMS AND DOUBLE-WALLED HEAT EXCHANGERS Progress Report, Jan - Sep 1978

Oct 1978 11 p Prepared for DOE

(Contract NAS8-32245)

(NASA-CR-150854) Avail NTIS HC A02/MF A01 CSCL 10A

Development progress made on two solar-heated hot water systems and two heat exchangers is reported. The development, manufacture, installation, maintenance, problem resolution and system evaluation are described. S B S

N79-13496*# General Electric Co, Santa Barbara Calif TEMPO

CONCEPTUAL DESIGN OF THERMAL ENERGY STORAGE SYSTEMS FOR NEAR TERM ELECTRIC UTILITY APPLICATIONS VOLUME 1 SCREENING OF CONCEPTS

W Hausz B J Berkowitz and R C Hare Oct 1978 266 p

Sponsored in part by Electric Power Research Inst 2 Vol

(Contracts DEN-3-12 EC-77-A-31-1034)

(NASA-CR-159411-Vol-1, GE78TMP-60-Vol-1)

DOE/NASA/0012-78/1-Vol-1 EPRI-RP1082-1-Vol-1) Avail NTIS HC A12/MF A01 CSCL 10C

Over forty thermal energy storage (TES) concepts gathered from the literature and personal contacts were studied for their suitability for the electric utility application of storing energy off-peak discharge during peak hours. Twelve selections were derived from the concepts for screening, they used as storage media high temperature water (HTW), hot oil, molten salts and packed beds of solids such as rock. HTW required pressure containment by prestressed cast-iron or concrete vessels, or lined underground cavities. Both steam generation from storage and feedwater heating from storage were studied. Four choices were made for further study during the project. Economic comparison by electric utility standard cost practices, and near-term availability (low technical risk) were principal criteria but suitability for utility use, conservation potential and environmental hazards were considered. Author

N79-13498*# Solaron Corp Denver, Colo Solaron Energy Systems

PROTOTYPE SOLAR HEATING AND COOLING SYSTEMS INCLUDING POTABLE HOT WATER Quarterly Reports

Oct 1978 35 p Prepared for DOE

(Contract NAS8-32249)

(NASA-CR-150850) Avail NTIS HC A03/MF A01 CSCL 10A

These combined quarterly reports summarize the activities from November 1977 through September 1978 and over the progress made in the development, delivery and support of two prototype solar heating and cooling systems including potable hot water. The system consists of the following subsystems: solar collector, auxiliary heating, potable hot water storage, control, transport and government-furnished site data acquisition. Author

N79-13499*# IBM Federal Systems Div Huntsville Ala **SIMS PROTOTYPE SYSTEM 4 - PERFORMANCE TEST REPORT**

9 Oct 1978 130 p Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150820) Avail NTIS HC A07/MF A01 CSCL 10B

A self-contained preassembled air type solar system designed for installation remote from the dwelling to provide space heating and hot water was evaluated. Data analysis is included which documents the system performance and verifies its suitability for field installation. G G

N79-13500*# Wyle Labs Inc Huntsville Ala Solar Energy Systems Div

LARGO HOT WATER SYSTEM THERMAL PERFORMANCE TEST REPORT

Nov 1978 35 p refs Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150841) Avail NTIS HC A03/MF A01 CSCL 10A

The thermal performance tests and results on the LARGO Solar Hot Water System under natural environmental conditions is presented. Some objectives of these evaluations are to determine the amount of energy collected, the amount of energy delivered to the household as contributed by solar power supplied to operate the system and auxiliary power to maintain tank temperature at proper level, overall system efficiency and to determine temperature distribution within the tank. The Solar Hot Water system is termed a Dump-type because of the draining system for freeze protection. The solar collector is a single glazed flat plate. An 82-gallon domestic water heater is provided as the energy storage vessel. Water is circulated through the collector and water heater by a 5.3 GPM capacity pump and control of the pump motor is achieved by a differential temperature controller. Author

N79-13501*# Jet Propulsion Lab Calif Inst of Tech Pasadena **PARAMETRIC STUDY OF TWO PLANAR HIGH POWER FLEXIBLE SOLAR ARRAY CONCEPTS**

J A Garba, D A Kudija, B Zeldin and E N Costogoue 15 Dec 1978 586 p refs

(Contract NAS7-100)

(NASA-CR-157841 JPL-Pub-78-95) Avail NTIS HC A25/MF A01 CSCL 10A

The design parameters examined were frequency aspect ratio, packaging constraints and array blanket flatness. Specific power-to-mass ratios for both solar arrays as a function of array frequency and array width were developed and plotted. Summaries of the baseline design data, developed equations, the computer program operation, plots of the parameters and the process for using the information as a design manual are presented. G G

N79-13502*# Massachusetts Inst of Tech Cambridge Dept of Mechanical Engineering

AN ASSESSMENT OF THERMAL ENERGY STORAGE AND WASTE HEAT DISSIPATION WITH TOTAL ENERGY SYSTEMS FOR MIT M S Thesis

James Duane Palmer Feb 1978 184 p refs

(AD-A059061) Avail NTIS HC A09/MF A01 CSCL 10/2

Total energy systems have been proposed for installation at MIT. Competing power plant configurations based on three different prime movers: steam turbine, gas turbine and internal combustion engine are analyzed to determine their coincident electrical and thermal power generation capacities. Power generation and demand profiles are compared and methods to match these profiles are formulated. Thermal energy storage is

considered as a means of decoupling the thermal power production and demand. The waste heat rejected from each plant configuration is determined. Systems for dissipation of this waste heat are addressed and evaluated to determine their applicability at the MIT site. Configurations incorporating each of the prime movers with an optimal waste heat dissipation system are proposed for detailed simulation of operation and cost comparison.

Author (GRA)

N79-13503# American Univ Washington D C
DEFINITION OF CHEMICAL AND ELECTROCHEMICAL PROPERTIES OF A FUEL CELL ELECTROLYTE Interm Techncal Report, 25 Dec 1977 - 24 Jul 1978
 T Sarada and John F McIntyre Jul 1978 43 p refs
 (Contract DAAK70-77-C-0080 DA Proj 1L1-61102-AH-51)
 (AD-A058795) Avail NTIS HC A03/MF A01 CSCL 10/2

The present research is oriented toward the task of developing an improved electrolyte for the hydrocarbon-air fuel cell. The following compounds are being evaluated as potential fuel cell electrolytes: sulfoacetic acid, methane sulfonic acid, sulfosalicylic acid, 10-camphorsulfonic acid-di, benzene sulfonic acid, ethylene disulfonic acid-di, benzene sulfonic acid, ethylene disulfonic acid, 1,3,6-naphthalene trisulfonic acid, sulfosuccinic acid, sulfopropionic acid, ethane sulfonic acid, methane disulfonic acid, and propane sulfonic acid. These compounds are being evaluated in terms of their ionic conductivities, vapor pressures, surface properties, chemical stabilities, and electrochemical behaviors. The present status of the project and the outstanding problems are reviewed.

Author (GRA)

N79-13504# Army Electronics Command, Fort Monmouth, N J
 Electronics Technology/Devices Lab
IMPROVED ANODES FOR LIQUID HYDROCARBON FUEL CELL
 John Perry Apr 1978 17 p ref
 (DA Proj 157-62705-AH-94)
 (AD-A058456 DELET-TR-78-8) Avail NTIS
 HC A02/MF A01 CSCL 10/2

Low power fuel cells operating on liquid hydrocarbons, such as methanol and ethylene glycol, have received renewed attention. The current state-of-the-art of anodes used in liquid hydrocarbon fuel cells operating at ambient temperatures of 22 C consist of platinum and palladium catalyst loadings of approximately 10 mg/sq cm. The cost and quantity of these noble metals required for anode electrode fabrication are high. Investigations conducted to reduce the noble metal catalyst loadings have led to the development of an electrode consisting of graphite, platinum (2.4 mg/sq cm) and anodic lead dioxide. Cells fabricated with the new anode (graphite, platinum, and lead dioxide) and silver amalgam cathodes were capable of operating at current densities of 20 mA/sq cm at 0.60 V when charged with an anolyte solution of either methanol in potassium hydroxide or ethylene glycol in potassium hydroxide.

Author (GRA)

N79-13505# General Electric Co, Wilmington Mass
EVALUATION AND OPTIMIZATION OF SOLID POLYMER ELECTROLYTE (SPE) FUEL CELLS Final Technical Report, 23 May 1977 - 23 Apr 1978
 Edward N MacLeod and James E McElroy 15 May 1978 45 p
 (Contract DAAK70-77-C-0128)
 (AD-A058380, MPR-022) Avail NTIS HC A03/MF A01 CSCL 10/2

The reaction air of a fuel/air solid polymer electrolyte (SPE) fuel cell was water saturated utilizing excess moisture in the fuel by diffusion thru an uncatalyzed portion of the SPE. This device eliminated the need for external humidification controls. Fuel/air current densities up to 750 ma/sq cm were demonstrated.

Author (GRA)

N79-13506# Dubin-Bloome Associates, New York
SOLAR ASSISTED HEAT PUMP STUDY FOR HEATING OF MILITARY FACILITIES Final Report, Jul, 1970 - Nov, 1977
 Freddie L Beason and Larry W Strother Tyndall AFB Fla AFCEC Jul 1978 203 p refs
 (Contract F08635-76-C-0276)

(AD-A058626 AFCEC-TR-78-6) Avail NTIS
 HC A10/MF A01 CSCL 13/1

This study identified 21 generic solar assisted heat pump systems and subjectively evaluated them. The six most promising systems were evaluated in further detail. A complete objective analysis of the two most promising systems was then made to determine which could be most economical to install in a family housing unit at Little Rock Air Force Base, Arkansas. The system chosen was a solar hot water heating system in parallel with a water source heat pump. Preliminary drawings integrating this system into a family housing unit at Little Rock AFB were developed. The system selected had a 27-32 year pay back.

Author (GRA)

N79-13507# Colorado State Univ Fort Collins Solar Energy Applications Lab
EVALUATION OF HIGH PERFORMANCE EVACUATED TUBULAR COLLECTORS IN A RESIDENTIAL HEATING AND COOLING SYSTEM COLORADO STATE UNIVERSITY SOLAR HOUSE I Progress Report, 1 Oct, 1970 - 23 Sep, 1977
 W S Duff T M Conway, G O G Meredith, and R B Prott Mar 1978 101 p
 (Contract EY-76-S-02-2577)
 (COO-2577-14) Avail NTIS HC A06/MF A01

The CSU Solar House I is configured with a prototype Corning evacuated tubular collector and a lithium bromide water chiller designed for solar operation. Data were collected for this configuration since January 1977. An operating and control system for the configuration was developed and to the performance of the residential solar heating, cooling, and hot water system was compared with performance of the previous system. Many problems were encountered in the evolution of the operating and control systems due to the different operating characteristics of evacuated tubular collectors, such as their rapid thermal response and the possibility of much higher temperatures as compared to a flat plate collector.

DOE

N79-13508# Chicago Univ, Ill
INDUSTRIAL INTERNATIONAL DATA BASE: ENERGY ANALYSIS METHODOLOGY, NATIONAL USE OF ENERGY PROGRAM PILOT STUDY Final Report
 1978 55 p refs
 (Contract EX-76-C-10-3869)
 (NATO/CCMS-75) Avail NTIS HC A04/MF A01

The Industrial International Data Base Project represents an effort to provide information for the responsible development of energy resources and the allocation of energy research and development funds in industry. The Data Base Project and its organizational history are described. The recommendations of the methodology experts' group are reported along with brief justifications. The general outline and discussion of the recommended method of analyzing total energy use are provided. It is directed at industrial managers, government officials, and potential energy analysts who are unfamiliar with the techniques and inherent difficulties of such assessments. Detailed examinations of more technical aspects of the analyses, exhibits that compare total sectoral energy use in selected countries, a list of documents published under the auspices of the Data Base Project, and a list of attendees at the experts' meetings are included.

DOE

N79-13509# Bechtel Corp, San Francisco, Calif
DESIGN OF LOW-COST STRUCTURES FOR PHOTOVOLTAIC ARRAYS, TASK 1. SURVEY OF ARRAY STRUCTURAL CHARACTERISTICS
 Feb 1978 60 p refs
 (Contract EY-76-C-04-0789)
 (SAND-78-7021) Avail NTIS HC A04/MF A01

In developing design concepts for low cost photovoltaic arrays structural details and functions, manufacturing capability, installation methods, and the maintenance of operating systems are considered. So much is involved in establishing feasible support concepts that it is important to determine the evolution of existing solar array support designs as presently installed or conceptualized by manufacturers. A data base for solar collector systems using

existing sources of information was established. Technical literature was surveyed and solar industry manufacturers were surveyed by mail and telephone to acquire basic data about their products. Companies that make either thermal or photovoltaic collectors were included in the survey listings and company names continue to be added. The nonsolar industry was contacted as well because of the potential for including their knowledge and experience. Results of the surveys and visits are discussed. DOE

N70-13510/ General Electric Co., Philadelphia, Pa. Space Div
 APPLIED RESEARCH ON ENERGY STORAGE AND CONVERSION FOR PHOTOVOLTAIC AND WIND ENERGY SYSTEMS. VOLUME 2. PHOTOVOLTAIC SYSTEMS WITH ENERGY STORAGE. Final Report
 Jan 1978. 344 p. refs. Sponsored in part by DOE
 (Contract NSF C-75-22221-01)
 (HCP/T22221-01/2-2) Avail NTIS HC A15/MF A01

Energy storage technologies deemed best suited for use in conjunction with a photovoltaic energy conversion system in utility, residential and intermediate applications are evaluated. Break-even cost goals are developed for several storage technologies in each application. These break-even costs are then compared with cost projections to show technologies and time frames of potential economic viability. The results, conclusions and recommendations pertaining to use of energy storage with photovoltaic energy conversion systems are given. Candidate storage concepts studied include (1) above ground and underground pumped hydro, (2) underground compressed air, (3) electric batteries, (4) flywheels, and (5) hydrogen production and storage. DOE

N70-13511/ General Electric Co., Philadelphia, Pa. Space Div
 APPLIED RESEARCH ON ENERGY STORAGE AND CONVERSION FOR PHOTOVOLTAIC AND WIND ENERGY SYSTEMS. VOLUME 1. STUDY SUMMARY AND CONCEPT SCREENING. Final Report
 Jan 1978. 227 p. refs. Sponsored in part by DOE
 (Contract NSF C-75-22221-01)
 (HCP/T22221-01/1-Vol-1) Avail NTIS HC A11/MF A01

Storage technologies particularly those which might be best suited for use in conjunction with wind and photovoltaics, were reviewed. The potential worth added by incorporating storage was extensively analyzed for both wind and photovoltaics. Energy storage concepts studied include (1) above ground pumped hydro storage, (2) underground pumped hydro storage, (3) thermal storage oil, (4) thermal storage steam, (5) underground compressed air storage, (6) pneumatic storage, (7) lead acid batteries, (8) advanced batteries, (9) inertial storage (flywheel), (10) hydrogen generation and storage, and (11) superconducting magnetic energy storage. Results, conclusions, and recommendations of the investigations are presented. DOE

N70-13512/ Midwest Research Inst., Kansas City, Mo.
 SOLAR HEATING AND COOLING OF BUILDINGS (SHACOB) COMMERCIALIZATION REPORT PART A. OPTIONS AND STRATEGIES. VOLUME 1. EXECUTIVE SUMMARY
 May 1978. 40 p.
 (Contract EM-77-C-01-8727)
 (HCP/M70065-01/1) Avail NTIS HC A03/MF A01

Potential barriers to the commercialization of solar heating and cooling of buildings in the residential and commercial sectors are analyzed, and government incentives that could accelerate the commercialization process are investigated. Solar hot water and space heating are emphasized. DOE

N70-13513/ Little (Arthur D.), Inc., Cambridge, Mass.
 SOLAR HEATING AND COOLING OF BUILDINGS (SHACOB) COMMERCIALIZATION REPORT PART D. ANALYSIS OF MARKET DEVELOPMENT. VOLUME 2
 May 1978. 88 p. refs.
 (HCP/M70066-01/2) Avail NTIS HC A05/MF A01

The SHACOB Commercialization Model is designed to gauge the impacts of selected federal incentive programs to encourage

the development of solar energy equipment for hot water heating, space heating and space cooling in residential and commercial buildings. The origin of the major economic and technical data base elements used in the model are discussed and trends of these elements are projected over the time frame. The status of the solar industry is reviewed briefly. The results of the SHACOB Model analysis are discussed in the following areas: a comparison of the four major incentive scenarios; the sensitivity of the SHACOB Model to key data assumptions; the impact of single incentives (versus incentive packages); a comparative view of the National Energy Plan (NEP) projections versus the COMP/NEP approach; and a brief investigation of possible phased incentive programs designed to avoid the disruptive effects resulting from the sudden termination of major incentives. DOE

N70-13514/ Princeton Combustion Lab., N. J.
 THE DEFINITION OF A NATIONAL PROGRAM IN ENERGY-EFFICIENT PUMP UTILIZATION. VOLUME 1. Final Report.
 10 May 1970 - 9 Mar. 1977
 Jun 1978. 114 p. refs.
 (Contract EY-76-C-03-1260)
 (HCP/W1260-01/1) Avail NTIS HC A06/MF A01

Up to half of the energy consumed by industrial and commercial machinery estimated to go toward the movement of liquids by pumping equipment; the remainder being consumed by compressors, blowers, fans, machine tools, refrigeration and so forth. The pumping of liquids is vital to almost every segment of the national economy. The majority of pumps used in the U.S. are of the centrifugal type. The efficiency of such a pump may be above 90 percent at best and below 10 percent at worst. Many pumps and pumping systems are known to operate at low efficiencies due to improper selection, lack of maintenance and inefficient pump design. The current study was carried out to assess the magnitude of energy consumption by pumping equipment in the United States, to project the energy savings possible by appropriate measures, and to define a national program aimed at implementing these savings. DOE

N70-13515/ Princeton Combustion Lab., N. J.
 THE DEFINITION OF A NATIONAL PROGRAM IN ENERGY-EFFICIENT PUMP UTILIZATION. VOLUME 2. APPENDICES. Final Report.
 10 May 1970 - 9 Mar 1977
 Jun 1978. 236 p. refs.
 (Contract EY-76-C-03-1260)
 (HCP/W1260-01/2) Avail NTIS HC A11/MF A01

The Appendices are entitled: (1) Auto coolant pump performance tests and results; (2) Future predictions of pump energy usage; (3) Electric power station downtime due to pumping problems; (4) Questionnaire survey of pump manufacturers and users, and analysis of pumping categories; (5) Methods of economic assessment of the shift to energy-efficient pumping systems; and (6) Survey of pumps in use and energy consumption in the U.S. DOE

N70-13517/ Department of Energy, Washington, D. C. Div of Electric Energy Systems
 PROGRAM INFORMATION NOTICE
 Jun 1978. 55 p.
 (DOE/ET-0059) Avail NTIS HC A04/MF A01

Information on those technologies which are relevant and applicable to the systems aspects of U.S. electric energy systems is presented. Emphasis is placed on those research and development projects which are designed to: (1) ensure that all the elements of future electric energy systems are integrated as required to achieve an overall energy efficient system; (2) ensure the continued availability of the system's capability of delivering electrical energy from the source to the user as needed; (3) develop the system design and control techniques that will be required to accelerate the commercialization of emerging technologies with significant near-term energy benefits; and (4) meet the need for electric energy systems input for national energy policy planning. Environmental and socio-economic considerations are included. DOE

N70-13518/ Department of Energy, Washington, D. C. Div of Solar Technology

SOLAR THERMAL POWER SYSTEMS PROGRAM: PROGRAM SUMMARY

Jan 1978 170 p

(DOE/ET-0018/1) Avail NTIS HC A08/MF A01

The accomplishments, projects, and plans of the program are summarized. The objectives of the program are accomplished through research, development, and demonstration in three program areas: (1) dispersed power applications, (2) central power applications, and (3) advanced thermal technology. Efforts in the dispersed power applications include (1) total energy systems, (2) small power systems, and (3) irrigation systems. The program elements and their funding are tabulated. Summary sheets are included for all the projects. DOE

N79-13619# Department of Energy, Washington, D C Div of Solar Applications Developments

SOLAR HEATING AND COOLING RESEARCH AND DEVELOPMENT. PROJECT SUMMARIES

May 1978 291 p

(DOE/CS-0010) Avail NTIS HC A13/MF A01

The Conservation and Solar Applications Solar Heating and Cooling Research and Development Program is described. The evolution of the program is described and the present program is outlined. A series of project descriptions summarizes the research and development presently supported for further development of collectors, thermal energy storage and heat exchangers, heat pumps, solar cooling, controls, and systems. DOE

N79-13620# Los Alamos Scientific Lab, N Mex VERIFICATION METHODOLOGY FOR THE DOE-1 BUILDING ENERGY ANALYSIS COMPUTER PROGRAM

S C Diamond, B D Hunn, and T E McDonald 1978 5 p refs Presented at the Systems Simulation and Econ Analysis for Solar Heating and Cooling Conf., San Diego, Calif., 26-27 Jun 1978

(Contract W-7405-eng-36)

(LA-UR-78-1493, Conf-780639-3)

Avail NTIS

HC A02/MF A01

A computer program, DOE-1, was developed to provide architect/engineers with a public domain design tool for fast and economic energy analysis of buildings. This program can be used to rapidly analyze various design options, including several active solar heating/cooling configurations. It also produces life-cycle cost data, as well as thermal performance predictions. The verification for the real-system simulation of DOE-1 centers on the task of determining the range of applicability (limitations) of the model and the desired accuracy within this range. Tests include an analytical verification test and a field verification test designed to examine the DOE-1 program on an individual algorithm basis. Tasks in the project are listed. DOE

N79-13621# Los Alamos Scientific Lab, N Mex

COMPONENT-BASED SIMULATOR FOR SOLAR SYSTEMS

M A Roschke, B D Hunn, and S C Diamond 1978 5 p refs Presented at the Conf on Systems Simulation and Econ Analysis for Solar Heating and Cooling, San Diego, Calif., 27-29 Jun 1978

(Contract W-7405-eng-36)

(LA-UR-78-1494, Conf-780639-4)

Avail NTIS

HC A02/MF A01

The CBS program was designed as a module of the DOE-1 building energy analysis program package. The CBS program features are described and compared with TRANSYS. Sample results and output listing are shown. DOE

N79-13622# Sandia Labs, Albuquerque, N Mex CONCENTRATING SOLAR COLLECTOR TEST RESULTS, COLLECTOR MODULE TEST FACILITY

V E Dudley (Edgerton, Germeshausen and Grier Inc., Bedford, Mass.) and Robert M Workhoven May 1978 52 p refs (Contract EY-76-C-04-0789)

(SAND-78-0815) Avail NTIS HC A04/MF A01

The results of tests on a series of five concentrating solar collectors from Suntec Systems, Inc., Hexcel Corporation, General

Atomic Company, McDonnell Douglas Astronautics Company and Solar Kinetics Inc. are summarized. The Hexcel design performed better than the others primarily because of a highly reflective, precisely shaped mirror that focused almost all the reflected light onto the absorber. McDonnell Douglas, Suntec Systems, and Solar Kinetics designs were down about 10% in efficiency at temperatures near 300 C. The General Atomic FMSC performed at a lower level at low temperatures because of large reflected light spillover but only about 3 to 4% lower than the others near operating temperatures of 300 C. DOE

N79-13623# Pacific-Sierra Research Corp, Santa Monica, Calif NON-ELECTRIC APPLICATIONS OF GEOTHERMAL ENERGY IN SIX ALASKAN TOWNS Final Report, Oct 1976 - Nov 1977

J Farquhar, R Grijalva and P Kirkwood Nov 1977 243 p refs

(Contract EY-77-C-07-1622)

(IDO-1622-4) Avail NTIS HC A11/MF A01

A major objective of this study was to stimulate development and use of the geothermal resource provided by the earth's average thermal gradient, as opposed to the few anomalies that are typically chosen for geothermal development. Hence six towns for study were selected as being representative of remote Alaskan conditions. The moderate-temperature heat available almost everywhere at depths of two to four kilometers into the earth's mantle could satisfy a major portion of the nation's heating requirements but the cost must be reduced. DOE

N79-13624# Brookhaven National Lab, Upton, N Y Policy Analysis Div

ANALYTICAL FRAMEWORK FOR THE ASSESSMENT OF ENERGY RESOURCE AND TECHNOLOGY OPTIONS FOR DEVELOPING COUNTRIES

Feb 1978 23 p refs

(Contract EY-76-C-02-0016)

(BNL-50800) Avail NTIS HC A02/MF A01

The potentials of various energy resource and technology options in meeting national economic and social development goals for developing countries are evaluated. Resource options are the development of various indigenous conventional resources such as oil, oil shale, natural gas, coal, uranium, hydropower, or geothermal energy. Technology options include advanced coal-combustion technologies, solar energy for water heating or crop drying, wind-driven irrigation pumps and energy-efficient industrial processes. Two categories of options considered are those that correspond to the accelerated implementation of existing elements of the energy system (such as oil-fired electricity generation) and those that correspond to the introduction of a new technology (such as solar electricity). The various resource and technology options are analyzed with respect to a number of parameters of concern, or objective functions, or payoff functions. Among the most prominent of these are the following: total fuel demand and fuel mix, oil imports and exports, national social goals, total energy costs, balance of payments, labor and capital requirements, and environmental quality. The basic approach is described. DOE

N79-13625# Brookhaven National Lab, Upton, N Y SOME MEASURES OF REGIONAL-INDUSTRIAL INTERFUEL SUBSTITUTION POTENTIALS

E J Goettle, IV May 1978 43 p refs Presented at 53rd Conf of the Western Econ Assoc., Honolulu and Kona, Hawaii, 20 Jun 1978

(Contract EY-76-C-02-0016)

(BNL-24368, Conf-780651-1) Avail NTIS HC A03/MF A01

The potential for the substitution of coal for oil and gas in the manufacturing sector is assessed. Demand functions for the alternative energy inputs are derived from a general model of producer behavior. Data for the manufacturing sectors of thirty-three states for the years 1971, 1974, 1975 are pooled into three regional groupings. Two statistical specifications are then estimated. The first is predicted on the assumption that the response parameters are completely heterogeneous across the three regions. The second has regional equality imposed on the parameter estimates and is identical to the complete pooling of the observations. From the above, the regional interfuel

substitution and demand elasticities are determined and comparatively examined. Potentially serious misinformation is shown to occur when completely pooled crossregional and time series data are used to estimate national (or subnational) average response parameters. DOE

N79-13520// Brookhaven National Lab, Upton, N Y
ENERGY SYSTEMS STUDIES PROGRAM Annual Report,
Fiscal Year 1977
M Beller, ed Jan 1978 100 p refs
(Contract EY-76-C-02-0016)
(BNL-50822) Avail NTIS HC A05/MF A01

The Energy Systems Studies Program carried out for the Department of Energy (DOE) is summarized. Topics include the work done by the energy modeling and data group, the technology assessment group, and the economic analysis division in support of DOE programs. The scope of work planned for FY 1978 is briefly described. DOE

N79-13527// Battelle Pacific Northwest Labs, Richland, Wash
CITING HANDBOOK FOR SMALL WIND ENERGY CONVERSION SYSTEMS
H L Wegley, M M Orgill, and R L Drake May 1978 118 p refs
(Contract EY-76-C-06-1830)
(PNL-5251) Avail NTIS HC A06/MF A01

A user's guide for proper site selection for small wind energy conversion systems is presented. Topics included are (1) feasibility study, (2) system selection, (3) wind description, (4) environmental hazards, (5) flat terrain sites, (6) nonflat terrain sites, and (7) site analysis methods. DOE

N79-13528// Arizona Univ, Tucson Optical Sciences Center
OPTICAL DESIGN OF A SOLAR COLLECTOR FOR THE
ADVANCED SOLAR THERMAL ELECTRIC CONVERSION/
PROCESS HEAT PROGRAM
C W Chen, G W Hopkins, K D Masterson, A B Meinel, D
E Osborn, O N Stavroudis, K P Thompson, and A F Turner
Oct 1977 223 p refs
(Contract W-7405-eng-26)
(Y/Sub-77/14261) Avail NTIS HC A10/MF A01

A technical feasibility study was carried out for a concentrating solar collector system with receiver at ground level to result in an optical design carried out in sufficient detail to enable the sponsor to evaluate cost and potential for using its technology. Potential problem areas were identified. Several potential systems were considered, but one configuration, the tower reflector-concentrator, was the only one that met requirements at reasonable technological risk. This system was adopted for detailed development and analysis. Techniques for calculating the optical specifications were developed. A study of funnel concentrators, which required development of analytical tools and computer programs, and a review of materials and coatings for optical elements are included. DOE

N79-13529// Department of Energy Washington, D C Div
of Solar Technology
PHOTOVOLTAIC PROGRAM: PROGRAM SUMMARY
Jan 1978 215 p
(DOE/ET-0019/1) Avail NTIS HC A10/MF A01

The time-phased program goals and strategy are outlined, and the individual projects of the Photovoltaics Program during the Fiscal Year 1977 are summarized. A list of contractors is given, and an appendix on unsolicited proposal requirements is included. DOE

N79-13530// Colorado State Univ, Fort Collins Solar Energy
Applications Lab
SOLAR EVACUATED TUBE COLLECTOR ABSORPTION
CHILLER SYSTEMS SIMULATION
J A Leflar and W S Duff Dec 1977 92 p refs
(Contract EY-76-S-02-2577)
(COO-2577-13) Avail NTIS HC A05/MF A01

A residential air conditioning system incorporating an absorption chiller and evacuated tube collectors is simulated and

the design parameters studied. Mathematical models of the evacuated tube collector and absorption chiller based on experimental results of the components were created and incorporated into a complete system simulation. The chiller model includes transient start-up effects and the evacuated tube collector model includes numerous optical effects. A standard chiller in a humid climate (Washington, D C) and a unit with a modified charge for dry climates (Fort Collins, Colorado) are studied. Design parameters considered include the use of chilled water storage to reduce transient start-up effects of the absorption unit, the effects of removing heat from the solar system for preheating service hot water, the use of a tempering valve to prevent over-firing of the absorption unit in dry climates, and solar storage sizing considerations. A cooling system design is specified. DOE

N79-13531// Institute for Energy Analysis, Oak Ridge, Tenn
THREE MODES OF ENERGY COST ANALYSIS, THEN-
CURRENT DOLLARS, BASE-YEAR DOLLARS, AND
PERPETUAL-CONSTANT DOLLARS
R M Hammett and D L Phung Jun 1978 22 p refs
(Contract EY-76-C-05-0033)
(ORAU/IEA-78-10(M)) Avail NTIS HC A02/MF A01

The cost analysis of energy supplied by a facility over its life cycle is complicated by inflation and by discount rates. Neglect of inflation and improper use of discount rates have often rendered elaborate cost calculations meaningless and have added to the great confusion as to the merits of competing technologies. It is shown in this paper that three modes of energy-cost calculations can be clearly distinguished by the manner in which inflation is treated. Each mode has a well-defined discount rate and is used in conjunction with a well-defined set of input data. A numerical example is provided for the cost comparison of several alternatives for supplying synthetic fuels. DOE

N79-13532// Sandia Labs, Albuquerque, N Mex
SOLAR IRRADIATION PROGRAM DATA BASE MANAGE-
MENT SYSTEM (SIPDBMS)
P C Koestner May 1978 141 p refs
(Contract EX-76-C-04-0789)
(SAND-78-0341) Avail NTIS HC A07/MF A01

A user's guide to (SIPDBMS) and the data bases available is presented. The code is described in some detail to make code modifications easier. SIPDBMS is operational on the CDC 6600. DOE

N79-13533// Ocean Data Systems, Inc, Monterey, Calif
OTEC THERMAL RESOURCE REPORT FOR CENTRAL GULF
OF MEXICO
Oct 1977 111 p refs
(Contract EG-77-C-01-4028)
(TD-27951) Avail NTIS HC A06/MF A01

Most probable monthly temperature profiles from surface to 1500-meter depths were developed for nineteen one-degree latitude-longitude squares in the Central Gulf of Mexico for Ocean Thermal Energy Conversion (OTEC) purposes. This part of the Gulf of Mexico is the site of a semi-permanent current system. An inventory summary of the temperature observations available in the area is included as well as overall bathymetric information. The monthly temperature data are provided in tabular form and as plots of delta T versus depth for each latitude-longitude square. DOE

N79-13534// Environmental Law Inst, Washington, D C
LEGAL BARRIERS TO SOLAR HEATING AND COOLING
OF BUILDINGS
Mar 1978 231 p refs
(Contract EX-76-C-01-2528)
(HCP/M2528-1) Avail NTIS HC A11/MF A01

A study of the legal problems that may be encountered by commercial, industrial, and individual users of solar energy for heating and cooling is presented. The study consists primarily of a review of existing literature, and extensive lists of references are included. Topics by section include (1) solar access and land use issues, (2) building codes, (3) home financing, (4) utilities, (5) mandatory installation, (6) ERDA patent policy, (7) antitrust and fostering competition, (8) labor union resistance and conflicts,

(9) property taxes, (10) mobile homes, and (11) tort liability, insurance, and warranties Author (DOE)

N79-13535# Department of Energy, Washington, D C
SOLAR ENERGY

Jun 1978 59 p refs
(DOE/ET-0062) Avail NTIS HC A04/MF A01

The current status and potential of solar energy is presented Various public industrial, and government funded studies and developments are described Economics and market penetration potential and White House issues memorandum are included
DOE

N79-13536# Public Technology, Inc., Washington, D C
PLANNING PROGRAM TO ACCELERATE ENERGY CONSERVATION IN MUNICIPALITIES Interim Report

Jul 1978 80 p
(Contract EC-77-C-01-5017)
(HCP/M05017-01/1) Avail NTIS HC A05/MF A01

The energy needs of representative jurisdictions are identified A user requirements committee assisted the program in the selection of energy needs and in identifying the most appropriate solution that matches the energy need One energy technology was selected for immediate implementation (i.e., The Energy Conservation Retrofit Manual for Existing Public Institutional Facilities) and an agenda of other energy technologies was developed for future implementations in urban communities The discussion of each of the above topics is presented in detail Results show a significant number of local government officials are eager and willing to participate in energy-conservation programs that can provide direct benefit to local governments in general, and an existing technology delivery system (the Urban Technology System) is successfully being used to implement energy technologies in local governments
DOE

N79-13537# Sandia Labs., Albuquerque, N Mex Advanced Energy Products Div

SOLAR IRRIGATION PROGRAM Status Report, 1 Oct. 1977

Robert L Alvis Mar 1978 59 p refs
(Contract EY-76-C-04-0789)
(SAND-78-0049) Avail NTIS HC A04/MF A01

The construction, dedication, and initial operation of the shallow-well solar irrigation project and the initial operational phase of the deep-well project are documented Solar irrigation systems analyses are also discussed
DOE

N79-13538# Brookhaven National Lab., Upton, N Y Dept of Energy and Environment

BROOKHAVEN NATIONAL LABORATORY BURNER-BOILER/FURNACE EFFICIENCY TEST PROJECT. ANNUAL FUEL USE AND EFFICIENCY REFERENCE MANUAL: HYDRONIC EQUIPMENT

J Batey, R Hoppe, A L Berlad, T Allen, and R McDonald
Dec 1977 20 p
(Contract EY-76-C-02-0016)
(BNL-50816) Avail NTIS HC A02/MF A01

A procedure for calculating the annual fuel use and seasonal efficiency of a particular heating unit was developed based upon laboratory measurement of steady state and part-load efficiency The Annual Fuel Use and Efficiency (AFUE) calculation procedure provides a simple and direct method by which detailed efficiency measurements can be translated to annual fuel use data for ranges of field variables The direct efficiency measurements performed in the laboratory in conjunction with the AFUE procedure provide a standard quantitative method for comparison of heating units on a common and realistic basis
DOE

N79-13539# Battelle Pacific Northwest Labs., Richland, Wash
ANALYSIS OF FEDERAL INCENTIVES USED TO STIMULATE ENERGY PRODUCTION

Jun 1978 400 p refs
(Contract EY-76-C-06-1830)
(PNL-2410) Avail NTIS HC A17/MF A01

A Federal incentive is any action that can be taken by the government to expand residential and commercial use of solar energy The text of this report identifies, qualifies and analyzes such incentives and relates them to current thought about solar energy Four viewpoints used in this discussion come from four types of analysis economic, political organizational and legal Actions (primarily domestic) that the Federal government has taken are identified Incentives, investments liabilities regulations and other factors are analyzed in detail for nuclear energy, hydroelectric power, coal, petroleum, and natural gas Incentives of all energy sources are discussed with respect to solar energy policy
Author (DOE)

N79-13540# Gordian Associates, Inc., New York
HEAT PUMP TECHNOLOGY. A SURVEY OF TECHNICAL DEVELOPMENTS, MARKET PROSPECTS AND RESEARCH NEEDS

Jun 1978 562 p refs
(Contract EX-76-C-01-2121)
(HCP/M2121-01) Avail NTIS HC A24/MF A01

The on-site energy consumption energy and life cycle cost, market prospects, institutional factors and primary or resource energy efficiency of heat pumps for residential and commercial applications were evaluated Calculations of the on-site and primary energy effectiveness, and cost of conventional and advanced heat pumps in comparison to electric and combustion furnaces and baseboard heat were made by means of two hour-by-hour computer simulation programs, one for a 2-story frame residential building, one for a 2-story masonry office building These buildings were hypothetically moved about to nine different locations (cities) selected as representative of the various climatic regions of the continental United States Electric heat pumps were more efficient than any other all-electric HVAC system The general conclusion is that no residential or commercial HVAC system is universally to be preferred to any other if energy effectiveness, life-cycle cost, building application and other pertinent factors are considered
DOE

N79-13541# Battelle Pacific Northwest Labs., Richland, Wash
STORED ENERGY CALCULATION: THE STATE OF THE ART

M E Cunningham, D D Lanning, A R Olsen, R E Williford, and C R Hann May 1978 145 p refs
(Contract EY-76-C-06-1830)
(PNL-2581) Avail NTIS HC A07/MF A01

State of the art of fuel temperature, gap conductance, and stored energy calculations was reviewed Major emphasis was placed on the propagation of input and model uncertainties A comparison was made of the observed variability of experimental data for fuel centerline temperature and gap conductance values The uncertainty analysis was performed by identifying major thermal models and collecting them into an abstract of a thermal performance code Uncertainties in the calculations were determined using the method of propagation of uncertainties with a first order Taylor series approximation to the nonlinear functions Output uncertainty results were presented for the beginning of fuel life the end of life, and throughout a typical power history Also presented was an influence and importance analysis for the input parameters It was concluded that the relative uncertainty in stored energy is approximately +20 percent at beginning of fuel life, and increases to +25 to 40 percent contact
DOE

N79-13542# Honeywell, Inc., Minneapolis, Minn Energy Resources Center

SOLAR PILOT PLANT, PHASE 1 Final Report, 1 Jul. 1977

1 Feb 1978 92 p
(Contract EY-76-C-03-1109)
(SAN-1109-77-7) Avail NTIS HC A05/MF A01

The preliminary design for a 10-MW(e) solar pilot plant of the central receiver type was developed The design includes estimates of cost, performance, and cost for a 100-MW(e) plant Subsystem research experiments were conducted on the collector subsystem and the steam generator portion of the receiver

subsystem. A lesser amount of testing was done on a latent-heat storage subsystem before a sensible-heat storage subsystem was incorporated at the direction of ERDA. All test results and analyses point to the feasibility of the pilot plant, and by extension to commercial-scale plants. On this basis and in light of the worsening energy situation, it is recommended that Phase II of the program be undertaken as quickly as practical. DOE

N79-13543# New Zealand Energy Research and Development Committee Auckland
ENERGY SCENARIOS: SUPPLEMENTARY STUDIES
 G S Harris Murray J Ellis Graham C Scott, Jonathan R Wood, Peter H Phillips, and Nigel P Isaacs Apr 1978 17 p refs
 (NP-23292, Rept-33) Avail NTIS (US Sales Only)
 HC A02/MF A01, DOE Depository Libraries

Three paths for New Zealand's energy future were discussed previously in Energy Scenarios for New Zealand. The three scenarios, Continuation, Low New Zealand Pollution, and Limited Growth demonstrated the energy implications of different social attitudes to material wealth, environment, and resources. Additional work was undertaken on four of the most important problems on which it was felt the scenarios provided insufficient information. These studies attempt to answer questions about the impact of particular policy options on energy supplies. They all use the economic structure of the Continuation scenario for determining energy demands. The themes of the three new studies used on modifying the energy supplies and demands of Continuation are, increased energy efficiency, reduced imports of fossil fuels, and renewable sources. Author (DOE)

N79-13544# Carrier Corp., Syracuse, N Y Energy Systems Div
CANDIDATE CHEMICAL SYSTEMS FOR AIR COOLED, SOLAR POWERED, ADSORPTION AIR CONDITIONER DESIGN PART 2. SOLID ADSORBENTS, HIGH LATENT HEAT REFRIGERANTS
 W J Biermann Apr 1978 81 p refs
 (Contract EG-77-C-03-1587)
 (SAN-1587-2) Avail NTIS HC A05/MF A01

Work done in attempting to qualify absorption refrigeration systems based on refrigerants with intermediate latent heats of vaporization is summarized. In practice, these comprise methanol, ammonia, and methylamine. A wide variety of organic substances, salts, and mixtures were evaluated in a systematic manner as possible. Several systems of interest are described. The system, LiClO₃-LiBr-H₂O, is a good back up system to our first choice of an antifreeze additive system, and thermodynamically promising but subject to some inconvenient materials limitations. The system, LiBr/ZnBr₂-methanol, is thermodynamically promising but requires additional kinetic qualification. Chemical stability of the system, LiClNS-ammonia/methylamine with various other third components, does not appear to be adequate for a long-lived system. DOE

N79-13545# National Technical Information Service, Springfield, Va
SOLAR SPACE HEATING AND AIR CONDITIONING, VOLUME 2. CITATIONS FROM THE NTIS DATA BASE
 Progress Report, 1970 - Aug. 1977
 Audrey S Hundemann Sep 1978 247 p
 (NTIS/PS-78/1014/6) Avail NTIS HC \$28 00/MF \$28 00 CSCL 13A

Design, technical feasibility, performance, and economic factors pertaining to solar heating and cooling of buildings are discussed. Commercial buildings, schools, and residential buildings are covered, with emphasis on the assessment of solar heating and cooling systems for residential buildings. A few abstracts are included on solar energy as a national energy resource, solar energy research program alternatives, and social, environmental, and institutional factors affecting the feasibility of using solar energy for heating and cooling buildings. This updated bibliography contains 241 abstracts, one of which are new entries to the previous edition. GRA

N79-13546# National Technical Information Service, Springfield, Va
SOLAR SPACE HEATING AND AIR CONDITIONING, VOLUME 3. CITATIONS FROM THE NTIS DATA BASE
 Progress Report, Sep. 1977 - Sep. 1978
 Audrey S Hundemann Sep 1978 96 p Supersedes NTIS/PS-77/0827, NTIS/PS-76/0727, NTIS/PS-75/689 NTIS/PS-75/345
 (NTIS/PS-78/1015/3, NTIS/PS-77/0827, NTIS/PS-76/0727, NTIS/PS-75/689 NTIS/PS-75/345) Avail NTIS
 HC \$28 00/MF \$28 00 CSCL 13A

Design, technical feasibility, performance, and economic factors pertaining to solar heating and cooling of buildings are discussed. Commercial buildings, schools, and residential buildings are covered, with emphasis on the assessment of solar heating and cooling systems for residential buildings. A few abstracts on solar energy as a national energy resource, solar energy research program alternatives, and social environmental and institutional factors affecting the feasibility of using solar energy for heating and cooling buildings. This updated bibliography contains 90 abstracts, all of which are new entries to the previous edition. GRA

N79-13547# National Technical Information Service, Springfield, Va
SOLAR SPACE HEATING AND AIR CONDITIONING, VOLUME 3. CITATIONS FROM THE ENGINEERING INDEX DATA BASE
 Progress Report, Sep 1977 - Sep. 1978
 Audrey S Hundemann Sep 1978 103 p Supersedes NTIS/PS-77/0829, NTIS/PS-76/0728

(NTIS/PS-78/1017/9, NTIS/PS-77/0829, NTIS/PS-76/0728)
 Avail NTIS HC \$28 00/MF \$28 00 CSCL 13A

The use of solar energy to heat and cool buildings is studied, with emphasis on the heating and cooling of residential buildings and schools. Design technical feasibility, economics, and performance simulation studies are cited. Abstracts pertaining to solar assisted heat pump systems and assessment of solar heated Rankine cycle cooling are included. This updated bibliography contains 97 abstracts, all of which are new entries to the previous edition. GRA

N79-13548# Cameron Engineers, Inc., Denver, Colo
EPA PROGRAM STATUS REPORT: OIL SHALE
 L Eckstein Feb 1978 57 p refs
 (Contract EPA-68-01-4337)
 (PB-284480/1, EPA-600/7-78-020) Avail NTIS
 HC A04/MF A01 CSCL 081

An overview of oil shale research and development efforts performed by EPA, or funded by EPA monies passed through to other federal agencies under the interagency Energy/Environment R and D Program is presented. Topics included are the purpose, background, and rationale behind EPA's efforts, EPA program goals and fiscal year 1977 program funding, and the scope-of-work for 55 projects. A table summarizes these projects by presenting project title, sponsoring agency, performing organization, and project duration. GRA

N79-13549# Arizona Univ., Tucson Office of Arid Lands Studies
SOLAR ENERGY, WATER, AND INDUSTRIAL SYSTEMS IN ARID LANDS: TECHNOLOGICAL OVERVIEW AND ANNOTATED BIBLIOGRAPHY
 Christopher Quiffeld 1978 185 p refs Sponsored by the Dept of Interior
 (PB-285129/3, ARID-LANDS-RESOURCE-IP-12 W78-10288, QWRT-W-211(8254)(1)) Avail NTIS HC A08/MF A01 CSCL 10A

A new conceptual framework within which the countless diverse details of the burgeoning solar energy field can be unified and easily comprehended is presented. The bibliography offers a small but typical selection from the solar energy literature. It includes mostly recent items (1975-1977), and a few important older ones. Major focus is on introductory and review publications, and specialized works dealing with arid lands and water. GRA

N79-13550# National Technical Information Service Springfield, Va

SOLAR SPACE HEATING AND AIR CONDITIONING, VOLUME 2 CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1976 - Aug. 1977

Audrey S Hundemann Sep 1978 221 p (NTIS/PS-78/1016/1) Avail NTIS HC \$28 00/MF \$28 00 CSCL 13A

Studies from worldwide literature on the use of solar energy to heat and cool buildings are discussed, with emphasis on the heating and cooling of residential buildings and schools Design technical feasibility, economics, and performance simulation studies are cited Abstracts pertaining to solar assisted heat pump systems and assessment of solar heated Rankine cycle cooling are included This bibliography contains 215 abstracts GRA

N79-13551# National Technical Information Service, Springfield Va

FLAT PLATE SOLAR COLLECTOR DESIGN AND PERFORMANCE. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Jun 1978

Audrey S Hundemann Aug 1978 104 p (NTIS/PS-78/0840/5) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10A

Federally-funded research on the design and thermal efficiency of air- and liquid-type flat plate collectors is discussed Topic areas cover convection characteristics, methods to reduce heat loss, optical coatings, and corrosion control Emphasis is on basic research studies This bibliography contains 97 abstracts GRA

N79-13552# Reznik (Ben), Silver Spring, Md
AN ANNOTATED COMPILATION OF THE SOURCES OF INFORMATION RELATED TO THE USAGE OF ELECTRICITY IN NON-INDUSTRIAL APPLICATIONS Final Report

Ben Reznik Jul 1978 690 p Sponsored by HUD Prepared for NBS (PB-285260/6, NBS/GCR-78/130) Avail NTIS HC A99/MF A01 CSCL 10A

A thorough compilation is presented of the sources of information related to the usage of electricity in non-industrial applications as available in the open literature and from the U S electrical power industry The scope encompasses all aspects of electric loadmanagement, end-use and the various methods of acquisition, analysis, and implementation of electricity usage data There are over 400 abstracts 156 from LRC/AEIC reports and 264 from the open literature The abstracts cover references containing over 12 000 pages plus about 2,500 references and 6 200 graphs and tables pertinent to electricity usage in nonindustrial applications In addition to the LRC/AEIC abstracts, this document identifies over 100 sources of directly relevant information GRA

N79-13553# National Bureau of Standards Washington, D C
MATERIALS FOR FUEL CELLS Annual Report, Jan 1977 - Dec 1977

L H Bennett M I Cohen, A L Dragoo, A D Franklin and A J McAllister Jul 1978 133 p refs (PB-285360/4, NBSIR-78-1472) Avail NTIS HC A07/MF A01 CSCL 10B

In most fuel cell applications a major contribution to the overvoltage, and therefore to a reduction in useful voltage and to efficiency, comes from electrode polarization For use in hot H3PO4 no satisfactory substitutes for Pt were found but Pt is not completely satisfactory At the anode its sensitivity to CO poisoning forces the use of higher temperatures and catalytic shift conversion in the fuel processing train This program studies refractory metal-metalloid compounds as potential anode catalysts GRA

N79-13554# National Technical Information Service Springfield, Va

SILICON SOLAR CELLS, VOLUME 2 CITATIONS FROM THE NTIS DATA BASE Progress Report, Oct 1976 - Nov 1977

Mona F Smith Oct 1978 191 p (NTIS/PS-78/1114/4) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

Studies from Government-sponsored research reports on silicon crystal growth fabrication methods are included The performance and testing of these cells, as well as encapsulating materials are covered GRA

N79-13555# National Technical Information Service Springfield Va

SILICON SOLAR CELLS, VOLUME 3 CITATIONS FROM THE NTIS DATA BASE Progress Report, Dec 1977 - Oct. 1978

Mona F Smith Oct 1978 212 p Supersedes NTIS/PS-77/0956, NTIS/PS-76/0800, NTIS/PS-75/628 (NTIS/PS-78/1115/1, NTIS/PS-77/0956 NTIS/PS-76/0800, NTIS/PS-75/628) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

Citations of Government-sponsored research reports on silicon solar cell growth and fabrication are presented Processes covered include chemical vapor deposition the Czochralski method dendritic growth, ribbon growth, epitaxial growth and silicon sheet fabrication on substrates Silicon compound synthesis purification and reduction are discussed Casting cutting and shaping of silicon solar cells are included Solar energy conversion efficiency and performance are described Abstracts on costs and production of these cells are covered GRA

N79-13556# National Technical Information Service Springfield Va

SILICON SOLAR CELLS, VOLUME 2 CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Oct. 1978

Mona F Smith Oct 1978 200 p Supersedes NTIS/PS-77/0958 NTIS/PS-76/0801 (NTIS/PS-78/1116/9 NTIS/PS-77/0958 NTIS/PS-76/0801) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

Worldwide research on the development of solar energy conversion devices using silicon ribbons, sheets, films, crystals, and wafers is cited The preparation purity crystal defects, and efficiency of these cells are covered The economics of solar cell development is discussed The effects of radiation and weathering on performance are included GRA

N79-13557# National Technical Information Service, Springfield, Va

SOLAR ELECTRIC POWER GENERATION, VOLUME 2. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Sep 1978

Audrey S Hundemann Oct 1978 232 p Supersedes NTIS/PS-77/0898 NTIS/PS-76/0796, NTIS/PS-75/691 NTIS/PS-75/346 (NTIS/PS-78/1108/6 NTIS/PS-77/0898 NTIS/PS-76/0796, NTIS/PS-75/691 NTIS/PS-75/346) HC \$28 00/MF \$28 00 CSCL 10B

Citations of Federally-funded research are presented pertaining to electric power generation by both direct conversion with solar cells and indirect conversion using solar heat Topic areas cover equipment design, site surveys economics and feasibility studies of solar power satellite systems, photovoltaic systems, solar total energy systems, and central receiver solar thermal power systems A few abstracts deal with phase change materials and thermal energy storage systems GRA

N79-13558# National Technical Information Service Springfield, Va

SOLAR ELECTRIC POWER GENERATION, VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1976 - Sep 1978

Audrey S Hundemann Oct 1978 250 p Supersedes NTIS/PS-77/0900 NTIS/PS-76/0797 (NTIS/PS-78/1109/4 NTIS/PS-77/0900, NTIS/PS-76/0797) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

A worldwide literature survey cites power generation by direct conversion with solar cells and indirect conversion using solar heat Topic areas cover solar tower power plants, orbital solar energy technology photovoltaic power generation, and solar

augmentation of hydroelectric power systems A few abstracts pertain to the future role that solar energy will play in production of electric power and general studies comparing the technical and economic feasibility of various methods of electric power generation
GRA

N79-13569# Bolt Beranek and Newman, Inc. Cambridge, Mass
NOISE CONTROL NEEDS IN THE DEVELOPING ENERGY TECHNOLOGIES

D N Keast Mar 1978 250 p refs

(Contract EE-77-C-02-4389)

(COO-4389-1) Avail NTIS HC A11/MF A01

The noise characteristics of existing energy conversion technologies, e.g. from obtaining and processing fossil fuels to power plants operations, and of developing energy technologies (wind geothermal sources solar energy or fusion systems) are discussed in terms of the effects of noise on humans animals, structures and equipment and methods for noise control Regulations for noise control are described Recommendations are made for further research on noise control and noise effects
DOE

N79-13571# Argonne National Lab Ill

ENVIRONMENTAL CONTROL IMPLICATIONS OF GENERATING ELECTRIC POWER FROM COAL APPENDIX A, PART 2: COAL PREPARATION AND CLEANING ASSESSMENT STUDY APPENDIX Technology Status Report, 1977

Dec 1977 392 p refs Prepared in cooperation with Bechtel Corp San Francisco

(Contract W-31-109-eng-38)

(ANL/ECT-3-App-A-Pt-2) Avail NTIS HC A17/MF A01

The results of integrating coal washability and coal reserves data obtained from the U.S. Bureau of Mines are presented Two computer programs were developed to match the appropriate entries in each data set and then merge the data Approximately 18% of the total demonstrated coal reserves were matched with washability data However about 35% of the reserves that account for 80% of current production were successfully matched Each computer printout specifies the location and size of the reserve, and then describes the coal with data on selected physical and chemical characteristics Washability data are presented for three crush sizes and several specific gravities In each case, the percent recovery, Btu/lb, percent ash, percent sulfur and reserves available are given The sources of the original data and the methods used in the integration are discussed briefly
DOE

N79-13572# Brookhaven National Lab, Upton, N Y National Center for Analysis of Energy Systems

ASSESSMENT OF THE SOLID WASTE IMPACT OF THE NATIONAL ENERGY PLAN

P Meier, E Rubin, T Le R Stern, E Kaplan F Barvenik and K Blumer Feb 1978 65 p refs

(Contract EY-76-C-02-0016)

(BNL-50708) Avail NTIS HC A04/MF A01

The only significant effect of the National Energy Plan (NEP) on solid waste management in electric utilities will be to shift the regional distribution of impacts Nationally, NEP may result in an increase of ash by 1 percent, and a decrease in the scrubber sludge disposal area requirement by up to 10 percent A significant fraction of coal using industries will use FGD systems that produce liquid effluents rather than sludge residuals with discharge to municipal sewage systems or to water bodies This will increase dissolved solids concentrations in the receiving waters, but at concentrations that are not expected to be of environmental concern except in the arid regions of the west Because of the significant cost of sludge transportation, industries that have inadequate land for onsite disposal may incur significant cost penalties for sludge disposal, in addition to facing opposition at the local level to the use of regional or municipal disposal facilities The key environmental uncertainty is the fate of trace and heavy metals at industrial facilities using liquid scrubbing systems and subsequent liquid waste treatment processes
DOE

N79-13573# Department of Energy, Washington, D C
REQUIREMENTS FOR ENVIRONMENTAL MONITORING ASSESSMENT, AND CONTROLS FOR NONNUCLEAR ENERGY DEMONSTRATION PROJECTS. REPORT TO

CONGRESS, PREPARED IN FULFILLMENT OF PUBLIC LAW 95-39, SECTION 113

May 1978 41 p refs

(DOE/EV-0014) Avail NTIS HC A03/MF A01

Two demonstration projects pursued by DOE and authorized by Congress are reviewed Both projects are demonstrations of coal gasification technologies The environmental effects which are pertinent to the general area of coal gasification are delineated and a comprehensive overview is given of the potential environmental concerns
DOE

N79-13574# Department of Energy, Washington, D C
COAL LOAN GUARANTEE PROGRAM (PL 94-163) Final Environmental Impact Statement

Jul 1978 482 p refs

(DOE/EIS-0004) Avail NTIS HC A21/MF A01

The potential environmental impacts of the program are considered in the following sequence (1) identify the geographic areas where coal production and coal use will be most directly affected by the program, (2) quantify the extent to which coal production and use will be affected in these areas, (3) quantify for a typical mine, steam coal preparation plant and coal combustion facility, the extent to which environmental residuals (i.e., pollutants) will be affected, (4) aggregate the environmental residuals produced by such facilities for the geographic regions identified to assess the regional environmental impacts of implementing the program, and (5) consider alternatives to the program
DOE

N79-13590# Bureau of Mines, College Park Md Metallurgy Research Center

ANTIMONY, ARSENIC, AND MERCURY IN THE COMBUSTIBLE FRACTION OF MUNICIPAL SOLID WASTE

Benjamin W Hayes, James C McConnell, and Stephen L Law 1978 18 p refs

(PB-285196/2 BUMINES-RI-8293) Avail NTIS HC A02/MF A01 CSCL 13B

As part of the total metallurgical system to recover metals, glass, and a combustible fraction from urban refuse the Bureau of Mines conducted analytical studies to determine the concentration of antimony, arsenic, and mercury in the combustible fractions collected at various locations in the Bureau's urban refuse recycling pilot plant The samples processed through the plant were submitted by various municipalities that are considering resource recovery as an alternative to landfill or other means of disposal To provide the analytical data, sensitive reproducible chemical digestion-atomic absorption methods were evaluated
GRA

N79-13591# Pacific Northwest Environmental Research Lab, Corvallis, Ore

ENVIRONMENTAL EFFECTS OF INCREASED COAL UTILIZATION ECOLOGICAL EFFECTS OF GASEOUS EMISSION FROM COAL COMBUSTION Final Report

Norman R Glass Jun 1978 62 p refs

(PB-285440/4, EPA-600/7-78-108) Avail NTIS HC A04/MF A01 CSCL 06F

The economic implications of ecological effects are identified and the reliability of the data base upon which conclusions or estimates are made is evaluated Aquatic and terrestrial effects are distinguished where the pollutants in question are clearly problems in both media Sulfur oxide (SOx) emissions and nitrogen oxide (NOx) emissions are projected to be higher in 1985 and 2000 than in 1975 Since SOx and NOx are major contributors to acid precipitation, substantial increases in total acid deposition can be expected in the nation as a whole At present, acid precipitation is most abundant in the North Central and Northeastern States
GRA

N79-13592# Mitre Corp, McLean, Va METREK Div
AN ASSESSMENT OF MERCURY EMISSIONS FROM FOSSIL FUELED POWER PLANTS Final Report

Gerald R Goldgraben, Kit Kruckenberger, Paul Clifford, Norman Zimmerman, and Dennis Martin Jul 1978 106 p refs

(Contract EPA-68-01-3539)

(PB-285227/5, EPA-600/7-78-146) Avail NTIS HC A06/MF A01 CSCL 06F

The study has found no evidence of a health or environmental problem as a result of emissions of mercury from power plants. This conclusion has led to the recommendation that a specific control program to address mercury emissions from power plants is not necessary at this time. It is estimated that power plants contributed less than 8 percent of the more than 2000 tons of mercury lost to the environment by all man-made sources in 1974. Studies and scenarios indicate little or no effect of mercury from power plant emissions on ambient air or water concentrations. Health effects, standards and regulations, transport, and transformations of mercury are discussed. GRA

N79-13224/ Los Alamos Scientific Lab., N. Mex.
GASEOUS FUEL REACTORS FOR POWER SYSTEMS
H. H. Helmick and F. C. Schwenk 1978 7 p. Presented at 13th Intersoc. Energy Conversion Eng. Conf., San Diego, Calif., 20 Aug 1978.
(Contract W-7405-eng-36)
(LA-UR-78-1437, Conf-780801-18) Avail NTIS HC A02/MF A01

The Los Alamos Scientific Laboratory is participating in a NASA-sponsored program to demonstrate the feasibility of a gaseous uranium fueled reactor. The work is aimed at acquiring experimental and theoretical information for the design of a prototype plasma core reactor which will test heat removal by optical radiation. The basic goal of this work is for space applications, however other NASA-sponsored work suggests several attractive applications to help meet earth-bound energy needs. The final phase experimental activity now in progress is the fabrication and testing of a buffer gas vortex confinement system. DOE

N79-13249/ Oak Ridge National Lab., Tenn.
PROLIFERATION-RESISTANT NUCLEAR FUEL CYCLES
D. O. Campbell and E. H. Gift Jun 1978 18 p refs
(Contract W-7405-eng-26)
(ORNL/TM-6392) Avail NTIS HC A02/MF A01

The properties of plutonium containing unusually large proportions of the 238Pu isotope are considered in relation to resistance to nuclear proliferation. Several fuel cycle modifications for light water reactors are evaluated. It is shown that the 238Pu isotopic concentration can be increased substantially from the approximately 1.5% in discharged fuel from reactors operating presently. Concentrations of 8 to 10% are readily achievable, and values approaching 20% may be practical. DOE

N79-13271/ General Atomic Co., San Diego, Calif.
PARAMETRIC REQUIREMENTS FOR NONCIRCULAR TOKAMAK COMMERCIAL FUSION PLANTS
R. F. Bourque May 1978 59 p refs
(Contract EY-76-C-03-0167-038)
(GA-A-14876) Avail NTIS HC A04/MF A01

The fully integrated systems computer program SCOPE is described and used to determine the parameter ranges for the economical operation of equilibrium commercial fusion power plants using noncircular Tokamak reactors. Costs of electricity were used as the critical dependent variable by which the effects of changes in system parameters were observed. Necessary requirements for economical operation are discussed for wall loadings, electric power level, total beta values, duty and cycles, optimum aspect ratio, fall wall lifetime, and specific transport scaling. The results are insensitive to density and temperature profiles over wide ranges. DOE

N79-13272/ General Atomic Co., San Diego, Calif.
PARAMETRIC REQUIREMENTS FOR NONCIRCULAR TOKAMAK COMMERCIAL FUSION PLANTS
R. F. Bourque Apr 1978 7 p refs. Presented at 3d. ANS Topical Meeting on the Technol. of Controlled Nucl. Fusion, Santa Fe, New Mex., 9-11 May 1978.
(Contract EY-76-C-03-0167-038, Proj 3235)
(GA-A-14946, Conf-780508-19) Avail NTIS HC A02/MF A01

Systems analyses were performed in order to determine the parameter ranges for economic operation of equilibrium com-

mercial fusion power plants using noncircular Tokamak reactors. The results of these studies show that (1) neutron wall loadings over 2 megawatts per square meter may be unnecessary for economic Tokamak operation, (2) electrical power levels beyond 1000 MW(e) are not required and power levels as low as 100 MW(e) may be acceptable, (3) total beta values of 10 to 12 percent are adequate, (4) duty cycles as low as 50 percent have only a small effect on plant economics and (5) an acceptable first wall lifetime is 15 MW-yr per square meter. DOE

N79-13213/ National Academy of Sciences - National Research Council, Washington, D. C.
Ad Hoc Steering Committee for the Study of Research Applied to National Needs
STRATEGIES FOR APPLIED RESEARCH MANAGEMENT
1978 124 p refs
(Contract NSF C-310)
(PB-284741/6 NSF/RA-780088) Avail NTIS HC A06/MF A01 CSCL 05A

A product of interviews, deliberations, reviews, and a workshop—all dedicated to the identification of alternate workable management strategies for the effective use of RANN research results is reported. The study was conducted through interviews and discussions with the respective division directors, personnel of other agencies, representatives of participating governmental units, universities and/or industrial firms, and even with representatives of withdrawn unsuccessful bidders. The four case study areas were the delivery of public services to remote areas via telecommunications technology, the solar heating and cooling of buildings, trace contaminants in the environment from agricultural, mining, and manufacturing activities, and industrial productivity (automation). GRA

N79-13215/ National Aeronautics and Space Administration
Marshall Space Flight Center Huntsville, Ala.
FY 1978 SCIENTIFIC AND TECHNICAL REPORTS, ARTICLES, PAPERS, AND PRESENTATIONS
O. L. White, comp Oct 1978 79 p refs
(NASA-TM-78203) Avail NTIS HC A05/MF A01 CSCL 05B

Abstracts of 73 technical papers published or presented by MSFC personnel in FY-78 are presented. In addition, over 400 papers by contractors to that facility are listed along with the STAR document number for each report. Titles of 208 additional papers already cleared for publication are included. ARH

N79-13232/ Committee on Commerce, Science, and Transportation (U. S. Senate)
NATIONAL AERONAUTICS AND SPACE ACT OF 1958, AS AMENDED, AND RELATED LEGISLATION
Washington GPO 1978 190 p. Rept for Comm on Commerce, Sci., and Transportation, 95th Congr., 2d Sess., Dec 1978.
(GPO-34-175) Avail Comm on Commerce, Sci., and Transportation

A compilation of the texts of the public laws that relate to aeronautical and space research and development activities is presented. Emphasis is placed on how these activities relate to the functions and responsibilities of the National Aeronautics and Space Administration. JMS

N79-13224/ Department of Energy, Washington, D. C.
Office of Regulations and Emergency Planning
PROPOSED STANDBY GASOLINE RATIONING PLAN.
ECONOMIC AND REGULATORY ANALYSIS DRAFT
Jun 1978 293 p
(DOE/ERA-0009) Avail NTIS HC A13/MF A01

The potential economic impacts of the gasoline rationing contingency plan on the total national economy were evaluated using three separate projections: (1) the normal U.S. economy for a future period—the last quarter of 1980 through the third quarter of 1981, (2) the impacts which a petroleum supply interruption would have on the U.S. economy during this future period, assuming that DOE's standby allocation and price control regulations were implemented for crude oil and products, and (3) the incremental impacts of the gasoline rationing program on this already-perturbed future U.S. economy. DOE

N79-13835 Washington Univ Seattle
A METHODOLOGY FOR EVALUATING THE POTENTIAL MATERIALS AND ENERGY RECOVERY FROM MUNICIPAL SOLID WASTE Ph.D. Thesis

Charles Edward Findley 1978 222 p
 Avail Univ Microfilms Order No 7824451

The methodology considers the uncertainty associated with switching to resource recovery from the perspective of the local decision maker. The approach makes maximum use of both objective and subjective information. The methodology provides a mechanism for the decision maker to combine his own opinion with those of his experts. It also includes provisions for the decision maker to assess and weigh his degree of confidence in his own opinion relative to his confidence in his experts. Application of this approach results in estimates of operating deficits which will occur with successful, unsuccessful, and expected outcomes. Dissert Abstr

N79-13837* Jet Propulsion Lab., Calif Inst of Tech Pasadena
UTILIZATION OF WASTE HEAT IN TRUCKS FOR INCREASED FUEL ECONOMY Final Report

C J Leising, G P Purohit, S P DeGrey and J G Finegold
 Jun 1978 37 p refs

(Contract EX-76-A-31-1011)

(NASA-TM-79986 HCP/M1011-02) Avail NTIS
 HC A03/MF A01 CSCL 13F

The waste heat utilization concepts include preheating, regeneration, turbocharging, turbocompounding, and Rankine engine compounding. Predictions are based on fuel-air cycle analyses, computer simulation, and engine test data. All options are evaluated in terms of maximum theoretical improvements, but the Diesel and adiabatic Diesel are also compared on the basis of maximum expected improvement and expected improvement over a driving cycle. The study indicates that Diesels should be turbocharged and aftercooled to the maximum possible level. The results reveal that Diesel driving cycle performance can be increased by 20% through increased turbocharging, turbocompounding, and Rankine engine compounding. The Rankine engine compounding provides about three times as much improvement as turbocompounding but also costs about three times as much. Performance for either can be approximately doubled if applied to an adiabatic Diesel. DOE

N79-14099* National Aeronautics and Space Administration
 Lewis Research Center, Cleveland Ohio

EFFECT OF SWIRLER-MOUNTED MIXING VENTURI ON EMISSIONS OF FLAME-TUBE COMBUSTOR USING JET A FUEL

David B Ercegovic Jan 1979 23 p refs
 (NASA-TP-1393 AVRADCOM-TR-78-41 E-9762) Avail NTIS
 HC A02/MF A01 CSCL 21E

Six headplate modules in a flame-tube combustor were evaluated. Unburned hydrocarbons, carbon monoxide, and oxides of nitrogen were measured for three types of fuel injectors both with and without a mixing venturi. Tests were conducted using jet A fuel at an inlet pressure of 0.69 megapascal, an inlet temperature of 478 K, and an isothermal static pressure drop of 3 percent. Oxides of nitrogen were reduced by over 50 percent with a mixing venturi with no performance penalties in either other gaseous emissions or pressure drop. G G

N79-14143* Tennessee Univ., Knoxville Dept of Electrical Engineering

ACCURACY ANALYSIS OF POINTING CONTROL SYSTEM OF SOLAR POWER STATION Final Report, 23 Jun - 23 Dec, 1978

J C Hung and Peyton Z Peebles Jr 23 Dec 1978 73 p refs

(Contract NAS8-33065)

(NASA-CR-150880) Avail NTIS HC A04/MF A01 CSCL 22B

The first-phase effort concentrated on defining the minimum basic functions that the retrodirective array must perform, identifying circuits that are capable of satisfying the basic functions,

and looking at some of the error sources in the system and how they affect accuracy. The initial effort also examined three methods for generating torques for mechanical antenna control, performed a rough analysis of the flexible body characteristics of the solar collector, and defined a control system configuration for mechanical pointing control of the array. G G

N79-14165# California Univ Livermore Lawrence Livermore Lab

COMPARATIVE PROPERTIES OF FIBER COMPOSITES FOR ENERGY-STORAGE FLYWHEELS PART A EVALUATION OF FIBERS FOR FLYWHEEL ROTORS

Lynn S Penn 21 Oct 1977 7 p

(Contract W-7405-eng-48)

(UCRL-80116-Pt-A Conf-771053-10) Avail NTIS
 HC A02/MF A01

Four fiber-composite systems (Kevlar 49/epoxy, Kevlar 29/epoxy, S2-glass/epoxy, and E-glass/epoxy) were studied for use in flywheel rotors. The performance of the materials was compared as well as the relationship of the results of conventional tests (e.g., NOL ring hydroburst) to the results of flywheel rotor spin tests. The relatively inexpensive hydroburst test yielded failure stress results statistically identical to those obtained from the costly spin tests. Thus, at a given fiber volume, NOL ring burst data can be used to predict rotor performance. A comparison of materials performance revealed that in terms of energy storage potential, the Kevlar 49/epoxy composite ranks highest, but in terms of energy storage per unit cost, E-glass/epoxy is best. DOE

N79-14168# California Univ., Livermore Lawrence Livermore Lab

ENERGY AND TECHNOLOGY REVIEW, JUNE 1978

Henry D Shay, ed., Patricia L Luen, ed., Judyth K Prono, ed., and Jane T Staehle, ed. Jun 1978 35 p refs

(Contract W-7405-eng-48)

(UCRL-52000-78-6) Avail NTIS HC A03/MF A01

A yield of 7.3 x 10 to the 9th power neutrons and a 6 keV ion temperature was recorded for Shiva's first 20 beam shot on target. The laser delivered a record 26TW in less than 0.1 ns. The development of lightweight fiber composite materials for various applications is discussed with emphasis on their use in energy storage flywheels. Methods for preheating the rubble bed with hot inert gas as a startup means for controlled combustion retorting of oil shale are examined as well as efforts to improve and update the technical basis for assessing seismic safety at nuclear power facilities. A R H

N79-14184# Louisiana State Univ and A&M Coll., Baton Rouge Div of Engineering Research

COMBUSTION KINETICS OF SELECTED AROMATIC HYDROCARBONS Intern Report, 1 Jun 1977 - 31 May 1978

Richard A Matula and Richard C Farmer Jun 1978 30 p refs

(Grant AF-AFOSR-3384-77)

(AD-A059381, AFOSR-78-1294TR) Avail NTIS
 HC A03/MF A01 CSCL 07/3

The primary objective of the research program is to develop an understanding of the high temperature pyrolysis, oxidation, and carbon formation processes in selected aromatic-hydrocarbon/air-combustion systems. The results of this study can be subsequently utilized to optimize the use of high-aromatic-content synthetic jet-fuels in both present and future jet combustors. Specific objectives of the research are to study the kinetics of aromatic hydrocarbon pyrolysis in temperature and ranges of interest, study the ignition and oxidation of aromatic hydrocarbon-air systems, measure the critical fuel-oxidizer equivalence ratio for incipient soot formation in aromatic hydrocarbon-air mixtures, and develop quasi-global and/or detailed oxidation mechanisms for these aromatic hydrocarbons based on experimental data and computer modeling of the reaction systems. Author (GRA)

N79-14192* Massachusetts Inst of Tech., Cambridge
PRESENT STATUS OF GaAs

N79-14231

H C Gatos, J Lagowski, and L Jastrzebski. Jan 1979. 32 p (Grant NsG-7331)

(NASA-CR-3093) Avail NTIS HC A03/MF A01 CSCL 11F

An extensive literature survey on GaAs was carried out for the period December 31, 1970 to December 31, 1977. The increasing interest in GaAs device structures increased steadily during that period. The leading research and development centers and the specific areas of interest were identified. A workshop on GaAs was held in November 1977 to assess the present status of melt-grown GaAs and the existing needs for reliable chemical, structural and electronic characterization methods. It was concluded that the present available bulk GaAs crystals are of poor quality and that GaAs technology is lagging demonstrated or potentially feasible GaAs devices and systems. Author

N79-14231# Air Force Aero Propulsion Lab. Wright-Patterson AFB, Ohio

EVALUATION OF FUTURE JET FUEL COMBUSTION CHARACTERISTICS. Final Report, 1 Jul 1975 - 30 Nov 1976

W S Blazowski and T A Jackson. Jul 1978. 74 p refs (AF Proj 3048)

(AD-A060218, AFAPL-TR-77-93) Avail NTIS HC A04/MF A01 CSCL 21/4

Future anticipated changes in jet fuel character can be expected to have substantial combustion system effects. This report contributes technical information to assist in future definition of new jet fuel specifications formulated with the intent of minimizing total cost of system operation while maintaining performance and flight safety. The impact of lower fuel hydrogen content on combustor liner temperatures, smoke and gaseous emissions has been evaluated and improved correlations with hydrogen content have been developed. Results obtained with the various fuel blends tested have confirmed the dominant influence of hydrogen content on combustion characteristics when compared to volatility and hydrocarbon type effects. Use of the new non-dimensional liner temperature parameter has also resulted in a good correlation of a wide variety of previous combustor data involving rich combustion systems. GRA

N79-14232# Southwest Research Inst. San Antonio, Tex. Fuels and Lubricants Research Lab

HIGH SULFUR FUEL EFFECTS IN A TWO-CYCLE HIGH SPEED ARMY DIESEL ENGINE. Interim Report

Edwin A Frame. May 1978. 151 p refs

(Contracts DAAK70-78-C-0001, DAAG56-76-C-0003)

(AD-A059534, AFLRL-105) Avail NTIS HC A08/MF A01 CSCL 21/4

The effects of increasing the fuel sulfur content while using a constant lubricant (MIL-L-2104C) were determined. Key areas of engine distress were identified and baselines were established using high (10%w) and low (0.4%w) sulfur fuels. Effects of more frequent oil drain intervals were determined. Author (GRA)

N79-14235# Naval Air Systems Command, Washington, D C. **NAVAL AIR SYSTEMS COMMAND-NAVAL RESEARCH LABORATORY WORKSHOP ON BASIC RESEARCH NEEDS FOR SYNTHETIC HYDROCARBON JET AIRCRAFT FUELS**

1978. 303 p refs. Workshop held at Washington, D C, 15-16 Jun 1978

(AD-A060081) Avail NTIS HC A14/MF A01 CSCL 21/4

The Workshop emphasized the technical aspects of synthetic jet fuels. The purpose was to examine what is known about synfuels, highlight current research programs, and suggest areas of basic research which are important to the future use of synthetic hydrocarbon fuels in jet aircraft. GRA

N79-14239# Systems Research Labs, Inc., Dayton, Ohio. Aerosystems Research Div

HIGH ENERGY MHD FUELS DEVELOPMENT PROGRAM. Final Report, Mar 1975 - Dec. 1977

Richard E Eckels. Apr 1978. 374 p refs

(Contract F33615-75-C-2043, AF Proj 3145)

(AD-A060156, AFAPL-TR-78-10) Avail NTIS HC A16/MF A01 CSCL 21/4

An analytical study compared the electrical conductivity and velocity squared product for several MHD liquid or liquified fuels. Aluminum additive to liquid hydrocarbon was found to be attractive for high power density MHD. A number of MHD power tests showed that developed emulsified slurry fuels were engineeringly feasible. Various emulsification processes are described.

Author (GRA)

N79-14240# Battelle Pacific Northwest Labs., Richland, Wash. **CATALYST DEVELOPMENT PROGRAM FOR HYDRODESULFURIZATION AND LIQUEFACTION OF COAL TO PRODUCE CLEAN BOILER FUELS. Quarterly Report, Dec. 1976 - Feb 1977**

L J Hillenbrand, H M Grotta, G W Felton, and W R Alcorn. Mar 1977. 16 p

(Contract E(49-18)-2321)

(FE-2321-12) Avail NTIS HC A02/MF A01

The first series of candidate catalysts was identified for trial in a rapid screening reactor. The list is intended primarily as a survey of types with the intention to demonstrate that the screening tests show differences among these catalysts and to provide clues for development. A modified work plan was adopted for the rapid screening reactor calling for use of a one liter autoclave with continuous gas purge. A catalyst holder basket was designed for trial which suspends the catalyst in the gas phase of the autoclave during the preliminary liquefaction stage and then causes it to drop into the liquid phase for the subsequent catalytic transformation. A special heavy aromatic distillate from coal tar was identified for trial as the vehicle to be used in the rapid screening reactor. G Y

N79-14241# Energy Research and Development Administration, Grand Forks, N Dak

TECHNOLOGY AND USE OF LIGNITE

Gordon H Gronhvd, comp and Wayne R Kube, Comp. 1977. 96 p refs. Symp. Held at Grand Forks, N Dak, 18-19 May 1977

(GFERC/IC-77/1) Avail NTIS HC A05/MF A01

Developments in the technology and utilization of low rank coals, are presented with emphasis on Western United States lignite and subbituminous coal. The potential of the low rank coals from the Northern Great Plains Coal Province as a source of energy for power generation and for conversion processes is covered. Other topics discussed include combustion, liquefaction, gasification, emission control and regulation, and mined-land reclamation. DOE

N79-14242# Argonne National Lab., Ill. Chemical Engineering Div

COAL LIQUEFACTION SUPPORT STUDIES. TASK 1. HEAT OF REACTION OF HYDROGEN WITH COAL SLURRIES. TASK 2. HEAT TRANSFER COEFFICIENT. Quarterly Report, Apr. - Jun. 1977

J Fischer, J Young, R Lo, T Mulcahey, D Fredrickson, R Bane, T Cannon, R Brock, W Wilson, and A Jonke. 1977. 21 p refs

(Contract W-31-109-eng-38)

(ANL/CEN/FE-77-5) Avail NTIS HC A02/MF A01

A development program is being carried out to obtain information applicable to the Synthoil process for converting coal to liquid fuel of low sulfur content. This report presents information on (1) a calorimeter to measure heat of reaction of hydrogen with coal slurries, and (2) the construction status and a test program for the apparatus for measuring heat transfer coefficients of Synthoil feed and effluents. DOE

N79-14243# General Electric Co., Philadelphia, Pa. Re-entry and Environmental Systems Div

COAL DESULFURIZATION USING MICROWAVE ENERGY. Final Report, Aug 1976 - Oct 1977

P D Zavitsanos, K W Bleiler, J A Golden, and W K Kinkead. Jun 1978. 79 p refs

(Contract EPA-68-02-2172)

(PB-285880/1, EPA-600/7-78-089) Avail NTIS HC A05/MF A01 CSCL 081

The use of microwave energy and NaOH to remove pyritic and organic sulfur from several U S coals is described Exposure times on the order of 1 minute at 1 atmosphere of inert gas can remove up to 85% of the sulfur with little or no loss in heating value of the coal Data analysis suggests that sulfur is converted to water soluble sulfides (Na₂S Na₂Sx) in the process and that sulfur conversion follows first order reaction kinetics The mechanism by which fast rates of desulfurization are accomplished is most probably related to the fast (and to some degree selective) in-depth heating of the bed The activation of water, FeS₂ and NaOH creates local volatilization, high temperature and pressure conditions which accelerate sulfur reactions before the coal has a chance to decompose GRA

N79-14244# National Aviation Facilities Experimental Center Atlantic City, N J

FIRE DETECTION, EXTINGUISHMENT, AND MATERIAL TESTS FOR AN AUTOMATED GUIDEWAY TRANSIT VEHICLE Final Report, May - Aug 1976

Richard G Hill and George R Johnson May 1978 29 p refs Revised

(FAA Proj 052-241-000)
(AD-A056229 FAA-NA-76-52-Rev) Avail NTIS
HC A03/MF A01 CSCL 13/12

Tests were conducted in a simulated automated guideway transit vehicle to determine the effectivity of a Halon 1301 fire-extinguishing system during various types of fires evaluate a photoelectric and an ionization fire detection system and compare various materials under full-scale fire conditions A portion of a school bus supplied with an airflow system was used as the test article Smoke density, temperature, carbon monoxide, and Halon 1301 concentrations were monitored throughout the tests Hydrogen fluoride (HF) samples were taken during the fire extinguishing tests Test results showed that the photoelectric detector was faster responding than the ionization detector Material tests indicated that underseat fires were more severe than fires on or in the seat for both neoprene and urethane cushions Author

N79-14277*# National Aeronautics and Space Administration Pasadena Office, Calif

FREQUENCY TRANSLATING PHASE CONJUGATION CIRCUIT FOR ACTIVE RETRODIRECTIVE ANTENNA ARRAY Patent Application

Ralph C Chernoff, inventor (to NASA) (JPL) Filed 29 Dec 1978 26 p

(Contract NAS7-100)
(NASA-Case-NPO-14536-1, US-Patent-Appl-SN-974471) Avail
NTIS HC A03/MF A01 CSCL 20N

A frequency translating phase conjugation circuit (PCC) for active retrodirective antenna arrays, particularly for large arrays which require exact conjugation to avoid squirt of the retrodirected beam is presented The novelty resides in the PCC which yields exact frequency translation and which is free of mixer degeneracy problems The PRR is also novel, and like the PCC is exact and free from mixer degeneracy NASA

N79-14297# General Electric Co, Syracuse NY Electronic Systems Div

UNATTENDED RADAR STATION DESIGN FOR DEWLINE APPLICATION Final Report, 19 Jnl. - 19 Dec 1977

W E Abriel, S E Bell J R Golden J T Gorham R M Johnson and E J Gersten comp Hanscom AFB, Mass ESD 19 Jan 1978 253 p

(Contract F19628-77-C-0212)
(AD-A060061 ESD-TR-78-176-Vol-3) Avail NTIS
HC A12/MF A01 CSCL 17/9

This report examines the feasibility of implementing and maintaining a string of Unattended Radar Stations in the Arctic The study is conceptual relative to design, installation, operation, maintenance, and support of Unattended Stations and attendant problems such as security reliability maintainability, availability, and life cycle cost Cost Drivers are identified and potential solution alternatives with recommendations presented The conclusion is that, with reasonable development, economical Unattended Arctic Radar Stations are possible Author (GRA)

N79-14607# Civil and Environmental Engineering Development Office Tyndall AFB Fla

FLAME FORESTRY LANDS ALLOCATED FOR MANAGING ENERGY FEASIBILITY STUDY Final Report, Jun - Aug 1978

James D Lowther Sep 1978 28 p refs
(AD-A059993 CEEDO-TR-78-41) Avail NTIS
HC A03/MF A01 CSCL 21/4

This study evaluated the feasibility of using wood grown on USAF installations as fuel to supply the heating energy requirements of the installations, replacing conventional fossil fuels currently being used Arnold Engineering Development Center Tennessee Barksdale AFB Louisiana Eglin AFB, Florida and Tyndall AFB Florida have the potential for supplying significant portions of their heating energy requirements with non-merchantable timber grown on the installations Avon Park Air Force Range Florida has the potential to supply its own small heating energy requirements plus those of MacDill AFB which is 75 miles away Arnold Engineering Development Center presently has a central plant heating system The system can be converted to a wood-burning system by altering existing boilers or replacing them with boilers having wood-firing capability The remaining installations do not have central plant heating systems but use small natural gas and oil-fired heating units in individual buildings Conversion of these installations to burn wood would require construction of a wood-fired central system or systems An alternate method of converting these installations is through the use of a pyrolysis unit to convert wood to fuel gas and fuel oil which can be burned in existing heating units The latter alternative cannot be implemented until a large scale continuously operated pyrolysis unit is developed Author (GRA)

N79-14521# Bureau of Mines Washington, D C

BUREAU OF MINES RESEARCH 1977 A SUMMARY OF SIGNIFICANT RESULTS IN MINING, METALLURGY, AND MINERAL ECONOMICS

1977 147 p refs
(PB-284743/2, BM-SP-2-78) Avail NTIS HC A07/MF A01
CSCL 08I

Significant research projects and mineral studies conducted by the Bureau of Mines are described Areas of discussion include helium activities coal preparation, mineral processing hydrometallurgy pyrometallurgy secondary resource recovery, advanced mining techniques health and safety and mineral and materials supply/demand analysis GRA

N79-14528* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

BACK WALL SOLAR CELL Patent

Henry W Brandhorst Jr inventor (to NASA) Issued 26 Dec 1978 5 p Filed 24 Apr 1978 Supersedes N78-25556 (16-16, p 2137) Continuation-in-part of abandoned US Patent Appl SN-760771, filed 19 Jan 1977

(NASA-Case-LEW-12236-2, US-Patent-4,131 486,
US-Patent-Appl-SN-899123 US-Patent-Class-136-89SJ
US-Patent-Class-357-30 US-Patent-Appl-SN-760771) Avail
US Patent and Trademark Office CSCL 10A

A solar cell is disclosed which comprises a first semiconductor material of one conductivity type with one face having the same conductivity type but more heavily doped to form a field region arranged to receive the radiant energy to be converted to electrical energy and a layer of a second semiconductor material preferably highly doped, of opposite conductivity type on the first semiconductor material adjacent the first semiconductor material at an interface remote from the heavily doped field region Instead of the opposite conductivity layer a metallic Schottky diode layer may be used, in which case no additional back contact is needed A contact such as a gridded contact, previous to the radiant energy may be applied to the heavily doped field region of the more heavily doped same conductivity material for its contact Official Gazette of the U S Patent and Trademark Office

N79-14529* National Aeronautics and Space Administration Pasadena Office Calif

PRIMARY REFLECTOR FOR SOLAR ENERGY COLLECTION SYSTEMS Patent

Charles G Miller inventors (to NASA) (JPL) and James B Stephens (JPL) Issued 26 Dec 1978 9 p Filed 15 May 1978 Supersedes N78-25559 (16 - 16, p2138) Division of US Patent Appl SN-762363, filed 25 Jan 1977, which is a division of US Patent Appl SN-598969 filed 24 Jul 1975, US Patent-4 065 053 Sponsored by NASA (NASA-Case-NPO-13579-4, US-Patent-4,131,336 US-Patent-Appl-SN-906297, US-Patent-Class-350-292 US-Patent-Class-126-271 US-Patent-Class-350-293 US-Patent-Class-350-320 US-Patent-4 065,053 US-Patent-Appl-SN-762363 US-Patent-Appl-SN-598969) Avail US Patent and Trademark Office CSCL 10A

A fixed, linear, ground-based primary reflector is disclosed which has an extended curved sawtooth-contoured surface covered with a metalized polymeric reflecting material. The device reflects solar energy to a movably supported collector that is kept at the concentrated line focus of the reflector primary. The primary reflector may be constructed by a process utilizing well-known freeway paving machinery

Official Gazette of the U S Patent and Trademark Office

N79-14530# Office of Technology Assessment Washington, D C

APPLICATION OF SOLAR TECHNOLOGY TO TODAY'S ENERGY NEEDS, VOLUME 2

Sept 1978 764 p refs (OTA-E-77-Vol-2 LC-78-600060) Avail NTIS HC A99/MF A01 HC SOD

Analytical methods are presented for evaluating the economic and technical merits of numerous small-scale solar systems designed to meet the energy requirements of homes apartment buildings, shopping centers, industries and small communities

N79-14531# Office of Technology Assessment, Washington, D C

ANALYTICAL METHODS

In its App of Solar Technol to Today's Energy Needs Vol 2 Sep 1978 p 3-24 refs

Avail NTIS HC A99/MF A01, HC SOD

The perceived costs of solar energy depend not only on the perspective which they are examined but also from the methods used for evaluating them. Basic assumptions are discussed concerning inflation, homeowner financing, rental properties, industries and utilities. Quantitative methods for assessing financing alternatives are presented. Basic equations are given for determining consumer energy expenses and the sensitivity of capital charges to consumers discount rates as well as to the rate of return for the corporate owner are discussed. A R H

N79-14532# Office of Technology Assessment, Washington, D C

CURRENT AND PROJECTED FUEL COSTS

In its Appl of Solar Technol to Today's Energy Needs, Vol 2 Sep 1978 p 27-39 refs

Avail NTIS HC A99/MF A01 HC SOD

Residential consumer prices for natural gas, heating oil and electricity vary significantly in different parts of the country. Future prices will depend on (1) the cost of developing and producing domestic fuel resources (2) the price of imported fuels, (3) the cost of producing synthetic fuel substitutes (4) externalities such as environmental regulations and (5) explicit and implicit regulatory impact. Confident estimates in these areas simply are not possible, although a large number of the estimates can be supported. The predicted future price of fuel can have a strong influence on both private and public decisions about solar energy. Investments in solar and other conservation equipment will appear more attractive if energy prices are expected to rise sharply instead of remaining constant or increasing gradually. A R H

N79-14533# Office of Technology Assessment Washington, D C

CALCULATION OF BACKUP REQUIREMENTS

In its Appl of Solar Technol to Today's Energy Needs, Vol 2 Sep 1978 p 43-92

Avail NTIS HC A99/MF A01 HC SOD

A critical question in the operation of a solar energy system is the amount of backup energy required and the pattern of this backup demand. Techniques are provided for approximating the optimum performance of several types of solar cogeneration systems including the optimum operation of possible combinations of storage equipment. A FORTRAN program was developed to (1) determine the onsite energy demand of the building which includes heating, cooling, hot water and miscellaneous electrical demands, (2) determine the output of solar collector, and (3) determine the fraction of the onsite energy demand that can be met from solar energy directly or from storage and the fraction that must be supplied from external energy sources (utility electricity, gas or oil). A R H

N79-14534# Office of Technology Assessment Washington, D C

RESULTS OF SYSTEMS ANALYSIS

In its Appl of Solar Technol to Today's Energy Needs Vol 2 Sep 1978 p 95-663

Avail NTIS HC A99/MF A01, HC SOD

A number of integrated solar energy systems designed to meet the energy needs of single family houses, apartment buildings, shopping malls, communities, and industrial plants located in Albuquerque, N Mex, Boston, Mass., Fort Worth, Tex., and Omaha, Nebr. were analyzed and compared to demonstrate their capability to meet the energy requirements of these buildings and communities. The examples were chosen to indicate the relative attractiveness of a number of different system components which may become available during the next decade and indicate the facility with which different combinations of components work together as integrated systems. A summary table indicates the monthly costs for each system analyzed and the effective cost of solar energy generated. The assumptions made in analyzing the performance of each system are discussed. A R H

N79-14535# Office of Technology Assessment, Washington, D C

A DETAILED ANALYSIS OF THE IMPACT OF ONSITE EQUIPMENT ON UTILITY COSTS

In its Appl of Solar Technol to Today's Energy Needs, Vol 2 Sep 1978 p 729-752

Avail NTIS HC A99/MF A01 HC SOD

Cases are examined where 1,000 homes equipped with a specific kind of energy equipment are added to the utility grid and cases are examined where 25 percent and 100 percent of the houses in the utility are assumed to be converted to use the system being examined. Two sets of two tables are provided for each of the four cities examined. The first of each pair presents information about the overall impact of the load under examination on utility costs, on the demand for nuclear, coal and peaking capacity and on the annual fuel demands of the utility. The second of each pair presents the ratios between the marginal cost of serving loads created by adding solar energy equipment with the marginal costs incurred by changing loads and adding a similar number of buildings served with conventional energy equipment. The first of the two sets for each city presents information assuming that standard utility rates are charged and the second set assumes that consumers purchase energy during offpeak periods to help reduce utility peaks. Details of how these tables were computed are explained. A R H

N79-14537# SRI International Corp., Menlo Park, Calif
NOVEL DUPLEX VAPOR ELECTROCHEMICAL METHOD FOR SILICON SOLAR CELLS Quarterly Progress Report, 1 Aug - 31 Oct 1978

V Kapur, K M Sanclier, A Sanjurjo, S Leach, S Westphal, R Bartlett, and L Nanis 1978 55 p refs Prepared for JPL

(Contracts NAS7-100 JPL-954471)
(NASA-CR-158039, ERDA/JPL-954471-77/3, QPR-11) Avail
NTIS HC A04/MF A01 CSCL 10A

Progress in the development of low-cost solar arrays is reported. Topics covered include (1) development of a simplified feed system for the Na used in the Na-SiF₄ reactor (2) production of high purity silicon through the reduction of sodium fluosilicate with sodium metal (3) the leaching process for recovering silicon from the reaction products of the SiF₄-Na reaction, and (4) silicon separation by the melting of the reaction product J M S

N79-14540*# Crystal Systems Inc. Salem, Mass
SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SHEET TASK OF THE LOW COST SOLAR ARRAY PROJECT HEAT EXCHANGER METHOD - INGOT CASTING FIXED ABRASIVE METHOD - MULTI-WIRE SLICING Quarterly Progress Report, 1 Jul 1978 - 30 Sep 1978

Frederick Schmid and Chandra P. Khattak 15 Oct 1978 67 p refs Prepared for DOE and JPL
(Contract NAS7-100, JPL-954373)
(NASA-CR-158038 QPR-4 DOE/JPL-954373-78/7, DRL-58-DRD-SE-7) Avail NTIS HC A04/MF A01 CSCL 10A

Solar cells fabricated from HEM cast silicon yielded up to 15% conversion efficiencies. This was achieved in spite of using unpurified graphite parts in the HEM furnace and without optimization of material or cell processing parameters. Molybdenum retainers prevented SiC formation and reduced carbon content by 50%. The oxygen content of vacuum cast HEM silicon is lower than typical Czochralski grown silicon. Impregnation of 45 micrometers diamonds into 7.5 micrometers copper sheath showed distortion of the copper layer. However, 12.5 micrometers and 15 micrometers copper sheath can be impregnated with 45 micrometers diamonds to a high concentration. Electroless nickel plating of wires impregnated only in the cutting edge showed nickel concentration around the diamonds. This has the possibility of reducing kerf. The high speed slicer fabricated can achieve higher speed and longer stroke with vibration isolation.
Author

N79-14541*# Lamar Univ., Beaumont Tex. Dept. of Chemical Engineering

PROCESS FEASIBILITY STUDY IN SUPPORT OF SILICON MATERIAL TASK 1 Quarterly Technical Progress Report, Sep. 1978 - Dec 1978

Ku-Yen L., Keith C. Hansen, and Carl L. Yaws Dec 1978 69 p refs Prepared for DOE and JPL
(Contract JPL-954343)
(NASA-CR-158034, ERDA/JPL-954343-78/13, QTPR-13) Avail NTIS HC A04/MF A01 CSCL 10A

Process system properties are analyzed for materials involved in the alternate processes under consideration for solar cell grade silicon. The following property data are reported for trichlorosilane: critical constants, vapor pressure, heat of vaporization, gas heat capacity, liquid heat capacity, density, surface tension, viscosity, thermal conductivity, heat of formation, and Gibbs free energy of formation. Work continued on the measurement of gas viscosity values of silicon source materials. Gas phase viscosity values for silicon tetrafluoride between 40 C and 200 C were experimentally determined. Major efforts were expended on completion of the preliminary economic analysis of the silane process. Cost, sensitivity and profitability analysis results are presented based on a preliminary process design of a plant to produce 1,000 metric tons/year of silicon by the revised process.
G G

N79-14546*# Lockheed Missiles and Space Co., Palo Alto Calif

CONCENTRATOR ENHANCED SOLAR ARRAYS DESIGN STUDY Final Report

D R Lott Oct 1978 114 p Prepared for JPL
(Contracts NAS7-100, JPL-955110)
(NASA-CR-158032 LMSC-D665407) Avail NTIS HC A06/MF A01 CSCL 10A

The analysis and preliminary design of a 25 kW concentrator enhanced lightweight flexible solar array are presented. The study was organized into five major tasks: (1) assessment and

specification of design requirements (2) mechanical design, (3) electric design (4) concentrator design and (5) cost projection. The tasks were conducted in an iterative manner so as to best derive a baseline design selection. The objectives of the study are discussed and comparative configurations and mass data on the SEP (Solar Electric Propulsion) array design, concentrator design options and configuration/mass data on the selected concentrator enhanced solar array baseline design are presented. Design requirements supporting design analysis and detailed baseline design data are discussed. The results of the cost projection analysis and new technology are also discussed.
G Y

N79-14548*# Solarex Corp. Rockville Md
PILOT LINE REPORT DEVELOPMENT OF A HIGH EFFICIENCY THIN SILICON SOLAR CELL

Nov 1978 65 p Prepared for JPL
(Contract NAS7-100 JPL-954883)
(NASA-CR-158028 SX/115/PL) Avail NTIS
HC A04/MF A01 CSCL 10A

Experimental technology advances were implemented to increase the conversion efficiency of ultrathin 2cm x 2cm cells, to demonstrate a capability for fabricating such cells at a rate of 10,000 per month, and to fabricate 200 large-area ultrathin cells to determine their feasibility of manufacture. A production rate of 10,000 50 micron m cells per month with lot average AMO efficiencies of 11.5% was demonstrated, with peak efficiencies of 13.5% obtained. Losses in most stages of the processing were minimized, the remaining exceptions being in the photolithography and metallization steps for front contact generation and breakage handling. The 5cm x 5cm cells were fabricated with a peak yield in excess of 40% for over 10% AMO efficiency. Greater fabrication volume is needed to fully evaluate the expected yield and efficiency levels for large cells.
A R H

N79-14551*# General Electric Co. Philadelphia Pa. Space Div

CONCEPTUAL APPROACH STUDY 200 WATT PER KILOGRAM SOLAR ARRAY, PHASE 3 Final Report

G J Rayl 30 Oct 1978 51 p Prepared for JPL
(Contracts NAS7-100, JPL-954393)
(NASA-CR-158046 DOC-78SDS4257) Avail NTIS
HC A04/MF A01 CSCL 10A

Activities are described that were directed by JPL to support the earlier conceptual design work with proof of concept models on the one hand and laboratory test and evaluation of alternate designs and materials that hold promise for further mass economies on the other. In support of this advanced solar blanket technology the following work was accomplished: (1) preparation of an 80 cell solar module for a 1000 cycle thermal test, (2) fabrication of a 660 cell solar panel and performance evaluation of this article after a 0' g flight test, (3) design improvement of the cell interconnect for further mass reduction, (4) completion of UV exposure and thermal cycle tests for a variety of cell cover material and adhesives and (5) preparation of a quantity of representative solar array test specimens for space flight on NASA's Long Duration Exposure Facility (LDEF).
Author

N79-14555*# AeroChem Research Labs Inc., Princeton N J
DEVELOPMENT OF A MODEL AND COMPUTER CODE TO DESCRIBE SOLAR GRADE SILICON PRODUCTION PROCESSES Quarterly Report

R K Gould Nov 1978 13 p refs Sponsored by NASA
Prepared for JPL
(Contract JPL-954862)
(NASA-CR-15803, AeroChem-TN-200)
DOE/JPL-954862-78/4, QR-4) Avail NTIS
HC A02/MF A01 CSCL 10A

Mechanisms for the SiCl₄/Na and SiF₄/Na reaction systems were examined. Reaction schemes which include 25 elementary reactions were formulated for each system and run to test the sensitivity of the computed concentration and temperature profiles to the values given estimated rate coefficients. It was found that, for SiCl₄/Na the rate of production of free Si is largely mixing-limited for reasonable rate coefficient estimates. For the

N79-14556

SiF₄/Na system the results indicate that the endothermicities of many of the reactions involved in producing Si from SiF₄/Na cause this system to be chemistry-limited rather than mixing-limited
Author

N79-14556*# Solar Engineering and Mfg Co Deerfield Beach Fla
DESIGN AND INSTALLATION PACKAGE FOR SOLAR HOT WATER SYSTEM

Dec 1978 32 p Prepared for DOE
(Contract NAS8-32248)
(NASA-CR-150859) Avail NTIS HC A03/MF A01 CSCL 10A

Included are the system performance specifications system design drawings hazard analysis and other information necessary to evaluate the design and install the system
LS

N79-14557*# Honeywell Inc Minneapolis Minn
PRELIMINARY DESIGN PACKAGE FOR PROTOTYPE SOLAR HEATING SYSTEM

Dec 1978 113 p Prepared for DOE
(Contract NAS8-32093)
(NASA-CR-150858) Avail NTIS HC A06/MF A01 CSCL 10A

A summary is given of the preliminary analysis and design activity on solar heating systems The analysis was made without site specific data other than weather therefore, the results indicate performance expected under these special conditions Major items include system candidates design approaches trade studies and other special data required to evaluate the preliminary analysis and design The program calls for the development and delivery of eight prototype solar heating and cooling systems for installation and operational test
LS

N79-14558*# Aerospace Corp El Segundo, Calif Chemistry and Physics Lab
A STATE OF CHARGE MONITOR FOR SEALED LEAD-ACID CELLS

A H Zimmerman M R Martinelli and C C Badcock 20 Jul 1978 42 p refs
(ATR-78(8114)-2) Avail NTIS HC A03/MF A02

Instrumentation for monitoring the state of charge of sealed lead-acid cells during discharge was designed This monitor utilizes the cell voltage during discharge compensating for variations in load current and temperature The discharge voltage is converted to a linear function of state of charge by a nonlinear amplifier Statistics are given for the uncertainty in the monitor
S E S

N79-14559*# Air Force Inst of Tech Wright-Patterson AFB Ohio
THE APPLICATION OF OPTIMAL CONTROL THEORY HYBRID ELECTRIC TRANSIT SYSTEMS M S Thesis

Michael J Keane Oct 1977 137 p refs
(AD-A059365 AFIT-CI-78-113) Avail NTIS HC A07/MF A01 CSCL 13/6

In an effort to minimize energy losses through the optimal control of an electric rapid transit system three vehicle/flywheel configurations are modeled using the bond graph technique Field and armature control of an on-board flywheel are presented along with field control of a station flywheel used in conjunction with a typical regenerative vehicle Pontryagin's Minimum Principle is used to develop the optimal control trajectories for vehicle accelerations and decelerations The time integral of mechanical and electrical losses is minimized as the cost function Armature control of the hybrid vehicle and field control of the station flywheel are equally efficient in the reversible energy flow between vehicle and flywheel Field control of the hybrid vehicle is slightly less efficient The optimal trajectory for deceleration is nearly linear but the optimal trajectory for acceleration due to the effect of mechanical losses over a longer time period is highly concave and differs radically from a typical transit acceleration The vehicle weight and resistance in the armature windings have a large influence on system performance
Author (GRA)

N79-14561*# Eagle-Picher Co Joplin Mo Couples Dept
NICKEL-ZINC BATTERY FOR AIRCRAFT AND MISSILE APPLICATIONS Final Report, 14 Feb 1975 - 14 Feb 1978

Robert A Brown Apr 1978 146 p refs
(Contract F33615-75-C-2004)
(AD-A059295 AFAPL-TR-78-16) Avail NTIS HC A07/MF A01 CSCL 10/3

For aircraft applications a nickel-zinc battery has been developed which exhibits an improvement in low temperature/high rate performance as compared to the standard nickel-cadmium aircraft battery (MS-24497-5) The nickel-zinc battery is the same size and weight as the nickel-cadmium battery but is rated at 45 AH capacity vs 22 AH for the nickel-cadmium Cycle life of 200 cycles (20 amperes for 1 hour) have been demonstrated in a configuration capable of delivering 1000 ampere discharge at -20 F Nickel-zinc batteries were also manufactured for remotely piloted vehicle (RPV) applications to compare to existing lead-acid and silver-zinc batteries These vehicles require a limited number of cycles at a high energy density and are a logical application of the nickel-zinc system For missile applications a remotely activated nickel-zinc battery has been developed to compare to the standard remotely activated silver-zinc battery Reductions in the amount of separator needed for wet stand capability allow the nickel-zinc battery to exhibit higher capacity than the silver-zinc battery at room temperature discharge
Author (GRA)

N79-14564*# Oak Ridge National Lab Tenn Div of Coal Conversion and Utilization
FLUIDIZED BED GAS TURBINE EXPERIMENTAL UNIT FOR MIUS APPLICATIONS Quarterly Progress Report, 1 Jul - 30 Sep 1975

A P Fraas Nov 1977 23 p refs
(Contracts E(49-18)-1742 HUD-H-40-72)
(ORNL/HUD/MIUS-32) Avail NTIS HC A02/MF A01

The conceptual design of an experimental coal fired closed cycle gas turbine having an electrical output of approximately 325 kW(e) is described Application to modular integrated utility systems is considered
DOE

N79-14565*# Mitre Corp McLean, Va
LEAD-ACID BATTERY AN EVALUATION OF COMMERCIALIZATION STRATEGIES

Floyd Davis Ralph Kuchnel Jerry Price, and Geoffrey Smith Nov 1977 268 p refs
(Contract EC-77-C-01-5025)
(MTR-7593) Avail NTIS HC A12/MF A01

The lead-acid battery energy storage for electric utility peaking applications in the near term is explored A review of existing literature and interviews with selected electric utilities are used to identify key parameters for market acceptance Analytical techniques are developed to quantify these parameters and estimates of regional and national market size are made Possible government actions are identified and qualitative criteria and measurements of cost effectiveness are developed
DOE

N79-14566*# Sandia Labs Albuquerque N Mex Systems Analysis Dept
PRELIMINARY ECONOMIC ANALYSIS OF SOLAR IRRIGATION SYSTEMS (SIS) FOR SELECTED LOCATIONS

Laurance L Lukens Audrey M Perino and Sharla G Vandevender Nov 1977 53 p refs Sponsored by DOE
(SAND-77-1403) Avail NTIS HC A04/MF A01

The economic feasibility of stand-alone solar irrigation systems is considered for certain locations by comparing the life cycle cost (LCC) of the solar system to the LCC of conventional systems The results show that economic feasibility is dependent on utilization of the SIS for production of energy in addition to that required to water crops In Southern Arizona the LCC of the SIS when used only to pump water ranges from 3 to 17 times that of a conventional electric system for start-up dates of 1980 and 1990 For the same system the LCC ratio ranges from 1.6 to 0.9 when 100% utilization of the system capacity is achieved The feasibility of a hybrid system was also examined for Arizona This system purchased 21% of the required power yet the hybrid LCC was only 0% of that of a conventional electric system with a 1990 start-up date
DOE

N79-14567# Sandia Labs Albuquerque N Mex Advanced Energy Project Div

LIGHTNING PROTECTION FOR THE VERTICAL AXIS WIND TURBINE

Curtis W Dodd Oct 1977 26 p refs Sponsored by DOE (SAND-77-1241) Avail NTIS HC A03/MF A01

The results are reported of lightning protection studies for Vertical Axis Wind Turbines. The methodology is established for determining the chances for a lightning strike at a VAWT site. Proposed designs for lightning protector systems are described. These designs include an insulator design, a brush by-pass design, a cone of protecting lightning termination device, and a concentric tower protection system. The work also describes an effective grounding system. DOE

N79-14568# Sandia Labs Albuquerque N Mex Facilities/Test Equipment Design and Development Div

SOLAR THERMAL TEST FACILITY EXPERIMENT MANUAL
David M Darsey John T Holmes Larry O Seamons Dean J Kuehl David B Davis John M Stomp Larry K Matthews and John V Otts Oct 1977 49 p Sponsored by DOE (SAND-77-1173) Avail NTIS HC A03/MF A01

The Solar Thermal Test Facility (STFF) is operated to advance the development of solar thermal electric power to a commercial scale. The STFF with a thermal collection capability of about 5 megawatts is designed to perform a variety of functions. Information on administrative procedures, the capabilities of the STFF and the requirements of the experimenter is given. DOE

N79-14569# Edgerton Germeshausen and Grier Inc., Albuquerque, N Mex

PERFORMANCE TESTING OF THE HEXCEL PARABOLIC TROUGH SOLAR COLLECTOR

Vernon E Dudley and Robert M Workhoven (Sandia Labs, Albuquerque) Mar 1978 24 p refs Sponsored by DOE (SAND-76-0381) Avail NTIS HC A02/MF A01

The testing is summarized which was performed on the Hexcel Parabolic Trough Solar Collector at the Solar Total Energy Test Facility. Test objectives are defined, test procedures are described and results and conclusions are given. DOE

N79-14570# Sandia Labs Livermore Calif
THERMOCHEMICAL ENERGY STORAGE AND TRANSPORT PROGRAM Semiannual Report, Apr - Sep 1977

T Tazwell Bramlette, comp and Raymond W Mar comp Mar 1978 113 p (SAND-78-8056) Avail NTIS HC A06/MF A01

A state-of-the-art assessment project goals and project accomplishments are presented. Project activities described include chemical energy storage, solar energy storage, open and closed loop energy storage systems, chemical heat pumps and several generic research projects. DOE

N79-14571# Sandia Labs Albuquerque N Mex
RECOMMENDATIONS FOR THE CONCEPTUAL DESIGN OF THE BARSTOW, CALIFORNIA, SOLAR CENTRAL RECEIVER PILOT PLANT EXECUTIVE SUMMARY

Oct 1977 34 p (SAND-77-8035) Avail NTIS HC A03/MF A01

Recommended subsystem designs that should be incorporated into the 10 MWe pilot plant to be built at Barstow, California are presented. A summary of technical information used in making the selections is included. These recommendations are relative to the design concept only; they are not intended to represent a rating of the contractors. DOE

N79-14574# Blalock (S D Jr) Kingsport, Tenn
USE OF WASTE HEAT FROM THERMAL ELECTRIC POWER PLANTS AND NUCLEAR POWER PLANTS TO HEAT GREENHOUSES

R Minasyan I Korolev and G Ageyan 1977 11 p Transl into ENGLISH from the Joint Soviet-Amer Coord Comm on theme 08 0203 (Moscow) 1977 p 1-17 (ORNL-TR-4483) Avail NTIS HC A02/MF A01

Main technical and economical premises are presented concerning utilization of nuclear and steam power plant waste

heat for heating of greenhouses. Heating systems developed for such greenhouses are described. Principles are given of heat engineering design for heating of greenhouses by nuclear and steam power plant waste heat. DOE

N79-14575# Oak Ridge National Lab Tenn
FLUIDIZED BED GAS TURBINE EXPERIMENTAL UNIT FOR MIUS APPLICATIONS Quarterly Progress Report, 1 Oct. - 31 Dec 1975

A P Fraas Nov 1977 23 p refs (Contract E(49-18)-1742)

(ORNL/HUD/MIUS-33) Avail NTIS HC A02/MF A01

Discussions with vendors are proceeding based on the Phase 1 layout drawings. Several modifications were made in detailed elements of the furnace design to simplify fabrication. A study contract was arranged and the problems involved in adapting an engine to operate with a fluidized bed heat source are being examined. Cold flow tests to investigate the rate of dispersion of coal injected into the 4 ft square bed through the coal feed ports were started. The Iron Fireman stroker was installed and bench tests were initiated. DOE

N79-14576# Federal Energy Administration Washington D C National Energy Information Center

ENERGY INFORMATION REPORT TO CONGRESS Quarterly Report, first quarter, 1977

C R Pelto, ed 1977 118 p (NTISUB/C/O27-001 FEA/B-77/181 QR-1) Avail NTIS HC A06/MF A01 CSCL 10A

Data are compiled on energy sources in the United States. Gains in total resource developments are discussed. Data on production, consumption, stocks, imports, exports, transportation and reserves of coal are summarized. Data on natural gas and NGL are provided followed by data on supply and demand, production, imports, exports, refinery activities, inventories, allocations and reserves for petroleum. Information on the status of domestic nuclear power plants, operating plants, construction capacity, projections and requirements, supply of nuclear fuels, materials, and policy decisions are included. Electricity consumption, imports and exports, production, primary energy consumed and stockpiled by power plants and power plant conversion efficiency are presented. Data on hydropower are tabulated. DOE

N79-14577# Boeing Aerospace Co Seattle Wash
IMPROVED SEMICONDUCTORS FOR PHOTOVOLTAIC SOLAR CELLS Quarterly Progress Report, 18 Sep - 18 Dec. 1976

R A Mickelsen and W S Chen Oct 1977 27 p refs (DSE/2459-2, QPR-2) Avail NTIS HC A03/MF A01

Copper indium selenide was investigated as a potential semiconductor material for low cost, mass produced thin film photovoltaic solar cells. Techniques for producing single phase CuInSe₂ films deposited by vacuum evaporation from three independent vapor sources (Cu, In, and Se) were developed. Achievement of single phase chalcopyrite CuInSe₂ is reported by utilizing postdeposition baking in an Se environment at 500 C and in high vacuum at 350 C to 400 C. Electrical properties of the deposited P-type films are presented which show a strong dependence on film composition. Copper rich films are reported to be of low resistivity, low hole mobility, and high carrier concentration while with increasing indium content the reverse is noted. Typical optical absorption vs wavelength behavior for the CuInSe₂ thin films is presented and interpreted in terms of the absorption edge and free carrier absorption. DOE

N79-14578# Brookhaven National Lab, Upton N Y Energy Technology Assessment Group

ENERGY USE IN JAPAN AND THE UNITED STATES

Andres Doernberg 1977 27 p refs Presented at the RFF-EPRI Workshop on Intern Energy Consumption Comparisons, 15-16 Sep 1977 (BNL-23101) Avail NTIS HC A03/MF A01

The energy consumption patterns in Japan and the United States are compared in terms of per capita Gross Domestic Product (GDP). Energy use in the residential sector, transportation sector and the industrial sector of the two countries is considered.

Import/export practices prices and taxes for petroleum products and energy supplies are among the factors discussed Japan's lower energy consumption is attributed to larger use of passenger rail transportation smaller consumption of space heat and more efficient iron and steel industry J M S

N79-14579# Westinghouse Electric Corp Tampa Fla
DESIGN AND COST STUDY OF A NICKEL-IRON OXIDE BATTERY FOR ELECTRIC VEHICLES VOLUME 2 PUBLIC REPORT Final Report

R E Vaill Aug 1977 73 p refs 2 Vol
 (Contract ANL-31-109-38-3723)
 (ANL-K-3723-Vol-1) Avail NTIS HC A04/MF A01

A nickel-iron oxide battery design concept proposed to meet the performance and cost objectives for a viable electric vehicle battery is described This design is based to a large extent on proven past practice but incorporates those design improvements which are expected to be realizable within a two-year development program Developmental problems are addressed and the methods of solution identified The manufacturing cost of the proposed design is identified for annual production quantities of 1,000 10,000 and 100,000 25 KWHR batteries Based on the high volume estimates of material labor and capital requirements, a selling price of \$60/KWHR is found to be attainable Battery test requirements are identified which will serve to define the performance characteristics of interest to a potential user DOE

N79-14581# National Oceanic and Atmospheric Administration
 Washington, D C

HARNESSING TIDAL ENERGY

Aug 1978 15 p refs

(PB-286671/3, CIO-78/2 NOAA-78082203) Avail NTIS HC A02/MF A01 CSCL 10A

About 3 000 000 megawatts (MW) of power are continuously dissipated through the motion of the tides over the surface of the earth Due to physical limitations only 2 percent of this may ever be harnessed This amounts to about 5 percent of the present worldwide power generation from all sources This inexhaustible power source can make a small but significant contribution The background and fundamental principles of tidal power are discussed and recent developments are given A selected listing of some of the published material relating to electrical power generation from tides is included GRA

N79-14582# Aerospace Corp Germantown Md Environment and Safety Directorate

WATER RELATED CONSTRAINTS IN ENERGY PRODUCTION Final Report

Norman F Hampton Jun 1978 271 p refs
 (PB-285713/4, ATR-78(9409)-1) Avail NTIS HC A12/MF A01 CSCL 10A

The relationships between water resources and this Nation's efforts to achieve energy self-sufficiency are elucidated Water is demanded by the energy industries for mining, reclamation of mined lands, transportation onsite processing and cooling refining, and conversion of fuels to other forms of energy In addition water is demanded for municipal industrial agricultural navigational, and recreational uses and to maintain ambient water quality and fish and wildlife habitats Given these demands conflicts in water resource allocation are likely to arise particularly in areas of limited water supply The information contained herein is intended to provide a first-order assessment preparatory to resource allocation decisionmaking GRA

N79-14583# General Accounting Office Washington D C
 Energy and Minerals Div

REGION AT THE CROSSROADS THE PACIFIC NORTHWEST SEARCHES FOR NEW SOURCES OF ELECTRIC ENERGY Report to the Congress

10 Aug 1978 270 p refs
 (PB-284691/3, EMD-78-76) Avail NTIS HC A12/MF A01 CSCL 10A

The options for the Pacific Northwest in meeting its electric energy needs through the year 2000 and the Bonneville Power Administration's role in meeting those needs are discussed GRA

N79-14586# Washington Univ St Louis, Mo Center for the Biology of Natural Systems

THE GROUND WATER AND ENERGY SUPPLY SITUATION FOR GREAT PLAINS IRRIGATION

Ajay K Sanghi and David Johnson Apr 1978 43 p refs
 (Grant NSF AER-77-17031)

(PB-286002/1, CBNS-AE-10 NSF/RA-780018) Avail NTIS HC A03/MF A01 CSCL 10A

The energy supply and groundwater situations for irrigation in Texas Oklahoma Kansas and Nebraska are assessed The highly seasonal distribution of electricity demand for irrigation creates a peak load problem for electricity cooperatives in the region This problem is most serious in Nebraska where it has led to restrictions or delays in new irrigation hookups A survey of available data on saturated thickness of the aquifer depth to water table, and annual rate of decline (or rise) in the water table was conducted for counties in the four states overlying the Ogallala Formation The most serious problems are in Texas which has the greatest average depth to the water table the greatest average yearly water table decline and the lowest average saturated thickness GRA

N79-14587# National Technical Information Service Springfield Va

COMBINED CYCLE POWER GENERATION CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Oct 1978

Audrey S Hundemann Nov 1978 112 p Supersedes NTIS/PS-77/0991 2 Vol
 (NTIS/PS-78/1156/5 NTIS/PS-77/0991) Copyright Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

Federally-funded research pertaining to design efficiency, cost resource requirements, and environmental aspects of combined cycle power plants is discussed Abstracts primarily deal with use of coal gasification in conjunction with combined gas and steam turbine generation including subsystems development studies This updated bibliography contains 106 abstracts 37 of which are new entries to the previous edition GRA

N79-14588# National Technical Information Service Springfield, Va

COMBINED CYCLE POWER GENERATION CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Oct 1978

Audrey S Hundemann Nov 1978 159 p Supersedes NTIS/PS-77/0992 2 Vol
 (NTIS/PS-78/1157/3 NTIS/PS-77/0992) Copyright Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

The design performance, efficiency, economics, and environmental aspects of combined cycle power plants are discussed Abstracts of worldwide research cover the use of waste heat from gas turbines to drive steam turbines and the thermal efficiency of integrated gasification combined cycle plants using low or intermediate Btu gas A few abstracts pertain to control and instrumentation used in the plants This updated bibliography contains 153 abstracts 38 of which are new entries to the previous edition GRA

N79-14602# Los Alamos Scientific Lab N Mex
TRACE ELEMENT CHARACTERIZATION AND REMOVAL/RECOVERY FROM COAL AND COAL WASTES Progress Report, 1 Oct 1977 - 30 Sep 1978

Eugene M Wewerka and Joel M Williams Dec 1977 15 p
 (Contract W-7405-eng-36)

(LA-7048-PR) Avail NTIS HC A02/MF A01

Research activities are described for FY 78 for the Environmental Protection Agency (EPA)-Department of Energy (DOE) program on environmental contamination from trace elements in coal preparation wastes The main objectives of this program are (1) to assess and define the technology options to control or prevent the release of environmentally harmful trace elements in the drainages from high-sulfur coal preparation wastes, and (2) to identify the trace elements of greatest environmental concern in the aqueous discharges from selected samples of Appalachian Basin coal refuse with the aim of delineating suitable pollution control technology or research development and demonstration

programs The details of the experimental activities to accomplish these objectives are discussed herein DOE

N79-14618# Southern Research Inst. Birmingham, Ala
EVALUATION OF ELECTROSTATIC PRECIPITATOR DURING SRC COMBUSTION TESTS Final Task Report, Apr. - Aug 1977

Grady B Nichols and William J Barrett Jul 1978 57 p refs
 (Contract EPA-68-02-2610)
 (PB-285864/5, EPA-600/7-78-129) Avail NTIS
 HC A04/MF A01 CSCL 13B

An electrostatic precipitator (ESP) and associated environmental factors were evaluated during the burning of solvent refined coal (SRC) in a boiler at Plant Mitchell of the Georgia Power Company The effort was part of an overall study of the use of SRC in a full-scale electric power plant Results of a performance evaluation of the ESP are reported and interpreted Samples of stack emissions were collected with a Source Assessment Sampling System (SASS) train for chemical analysis GRA

N79-14635# Monsanto Research Corp., Dayton Ohio
SOURCE ASSESSMENT WATER POLLUTANTS FROM COAL STORAGE AREAS Final Report, Nov 1976 - Dec 1977

R A Wachter and T R Blackwood May 1978 123 p refs
 (Contract EPA-68-02-1874)
 (PB-285420/6, MRC-DA-748, EPA-600/2-78-004M) Avail
 NTIS HC A06/MF A01 CSCL 13B

Water pollution levels that result from coal stockpiles maintained outdoors were studied A representative source was defined to characterize the pollution levels Effluent data was obtained by placing coals, collected from various regions in the U S under a rainfall simulator Drainage samples were analyzed for water quality parameters organic and inorganic substances, and pollutants covered by effluent limitations Coal drainage effluent concentrations rates and factors were determined Hydrologic relationships were used to calculate the diluted concentrations entering a waterway The ratio of this level to water quality criteria was determined as an indication of the potential environmental impact GRA

N79-14641# PEDCO-Environmental Specialists Inc., Cincinnati, Ohio

AIR QUALITY ASSESSMENT OF PARTICULATE EMISSIONS FROM DIESEL-POWERED VEHICLES Final Report

Terrence Briggs, Jim Throgmorton, and Mark Karaffa Mar 1978 157 p refs
 (Contract EPA-68-92-2515)
 (PB-286172/2, EPA-450/2-78-038) Avail NTIS
 HC A08/MF A01 CSCL 13B

Estimates of the impact projected diesel-powered vehicle sales will have on the levels of total suspended particulates (TSP) and benzo(a)pyrene (BaP) to which the population is exposed are presented A detailed particulate emission inventory is developed for a representative test city (Kansas City MO) for a base year (1974) Emissions and population exposure to TSP & BaP are projected for 1981, 1983, 1985 and 1990 Emissions from all sources except diesel are assumed to remain constant in order that the full impact of diesels can be seen and because insufficient time was available to vary the model An abbreviated discussion of possible health effects attributable to organic emissions from diesel powered vehicles is included GRA

N79-14643# Monsanto Research Corp., Dayton, Ohio
ENERGY REQUIREMENTS OF PRESENT POLLUTION CONTROL TECHNOLOGY Final Report, 4 Mar - 30 Jun, 1976

R W Serth May 1978 103 p refs
 (Contract EPA-68-02-1320)
 (PB-286231/6, MRC-DA-762, EPA-600/7-78-084) Avail
 NTIS HC A06/MF A01 CSCL 13B

Estimates of energy requirements for pollution control at stationary sources in the United States, as compiled from the literature, are presented and discussed The data are analyzed to determine the distribution of energy requirements among

economic sectors and among pollutant types Alternative methods of pollution control that are potentially less energy intensive and still capable of meeting environmental regulations are also discussed GRA

N79-14678*# National Aeronautics and Space Administration
 Marshall Space Flight Center, Huntsville, Ala
SUMMARY OF ATMOSPHERIC WIND DESIGN CRITERIA FOR WIND ENERGY CONVERSION SYSTEM DEVELOPMENT

Walter Frost (Tennessee Univ Space Inst., Tullahoma) and Robert E Turner Jan 1979 54 p
 (Contract NAS8-32118)
 (NASA-TP-1389 M-280) Avail NTIS HC A04/MF A01 CSCL 04B

Basic design values are presented of significant wind criteria, in graphical format for use in the design and development of wind turbine generators for energy research It is a condensed version of portions of the Engineering Handbook on the Atmospheric Environmental Guidelines for Use in Wind Turbine Generator Development Author

N79-14679*# National Aeronautics and Space Administration
 Marshall Space Flight Center, Huntsville Ala
ENGINEERING HANDBOOK ON THE ATMOSPHERIC ENVIRONMENTAL GUIDELINES FOR USE IN WIND TURBINE GENERATOR DEVELOPMENT

Walter Frost (Tennessee Univ Space Inst., Tullahoma), B H Long (Tennessee Univ Space Inst., Tullahoma), and R E Turner Dec 1978 379 p refs
 (NASA-TP-1359, M-267) Avail NTIS HC A17/MF A01 CSCL 04B

The guidelines are given in the form of design criteria relative to wind speed, wind shear, turbulence, wind direction, ice and snow loading, and other climatological parameters which include rain hail thermal effects abrasive and corrosive effects, and humidity This report is a presentation of design criteria in an engineering format which can be directly input to wind turbine generator design computations Guidelines are also provided for developing specialized wind turbine generators or for designing wind turbine generators which are to be used in a special region of the United States Author

N79-14918# Air Force Inst of Tech., Wright-Patterson AFB, Ohio School of Systems and Logistics
DEVELOPMENT OF AN AIR FORCE FACILITIES ENERGY INFORMATION SYSTEM M S Thesis

David F Manchester and Ronald L Schuldt Jun 1978 156 p refs
 (AD-A059309, AFIT-LSSR-8-78A) Avail NTIS
 HC A08/MF A01 CSCL 05/2

There is some doubt about whether or not Air Force Civil Engineering personnel, who are responsible for the planning, construction, operation and maintenance of all Air Force facilities, have the proper background information to cope with the current energy crisis This thesis analyzes the results of a survey of over 500 Civil Engineering officers and equivalent civilians on the subject of energy information The analysis shows that, in spite of the recent interest in energy very few managers feel that they have enough background information to make educated decisions about energy problems in their functional areas Seventy-seven percent of the respondents feel that Civil Engineering needs an energy background information system Based on questionnaire responses readings, and interviews, the requirements for such a system are discussed Sources of energy information which should be incorporated into an Air Force Energy Information System are described The system could be established during the current headquarters reorganization Author (GRA)

N79-14934# Boeing Computer Services Co., Falls Church, Va
INTEGRATED SAFEGUARDS INFORMATION SYSTEM (ISIS), EXECUTIVE SUMMARY

R H Simonsen Jun 1978 34 p
 (Contract NRC-04-77-065)
 (PB-286869/3, NUREG-CR-0328) Avail NTIS
 HC A03/MF A01 CSCL 05B

Current and projected information required to safeguard nuclear materials against attack and/or sabotage was refined and the capabilities of relevant and existing safeguards information systems within both the government and the licensed nuclear industry were examined. The general design of a system developed to collect, process, and integrate safeguards-related information is described. GRA

N79-14946# Parsons (Ralph M.) Co. Pasadena, Calif
ENGINEERING AND ECONOMIC ANALYSIS OF WASTE TO ENERGY SYSTEMS Final Report, Apr 1975 - Jun 1977
 E Milton Wilson, John M Leavens Nathan W Snyder John J Brehany and Richard F Whitman May 1978 460 p refs (Contract EPA-68-02-2101) (PB-285797/7 RMP-5495-1, EPA-600/7-78-086) Avail NTIS HC A20/MF A01 CSCL 13B

Waste quantities and characteristics in the US are reviewed and waste-to-energy conversion technology evaluated. All waste materials, exclusive of those from mining operations, are considered. The technology is reviewed under the categories of mechanical processing, biological conversion systems, thermal/chemical systems and combustion. Important features of many operating facilities are described and detailed engineering and economic analyses of seven specific systems are presented. An analysis is also made of the technology and costs for conversion of pyrolytic off-gas to methane, methanol, and ammonia. Environmental pollution data are presented where available and the current control technology briefly reviewed. Conclusions on the conversion technology are made and research needs considered in a series of recommendations. GRA

N79-15105# Committee on Commerce, Science, and Transportation (U S Senate)

SYMPOSIUM ON THE FUTURE OF SPACE SCIENCE AND SPACE APPLICATIONS

Washington GPO 1978 114 p refs Hearing before the Subcomm on Sci Technol and Space of the Comm on Commerce Sci and Transportation, 95th Congr 2d Sess, 7 Feb 1978

(GPO-23-876) Avail Subcomm on Sci Technol, and Space

Current and projected uses of space technology and sciences to meet human needs on Earth and in space are discussed. Factors influencing mission priorities are considered as well as methods for cost/benefit analyses.

N79-15107# Aerospace Corp., El Segundo Calif
STATEMENT OF IVAN BEKEY, DIRECTOR OF ADVANCED MISSION STUDIES, AEROSPACE CORPORATION

Ivan Bekey /In Comm on Commerce, Sci, and Transportation (U S Senate) Symp on the Future of Space Sci and Space Appl 1978 p 9-27

Avail Subcomm on Sci, Technol, and Space

The main problems facing the United States space programs are social and political rather than technological. Long range goals must be established for space, and the space program must provide bold and imaginative services which can be relevant in the everyday lives of citizens as well as to business and government at all levels using space systems that can pay their own way and attract private capital. Such advances as large heavy complex communications satellites will permit the use of tiny and cheap user terminals for personal wrist radios, personal emergency panic buttons to summon help, law enforcement communications, electronic mail, and the continuous tracking of all nuclear fuel shipments to prevent undetected diversion or hijacking. Observations spacecraft growing out of current meteorological and earth resource satellites will permit dial-up images for farmers and other concerned individuals. Other benefits are to be derived from space processing, space manufacturing, space-based energy transmission to Earth, and space disposal of nuclear wastes. A R H

N79-15108# Space Global, La Jolla, Calif
STATEMENT OF DOCTOR KRAFFT A EHRRICKE, PRESIDENT, SPACE GLOBAL, LA JOLLA, CALIFORNIA
 Krafft A Ehricke /In Comm on Commerce, Sci and Transportation

(U S Senate) Symp on the Future of Space Sci and Space Appl 1978 p 11-27 refs

Avail Subcomm on Sci Technol and Space

The social, economic, and political aspects of the aerospace-related industries and of projected space industrialization are discussed with emphasis on jobs, energy, and national prestige. The nation's economic base is eroding and space industrialization presents the opportunity to convert capital-intensive technologies into labor-intensive industries through public and private enterprises. World population shifts and the dwindling minorities of leading industrial nations indicate that the economic survival of the U S may well depend on making transition to fully developed space industrialization capabilities. A R H

N79-15110# ECON, Inc., Princeton N J
STATEMENT OF DOCTOR KLAUS HEISS, PRESIDENT, ECON, INCORPORATED, PRINCETON, NEW JERSEY

Klaus Heiss /In Comm on Commerce Sci and Transportation (U S Senate) Symp on the Future of Space Sci and Space Appl 1978 p 40-55 refs

Avail Subcomm on Sci Technol and Space

The economic self-interest of the United States over a horizon broader than the next 20 years will lead ultimately to some exciting adventures including establishments of space energy bases and space habitats. The time horizon is to the year 2075. At this juncture of the U S space program a major opportunity exists to give a new impetus to space applications and sciences for the next two decades. This opportunity involves a redirection of the funding of space programs from an emphasis on means (rocket systems and space transportation systems) to an emphasis on the goals of space ventures in applications sciences and long term in-orbit activities by man. Four transfer application themes discussed include: global information systems, large space structure capability, space as an energy base, phases of space industrialization and space habitation. Cost benefits and funding requirements for these ventures are projected. A R H

N79-15111# National Aeronautics and Space Administration Washington D C

STATEMENT OF DOCTOR ROBERT A FROSCHE, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Robert A Frosch /In Comm on Commerce, Sci and Transportation (U S Senate) Symp on the Future of Space Sci and Space Appl 1978 p 55-62

Avail Subcomm on Sci Technol and Space

Short term views must be taken in order to concentrate on the foundations and steps to be followed in the next 10 years so that the need for economics and tangible values of long range dreams can be fully understood. Although the technological basis for many projected applications already exist, there is difficulty in obtaining funding for the initial steps toward the realization of any venture unless a quantitative basis can be demonstrated for the costs and benefits to be achieved. Computations are exaggerated for space systems because of their extreme front-end capitalization problems. The investment for satellite solar-powered satellite systems is comparable in magnitude to that contemplated for other energy systems although there is a difference in the economics of the problem and in the technologies of the problem. A R H

N79-15113*# National Aeronautics and Space Administration Langley Research Center Hampton Va

OAST SPACE THEME WORKSHOP VOLUME 1 / SUMMARY REPORT. 1 INTRODUCTION 2 GENERAL OBSERVATIONS AND SOME KEY FINDINGS 3 FOLLOW-ON ACTIVITY QUICK-LOOK COMMENTS AND WORKING PAPERS

1976 77 p Workshop held at Langley Station, Va., 26-30 Apr 1976 17 Vol (NASA-TM-80001) Avail NTIS HC A05/MF A01 CSCL 22A

The Outlook for Space Study, consideration of National needs and OAST technology goals were factors in the selection of the following themes for candidate technical initiative and supporting

program plans space power station, search for extraterrestrial life, industrialization of space, global service station, exploration of the solar system, and advanced space transportation system. An overview is presented of the Space Theme Workshop activities in developing technology needs, program requirements, and proposed plans in support of each theme. The unedited working papers used by team members are included. A R H

N79-15114*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
OAST SPACE THEME WORKSHOP VOLUME 2 THEME SUMMARY 1: SPACE POWER (NO 7) A THEME STATEMENT. B 26 APRIL 1976 PRESENTATION C SUMMARY D INITIATIVE ACTION

1976 35 p refs Workshop held at Langley Station, Va., 26-30 Apr 1976 17 Vol
 (NASA-TM-80002) Avail NTIS HC A03/MF A01 CSCL 22A

A long-lived space-based system that converts on-orbit solar and/or nuclear energy to a suitable form for distribution to using space systems is described. Mission applications requirements, issues, problems, benefits, and technology thrusts are identified for the multipurpose power platform. Power levels of at least 10-100Kw are required for space manufacturing satellites, and space station operations. Two Mw are needed for a proposed passive radar system. Propulsion system requirements are in the 100Kw-100Mw range. A R H

N79-15125*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
OAST SPACE THEME WORKSHOP, VOLUME 3, WORKING GROUP SUMMARY, 6 POWER (P-2) A STATEMENT, B TECHNOLOGY NEEDS (FORM 1) C. PRIORITY ASSESSMENT (FORM 2)

1976 123 p Workshop held at Langley Station, Va., 26-30 Apr 1976 17 Vol
 (NASA-TM-80013) Avail NTIS HC A06/MF A01 CSCL 22A

Power requirements for the multipurpose space power platform for space industrialization, SETI, the solar system exploration facility, and for global services are assessed for various launch dates. Priorities and initiatives for the development of elements of space power systems are described for systems using light power input (solar energy source) or thermal power input, (solar chemical nuclear radioisotopes reactors). Systems for power conversion, power processing, distribution and control are likewise examined. A R H

N79-15137*# Rockwell International Corp., Downey, Calif Space Div
SATELLITE POWER SYSTEM (SPS) CONCEPT DEFINITION STUDY (EXHIBIT C) Quarterly Review, 21 - 22 Jun 1978

Jun 1978 371 p
 (Contract NAS8-32475)
 (NASA-CR-150733, SD-78-AD-0075, QR-1) Avail NTIS HC A16/MF A01 CSCL 22B

The SPS program plan is outlined. An overall review of the component systems which comprise the SPS is presented. The report is presented in the form of charts, graphs, data tables and engineering drawings. G Y

N79-15138*# Rockwell International Corp., Downey, Calif Space Div
SATELLITE POWER SYSTEMS (SPS) CONCEPT DEFINITION STUDY VOLUME 3: SPS CONCEPT EVOLUTION Final Report

G Hanley Apr 1978 307 p
 (Contract NAS8-32475)
 (NASA-CR-158066, SD-78-AP-0023-3-Vol-3) Avail NTIS HC A14/MF A01 CSCL 22B

A solar photovoltaic satellite based upon the utilization of a GaAlAs solar cell is defined. Topics covered include silicon-based photovoltaics, solar thermal power conversion, microwave energy transmission, power distribution, structures, attitude control and stationkeeping, thermal, and information management and control. A R H

N79-15139*# Rockwell International Corp Downey, Calif Space Div

SATELLITE POWER SYSTEMS (SPS) CONCEPT DEFINITION STUDY, VOLUME 5, TRANSPORTATION AND OPERATIONS ANALYSIS Final Report

G Hanley Apr 1978 195 p
 (Contract NAS8-32475)
 (NASA-CR-158067, SD-78-AP-0023-5-Vol-5) Avail NTIS HC A09/MF A01 CSCL 22B

The development of transportation systems to support the operations required for the orbital assembly of a 5-gigawatt satellite is discussed as well as the construction of a ground receiving antenna (rectenna). Topics covered include heavy lift launch vehicle configurations for Earth-to LEO transport, the use of chemical, nuclear, and electric orbit transfer vehicles for LEO to GEO operations, personnel transport systems, ground operations end-to-end analysis of the construction, operation and maintenance of the satellite and rectenna, propellant production and storage and payload packaging. A R H

N79-15140*# Rockwell International Corp Downey Calif Space Div

SATELLITE POWER SYSTEMS (SPS) CONCEPT DEFINITION STUDY VOLUME 6 SPS TECHNOLOGY REQUIREMENTS AND VERIFICATION Final Report

G Hanley Apr 1978 136 p 7 Vol
 (Contract NAS8-32475)
 (NASA-CR-150685 SD-78-AP-0023-6-Vol-6) Avail NTIS HC A07/MF A01 CSCL 22B

Volume 6 of the SPS Concept Definition Study is presented and also incorporates results of NASA/MSFC in-house effort. This volume includes a supporting research and technology summary. Other volumes of the final report that provide additional detail are as follows: (1) Executive Summary, (2) SPS System Requirements, (3) SPS Concept Evolution, (4) SPS Point Design Definition, (5) Transportation and Operations Analysis, and Volume 7 SPS Program Plan and Economic Analysis. G Y

N79-15141*# Rockwell International Corp., Downey, Calif Space Div

SATELLITE POWER SYSTEMS (SPS) CONCEPT DEFINITION STUDY VOLUME 7 SPS PROGRAM PLAN AND ECONOMIC ANALYSIS Final Report

G Hanley Apr 1978 152 p
 (Contract NAS8-32475)
 (NASA-CR-158068 SD-78-AP-0023-7-Vol-7) Avail NTIS HC A08/MF A01 CSCL 22B

The economic and programmatic requirements for a recommended SPS solar photovoltaic baseline concept were analyzed. Costs are determined for the DDT&E, initial capital investment (covers initial procurement and emplacement of each SPS plant and equipment), replacement capital investment (capital asset replacement over the SPS operating life), operations and maintenance (expendables, minor maintenance, repair crews) and taxes/insurance. A R H

N79-15142*# Rockwell International Corp., Downey, Calif Space Div

SATELLITE POWER SYSTEMS (SPS) CONCEPT DEFINITION STUDY VOLUME 7 SPS PROGRAM PLAN AND ECONOMIC ANALYSIS, APPENDICES Final Report

G Hanley Apr 1978 270 p
 (Contract NAS8-32475)
 (NASA-CR-150702 SD-78-AP-0023-7-Vol-7-App) Avail NTIS HC A12/MF A01 CSCL 22B

Three appendices in support of Volume 7 are contained in this document. The three appendices are: (1) Satellite Power System Work Breakdown Structure Dictionary, (2) SPS cost Estimating Relationships, and (3) Financial and Operational Concept. Other volumes of the final report that provide additional detail are: Executive Summary, SPS Systems Requirements, SPS Concept Evolution, SPS Point Design Definition, Transportation and Operations Analysis, and SPS Technology Requirements and Verification. G Y

N79-15145# Lincoln Lab Mass Inst of Tech, Lexington
FLYWHEEL COMPONENTS FOR SATELLITE APPLICATIONS

Alan R Millner 16 May 1978 145 p
 (Contract F19628-78-C-0002)
 (AD-A060586 TN-1978-4, ESD-TR-78-97) Avail NTIS
 HC A07/MF A01 CSCL 10/3

The following paper studies the possibilities of using high-speed flywheels with magnetic bearings in communications spacecraft Hardware point designs have been completed for a very low drag bearing and a very efficient, compatible motor generator Using the results of these designs a tradeoff study compares these flywheels with combinations of NiCd batteries, NiH₂ batteries and conventional low-speed momentum wheels Section I presents the tradeoff studies for flywheels used for energy storage only for attitude control only and for combined energy storage and attitude control The results show that such wheels look excellent for attitude control alone (as high-speed high-reliability momentum wheels) and attractive for combined power and attitude control, but not much better than NiH₂ for power alone GRA

N79-15177# New Mexico Energy Inst Albuquerque
METHANE PRODUCTION FROM CARBON OXIDES OVER BOROHYDRIDE-REDUCED TRANSITION METALS Final Report

Thomas W Russell Jan 1978 40 p refs Sponsored by New Mexico Energy and Minerals Dept Prepared in cooperation with Eastern New Mexico Univ, Portales (PB-286385/0 NMEI-76/173) Avail NTIS HC A03/MF A01 CSCL 07D

The utility of borohydride-reduced transition metals as catalysts was studied for the hydrogenation of carbon oxides to produce synthetic fuels Work with cobalt copper nickel and palladium has resulted in methane production from both carbon oxides, with carbon dioxide being only slightly less productive than carbon monoxide From the last three metals, methane is the only product formed (besides water) Continuous methanation over nickel has shown no decrease in methane production during a two-week run Continuous methanation over cobalt in the presence of 10 ppm of sulfur dioxide has shown an increase in methane production during a two-week run GRA

N79-15203# Dayton Univ Research Inst Ohio
BEHAVIOR OF NONMETALLIC MATERIALS IN SHALE OIL DERIVED JET FUELS AND IN HIGH AROMATIC AND HIGH SULFUR PETROLEUM FUELS Final Report, Jan 1975 - Aug 1977

William E Berner and Leonard C Angello Wright-Patterson AFB Ohio AFML Jul 1978 84 p refs
 (Contract F33615-76-C-5034 AF Proj 2421)
 (AD-A060322, AFML-TR-78-100) Avail NTIS
 HC A05/MF A01 CSCL 21/4

Aircraft materials that are normally in contact with or exposed to fuels were evaluated in order to determine their compatibility with fuels previously considered unacceptable, such as those derived from shale oil or those having high levels of aromatics, sulfur, and mercaptan sulfur Adhesives, coatings, sealants O ring seals and clamps were studied in ten fuel formulations ARH

N79-15207# Massachusetts Inst of Tech Cambridge Marine Industry Advisory Services
THE ECONOMICS AND ENGINEERING OF LARGE-SCALE ALGAE BIOMASS ENERGY SYSTEMS

Norman Doelling May 1978 34 p refs Sponsored by NOAA, Rockville Md
 (PB-287868/4 MITSG-78-11 Opportunity-Brief-11
 NOAA-78090601 Index-78-711-Zlg) Avail NTIS
 HC A03/MF A01 CSCL 21D

The current state of the art and the potential of aquatic plant biomass systems over the next three to five years is outlined to suggest industrial development and research opportunities Giant kelp (Macrocystis) capable of prodigious absolute growth rates (but low percentage growth rates) is recognized as a choice source of biomass for energy The major unsolved problem in algal farms is harvesting the algae in a way that does not consume more energy than it produces Centrifuging and drying require

so much energy as to be prohibitive Some form of filtering and concentration of the algae by means of induced settling floatation or filtering followed by anaerobic digestion of the algae medium to produce methane is the most probable technique GRA

N79-15247*# National Aeronautics and Space Administration Marshall Space Flight Center Huntsville Ala
THE 25 kW POWER MODULE UPDATED BASELINE SYSTEM

Dec 1978 85 p refs
 (NASA-TM-78212) Avail NTIS HC A05/MF A01 CSCL 09C
 Analyses and trades were performed to improve the original base line system This report describes a suggested new baseline that incorporated modifications to the September 1977 system G G

N79-15267*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
SOME HEAT TRANSFER AND HYDRODYNAMIC PROBLEMS ASSOCIATED WITH SUPERCONDUCTING CABLES (SPTL)

Robert C Hendricks David E Daney (NBS Boulder Colo), V M Yeroshenko (Krzhizhanovsky Power Inst, Moscow) Ye V Kuznetsov (Krzhizhanovsky Power Inst, Moscow) and O A Shevchenko (Krzhizhanovsky Power Inst, Moscow) 1978 28 p refs Presented at the US-USSR Comm for Superconducting Power Transmission Upton N Y 5-6 oct 1978 (NASA-TM-79023 DOE/NASA/0207-78/1) Avail NTIS HC A03/MF A01 CSCL 20D

To study some effects of thermogravitation on (CIHK-SPTL) systems a heated tube experiment was set up at Krzhizhanovsky Power Engineering Institute Moscow U S S R Heat transfer data were taken with fluid helium flowing through a 2.85 m 19 mm diameter uniformly heated horizontal tube Temperatures were measured on the top and bottom of the tube at six axial locations with three other circumferential measurements made at (X/L) = 57 Typical temperature profiles show significant variations both axially and circumferentially The data are grouped using reduced Nusselt number (NuR) and the bulk expansion parameter for each axial location The average data for 0.26 less than or equal to X/L less than or equal to 0.76 follow a power law relation with the average expansion parameter System instabilities are noted and discussed Future work including heat transfer in coaxial cylinders is discussed Author

N79-15304# Department of Energy Bartlesville Okla Energy Research Office
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES FIRST SERIES REPORT NO 14 1975 MAZDA ROTARY 79 CID (1.1 LITERS), 4V Interim Report, Jul 1977

W F Marshall and K R Stamper May 1978 40 p
 (PB-286074/0 BERC/OP-76/32 Rept-14
 DOT-TSC-NHTSA-78-9, DOT-HS-803324) Avail NTIS
 HC A03/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of a 1975 Mazda 70 CID 4V rotary engine to determine fuel consumption and emissions (hydrocarbon carbon monoxide oxides of nitrogen) at steady-state engine-operating modes Engine performance data for estimating emissions and fuel economy for varied engine service and duty were acquired to prove basic engine characteristic data required as input for engineering calculations involving ground transportation GRA

N79-15305# Department of Energy Bartlesville Okla Energy Research Center
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES FIRST SERIES REPORT NO 15 1975 DODGE COLT 98 CID (1.6 LITERS), 2V Interim Report, Aug 1977

T W Chamberlain D E Koehler K R Stamper and W F Marshall May 1978 41 p
 (PB-286075/7 BERC/OP-77/42 DOT-TSC-NHTSA-78-9
 DOT-HS-803325) Avail NTIS HC A03/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of a 1975 Dodge Colt 1.6 liter (98 CID) engine to determine fuel consumption and emissions (hydrocarbon carbon monoxide oxides of nitrogen) at steady-state engine-operating modes. Engine performance data for estimating emissions and fuel economy for varied engine service and duty were acquired to provide basic engine characteristic data required as input for engineering calculations involving ground transportation. GRA

N79-15306# Department of Energy Bartlesville Okla Energy Research Center
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES SECOND SERIES REPORT NO 5 1977 FORD 140 CID (2.3 LITERS) 2V Interim Report, Nov 1977

T W Chamberlain and D E Koehler May 1978 62 p (PB-286076/5 BERC/OP-77/57 DOT-TSC-NHTSA-78-16 DOT-HS-803332) Avail NTIS HC A04/MF A01 CSCL 21G
 Experimental data were obtained in dynamometer tests of a 1977 Ford 2.3 liter (140 CID) engine to determine fuel consumption and emissions (hydrocarbon carbon monoxide oxides of nitrogen) at steady-state engine-operating modes. The engine performance data are used to estimate emissions and fuel economy for varied engine service and duty and provide basic engine characteristic data required as input for engineering calculations involving ground transportation. GRA

N79-15307# Department of Energy Bartlesville Okla Energy Research Center
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES THIRD SERIES REPORT NO 1 1977 VOLVO 130 CID (2.1 LITERS), F I Interim Report, Nov 1977

D E Koehler K R Stamper and W F Marshall May 1978 46 p (PB-286077/3 BERC/OP-77/60 DOT-TSC-NHTSA-78-19 DOT-HS-803335) Avail NTIS HC A03/MF A01 CSCL 21G
 Dynamometer tests of a 1977 Volvo 130 CID engine were conducted to determine fuel consumption and emissions (hydrocarbon carbon monoxide oxides of nitrogen) at steady-state engine-operating modes. Engine performance data are used to estimate emissions and fuel economy for varied engine service and duty and provide basic engine characteristic data required as input for engineering calculations involving ground transportation. GRA

N79-15308# Department of Energy Bartlesville Okla Energy Research Center
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES SECOND SERIES, REPORT NO 4 1976 CHEVROLET 85 CID (1.4 LITERS), IV Interim Report, Nov 1977

D E Koehler T W Chamberlain K R Stamper, and W F Marshall May 1978 54 p (Contract DOT/TSC-RA-76-23) (PB-286294/4, BERC/OP-77/58 DOT-TSC-NHTSA-78-15 DOT-HS-803331) Avail NTIS HC A04/MF A01 CSCL 21G
 Experimental data were obtained in dynamometer tests of a 1976 Chevrolet 85 CID engine to determine fuel consumption and emissions (hydrocarbon carbon monoxide oxides of nitrogen) at steady-state engine-operating modes. Engine performance data were obtained for estimating emissions and fuel economy for varied engine service and duty. Basic engine characteristic data required as input for engineering calculations involving ground transportation are provided. GRA

N79-15309# Department of Energy Bartlesville, Okla Energy Research Center
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES SECOND SERIES, REPORT NO 6 1976 NISSAN DIESEL 198 CID (3.2 LITERS), F I Interim Report, Nov 1977

D E Koehler K R Stamper, and W F Marshall May 1978 36 p (Contract DOT/TSC-RA-76-23) (PB-286295/1, BERC/OP-77/61, DOT-TSC-NHTSA-78-17,

DOT-HS-803333) Avail NTIS HC A03/MF A01 CSCL 21G
 Experimental data were obtained in dynamometer tests of a 1976 Nissan diesel engine Model SD-33 CN6-33 to determine fuel consumption and emissions (hydrocarbon carbon monoxide oxides of nitrogen) at steady-state engine-operating modes. Engine performance data were obtained for estimating emissions and fuel economy for varied engine service and duty. Basic engine characteristic data required as input for engineering calculations involving ground transportation are provided. GRA

N79-15310# Department of Energy Bartlesville Okla Energy Research Center
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES SECOND SERIES, REPORT NO 7 1977 FORD 171 CID (2.8 LITERS), 2V Interim Report, Nov 1977

D E Koehler K R Stamper and W F Marshall May 1978 64 p (Contract DOT/TSC-RA-76-23) (PB-286296/9 BERC/OP-77/62 DOT-TSC-NHTSA-78-18 DOT-HS-803334) Avail NTIS HC A04/MF A01 CSCL 21G
 Experimental data were obtained in dynamometer tests of a 1977 Ford 171 CID engine to determine fuel consumption and emissions (hydrocarbon carbon monoxide oxides of nitrogen) at steady-state engine operating modes. Engine performance data were obtained for estimating emissions and fuel economy for varied engine service and duty. Basic engine characteristic data required as input for engineering calculations involving ground transportation are provided. GRA

N79-15311# Department of Energy Bartlesville Okla
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES FIRST SERIES, REPORT NO 16 1975 121 CID (2.0 LITERS), F I Interim Report, Aug 1977

T W Chamberlain D E Koehler K R Stamper and W F Marshall Aug 1977 34 p (Contract DOT/TSC-RA-75-10) (PB-286297/7 BERC/OP-77/41 DOT-HS-803326) Avail NTIS HC A03/MF A01 CSCL 21G
 Experimental data were obtained in dynamometer tests of a 1975 Volvo 2.0 liter (121 CID) engine to determine fuel consumption and emissions (hydrocarbon carbon monoxide oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation. GRA

N79-15312# Department of Energy Bartlesville Okla Energy Research Center
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES FIRST SERIES, REPORT NO 17 1975 BUICK 455 CID (7.5 LITERS), 4V Interim Report, Aug 1977

T W Chamberlain D E Koehler K R Stamper and W F Marshall May 1978 54 p (Contract DOT/TSC-RA-75-10) (PB-286298/5 BERC/OP-77/44 DOT-TSC-NHTSA-78-11 DOT-HS-803327) Avail NTIS HC A04/MF A01 CSCL 21G
 Experimental data were obtained in dynamometer tests of a 1975 Buick 455 CID 4V engine to determine fuel consumption and emissions (hydrocarbon carbon monoxide oxides of nitrogen) at steady-state engine-operating modes. Engine performance data were obtained for estimating emissions and fuel economy for varied engine service and duty. Basic engine characteristic data required as input for engineering calculations involving ground transportation are provided. GRA

N79-15313# Department of Energy Bartlesville Okla Bartlesville Energy Research Center
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES FIRST SERIES, REPORT

NO 18 1976 FORD CID (6 6 LITERS), 2V Interim Report, Aug 1977

W F Marshall and K R Stamper May 1978 56 p
(Contract DOT/TSC-RA-75-10)
(PB-286299/3 BERC/OP-77/52 DOT-TSC-NHTSA-78-12
DOT-HS-803328) Avail NTIS HC A04/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of a 1976 Ford 400 CID 2V engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide oxides of nitrogen) at steady-state engine-operating modes. Engine performance data are used to estimate service and duty and provide basic engine characteristic data required as input for engineering calculations involving ground transportation. GRA

**N79-15314# Department of Energy Bartlesville Okla
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE
ENGINES IN THE UNITED STATES FIRST SERIES, REPORT
NO 19 1976 FORD WINDSOR 351 CID (5 7 LITERS), 2V
Interim Report, Aug 1977**

W F Marshall and K R Stamper May 1978 40 p
(Contract DOT/TSC-RA-75-10)
(PB-286300/9 BERC/OP-77/53, DOT-TSC-NHTSA-78-13
DOT-HS-803329) Avail NTIS HC A03/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of a Windsor engine to determine fuel consumption and emissions (hydrocarbon carbon monoxide oxides of nitrogen) at steady-state engine operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation. GRA

**N79-15315# Department of Energy Bartlesville Okla Energy
Research Center**

**PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE
ENGINES IN THE UNITED STATES FIRST SERIES, REPORT
NO 20 1976 CHEVROLET 350 CID (5 7 LITERS) WITH
DRESSER VARIABLE-AREA VENTURI SYSTEM Interim
Report, Nov 1977**

T W Chamberlain, D E Koehler K R Stamper and W F
Marshall May 1978 42 p
(Contract DOT/TSC-RA-75-10)
(PB-286301/7 BERC/OP-77/56 DOT-TSC-NHTSA-78-14
DOT-HS-803330) Avail NTIS A03/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of a 1975 Chevrolet 350 CID engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide oxides of nitrogen) at steady-state engine-operating modes. Engine performance data were obtained for estimating emissions and fuel economy for varied engine service and duty. Basic engine characteristic data required as input for engineering calculations involving ground transportation are provided. GRA

**N79-15379# Lockheed Electronics Co Inc Las Vegas, Nev
Remote Sensing Lab**

REMOTE MONITORING OF COAL STRIP MINE REHABILITATION Final Report, 1 Jul 1975 - 31 Dec 1976

James E Anderson and Charles E Tanner Jul 1978 71 p
refs

(Contract EPA-68-03-2636)
(PB-286647/3 EPA-600/7-78-149) Avail NTIS
HC A04/MF A01 CSCL 081

The results of manual photointerpretation and automated data analysis are discussed. Included is a feasibility study to use LANDSAT data for performing a regional land-cover classification of a portion of the Powder River Basin area in northeastern Wyoming where there are numerous coal strip mines. GRA

**N79-15398# Committee on Interstate and Foreign Commerce
(U S House)**

**THE NATIONAL ENERGY PLAN OPTIONS UNDER
ASSUMPTIONS OF NATIONAL SECURITY THREAT**

Washington GPO 1978 411 p refs Rept with selected readings for use by the Subcomm on Energy and Power of the Comm on Interstate and Foreign Commerce 95th Congr, 2d

Sess Apr 1978 Prepared by Library of Congr Congressional Res Service

(H-Print-95-48 GPO-23-434) Avail SOD HC

The dependence of the United States and the free world on imported oil places free world economic political and military wellbeing at grave near term risk and requires an accelerated program to reduce oil import dependence and a shift to other fuels all with the equivalent of wartime urgency vigor, and scale. The types of programs and rationales that would be consistent with a credible near term threat are explored using analogous or comparable war-related mobilizations in the past.

A R H

**N79-15399# Committee on Interstate and Foreign Commerce
(U S House)**

**THE NATIONAL ENERGY PLAN OPTIONS UNDER
ASSUMPTIONS OF NATIONAL SECURITY THREAT OR
ENERGY POLICY AS IF IT REALLY MATTERED**

Washington GPO 1978 29 p refs Rept for the Subcomm on Energy and Power of the Comm on Interstate and Foreign Commerce and for the Subcomm on Energy Nuclear Proliferation and Federal Services of the Comm on Governmental Affairs, 95th Congr 2d Sess, Mar 1978 Prepared by the Library of Congr Congressional Res Service

(H-Print-95-42, GPO-23-442) Avail Subcomm on Energy and Power

In response to a congressional request the types of programs and rationales that would be consistent with a credible near-term national security threat are explored, based upon analogous or comparable war-related mobilizations in the past. This analysis does not assess the relative merits of the President's projection of national security threat of crisis dimensions against other less drastic interpretations but accepts that projection and the need for wartime emergency measures as assumptions for this paper.

Author

**N79-15400# Committee on Interstate and Foreign Commerce
(U S House)**

**US ENERGY DEMAND AND SUPPLY, 1976-1985 LIMITED
OPTIONS, UNLIMITED CONSTRAINTS Final Report**

GPO 1978 154 p refs Rept for use of the Subcomm on Energy and Power of the Comm on Interstate and Foreign Commerce 95th Congr, 1st Sess, Mar 1978 Prepared by Library of Congr, Congressional Res Service

(H-Print-95-43, GPO-21-616) Avail Subcomm on Energy and Power

Studies made in 1974 indicating that the United States could be energy self-sufficient by 1985 at energy growth rates are now considered much too high by most energy analysts. More recent studies project that U S primary energy consumption will rise from about 74 quadrillion Btu (Q) in 1976 to between 81 and 85 Q in 1980, between 91 and 104 Q in 1985 and between 105 and 116 Q by 1990. The National Energy Program is analyzed in terms of the theory of economic policy. The geological technical economic and institutional barriers that must be overcome to increase domestic energy supplies for the year 1985 are discussed for the production of coal natural gas oil, nuclear power, synthetic fuels and for solar geothermal, and hydropower conversion and utilization.

A R H

**N79-15401*# Wyle Labs, Inc Huntsville Ala Solar Energy
Div**

**THERMAL PERFORMANCE EVALUATION OF THE SOLAR-
GENICS SOLAR COLLECTOR AT OUTDOOR CONDITIONS**

Dec 1978 32 p ref Prepared for DOE
(Contract NAS8-32026)
(NASA-CR-150857) Avail NTIS HC A03/MF A01 CSCL 10A

Test procedures used during the performance of an evaluation program are presented. The test program was conducted to obtain the following performance data and information on the solar collector: (1) thermal performance data under outdoor conditions, (2) structural behavior of collector under static conditions, (3) effects of long term exposure to material weathering elements. The solar genics is a liquid single-glazed, flat plate collector. Approximate dimensions of each collector are 240 inches long, 36 inches wide and 3.5 inches in depth. Author

N79-15402*# Sigma Research Inc Richland, Wash
PASSIVE THERMOSYPHON SOLAR HEATING AND COOLING MODULE WITH SUPPLEMENTARY HEATING Quarterly Report

Oct 1977 58 p refs Prepared for DOE
 (Contract NAS8-32260)
 (NASA-CR-150849) Avail NTIS HC A04/MF A01 CSCL 10A

A collection of three quarterly reports from Sigma Research Inc, covering progress and status from January through September 1977 are presented Three heat exchangers are developed for use in a solar heating and cooling system for installation into single-family dwellings Each exchanger consists of one heating and cooling module and one submerged electric water heating element S E S

N79-15403*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
COMPARISON OF FUEL-CELL AND DIESEL INTEGRATED ENERGY SYSTEMS AND A CONVENTIONAL SYSTEM FOR A 500-UNIT APARTMENT

Stephen N Simons and William L Maag Nov 1978 26 p refs
 (NASA-TM-79037, E-9835) Avail NTIS HC A03/MF A01 CSCL 10B

The electrical and thermal energy utilization efficiencies of a 500 unit apartment complex are analyzed and compared for each of three energy supply systems Two on-site integrated energy systems, one powered by diesel engines and the other by phosphoric-acid fuel cells were compared with a conventional system which uses purchased electricity and on-site boilers for heating All fuels consumed on-site are clean, synthetic fuels (distillate fuel oil or pipeline quality gas) derived from coal Purchased electricity was generated from coal at a central station utility The relative energy consumption and economics of the three systems are analyzed and compared Author

N79-15404*# Owens-Illinois, Inc Toledo Ohio
DESIGN DATA BROCHURE FOR THE OWENS-ILLINOIS SUNPAK (TM) AIR-COOLED SOLAR COLLECTOR

Dec 1978 13 p ref Prepared for DOE
 (Contract NAS8-32259)
 (NASA-CR-150868) Avail NTIS HC A02/MF A01 CSCL 10A

Information necessary to evaluate the design and installation of the Owens-Illinois Sunpak TM Air-Cooled Solar Collector is presented Information includes collector features fluid flow thermal performance, installation and system tips The collector utilizes a highly selective wavelength coating in combination with vacuum insulation, which virtually eliminates conduction and convection losses L S

N79-15405*# Solar Designs Taylors South Carolina
SOLAR HOT WATER SYSTEM INSTALLED AT ANDERSON, SOUTH CAROLINA Final Report

Dec 1978 37 p Sponsored in part by NASA
 (Contract DOE-77-G-01-1663)
 (NASA-CR-150856) Avail NTIS HC A03/MF A01 CSCL 10A

A description is given of the solar energy hot water system installed in the Days Inns of America, Inc at Anderson South Carolina The building is a low-rise two-story 114-room motel The solar system was designed to provide 40 percent of the total hot water demand The collector is a flat plate liquid with an area of 750 square feet Operation of this system was begun in November 1977 and has performed flawlessly for one year Author

N79-15406*# Reynolds Metals Co Richmond Va Product Development Div
SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT LISTERHILL, ALABAMA

Dec 1978 134 p Sponsored by NASA
 (Contract DOE-G-77-A-01-4070)
 (NASA-CR-150870) Avail NTIS HC A07/MF A01 CSCL 10A

The Solar system was installed into a new building and was designed to provide 79% of the estimated annual space heating load and 59% of the estimated annual potable hot water requirement The collectors are flat plate liquid manufactured by Reynolds Metals Company and cover a total area of 2344 square feet The storage medium is water inhibited with NALCO 2755 and the container is an underground, unpressurized steel tank with a capacity of 5000 gallons This report describes in considerable detail the solar heating facility and contains detailed drawings of the completed system Author

N79-15409*# Honeywell Inc Minneapolis, Minn, Energy Resources Center

PRELIMINARY DESIGN PACKAGE FOR PROTOTYPE SOLAR HEATING AND COOLING SYSTEMS

Dec 1978 296 p Prepared for DOE
 (Contract NAS8-32093)
 (NASA-CR-150853) Avail NTIS HC A13/MF A01 CSCL 10A

A summary is given of the preliminary analysis and design activity on solar heating and cooling systems The analysis was made without site specific data other than weather, therefore, the results indicate performance expected under these special conditions Major items include a market analysis design approaches trade studies and other special data required to evaluate the preliminary analysis and design The program calls for the development and delivery of eight prototype solar heating and cooling systems for installation and operational test Two heating and six heating and cooling units will be delivered for Single Family Residences Multiple-family Residences and commercial applications Author

N79-15410*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

BENEFITS OF SOLAR/FOSSIL HYBRID GAS TURBINE SYSTEMS

Harvey S Bloomfield 1978 18 p refs Proposed for Presentation at the Gas Turbine Conf and Solar Energy Conf San Diego, Calif 12-15 Mar 1979 sponsored by Am Soc of Mech Engr
 (NASA-TM-79083 E-9905) Avail NTIS HC A02/MF A01 CSCL 10A

The potential benefits of solar/fossil hybrid gas turbine power systems were assessed Both retrofit and new systems were considered from the aspects of cost of electricity, fuel conservation operational mode technology requirements and fuels flexibility Hybrid retrofit (repowering) of existing combustion (simple Brayton cycle) turbines can provide near-term fuel savings and solar experience while new and advanced recuperated or combined cycle systems may be an attractive fuel saving and economically competitive vehicle to transition from today's gas and oil-fired powerplants to other more abundant fuels Author

N79-15411*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

PHOTOVOLTAIC POWER SYSTEMS FOR RURAL AREAS OF DEVELOPING COUNTRIES

Louis Rosenblum William J Bifano, Gerald F Hein, and Anthony F Ratajczak 1979 19 p refs Presented at the Intern Seminar on Solar Energy Tokyo, 5-10 Feb 1979 sponsored by the United Nations and Govt of Japan
 (NASA-TM-79097 E-9921) Avail NTIS HC A02/MF A01 CSCL 10A

Systems technology, reliability and present and projected costs of photovoltaic systems are discussed using data derived from NASA Lewis Research Center experience with photovoltaic systems deployed with a variety of users Operating systems in two villages, one in Upper Volta and the other in southwestern Arizona are described Energy cost comparisons are presented for photovoltaic systems versus alternative energy sources Based on present system technology reliability and costs photovoltaics provides a realistic energy option for developing nations

A R H

N79-15413# Rocketdyne Canoga Park, Calif
DEVELOPMENT OF A HIGH ENERGY STORAGE FLYWHEEL MODULE Final Report, 30 Jun 1975 - 30 May 1978

Donald R Hodson 30 May 1978 159 p refs
 (Contract DAAG53-75-C-0278)
 (AD-A060351, RI/RD78-207) Avail NTIS HC A08/MF A01 CSCL 10/3

A three-phase 35 month program was conducted to design and build a complete flywheel energy storage system rated at 30 KWH (40 HP-HRS) at 15 000 RPM In the first phase, tradeoff studies were completed to select optimum materials, flywheel configuration interface characteristics and to define performance characteristics During the second phase a detail design of the system was generated, including all drawings specifications, and descriptive data A subscale model of the fullscale flywheel was also fabricated and tested during phase 2 The third and final phase of the current program consisted of fabrication and assembly of the fullscale 30 KWH flywheel module and associated control equipment All program hardware was stored at Rocketdyne pending decisions to proceed with test of the system identified as Rocketdyne model RS-31 Author (GRA)

N79-15414# Maxwell Labs, Inc Woburn Mass
MAGNETOHYDRODYNAMIC LIGHTWEIGHT CHANNEL DEVELOPMENT Final Report, 28 Nov 1975 - 31 Dec 1977

D W Swallow, O K Sonju, D E Meader, and G T Heskey
 Jun 1978 171 p refs
 (Contract F33615-76-C-2001)
 (AD-A060429, AFAPL-TR-78-41) Avail NTIS
 HC A08/MF A01 CSCL 10/2

A lightweight, high performance MHD channel and diffuser were designed, built and tested The hardware was designed for testing with toluene and oxygen The design power level of 200 kW dc was obtained during the 125 tests The MHD channel design was a diagonal conducting wall generator with calcia stabilized zirconia electrodes and a filament wound epoxy coated fiberglass outer shell The diffuser design utilized thin wall copper construction with external cooling tubes These designs resulted in a significant reduction of the masses of the channel and diffuser The masses of the channel and diffuser were 40 kg and 24 kg, respectively which compared favorably to previous channels and diffusers of similar performance characteristics with masses of 160 kg and 150 kg respectively The novel design features of the channel construction technique included the use of a filament wound, epoxy coated fiberglass structural shell the presence of an RTV layer to provide the pressure seal, and the minimization of the use of the copper material in the electrode frames This fabrication procedure combined to provide a lightweight channel capable of withstanding sustained operation under a wide variety of operating conditions GRA

N79-15415# Air Force Aero Propulsion Lab Wright-Patterson AFB, Ohio

SOME FATIGUE CHARACTERISTICS OF NICKEL BATTERY PLAQUE Intern Report, Nov 1977 - Apr 1978

David H Fritts Jul 1978 35 p refs
 (AF Proj 2303)
 (AD-A060370, AFAPL-TR-78-37) Avail NTIS
 HC A03/MF A01 CSCL 10/3

The conductance of sintered nickel battery plaque is experimentally determined as the plaque is being mechanically stressed The plaque was subjected to bonding fatigue tests and to tensile testing It was found that the plaque conductance exponentially decreases with bonding fatigue cycling Also, it was determined that the plaque conductance is a function of its instantaneous state of stress Author (GRA)

N79-15421# Missouri Dept of Natural Resources Jefferson City

LPG IN MISSOURI

1978 190 p refs
 (PB-286329/8) Avail NTIS HC A01/MF A01 CSCL 10A

A brief history of the LPG (Liquified Petroleum Gases) industry the overall consumption and sector usage for both the U S and

Missouri, the movement and storage of LPG the future supply and demand and the identification of various state and federal regulations are presented GRA

N79-15422# Martin Marietta Labs Baltimore, Md
BIOLOGICAL SOLAR ENERGY CONVERSION APPROACHES TO OVERCOME YIELD, STABILITY AND PRODUCT LIMITATIONS Progress Report, 1 Apr - 30 Sep 1977

Bessel Kok, C F Fowler, H H Hardt, and R J Radmer 1977
 22 p refs
 (Grant NSF AER-73-03291)
 (PB-286487/4, MML-TR-77-57C, NSF/RA-770517, PR-5)
 Avail NTIS HC A02/MF A01 CSCL 10A

Studies of factors causing loss of function in isolated chloroplasts were continued The effects of linolenic acid on electron transport reactions in isolated spinach chloroplasts were investigated A spectrophotometer was assembled to measure fast absorption changes in the UV and visible Comparative studies of chloroplasts prepared from spinach leaves and bundlesheath and mesophyll tissue of corn were continued GRA

N79-15423# Kentucky Univ, Lexington Inst for Mining and Minerals Research

PROCEEDINGS OF ENERGY RESOURCE 5TH CONFERENCE

Aug 1978 119 p refs Conf held at Lexington Ky, 10-11 Jan 1978

(PB-286246/4, IMMR38-PD21-78, ISBN-0-89779-006-5)
 Avail NTIS HC A06/MF A01 CSCL 10A

The most recent information available on the rapidly changing energy resource picture fuel policies, economics, and technical advances is presented The theme of the conference was Gas from Coal for Industry Direct Utilization of Coal Problems and Solutions Topics covered include facilities siting, an update of energy resources state and federal regulations, economics, coal utilization, and environmental and social considerations GRA

N79-15424# General Accounting Office, Washington, D C
 Energy and Minerals Div

GAO WORK INVOLVING TITLE V OF THE ENERGY POLICY AND CONSERVATION ACT OF 1975 Report to the Congress

4 Oct 1978 18 p
 (PB-286400/7, EMD-78-88) Avail NTIS HC A02/MF A01 CSCL 10A

The results of audit work that involved Title 5 of the Energy Policy and Conservation Act of 1975 (Public Law 94-163) was summarized The report covers the 19-month period ended July 31, 1978 GRA

N79-15425# Ecoview Napa, Calif National Rural Development Committee Staff

ENERGY CONSERVATION AND THE RURAL HOME ECONOMIC CONSIDERATIONS FOR THE NATION AND THE INDIVIDUAL

Melvin R Janssen Jun 1978 16 p
 (PB-286222/5) Avail NTIS HC A02/MF A01 CSCL 10A

One national goal, endorsed by the President, is to weatherize 90 percent of existing homes to minimum Federal Standards by 1985 The conservation effort in rural areas would save enough natural gas to heat over 4.3 million single-family dwellings In addition, 54 million barrels of fuel oil would be saved In all, energy savings in rural areas would equal 488,000 barrels of oil daily, representing 24.4 days of oil imports at 1976 import rates If you fully retrofit an average home you can anticipate a 35 percent reduction in fuel use GRA

N79-15428# Eastern Oregon Community Development Council La Grande

ENERGY EDUCATION TRAINING FEASIBILITY STUDY Final Report

George R Mead ed Jun 1978 300 p refs
 (Grant CSA-00757-G-77-01)

(PB-285910/6 CSA/LN-2286) Avail NTIS
HC A13/MF A01 CSCL 10A

The impact of rising energy prices on the poor and near poor was studied especially in the states of Oregon and Washington. The creation of an energy education training center is proposed to act as an agent in bringing energy conservation measures and technological innovations such as solar power to the local level. GRA

N79-15430# Oregon Department of Energy Salem
AMENDED OREGON STATE ENERGY CONSERVATION PLAN, 1978 PREPARED IN RESPONSE TO THE ENERGY POLICY AND CONSERVATION ACT OF 1975 (PL 94-163), AND THE ENERGY CONSERVATION AND PRODUCTION ACT OF 1976 (PL 94-385)

Feb 1978 210 p refs
(PB-286078/1) Avail NTIS HC A10/MF A01 CSCL 10A

A partial listing of contents includes residential energy conservation program measure, building standards and lighting standards and program measure, public awareness program measure, community energy conservation program measure, education program measure, transportation program measure, comprehensive planning program measure, energy audits program measure, agriculture program measure. GRA

N79-15431# United Engineers and Constructors Inc., Philadelphia Pa
COOLING SYSTEMS ADDENDUM CAPITAL AND TOTAL GENERATING COST STUDIES

Sep 1978 220 p refs
(Contracts AT(49-24)-0351 EY-76-C-02-2477)
(PB-287306/5, NUREG-0247 COO-2477-11) Avail NTIS
HC A10/MF A01 CSCL 10B

Design descriptions and capital cost information for three alternate cooling tower systems are presented. These cooling systems are designed for utilization with six different electric generating plants. The three cooling systems designs addressed are once-through cooling, natural draft evaporative towers, and fan-assisted natural draft evaporative towers. Impacts on the base construction cost of the electric generating plants as well as plant performance are identified for each of the alternate cooling systems. Included is a method for comparing the total generating costs for each of the six generating plants utilizing each of the cooling systems alternates. GRA

N79-15432# Utah Water Research Lab Logan
THE IMPACT OF ENERGY RESOURCE DEVELOPMENT ON WATER RESOURCE ALLOCATIONS

John E Keith, K S Turna, Sumel Padunchai, and Rangesan Narayanan May 1978 109 p refs
(Contract DI-14-34-0001-6125 OWRT Proj B-131-UTAH(1))
(PB-286135/9 UWRL-P-78/005 W78-11211) Avail NTIS
HC A06/MF A01 CSCL 10A

A linear programming model of the agricultural and energy sectors of Utah was used to examine the economically efficient allocation of water between agriculture and energy. Data were collected for agricultural returns, costs, and water requirements, energy returns, costs, and water requirements, and water supply costs. GRA

N79-15436# National Technical Information Service, Springfield Va

CADMIUM SULFIDE SOLAR CELLS CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Nov 1978

Mona F Smith Nov 1978 266 p Supersedes NTIS/PS-77/1051 NTIS/PS-76/0929 NTIS/PS-75/693 NTIS/PS-75/089 2 Vol
(NTIS/PS-78/1213/4 NTIS/PS-77/1051, NTIS/PS-76/0929, NTIS/PS-75/693 NTIS/PS-75/089) Avail NTIS
HC \$28 00/MF \$28 00 CSCL 10B

Citations from Federally-funded research cover cadmium sulfide solar cell theory, design, development, fabrication, and degradation. Studies include junctions with thin films of copper sulfide, selenides, and tellurides. The performance, testing analysis, efficiency, and costs of these cells are covered. This updated

bibliography contains 261 abstracts, 17 of which are new entries to the previous edition. GRA

N79-15437# National Technical Information Service Springfield Va

CADMIUM SULFIDE SOLAR CELLS CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Nov 1978

Mona F Smith Nov 1978 176 p Supersedes NTIS/PS-77/1052 NTIS/PS-76/0930 2 Vol
(NTIS/PS-78/1214/2 NTIS/PS-77/1052 NTIS/PS-76/0930)
Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

Worldwide research on cadmium sulfide solar cell design, development, fabrication, heterojunctions, doping, and performance are cited in this bibliography. Studies on defects, protective coatings, and arrays are included. Thin films of copper indium selenide, copper sulfide, indium phosphide, cadmium selenides, and cadmium tellurides are among those described in these photovoltaic systems. This updated bibliography contains 172 abstracts, 28 of which are new entries to the previous edition. GRA

N79-15438# Fish and Wildlife Service Ft Collins Colo Western Energy and Land Use Team

TEXAS LIGNITE ENVIRONMENTAL PLANNING OPPORTUNITIES

Thomas J Cloud Jr Jun 1978 19 p refs
(PB-286870/1 FWS/OBS-78/26) Avail NTIS
HC A02/MF A01 CSCL 08I

Aquatic, terrestrial, and recreational environmental impacts resulting from lignite development in Texas are reviewed. Various opportunities for proper environmental protection measures are discussed, such as involving concerned agencies and the public in planning the establishment of reclamation plans, and the development of information regarding the environmental requirements of plant and animal species. GRA

N79-15439# Municipal Environmental Research Lab Cincinnati Ohio Wastewater Research Div

TOTAL ENERGY CONSUMPTION FOR MUNICIPAL WASTEWATER TREATMENT

Robert Smith Aug 1978 52 p refs
(PB-286688/7, EPA-600/2-78-149) Avail NTIS
HC A04/MF A01 CSCL 10A

Quantities of all forms of energy consumed for collection and treatment of municipal waste water were estimated. Heat energy was equated to electrical energy by a conversion factor of 10,500 Btu/kwh. Total energy consumption expressed as kwh/mg of waste water treated ranges from 2300-3700 kwh/mg. Energy used for construction of the treatment plant and the sewage system represented 35-55% of the total energy consumed. The remainder used for plant operation was predominantly (65-75%) electrical energy. The use of high efficiency aeration devices combined with good maintenance practices appeared to offer the best opportunity for conservation of energy within the plant. GRA

N79-15440# Environmental Systems, Inc Annapolis, Md
USE OF SOLAR ENERGY TO HEAT ANAEROBIC DIGESTERS PART 1 TECHNICAL AND ECONOMIC FEASIBILITY STUDY PART 2 ECONOMIC FEASIBILITY THROUGHOUT THE UNITED STATES Feasibility Study, 5 Nov 1975 - 1 Jun 1976

Jess W Malcolm and David E Cassel Jul 1978 99 p
(Contract EPA-68-03-2356)
(PB-286940/2 EPA-600/2-78-114-Pt-1) Avail NTIS
HC A05/MF A01 CSCL 13B

Two distinct, yet related studies were conducted to determine the technical and economic feasibility of using solar energy as the source of heat for the anaerobic digestion process. Retrofitting a solar energy collection and heat transfer system to a digester at Annapolis, Maryland was proven feasible in the first part of the study, and the concept of using solar energy for digester heating throughout the United States, including Fairbanks, Alaska, was shown to be economically feasible in the second part of the study. GRA

N79-15473# Environmental Monitoring and Support Lab, Cincinnati, Ohio

ANALYSIS OF RADIOACTIVE CONTAMINANTS IN BY-PRODUCTS FROM COAL-FIRED POWER PLANT OPERATIONS

Herman Krieger and Betty Jacobs Jul 1978 41 p refs
(PB-286365/2, EPA-600/4-78-039) Avail NTIS
HC A03/MF A01 CSCL 18H

The major radionuclides detected in fossil fuel power plant operations were identified and quantified. Samples of coal, flyash, bottom ash and scrubber sludge were collected from different regions in the U S and analyzed for radium, thorium, and uranium. The report tabulates the spectrum of activity levels in a variety of samples and compares the results from nondestructive spectrometry and from radiochemical separations. The environmental impact of an expanding fossil-fuel power plant operation is discussed and it is concluded that for the present, no radiation hazard exists. GRA

N79-15474# Massachusetts Inst of Tech, Cambridge Dept of Chemical Engineering

COMBUSTION RESEARCH ON THE FATE OF FUEL-NITROGEN UNDER CONDITIONS OF PULVERIZED COAL COMBUSTION Final Task Report

J M Levy, J H Pohl, A F Sarofim, and Y H Song Aug 1978 187 p refs
(Grant EPA-R-803242)
(PB-286208/4, EPA-600/7-78-165) Avail NTIS
HC A09/MF A01 CSCL 21B

Coal pyrolysis and oxidation and char oxidation were studied to determine the effects of temperature and fuel/oxygen equivalence ratio on the conversion of coal-nitrogen to NOx. The devolatilization experiments showed that no nitrogen loss occurred until 10 to 15% of the coal had been devolatilized. Nitrogen was completely removed from the char by prolonged heating at above 1750 K. Loss of nitrogen and total weight loss are linearly correlated with a nitrogen-to-carbon slope of 1.25 to 1.5. Volatile nitrogen compounds accounted for the major fraction of NOx produced from coal-nitrogen. The results suggest that low NOx emissions from pulverized coal combustion are favored by a two-stage design: the first stage operated fuel-rich at high temperature, the second, fuel-lean at low temperature. GRA

N79-15479# Radian Corp, Austin, Tex
GUIDELINES FOR PREPARING ENVIRONMENTAL TEST PLANS FOR COAL GASIFICATION PLANTS Final Report, May 1976 - Dec 1977

G C Page, W E Corbett and W C Thomas Jul 1978 187 p refs
(Contract EPA-68-02-2147)
(PB-286659/8, EPA-600/7-78-134) Avail NTIS
HC A09/MF A01 CSCL 07D

A philosophy and strategy for preparing environmental assessment sampling and analysis (test) plans are outlined. Five major points of test plan development are addressed: (1) defining the test objectives, (2) performing an engineering analysis of the test site, (3) developing a sampling strategy, (4) selecting analytical methods, and (5) defining data management procedures. The important considerations involved in each area are discussed in relation to three types of environmental tests: (1) waste stream (levels 1, 2 and 3), (2) control equipment, and (3) process stream characterization. Specific sampling and analytical methods are presented, with numerous references cited for more detailed information. GRA

N79-15783# Los Alamos Scientific Lab, N Mex
ENVIRONMENTAL AND RADIOLOGICAL SAFETY STUDIES INTERACTION OF (Pu-238)O2 HEAT SOURCES WITH TERRESTRIAL AND AQUATIC ENVIRONMENTS Progress Report, 1 Jul - 30 Sep 1977

Glenn R Waterbury (comp) Nov 1977 30 p refs
(Contract W-7405-eng-36)
(LA-7033-PR) Avail NTIS HC A03/MF A01

The effects of terrestrial and aquatic environments on the containers for heat sources in radioisotope thermoelectric

generators was investigated in order to obtain data for designing even safer systems. Topics covered include analysis of data from environmental chamber experiments that simulate terrestrial conditions, experiments to measure PuO2 dissolution rates, and soil column experiments to measure sorption of plutonium by soils. Several aquatic experiments are described. DOE

N79-15815# Committee on Science and Technology (U S House)

UNITED STATES CIVILIAN SPACE PROGRAMS AN OVERVIEW

Marcia S Smith, George N Chatham, Christopher H Dodge, Barbara A Luxenberg, Len H Raleigh, and Charles S Sheldon II Washington GPO 1979 180 p refs. Rept for Subcomm on Space Sci and Applications of the Comm on Sci and Technol, 95th Congr, 2d Sess, Dec 1978. Prepared by the Library of Congr, Congressional Res Service (GPO-35-823) Avail SOD HC

An overview of NASA's history and its relationship to U S space policy is presented as well as a synopsis of the achievements and benefits derived from a many-faceted nonmilitary space program. Issues identified for congressional consideration of specific elements of a cohesive space policy relate to: (1) NASA as an organization, (2) NASA centers and facilities, (3) launch vehicles and propulsion, (4) applications satellites, (5) NASA tracking stations and the TDRSS, (6) space shuttle, (7) space sciences, (8) space life sciences, (9) materials processing in space, (10) international space programs, (11) domestic technology utilization, and (12) NASA university support. A RH

N79-15830# Oak Ridge Associated Universities, Tenn
COAL RESEARCH DATA SYSTEMS AND INFORMATION TRANSFER

W E Felling, ed Oct 1977 22 p. Sponsored by ERDA (ORAU-133, Conf-771207-1) Avail NTIS HC A02/MF A01

As a consequence of years of minimal support for coal processing research, only marginal communication occurs between those government agencies and educational institutions concerned with such research. The need for mechanisms by which universities and ERDA energy research centers can regularly communicate with each other and the need for a shared, reliable, and accessible coal data system are assessed. The Department of Energy's Coal Technology Information Center and Technical Information Center at Oak Ridge National Laboratory, RECON, and the Texas A&M University coal information data systems are described. A RH

N79-15864# Hydrocarbon Research, Inc, Lawrenceville, N J
DEMETALLIZATION CATALYST TESTS ON HEAVY RESIDUAL OILS Final Report, Feb 1975 - Jan 1977

P Maruhn, G Nongbri, William J Rhodes, V V Manshlin, Yu K Vail, B A Lpkind, and A V Agafonov Jun 1978 86 p refs. Prepared in cooperation with All-Union Sci Res Inst of Oil Refining, Moscow and Industrial Environ Res Lab, Research Triangle Park, N C (Contract EPA-68-02-0293)

(PB-285937/9, EPA-600/7-78-119) Avail NTIS
HC A05/MF A01 CSCL 07A

Results of a cooperative project between the U S and the USSR to exchange technology on the demetallization step of an overall process to produce low sulfur fuel oil from heavy petroleum residue are presented. Graphs are included for each aging test showing the degree of demetallization and desulfurization and the rate of catalyst deactivation. Fresh and used catalyst analyses are presented along with detailed run summaries and product inspections. Each nation's molybdenum-impregnated catalyst exhibited about equal demetallization capability; however, the U S catalyst exhibited higher desulfurization capability during demetallization. GRA

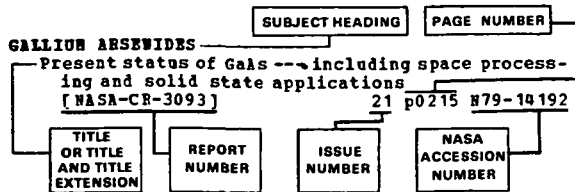
N79-15868# Transportation Research Board, Washington, D C
ENVIRONMENTAL CONSERVATION CONCERNS IN TRANSPORTATION ENERGY, NOISE, AND AIR QUALITY

Damian J Kulash, Carmen Difiglio, Philip S Shapiro, Richard H Pratt, and Charles A Lave 1977 82 p refs
(PB-286550/9, TRB/TRR-648, ISBN-0-309-02677-6, LC-78-13538) Avail NTIS HC A05/MF A01 CSCL 13F

Topics covered include impact of mandatory fuel economy standards on automobile sales and fuel use, energy-saving potential of transit, rail rapid transit and energy, the adverse effects, energy-crisis travel behavior and the transportation planning process potential energy savings resulting from a cessation of federal aid to urban highway construction policy preferences for conservation of transportation energy in case of fuel shortage, traffic noise prediction comparative analysis of HIWAY, California and CALINE 2 line source dispersion models, Philadelphia air quality control development of criteria for reserving exclusive bus lanes, line source emissions modeling and use of traffic simulation in analysis of carbon monoxide pollution GRA

SUBJECT INDEX

Typical Subject Index Listing



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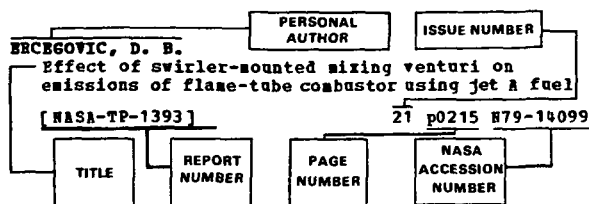
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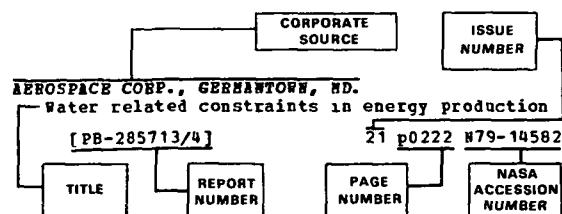
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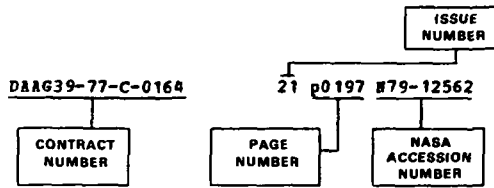
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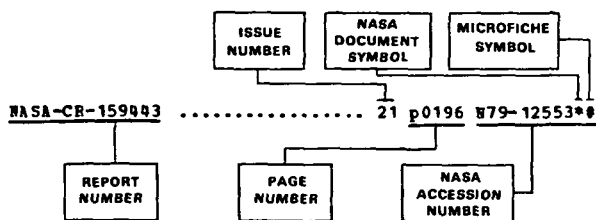
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