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ENERGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

Issue 34

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between April 1 and June 30, 1982 in

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

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(34)) lists 1015 reports, journal articles, and other documents announced between April 1, 1982 and June 30, 1982 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.

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 entries are arranged in eight major categories, with *IAA Entries* preceding *STAR Entries* in each category. 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.

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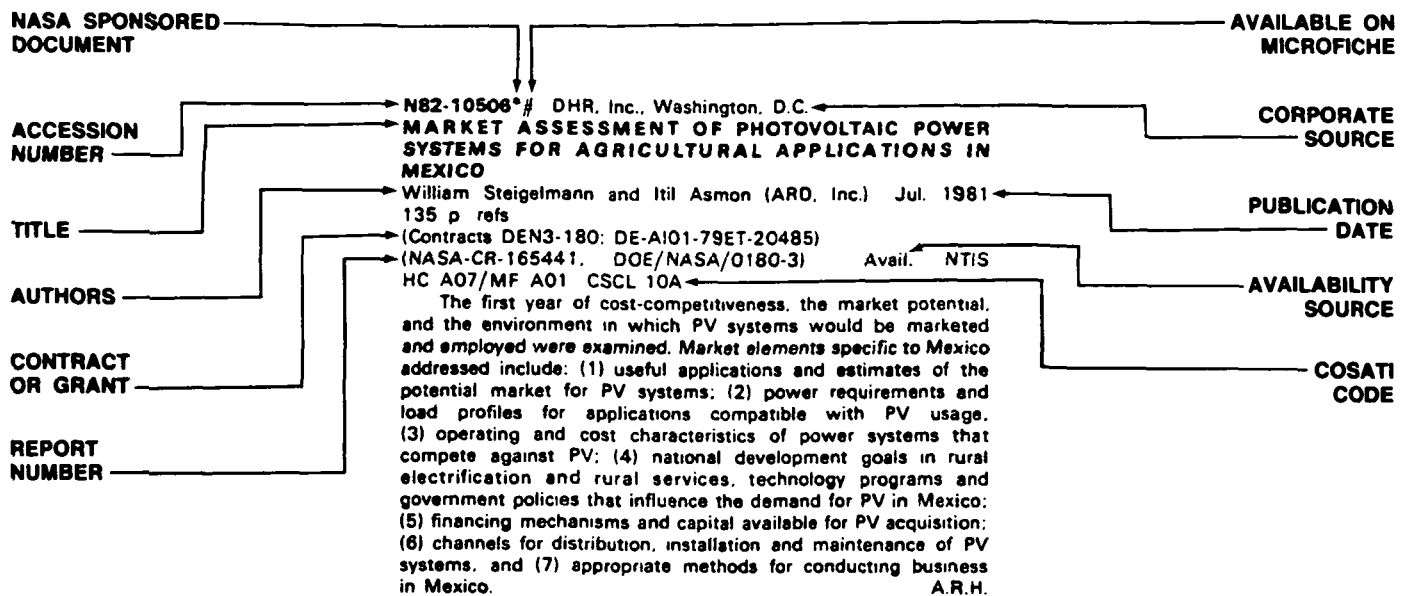
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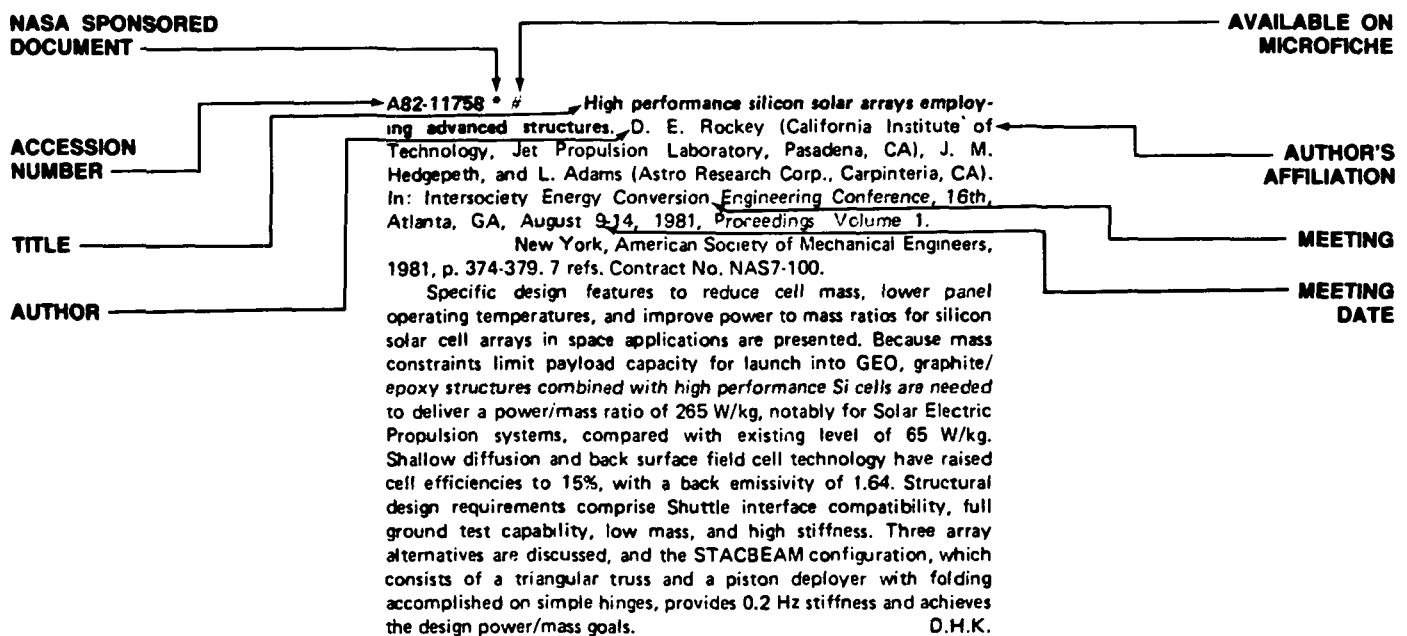
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A Listing of Energy Bibliographies Contained in This Publication:

1. National energy research and development program --- bibliography of Belgian scientific and technical reports

p0182 A82-18707

JULY 1982

01

ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

Includes energy requirements, energy conservation, and environmental impacts of energy systems.

A82-19053 # An impact assessment of MOD-2 wind generators on the TVA power system. D. W. Hilson, N. D. Sadanandan (Tennessee Valley Authority, Chattanooga, TN), H. M. Sendaula, and R. R. Johnson (Tennessee, University, Chattanooga, TN). In: Annual Allerton Conference on Communication, Control, and Computing, 18th, Monticello, IL, October 8-10, 1980, Proceedings.

Urbana, IL, University of Illinois, 1980, p. 196-205. 7 refs. Contract No. DE-AI01-79ET-23077.

The impact of significant amounts of wind generation on the daily operations of an electric power system is currently being investigated by the Tennessee Valley Authority (TVA) under sponsorship of the Department of Energy. This paper describes the characteristics and daily operations of the TVA system without wind, and summarizes the preliminary findings when simulating a reconfiguration of the transmission system to accommodate wind generation. The ongoing activities for simulation and analysis of the operation of the TVA system with wind generation are also briefly outlined. (Author)

A82-19112 System economic theory for WECS. A. P. Rockingham (Central Electricity Generating Board, Planning Dept., London, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 109-117. 6 refs.

A method for evaluating the design of wind energy conversion systems (WECS) as fuel and capacity savers for utilities is presented. A criteria of the marginal value of the WECS to the system is chosen as an indicator of savings in total system expense. Cost polygons are employed to show that the net effective cost is at a minimum when the cost of meeting an increment in demand at peak hour is lowest. Noting that actual operating experience with WECS is necessary for the validity of capacity credit analyses, the difficulties in maintaining optimum heat use loads in conventional plants due to fluctuations of input from WECS are outlined. Finally, it is shown that the cost of added WECS plants will decline as the number of WECS decreases, while the total capacity and the cost of power will remain the same. M.S.K.

A82-19118 The Hull wind powered housing project. D. C. Hodges (Hull College of Higher Education, Hull, Yorks., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 163-172.

This paper will describe a proposed scheme in Hull to utilize a medium scale wind generator to provide a large portion of the space and water heating requirements for a group of 32 highly insulated local authority houses. The proposed system to achieve this will be described, followed by analysis of the advantages of such systems and an estimate of their possible application. (Author)

A82-19119 Offshore siting of wind turbine generators in U.K. waters. P. B. Simpson and D. Lindley (Taywood Engineering, Ltd., Southall, Middx., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 173-185.

A technical and economic assessment is described of the generation of electricity using wind turbine generators located in shallow waters off the coast of the United Kingdom. The assessment involved studies of siting criteria, meteorology, sea surface conditions, engineering geology, construction materials, support structures, marination of complete installations, cluster efficiency, electrical transmission and control, availability and environmental aspects. Estimates of generation costs are quoted and some of the results of an analysis of the influence of various parameters on generation cost and performance are described. (Author)

A82-20141 Potential for a Danish power system using wind energy generators, solar cells and storage. S. Blegaa and G. Christiansen (Danmarks Tekniske Højskole, Lyngby, Denmark). *International Journal of Ambient Energy*, vol. 2, Oct. 1981, p. 223-232. 9 refs.

Performance characteristics of a combined solar/wind power system equipped with storage and an unspecified back-up power source are studied on the basis of meteorological data in Denmark from 1959-1972. A model for annual production and storage from wind/solar installations is presented, assuming 12% efficiency for the solar cells and various power coefficients of the windmills, in addition to long and short-term storage. Noting that no correlation between wind and solar energy availability was found, and a constant ratio of 60% wind/40% solar was determined to be the optimum mix for large scale power production without taking into consideration the variations among years. It is concluded that 80-90% of the total Danish electrical load can be covered by solar/wind systems, and 100% may be possible with the addition of pumped hydroelectric storage. M.S.K.

A82-20166 Wind - Prototypes on the landscape. M. L. Smith. *EPRI Journal*, vol. 6, Dec. 1981, p. 27-30, 32-34. 6 refs.

Large wind turbines are shown to be attractive to utilities because of the potential for decreasing gas and oil consumption, the relatively low costs for entry into the field, and the wide distribution of wind energy. The total generating capacity can be increased in incremental steps, experience in construction and operation of large turbines have been gained from the NASA Mod O, OA, 1, and 2 models, and advances in manufacturing processes will make the large turbines competitive as replacement power for oil and gas burning utility generators. The 300 ft rotor Mod 2 machines are described, along with designs for the Mod 5A and Mod 5B wind turbines, with 400 and 422 ft, 6.2 and 7.2 MW rotors and outputs, respectively. Current plans for multi-MW windfarms are reviewed, and the option of using the land around large wind turbines for other purposes is stressed. M.S.K.

A82-20207 # Advantages of permanent magnet VSCF generating systems on aircraft fuel economy. J. J. O'Neill (General Electric Co., Aircraft Equipment Div., Binghamton, NY). *Journal of Energy*, vol. 6, Jan.-Feb. 1982, p. 34-37. 8 refs. USAF-sponsored research.

Permanent magnet aircraft electrical generating systems offer many advantages to both the aircraft designer and the user. These systems are typically smaller, lighter, and more reliable. Another

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

advantage, which until recently has been overlooked, is the higher efficiency of this type of system. This paper examines the effect of the higher efficiency on aircraft fuel consumption. Data for several system sizes are presented as well as several techniques for calculating such parameters as differential power extraction, cost savings per hour, and total cost savings. (Author)

A82-20513 Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. Symposium sponsored by the Royal Aeronautical Society, London, Royal Aeronautical Society, 1981. 77 p.

Topics discussed include design possibilities for improved fuel efficiency of civil transport aircraft, energy management in military combat aircraft, and the control of aircraft gas turbines for fuel economy. Particular attention is given to the impact of increasing cost upon the design of avionic fuel management systems and the operational and performance aspects of fuel management in civil aircraft. Consideration is also given to the FS2 Bedford Civil Flight Research Program as well as current and future developments in thrust management. J.F.

A82-20514 Design possibilities for improved fuel efficiency of civil transport aircraft. D. H. Jagger (Airbus Industrie, Blagnac, Haute-Garonne, France). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 9 p.

The possible application and potential benefits of various technical advances in aerodynamics, structures, and propulsion for the reduction of fuel usage in future Airbus aircraft are discussed. In particular, technical comparisons and tradeoffs in terms of fuel economy are considered for a hypothetical medium-range project aircraft of the 1980's. Improvements in fuel used per passenger at 1,000 n.m. range over two successive periods of 20 years are estimated. A breakdown of the objectives, time-scales, and costs of various parts of the current NASA Aircraft Energy Efficiency Program is also given. This features such improvement as propulsion/aerodynamic integration winglets, the use of advanced composite materials, drag cleanup, structural-duct integration, minimum suction-natural laminar flow, reduction of engine performance losses, and active controls for load alleviation. J.F.

A82-20515 Energy management in military combat aircraft. J. W. Lyons (British Aerospace Public, Ltd., Co., Aircraft Group, Brough, Humberside, England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 6 p. 5 refs.

Energy management is important not only for fuel economy, but for efficient three-dimensional maneuvering capabilities as well. The principles of several new techniques for energy efficient three-dimensional maneuvers in combat aircraft are discussed. Efficient turbofan engines have been adopted which are electronically controlled for achieving precise thrust settings within engine limits. Engine bleed can be better controlled, and hydraulic pressure control, resulting in reduced mechanical offtakes from the engine, is now possible using microprocessors. Self-healing systems can be used in the battlefield scenario, and advanced display concepts are being employed to make better use of available maneuver energy. These techniques individually result in greater efficiency, but together they provide significant synergistic improvements. J.F.

A82-20516 The control of aircraft gas turbines for fuel economy. D. J. Lee (Rolls-Royce, Ltd., Bristol, England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 7 p.

Electronic controls are important to the fuel efficient aircraft of the future as sophisticated fly by wire controls, flight management systems, and complex ATC navigation systems. The functions obtainable using electronic controls are often more complex and more flexible than those produced with hydromechanical systems. They provide greater accuracy in staying within temperature and

stress limitations, as well as increased fuel economy. Electronic engine control is also very cost effective over the life-of the unit and has the benefit of reducing the pilot workload. Microprocessors have made the use of digital technology for engine control more popular; the benefits of digital control may be seen in terms of improved accuracy, fault diagnostics and tolerance, fuel-type variations, system complexity, and airframe integration. Finally, engine health monitoring systems are used for the programmed maintenance of mechanical parts of gas turbines. J.F.

A82-20517 The impact of increasing energy costs upon the design philosophy of avionic fuel management systems. P. R. Thrift (Smiths Industries Aerospace and Defence Systems Co., London, England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 9 p.

Parameters of fuel quantity remaining and rate-of-usage are determinate factors in the operational range of any aircraft. Methods for designing engines with lower fuel consumption, and airframes with lower drag coefficients to minimize the mass of fuel to be carried are being investigated. Operating costs may be reduced by using unused portions of fuel as dynamic balast to control the center of gravity throughout a flight profile. Fuel consumption can also be reduced by control of the aircraft's complete flight envelope. Strategies for measuring fuel mass and determining fuel density are discussed. Means of improving the twin concentric circular cross section transducers are discussed, and the production of a fault tolerant system by the incorporation of two computer systems is described. Finally, the use of microprocessors to control the center of gravity and to detect fuel leaks is discussed. J.F.

A82-20518 Operational and performance aspects of fuel management in civil aircraft. H. P. K. Dibley (British Airways, Hounslow, Middx., England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 13 p.

In order to carry maximum payload at minimum cost, an airline must find means of optimizing fuel purchasing, pre-flight planning, and in-flight procedures. Accurate forecasting and monitoring of fuel costs is needed to obtain adequate fuel supplies at the best price, to maximize uplift at cheap stations, and to show the effect of outages of uplift stations. Pre-flight planning is used to determine the route for minimum fuel consumption and to calculate the maximum take-off weight. Minimization of fuel consumption during flight can be achieved by (1) presentation of optimum climb, cruise and descent information; (2) flight management systems coupled to the autopilot; (3) optimizing the use of engine climb derate; (4) improving navigational accuracy; (5) presentation of more navigation parameters to the pilot; (6) vertical navigation; and (7) minimizing noise and fuel consumption on approach. J.F.

A82-20520 Thrust management - Current achievements and future developments. J. L. Weston (Smiths Industries Aerospace and Defence Systems Co., Cheltenham, Glos., England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 12 p.

A system architecture has been developed to provide a fuel efficient full-flight regime auto-throttle system and a second generation flight management computer system. The auto-throttle system is capable of controlling the engine throttle levers from before take-off until touchdown as well as providing command signals to the aircraft flight director system. The operation modes of the system include take-off, climb, cruise, descent, maximum continuous thrust, hold, approach and go-around. The flight management computer system is responsible for the overall operation of the aircraft between the take-off location and the destination point. Its eight major functions are (1) flight planning; (2) navigation; (3) control of VOR/DME receivers; (4) lateral guidance; (5) vertical path optimization; (6) vertical guidance; (7) look ahead information; and (8) provision of information to support the electronic flight instrument system. J.F.

A82-20644 Environmental effects of the Satellite Power System Microwave Power Transmission System. A. R. Valentino

(Argonne National Laboratory, Argonne, IL) and M. M. Abromavage (IIT Research Institute, Chicago, IL). In: NTC '80, National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record, Volume 3.

New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 48.5.1-48.5.4.

The potential environmental effects of the Satellite Power System (SPS) Microwave Power Transmission System (MPTS) have been studied as a part of the SPS Concept Development and Evaluation Program (CDEP). A number of issues have been identified including: health effects due to microwave exposure for the public as well as the SPS worker; effects on telecommunications due to ionospheric changes caused by the passage of the microwave beam; and electromagnetic compatibility with military systems, radio astronomy, satellite systems, and electronic systems in general. Assessments have been prepared based on existing data, and none of the issues precludes the continued study of SPS technology. To increase the certainty of the assessment, some research has been initiated and long-term research is being planned. (Author)

A82-20757 General aviation fuel conservation in the 1980's. G. R. Bromley (Beech Aircraft Corp., Wichita, KS). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 9-1 to 9-22.

Techniques for conserving fuel in-flight are given from a flight engineer's point-of-view, noting that aircraft designs will increasingly incorporate cleaner aerodynamics and better engine-to-airframe matching. The effects of wind and temperature at various altitudes and fuel consumption in ascent and descent are considered, and methods for determining maximum range airspeeds are developed, particularly for choosing long-range cruise airspeeds. Specific charts are presented for private pilots in general aviation aircraft, relating wind, no-wind, and tailwind conditions as regards to fuel consumption. M.S.K.

A82-20764 A study of the suitability of the all fiberglass XV-11A aircraft for fuel efficient general aviation flight research. G. Bennett (Mississippi State University, Mississippi State, MS). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980. Lancaster, CA, Society of Flight Test Engineers, 1980, p. 18-1 to 18-15. 8 refs.

The impact of rapidly rising fuel prices upon future general aviation aircraft requirements is explored. The current configuration of the fiberglass XV-11A aircraft is presented and it is shown that the aircraft can become a cost effective testbed for fuel efficient general aviation aircraft configurations. Several suitable research tasks for the aircraft are defined. A low cost method to produce master wing molds is proposed. (Author)

A82-20874 * # Advanced subsonic transport propulsion. D. L. Nored, C. C. Ciepluch, R. Chamberlin, E. T. Meleason, and G. A. Kraft (NASA, Lewis Research Center, Cleveland, OH). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, NJ, May 26-28, 1981, AIAA Paper 81-0811*. 30 p. 5 refs.

Examination of future subsonic commercial aircraft propulsion trends begins with a brief review of the current NASA Energy Efficient Engine (E3) Project. Included in this review are the factors that influenced the design of these turbofan engines and the advanced technology incorporated in them to reduce fuel consumption and improve environmental characteristics. In addition, factors such as the continuing spiral in fuel cost, that could influence future aircraft propulsion systems beyond those represented by the E3 engines, are also discussed. Advanced technologies that will address these influencing factors and provide viable future propulsion systems are described. And finally, the potential importance of other propulsion system types, such as geared fans and turboshaft engines, is presented. (Author)

A82-21225 Renewable energy - Target for 2050. W. D. Rowe (American University, Washington, DC). *IEEE Spectrum*, vol. 19, Feb. 1982, p. 58-63. 10 refs.

The possibilities of various renewable energy technologies to supply a projected world demand for 40,000 GW years of energy each year by the year 2050 are examined. Noting that industrial processes consume 50% of all energy needs, fossil fuel reserves are shown to be sufficient for a maximum of 370 yr in the U.S., when all supplies become depleted. Breeder reactors have a doubling time which is 30 yr too long for meeting more than 0.5% of world energy demand in 2050, while fusion, even considering ocean-derived deuterium as a fuel source, will not be supplying energy for another 35-70 yr. Among the solar technologies, the installation of ten million 100 m tall 4 MW wind generators is feasible to meet all the projected energy needs, and solar cells with 10% conversion efficiency could do the same with 14 times less land. Further discussion is given to geothermal, fuel cell, and OTEC technologies, as well as the forty trillion dollars necessary to erect the fully renewable systems. M.S.K.

A82-21362 Government-industry relationships in technology commercialization - The case of photovoltaics. J. D. Roessner (Georgia Institute of Technology, Atlanta, GA). *Solar Cells*, vol. 5, Jan. 1982, p. 101-134. 34 refs. NSF-supported research.

Interfaces between the U.S. government and the emerging photovoltaics industry are examined in terms of basic research programs, market studies, and strategies to accelerate the development of the industry. The process of the development of a model industry is outlined from innovation to large-scale, specific use production, and DOE programs are noted to shift from R and D, testing, and evaluation programs to market tests, demonstrations, and workshops when a product becomes commercially ready. The growth of funding for research, technology development, and purchases to gain operational experience with solar cell arrays is traced, and it is noted that firms specializing in photovoltaics production have managed to continue with irregular government funding and normal, private financing arrangements. Government procurement is suggested to have the greatest impact on a new industry, especially when coupled with performance and reliability requirements. M.S.K.

A82-21373 * # We have just begun to create efficient transport aircraft. D. J. Maglieri and S. M. Dollyhigh (NASA, Langley Research Center, Aeronautical Systems Div., Hampton, VA). *Astrodynamics and Aeronautics*, vol. 20, Feb. 1982, p. 26-38. 21 refs.

Factors affecting the cost-effectiveness and economics of the air transportation industry are reviewed. The delivery of more fuel-efficient aircraft and eventual total replacement in the 1990's by fleets of advanced aircraft are seen to offset rising fuel costs. Better airport operations are perceived to eliminate fuel-costly delays due to overcrowded runways, lack of available carriers, and maintenance of aircraft in holding patterns. Noise reduction research will lower the lawsuit costs from noise pollution, and the introduction of advanced turbofans for long, short, and medium range flights, advanced commuter planes, and advanced SSTs offering projected 50% increases in current aircraft efficiencies are seen to be limited only by the airlines' ability to provide purchase financing, rather than by a lack of available new technology. M.S.K.

A82-22097 # Testing of the low mass flow test train in the DOE Coal Fired Flow Facility. G. D. Smith, R. J. Schulz, and N. R. Johanson (Tennessee, University, Tullahoma, TN). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan 11-14, 1982, Paper 82-0378*. 12 p. 7 refs. Contract No. DE-AC02-79ET-10815.

The initial shakedown testing and evaluation of The Department of Energy (DOE) Coal Fired Flow Facility and the Low Mass Flow Magnetohydrodynamic Test Train are described. The testing included system and component performance determination and initial evaluation of the NO(x) relaxation through the flow train and SO₂ level existing in the exhaust. Satisfactory performance was obtained from the facility systems and flow train components including the vitiation heater, coal fired combustor, radiant slagging furnace and secondary combustor. The effect of primary stoichiometry and N/O ratio on NO(x) levels throughout the flow train was clearly demonstrated. The exhaust stack NO(x) and SO₂ levels for coal-fired operation are shown to be well below current EPA limits. Heat flux and wall static pressure distributions along the flow train are

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presented and were found to be consistent with previous experience in a smaller research facility. The facility is operational as a test facility for coal and oil fired combustion systems and is capable of operation over a range of conditions from 100% coal to 100% fuel oil or any combination of coal/fuel oil mixture. (Author)

A82-24025 Air transport in the 21st century. K. G. Wilkinson. *Aerospace* (UK), vol. 9, Jan. 1982, p. 18-23. 8 refs

Trends in aircraft design into the 21st century are discussed, based on the driving need for higher fuel efficiency and alternative fuels. Noting that fuel presently accounts for 30% of air transportation, results of an international study on the world energy supply and growth are used to present several scenarios of future aerospace operations. Global energy is projected to be provided from renewables and nuclear, coal and gas, and oil, each group producing 1/3 of the world energy demands, with aerospace consuming 3% of the total oil consumed. Advances in aerodynamics from NASA studies, in lightweight synthetic materials, in active controls, and in propulsion systems are outlined, with mention made of the CO₂ contribution to a global rise in temperature. The development of nuclear technology and the availability of nuclear fuels is contrasted against the environmental costs of using hydrocarbon fuels, and the necessity of developing a hydrogen-based fuel economy is emphasized. M.S.K.

A82-24075 # Stack gases desulfurization recovery processes in thermal power plants of the world. III - Processes based on absorption by solid materials. S. Kumar (Banaras Hindu University, Varanasi, India). *Indian Journal of Environmental Protection*, vol. 1, July 1981, p. 162-165. 17 refs.

A review of processes involving entrained contactor systems and efficient dust recovery equipment for desulfurization recovery in the stacks of thermal power plants is presented. The alkalized alumina process involves the contact of the stack gas with the absorber in an entrained solid reactor at high temperature. The removal of SO₂ occurs from 130-330 C by means of alkalized alumina with an active ingredient of sodium oxide. The DAP-Mn process comprises an absorption tower for the stack gases and a magnesium oxide absorber. Manganese sulphate is formed in the tower for collection in a multicyclone collector or an electrostatic precipitator. The absorber is later recycled. The Grillo process has an absorbent deposited on a carrier such as coke and contacted with stack gas in a moving bed absorber. Finally, the Sill process is examined for the absorber contact in an entrainment reactor, using high-calcium lignite ash for an absorber. M.S.K.

A82-24304 Fuel-efficient windshields for transport, commuter and business aircraft. G. L. Wiser (Sierracin Corp., Sylmar, CA). In: Conference on Aerospace Transparencies, London, England, September 8-10, 1980, Proceedings. London, Society of British Aerospace Companies, Ltd., 1981, p. 25-95. 34 refs.

The effects of weight and drag reduction measures involving windshields and their associated structures and systems on fuel efficiency are explored. It is shown that the incorporation of these techniques can save up to 80,000 gallons of fuel/year per aircraft in wide-body commercial aircraft applications, and 12,000 gallons/year per aircraft in the case of commuter designs. The alternatives considered include (1) flat glass windshields, (2) curved glass windshields, (3) curved high-strength glass windshields, (4) structurally-integrated curved windshields, (5) curved stretched acrylic windshields, (6) curved, chemically-strengthened glass windshields, and such associated systems as temperature controllers and rain removal. O.C.

A82-24394 Management of powerplant maintenance and restoration programs for fuel conservation. C. Reid (General Electric Co., Fairfield, CT). *Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 5-8, 1981, Paper 811052*. 15 p.

Powerplant operational and maintenance procedures are reviewed to minimize fuel consumption and total operating costs of existing large turbofan engines. Recommendations are made to reduce the rate of on-wing performance deterioration and to define cost effective performance refurbishment. Measures being taken to increase fuel and cost savings include the development of perfor-

mance diagnostic/analytical systems to permit better management control of engine operating costs. On-wing performance retention can be improved by the observance of line maintenance and operational procedures minimizing the impact of the major causes of performance deterioration, such as increased clearances, erosion, contamination and leakage. D.L.G.

A82-24395 Airline fuel saving through JT9D engine refurbishment. J. W. Allison and D. R. Weisel (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT). *Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 5-8, 1981, Paper 811051*. 12 p.

Since the JT9D engine entered airline service in 1970, increase in the price of jet fuel made it imperative to devise refurbishment procedures for in-service engines to improve their fuel economy. Developments leading to performance recovery and improvement of the engine are related to fan leading edge rework, and the one degree open first stator. Factors responsible for engine performance recovery and retention include also operational procedures, test configuration, and prevention of aircraft system pneumatic leakage. Attention is given to the fan strip panel concentric grinding tool, a properly repaired combustor with recently developed 'S-16' fuel nozzles, recommended refurbishment additions, operational procedures to maximize performance retention, a test configuration, and inspection techniques. G.R.

A82-24604 # Magnetohydrodynamics and its hazard assessment. W.-T. Chan. *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Saf-3* 7 p. 34 refs. Members, \$2.00; nonmembers, \$4.00. Research supported by the Montana Energy and Magnetohydrodynamics Research and Development Institute.

Potential occupational and environmental hazards of a typical combined open-cycle MHD/steam cycle power plant are critically assessed on the basis of direct/indirect research information. Among the potential occupational hazards, explosion at the coal feed system or at the superconducting magnet, combustor rupture in a confined pit, high intensity dc magnetic field exposure at the channel; and combustion products leakage from the pressurized systems are of primary concern. While environmental emissions of SO(x), NO(x) and fine particulates are considered under control in experimental scale, control effectiveness at high capacity operation remains uncertain. Gaseous emission of some highly toxic trace elements including radioactive species may be of concern without gas cleaning device in the MHD design. (Author)

A82-24683 The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 192 p. Members, \$22.50; nonmembers, \$30.

Technical and economic problems were addressed for developing technologies which hold promise for replacing world demand for oil based fuels. Monitoring and analysis of conservation measures were discussed, along with new sources of fossil fuels, and energy from OTEC and fusion power plants. Geothermal plant siting, construction, and operation were examined, and MHD prototype plants were described. The applications and social effects of energy storage systems were explored, along with biomass potentials and methods, solar thermal energy systems, and topics relevant to fission reactor power systems. Finally, the development and assessment of fuel cells for commercial and utility applications were described, and IEEE position papers were presented on reactors, safety, cogeneration, SPS, and solid waste energy sources. M.S.K.

A82-24686 OTEC power system development and environmental impacts. N. F. Sather (Argonne National Laboratory, Argonne, IL). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 50-55. 6 refs.

The costs, materials, maintainability, and environmental impacts of prospective OTEC plants are reviewed, along with developmental time tables. The plants are noted to cost almost three times per KW

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installed power as conventional coal or nuclear plants on land, with main expenses derived from the massive heat exchangers, which must necessarily be 500 times the size of those in conventional power plants. The issue of biofouling in the heat exchangers is addressed, and mechanical scrubbers, recirculating sponge balls, and low-level chlorination are suggested as possible solutions. A 10-40 MW installation is projected to be completed by 1984, and is intended for confirming the validity of OTEC concept for large-scale power generation, to test the methods of preventing biofouling, and to establish monitoring instrumentation for avoiding ammonia leaks from the working cycle into the ambient ocean. M.S.K.

A82-24687 Geothermal resource field development. T. Amor (Thermal Power Co., San Francisco, CA). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980.

New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 71-73.

The procedures for siting, constructing, and maintaining geothermal power plants are examined, with regard for the economic and environmental parameters. An initial survey involves leasing 10,000 acres of land to drill wells to depths of 5000-7000 feet in search of 340-400 F heat in the form of water or steam. The first well costs from \$700,000-1,200,000, and is required to yield a steam flow rate of 100,000 lb/hr to indicate economic feasibility. Generating units are chosen in the 20-55 MW range, and in the case of the Geysers Project 15 wells delivering two million lb/hr are used to drive 110 MW generating units, each installation costing \$20,000,000. Fluids are reinjected into the substrate to prevent subsidence of the land around the site and may actually extend the life of the resource. Problems with hydrogen sulfide abatement techniques are noted to decrease plant efficiencies and have not been solved. M.S.K.

A82-24688 Geothermal direct use projects. E. G. DiBello (EG & G Idaho National Engineering Laboratory, Idaho Falls, ID). In: The 1980's - A forest of energy decision trees, Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980.

New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 75-79.

The history of direct use of geothermal resources is presented, along with an outline of current U.S. based programs. Geothermal fluids have been used to evaporate mineralized water to produce boric acid, for health and bathing, and for district heating. Current programs target applications in agriculture, for fish farming, grain drying, greenhouse heating, soil heating, mushroom growing, and animal husbandry. Industrial uses include timber and diatomaceous earth drying, mineral extraction, dehydration, cement slab curing, pulp and paper processing, and ethanol production. Projects are being monitored for environmental effects, resource assessment, well drilling and evaluation, corrosion, water disposal methods, system design and construction, and operational characteristics. Costs for the heat have been found to span the range of \$.45-5.55/GJ, dependent on well depth and temperature, and space heating, commercial processing, and greenhouse heating systems are examined. M.S.K.

A82-24689 Description of the DOE Coal-Fired MHD Flow Facility /CFFF/. J. B. Dicks, J. F. Martin, J. W. Muehlhauser, and S. S. Strom (Tennessee University, Tullahoma, TN). In: The 1980's - A forest of energy decision trees, Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980.

New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 81-85.

Components, instrumentation, and operating parameters of the DOE MHD Coal-Fired Flow Facility are described, noting its extension and expansion from a previous prototype plant. The CFFF features three bays for coal delivery, offering hot gas flows of 8 and 30 lb/sec, and a third rate for outside contractor studies. A Low Mass Flow test train is intended for engineering tests of component performance, durability, and scaling parameters. An oxygen-rich gas composed of oxygen, nitrogen, and No. 2 fuel oil will be heated to 1283 K for mixing with pulverized coal, a carrier gas, and a seed material such as potassium carbonate and/or potassium sulfate and burned substoichiometrically to produce an ionized gas. The gas flow is routed through a diagnostic channel to determine the MHD output, plasma uniformity, and gas dynamic conditions. Further

systems for slag removal, pollution control, magnetic field generation, and data acquisition are detailed. M.S.K.

A82-24690 Biomass options for the big island of Hawaii. P. C. Meagher and E. M. Kinderman (SRI International, Menlo Park, CA). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980.

New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 92-98

Potential sources of renewable energy which can serve to displace some of the 500 million dollars spent each year by Hawaii for petroleum products are examined, particularly for biomass opportunities. Solar heating is noted to have minimal impact due to favorable weather conditions, while hydropower potential is limited and wind use, although very appealing, will be limited to a 10-15% contribution to the total due to aesthetic power quality, and land-use considerations. Geothermal is projected to steadily grow to 500 MW production. Sugar plants burn bagasse to produce power totalling 9 MW, while a growing logging industry offers increased forest residue for power production competitive with diesel fueled generators. Bagasse, cane trash, sweet sorghum, and ocean plants for alcohol and ethanol formation are not economically feasible unless coupled to a geothermal heating method for thermochemical conversion, and offers the only alternative for liquid fuels imports. M.S.K.

A82-24696 From steam to kilowatts - Planning, siting and regulatory considerations in geothermal resource development. J. F. McKenzie (Pacific Gas and Electric Co., San Francisco, CA). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980.

New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 166-173.

A82-24803 Novel metal-ceramics-composite sealing coatings in aircraft engines (Neuartige Metall-Keramik-Verbund-Dichtungsbelaege in Flugtriebwerken). A. Sickinger and V. Wilms (Motoren- und Turbinen-Union Munchen GmbH, Munich, West Germany). In: Composite materials; Lecture and Discussion Meeting, Constance, West Germany, April 17, 18, 1980, Reports.

Oberursel, West Germany, Deutsche Gesellschaft für Metallkunde, 1981, p. 133-140. In German.

Requirements for the enhancement of the performance of aircraft engines and the reduction of fuel consumption make it necessary to operate aircraft engines at higher gas pressures and temperatures. The development of novel metal-ceramics-composite sealing coatings makes it possible to overcome certain problems related to more exacting sealing requirements and greater thermal extension in connection with the new operational conditions. The sealing coating provides a means to compensate for different thermal extensions and manufacturing tolerances existing for rotating and stationary structural components. It is feasible to obtain minimum clearance values and to reduce attrition effects for the rotating component. Other important benefits of the coating are related to its thermal-barrier characteristics. Attention is given to the requirements which the coating has to satisfy, its application by thermal spraying, the coating composition, and some test results. G.R.

A82-25161 Trade-offs in NO_x control. R. Whitaker. EPRI Journal, vol. 7, Jan.-Feb. 1982, p. 18-25.

Mechanisms which produce NO_x pollutants in coal burning power plants are reviewed, along with methods for lowering the emissions. The pollutant is formed by oxidizing the nitrogen in the combustion air (20-40%) and from burning coal with too lean an air-fuel ratio in initial combustion stages (60-80%). All low-NO_x furnace designs currently feature staging with, e.g., delayed mixing as the fuel enters or reburning of the gases coming from the furnace. Control adjustments are noted to serve as immediate steps for pollutant reduction in retrofit plants, and tangentially fired boilers have demonstrated NO_x emissions as low as 0.2 lb/1,000,000 Btu. The selective catalytic reduction process, mentioned as showing the most cost-effective possibilities, is a post-combustion process which achieves a 60-80% reduction in NO_x flue gas. M.S.K.

A82-25507 Status and near-term development goal - A solar hydrogen economy. P. Brennecke, H. H. Ewe, and E. W. Justi

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(Braunschweig, Technische Universität, Braunschweig, West Germany). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1981, p. 52-57. 14 refs.

The possibilities of total conversion to a world hydrogen-based economy is discussed, noting that economically retrievable coal reserves will be depleted by 2033, at which time a 2-4 C rise in the world atmospheric temperature will have resulted. The removal of large coal, nuclear, and windpowered central generating plants to offshore locations, and solar thermal plants to remote, sunny locations, along with large photovoltaic installations, is recommended as a means of ameliorating the nuisances and dangers of building such facilities near populations. The removal of energy-producing centers from populated areas necessitates long-distance energy transmission, which is noted to be achievable by employing hydrogen gas in natural gas-type transmission pipes. The hydrogen could be produced electrolytically, and an effort during the 1980's to found a common hydrogen pipeline between France and Germany is mentioned. M.S.K.

A82-25660 **The Solar Power Satellite - An opportunity for Third World development.** R. Mayur and P. E. Glaser (SUNSAT Energy Council, Cold Spring, NY). (*United Nations, Conference on New and Renewable Sources of Energy, Nairobi, Kenya, Aug. 10-21, 1981.*) *Space Solar Power Review*, vol. 2, no. 4, 1981, p. 329-335. 26 refs.

The application of Solar Power Satellite (SPS) systems in conjunction with other renewable energy configurations such as flat plate collectors, windmills, hydroelectric power stations, OTEC, and photovoltaic cells to alleviate the shortages and costs of energy sources in developing nations is recommended. Education of people in the Third World to potential benefits of space resources exploitation is a way to involve them in space activities in the 21st century. SPS systems are noted to have a potential of freeing millions of tons of manure and firewood for other uses. Potential land-use and legal definitions of GEO problems are indicated, along with the potential for ocean-basing the rectennas as served as mariculture sites. M.S.K.

A82-25665 **Assessing the Solar Power Satellite - The OTA experience.** R. A. Williamson, S. Weisburd, and A. Wasserman (Office of Technology Assessment, Washington, DC). *Space Solar Power Review*, vol. 2, no. 4, 1981, p. 383-392. 19 refs.

A review of an Office of Technology Assessment examination of SPS potentials and problems as an energy source is presented, along with an examination of the SPS effects on other space systems. The SPS configuration considered included solar cell conversion to klystron transmission to rectennas, with the solid-state converters located on the back of each solar panel. A LEO-based laser system was also explored, along with LEO-based large mirrors to reflect light to selected spots on the earth. A need for the SPS if energy end-use requirements grow to more than 20 quads by the year 2015 was noted, and economic competitiveness with solar technologies and extent of development of the technology was concluded to be on the same level as fusion. Developing the SPS technology was found to offer significant opportunities for advancing U.S. space technology. M.S.K.

A82-25666 **Dust removal from small- and medium-sized coal-fired generators (Le dépolluissage des petites et moyennes chaudières à charbon).** R. Bouscaren (Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique, Paris, France). *Pollution Atmosphérique*, vol. 23, Oct.-Dec. 1981, p. 299-312. 11 refs. In French.

The problem of dust removal from the emissions of industrial coal-fired generators of capacity less than 50,000 th/h is considered in light of increasing emphasis on coal as an energy source. Following a brief review of dust emission standards and the characteristics of dust emission prior to purification, means for the reduction of dust production in various types of combustors are examined. The advantages and disadvantages of the various available types of removal systems are surveyed, with attention given to mechanical removal, wet removal, porous layer removal, and electrical removal. Economic aspects of the installation and operation of dust removal techniques are then surveyed. It is recommended that pollution

standards be temporarily relaxed in order to promote the use of coal in small installations, while intense efforts be undertaken to develop reliable, affordable equipment for dust removal from exhaust emissions. A.L.W.

A82-25669 **Ten years of the fight against air pollution in Japan - Evaluation of a policy (Dix années de lutte contre la pollution de l'air au Japon - Bilan d'une politique).** P. Jarrault (Institut Français de l'Energie, Paris, France), A. Pradinaud (Agence Financière Rhin-Meuse, France), and R. Guillet. *Pollution Atmosphérique*, vol. 23, Oct.-Dec. 1981, p. 337-352. 6 refs. In French.

Major aspects of the efforts at air pollution control in Japan over the past 10 years are discussed. Pollution control policy in Japan has been characterized by a basis in sentiment rather than economic considerations, an emphasis on certain types of pollution, enforcement by direct administrative surveillance, the use of indemnity payments to victims and the importance of the local authorities. While mean annual SO₂ concentrations have declined from 0.06 to 0.04 ppm from 1965 to 1977, nitrogen oxide levels have increased and stabilized at a level of 0.03 ppm and the air quality standards have been revised upwards. Pollution monitoring is accomplished through national and local networks. Detailed emission standards exist for sulfur dioxide and nitrogen oxides and to a lesser extent solid particles and odorous products, and are met by strategies including emission reduction, fuel and emission desulfurization, taxation of emissions, catalytic conversion, and pollution prevention. A.L.W.

A82-26327 **Air pollution control technology - An overview.** S. R. Orem (Industrial Gas Cleaning Institute, Inc., Alexandria, VA). *Air Pollution Control Association, Journal*, vol. 32, Mar. 1982, p. 246-249.

An overview is presented of the equipment and economics of pollution control devices for industrial applications. Attention is given to the Venturi scrubber, high order pressure drops, mechanical/centrifugal, cyclonic devices, baghouses, the Hersey reverse jet blow ring, electrostatic precipitators, and flue gas desulfurization. A total of over one and 1/3 billion dollars was spent on air pollution control equipment in 1980. The development of cartridge-type filters filled with synthetic fabrics such as fiberglass mesh for baghouses is reviewed, as is the growth of installed electrostatic precipitator units, totalling 42.274 GW of installed capacity in 1980. A steady growth in the total capacity of scrubbers is foreseen with the tendency for the use of coal as a primary energy source. M.S.K.

A82-26368 # **Progress on alternative energy resources.** H. T. Couch (United Technologies Research Center, East Hartford, CT). *Astronautics and Aeronautics*, vol. 20, Mar. 1982, p. 42-47.

Progress in the year 1981 toward the development of energy systems suitable for replacing petroleum products combustion and growing in use to fulfill a near term expansion in energy use is reviewed. Coal is noted to be a potentially heavy pollution source, and the presence of environmentally acceptable methods of use such as fluidized-bed combustion and gasification and liquefaction reached the prototype stage in 1981, MHD power generation was achieved in two U.S. plants, with severe corrosion problems remaining unsolved for the electrodes. Solar flat plate collectors sales amounted to 20 million sq ft in 1981, and solar thermal electric conversion systems with central receivers neared completion. Solar cells are progressing toward DOE goals of \$.70/peak W by 1986, while wind energy conversion sales were 2000 machines in 1981, and the industry is regarded as maturing. Finally, geothermal, OTEC, and fusion systems are reviewed. M.S.K.

A82-26407 **The Nanticoke shoreline diffusion experiment, June 1978. IV. A - Oxidation of sulphur dioxide in a power plant plume. B - Ambient concentrations and transport of sulphur dioxide, particulate sulphate and nitrate, and ozone.** K. G. Anlauf, P. Fellin, H. A. Wiebe (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada), and O. T. Melo (Ontario Hydro, Research Div., Toronto, Canada). *Atmospheric Environment*, vol. 16, no. 3, 1982, p. 455-466. 29 refs.

A82-26409 **Modeling continuous fumigation of Nanticoke generating station plume.** P. K. Misra (Ontario Ministry of the

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Environment, Air Resources Branch, Toronto, Canada) and S. Onlock (Monitek Limited Concord, Ontario, Canada). *Atmospheric Environment*, vol. 16, no. 3, 1982, p. 479-489. 13 refs.

A shoreline fumigation model is verified with the data from two studies conducted for the Ontario Hydro generating station plumes at Nanticoke. The model reproduces the physical system of continuous fumigation reasonably well. Predictions are shown to agree with observed values within the framework of the uncertainties in various input parameters. As expected, the parameters defining the state of the onshore air mass are critical in the estimate of ground level concentrations inside the fumigation zone. Also, sampling time plays an important role, even though data from the averaging of three to four helicopter passes conform to half hourly average concentration data and model predictions very well. (Author)

A82-26568 # Fuel optimal trajectory computation. J. W. Burrows (Boeing Computer Services Co., Energy Technology Applications Div., Seattle, WA). *Journal of Aircraft*, vol. 19, Apr. 1982, p. 324-329. 8 refs.

Roughly a quarter of the total fuel savings of the new generation of large jet transports will come from the capability of computing fuel optimal flight trajectories between departure point and destination. The shape of the trajectory in the vertical plane is treated here. A simplified mathematical model is described including spline fits to the drag and fuel flow functions. A suboptimal trajectory is found using the maximum principle of optimal control and singular perturbation theory. The inner or boundary-layer solutions are identified as the climb or descent segments of the flight, while the outer solution corresponds to cruise. The inner solutions are expanded to second order in the vicinity of the outer solution to develop cruise control laws for cost-effective response to altered in-flight conditions. (Author)

A82-27828 # Legal implications of economic activities in outer space. A. A. Cocca. In: Colloquium on the Law of Outer Space, 24th, Rome, Italy, September 6-12, 1981, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1982, p. 19-23. (IAF 81-SL-50)

The directions of economically-driven activities in space are projected, along with legal guidelines -present or future- which will ensure maximum freedom for space development and restraint in areas of general concern. Policy objectives in economic matters of space exploitation are defined as space resources development for integration in the world economy, open cooperation between nations, a prevention of monopolies, and pricing which is equitable. Celestial body-based resources are noted to be open to exploitation although no claim can be made on undeveloped territories. The formation of space-oriented companies such as Intelsat, Intersputnik, the Space Committee, New World, Inc., Otrag, etc. are mentioned as positive manifestations of business activities operating without legal interference. Further review is given to insurance policies, formation of a Space Bank, and maintaining the Shuttle under NASA control. M.S.K.

A82-27851 # Ecospace. E. R. Finch, Jr. (Finch and Schaefer, Attorneys, New York, NY). In: Colloquium on the Law of Outer Space, 24th, Rome, Italy, September 6-12, 1981, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1982, p. 189-193. (IAF 81-SL-40)

The paper defines Ecospace as the policy basis for 'international regimes' for global resources, including outer space. It discusses some 'Ecospace legal truths': (1) outer space requires long-range policy planning; (2) outer space is inherently international; (3) outer space provides solutions for the global resource shortage problems; (4) outer space is a factor for world peace, information and trade; and (5) participation by as many nations as possible in outer space is desirable. Various outer space treaties are marked as accomplishments. Solar power satellite plans are recommended noting Space Shuttle usages. Finally, four options are presented to the United States: (1) do it alone; (2) do nothing; (3) more R&D; and (4) cooperation with the Soviet Union. C.D.

A82-27853 # International legal basis and organizational framework for space activities - Present state, problems and

prospects. V. Kopal (United Nations, Outer Space Affairs Div., New York, NY). In: Colloquium on the Law of Outer Space, 24th, Rome, Italy, September 6-12, 1981, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1982, p. 201-205. 12 refs. (IAF 81-SL-51)

The present legal and organizational framework for international cooperation in space is reviewed with emphasis on the role of the United Nations and, in particular, of the UN Committee on the Peaceful Uses of Outer Space (COPUOS). The discussion covers principal legal instruments governing activities in space and international programs of space exploration and space applications promoted by the United Nations. Some current legal issues under consideration in the COPUOS are examined, including legal implications of remote sensing of the earth from space, the use of artificial satellites for direct television broadcasting, consideration of the possibility of supplementing the norms of international law relevant to the use of nuclear power sources in outer space, definition of outer space, and the legal status of the geostationary orbit. V.L.

A82-28000 Biomass energy systems and the environment. H. M. Braunstein, P. Kanciruk, R. D. Roop, F. E. Sharples, J. S. Tatum, and K. M. Oakes (Oak Ridge National Laboratory, Oak Ridge, TN). New York and Oxford, Pergamon Press, 1981. 190 p. 416 refs. \$13.50.

The technology, resources, applied, and experimental features of biomass energy resources are explored, with an emphasis on environmental and social implications of large-scale biomass development. The existing land and water based biomass resource is described in terms of available energy, ecological concerns, agricultural crops, livestock production, freshwater systems, and ocean systems. Attention is given to proposed systems of biomass energy production from forestry and silviculture, agricultural crops, livestock wastes, and freshwater and ocean systems. A survey is made of various biomass materials, techniques for conversion to gas, liquid fuels, or for direct combustion, and impacts of large-scale biomass production and harvest are examined. Particular note is made of the effects of scaling biomass conversion systems, including near- and long-term applications, and ethics and aesthetic concerns. M.S.K.

A82-28523 The impact of mixing cooling tower and power plant plumes on sulfate aerosol formation. J. F. Meagher, E. M. Bailey (Tennessee Valley Authority, Muscle Shoals, AL), and M. Luria (Jerusalem, Hebrew University, Jerusalem, Israel). *Air Pollution Control Association, Journal*, vol. 32, Apr. 1982, p. 389-391. 8 refs. Research supported by the Tennessee Valley Authority; U.S. Environmental Protection Agency Contract No. EPA-IAG-D9-E721-DL.

Results of a study to determine the effect of power plant-cooling tower interaction on sulfate production from a coal-burning power plant are described. The plant investigated had one 244 m and two 183 m stacks, each connected to an electrostatic precipitator. Intermixing of the plumes in the afternoon hours resulted in increased SO₂ oxidation. The excess SO₄(-2) production is concluded to occur in a water droplet or on the wet surface of a particle, with metal ions such as Fe(+3) and Mn(+2) also playing an as yet undetermined role. The formation enhancement lasts only as long as wetted surfaces and/or increased reactant concentrations are present. M.S.K.

N82-16057# Department of Energy, Washington, D C. SYMPOSIUM ON COMMERCIAL-AVIATION ENERGY-CONSERVATION STRATEGIES
1981 373 p refs Proceedings of Symp. on Commercial Aviation Energy Conserv. Strategies, Washington, D.C., 2-3 Apr. 1981 Sponsored in part by FAA, Washington, D C.
(DE81-028406. CONF-8104103) Avail: NTIS HC A16/MF A01

Energy conservation strategies applicable to commercial aviation are presented. General topics discussed include Federal and industry conservation programs such as flight operations, air traffic control, engineering and maintenance, and corporate management strategies. Included is a discussion of possible future actions. DOE

N82-16084*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

NASA RESEARCH ACTIVITIES IN AEROPROPULSION

John F. McCarthy, Jr and Richard J Weber 1982 30 p refs
Presented at the 24th Ann Conf. on Aviation and Astronautics,
Tel Aviv, Israel, 17-18 Feb 1982
(NASA-TM-82788; E-1113) Avail NTIS HC A03/MF A01
CSCL 21E

NASA is responsible for advancing technologies related to air transportation. A sampling of the work at NASA's Lewis Research Center aimed at improved aircraft propulsion systems is described. Particularly stressed are efforts related to reduced noise and fuel consumption of subsonic transports. Generic work in specific disciplines are reviewed including computational analysis, materials, structures, controls, diagnostics, alternative fuels, and high-speed propellers. Prospects for variable cycle engines are also discussed. Author

N82-16139*# Jet Propulsion Lab., California Inst of Tech., Pasadena.

ENERGY CONSUMPTION FOR THE ECHO STATION (DSS 12)

C. N Guiar and D Schonfeld *In its* The Telecommun and Data Acquisition Rept. 15 Dec 1981 p 355-363 refs

Avail NTIS HC A16/MF A01 CSCL 10B

Energy consumption for the Echo Station is analyzed. The HVAC equipment including vapor compression refrigeration units, absorption chillers, and heating units such as boilers and heat pumps is shown to be the largest consumer of electrical energy. The energy consumption for the buildings at the station is itemized and compared to the electrical meter data. The figures for energy consumption as predicted by the ECP computer program are found to agree well with the meter data. J.D.H.

N82-16259# Bevilacqua (O M) and Associates, Oakland, Calif. ENVIRONMENTAL ASSESSMENT OF THE USE OF ALCOHOL FUELS IN HIGHWAY VEHICLES

O M Bevilacqua, M J Bernard, III, D Sperling, S Rosenberg, L. J Hill, D Fingleton (WAPORA, Inc., Chicago), P DeLiscu (Santa Clara Univ.), and J R. Gasper Dec 1980 307 p refs
Prepared jointly with Argonne National Lab.
(Contract W-7405-eng-38)

(DE82-000887; ANL/CNSV-14) Avail NTIS HC A14/MF A01

Impact associated with alcohol fuel storage, distribution, and use are assessed under four possible scenarios of alcohol fuel use during the period 1980 to 2000. Alcohol use is projected to range from 196 million bbl/yr by 2000, up from 5 million barrels in 1980. In addition to effects on the physical environment (aquatic and terrestrial ecosystems, air quality, and energy resources), consideration is given to the impacts of alcohol fuel use on such social and economic concerns as health and safety, employment, retail fuel costs, balance of trade, capital investments, and regulatory needs. Although some potentially negative impacts are identified, in general, the assessment finds that the use of alcohol fuels would have a positive or neutral effect on the environment; moreover, the negative impacts could be mitigated through the judicious application of existing regulatory controls and procedural standards. DOE

N82-16265# Fulon Energy Corp., Tulsa, Okla. ASSESSMENT OF THE ECONOMIC, TECHNICAL, AND ENVIRONMENTAL FEASIBILITY OF DEVELOPING, CONSTRUCTING, AND OPERATING A 25-MILLION-GALLON-PER-YEAR GRAIN-ETHANOL-PRODUCTION FACILITY. VOLUME 1: EXECUTIVE SUMMARY

May 1981 47 p 4 Vol.
(Contract DE-FG07-80RA-50365)
(DE82-000294; DOE/RA-50365/T1-Vol-1) Avail: NTIS HC A03/MF A01

The economic, technical, and environmental feasibility of developing, constructing, and operating a 25 million gallon per year ethanol facility in northeastern Oklahoma was determined. The executive summary is presented. A site providing the necessary grain, energy, and labor resources, flexible transportation methods and alternatives for receiving and shipping; nearby markets for products and by-products, an existing environmental quality able to withstand the minor impacts of the process, and a receptive and growing business and community environment was selected. The ability to produce a high quality product at a reasonable and competitive price with or without federal assistance or state assistance in the form of tax exemptions is demonstrated. It is

shown that coal burning technologies are efficient, whether conventional burning methods or innovative methods such as fluidized-bed combustion are used. All resources for the process are available nearby. The grains required come from carryover reserves, thus not impacting the food supply. The residual by-products are in high demand. DOE

N82-16266# Fulon Energy Corp., Tulsa, Okla. ASSESSMENT OF THE ECONOMIC, TECHNICAL, AND ENVIRONMENTAL FEASIBILITY OF DEVELOPING, CONSTRUCTING, AND OPERATING A 25-MILLION-GALLON-PER-YEAR GRAIN-ETHANOL-PRODUCTION FACILITY. VOLUME 2: TECHNICAL ANALYSIS

May 1981 178 p 4 Vol.
(Contract DE-FG07-80RA-50365)
(DE82-000479; DOE/RA-50365/T1-Vol-2) Avail: NTIS HC A09/MF A01

The technical analysis of a study to determine the economic, technical, and environmental feasibility of developing, constructing, and operating a 25 million-gallon per year ethanol facility in northeastern Oklahoma is presented. It is shown that coal burning technologies are efficient, whether conventional burning methods or innovative methods such as fluidized-bed combustion are used. All resources for the process are available nearby. The grains required come from carryover reserves, thus not impacting the food supply. The residual by-products are in high demand. DOE

N82-16359# Bharat Heavy Electricals Ltd., Bhopal (India) SEMINAR: ENERGY CONSERVATION, ROLE OF POWER CAPACITORS: CONCEPTS AND POLICY ISSUES

R K Pachauri 6 Aug 1981 44 p refs
(PB81-247967) Avail: NTIS HC A03/MF A01 CSCL 09C

Energy conservation and power capacitors concepts and policy issues energy conservation by application of power capacitors in Indian power system network, the application of dynamic shunt compensation, and the application of series capacitors in distribution circuits are discussed. Author

N82-16417# Department of Energy, Bartlesville, Okla. Energy Technology Center

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES, THIRD SERIES, 1978 BUICK 196 CID (3.2L), 2V Interim Report, Jun. 1981

D E Koehler, W F Marshall, and K R Stamper Jun. 1981 57 p

(Contract DOT/TSC-RA-77-07)
(PB81-236630; BETC/OP-81/52; DOT-TSC-NHTSA-81-7; DOT-HS-805813; Rept-14) Avail: NTIS HC A04/MF A01 CSCL 21G

The 1978 Buick 196 CID engine was dynamometrically tested to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady state engine operating modes. The objective is to obtain engine performance data to estimating emissions and fuel economy for varied engine service and duty. The intent is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation. GRA

N82-16449# Colorado Energy Research Inst., Golden OIL SHALE 1982: A TECHNOLOGY AND POLICY PRIMER

Nov 1981 92 p refs Prepared in cooperation with Colorado School of Mines, Golden

Avail: NTIS HC A05/MF A01

An updated policy primer and technology assessment of the oil shale industry is presented for the benefit of policy makers and the general public. Methods for the development, management, and use of energy are discussed. The biological, economic, social, and political impacts and controversies surrounding current and future energy related activities are considered. Mining methods, retort processing, and methods for disposing of the shale are also discussed. M D.K.

N82-16458# Brookhaven National Lab., Upton, N Y. Process Sciences Div.

CARBON DIOXIDE POWER PLANT FOR TOTAL EMISSION CONTROL AND ENHANCED OIL RECOVERY

Frederick L. Horn and Meyer Steinberg Aug 1981 28 p refs
(Contract DE-AC02-76CH-00016)

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

(DE81-030734; BNL-30046) Avail: NTIS HC A03/MF A01

The design of a compact environmentally acceptable carbon dioxide diluted coal-oxygen fired power plant is described. The plant releases no combustion products to the atmosphere. The oxygen for combustion is separated in an air liquefaction plant and the effluent nitrogen is available for use in oil well production. Recycle carbon dioxide mixed with oxygen replaces the nitrogen for the combustion of coal in the burners. The carbon dioxide produced is used in enhanced oil recovery operations and injected into spent wells and excavated salt cavities for long-term storage. The recovery of CO₂ from a coal-burning power plant by this method appears to have the lowest energy expenditure and the lowest by-product cost compared to alternative removal and recovery processes. DOE

N82-16461# Federal Energy Regulatory Commission, Washington, D. C.

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: JORDAN RIVER BASIN, UTAH

Aug 1981 75 p refs

(DE82-000416; FERC-0084) Avail: NTIS HC A04/MF A01

The water resources of the Jordan River Basin which covers approximately 3450 sq mi in north central Utah are evaluated. Data are presented on existing and potential water resource development, on water use by existing and proposed steam-electric generating plants, and on the status of hydroelectric power plant licensing. Past and current planning studies are summarized. DOE

N82-16467# Department of Agriculture, Washington, D. C. Natural Resource Economics Div

IMPLICATIONS OF LAND, WATER AND ENERGY RESOURCE POLICIES ON AGRICULTURAL PRODUCTION

Klaus Alt, Norman Landgren, Richard Clark, Veral Benson, and William Anderson May 1981 96 p refs
(PB81-244063; AGESS-810513) Avail: NTIS HC A05/MF A01 CSCL 02A

The nature and potential impact of several natural resource and environmental policies on the use of land and water in agricultural production are discussed. The land control policies considered are those which may cause the owners to change land use to reduce soil erosion, to decrease wetland drainage and to preserve prime farmland in agriculture. Water policies are considered which related to the preservation of minimum in stream water flows, increasing the efficiency of irrigation, and meeting competition for water from energy production. DOE

N82-16494*# IIT Research Inst., Chicago, Ill. INTERNATIONAL MARKET ASSESSMENT OF STAND-ALONE PHOTOVOLTAIC POWER SYSTEMS FOR COTTAGE INDUSTRY APPLICATIONS Final Report

Therese M Philippi Nov 1981 290 p refs
(Contracts DEN3-197; DE-AI01-79ET-20485)
(NASA-CR-165287; DOE/NASA/0197-1; IITRI-J06519) Avail: NTIS HC A13/MF A01 CSCL 10B

The final result of an international assessment of the market for stand-alone photovoltaic systems in cottage industry applications is reported. Nonindustrialized countries without centrally planned economies were considered. Cottage industries were defined as small rural manufacturers, employing less than 50 people, producing consumer and simple products. The data to support this analysis were obtained from secondary and expert sources in the U.S. and in-country field investigations of the Philippines and Mexico. The near-term market for photovoltaics for rural cottage industry applications appears to be limited to demonstration projects and pilot programs, based on an in-depth study of the nature of cottage industry, its role in the rural economy, the electric energy requirements of cottage industry, and a financial analysis of stand-alone photovoltaic systems as compared to their most viable competitor, diesel driven generators. Photovoltaics are shown to be a better long-term option only for very low power requirements. Some of these uses would include clay mixers, grinders, centrifuges, lathes, power saws and lighting of a workshop. Author

N82-16496# Technische Hogeschool, Delft (Netherlands) Dept of Urban and Regional Planning

WIND ENERGY PLANNING CONSIDERATIONS [WINDENERGIE IN PLANOGISCH PERSPEKTIEF]

A vanSetten and H. Voogd Apr. 1980 19 p refs In DUTCH Presented at Planning Conf., Amsterdam, Apr. 1980 (PM-80-4) Avail: NTIS HC A02/MF A01

Windpowered utilization in the Netherlands and the search for wind rich areas is discussed. It is suggested that large water areas, like the North Sea and Market Lake, are the preferred areas for wind powered energy production. Storage of wind energy in large water basins is suggested. Government wind energy production programs like the installation of wind parks, and difficulties because of opposing local interests are discussed. Windmill exploration by small private industry, rather than by government administered programs, are outlined. E A K.

N82-16504# Oak Ridge National Lab., Tenn. ENERGY IN THE 1980S: A CALL FOR LEADERSHIP. THE PUBLIC AWARENESS SYMPOSIUM

Jul. 1981 79 p refs Presented at WATTec Energy Awareness Conf., Knoxville, Tenn., 18-20 Feb. 1981

(Contract W-7405-eng-26)

(DE81-027613; CONF-810250)

Avail: NTIS

HC A05/MF A01

A variety of programs was offered. Issues relevant to US energy problems were addressed. The energy-related wares of 43 leading domestic and foreign industrial and commercial institutions were displayed. The public awareness symposium included business, government, religious, and educational leaders. The technical societies' presidents' program brought together 25 national presidents or their representatives to discuss mutual concerns. Finally, two \$1000 engineering and communication scholarships were awarded for creating new and novel ways of providing the general public with information on complex energy-related technical matters. DOE

N82-16507# Oak Ridge National Lab., Tenn. Health and Safety Research Div

RISK OF PRODUCING ENERGY, AND CONSERVING IT

H Inhaber, G Caton, and R Gove 1981 25 p refs Presented at 6th Intern Symp on the Uranium Inst., London, Sep 1981 (Contract W-7405-eng-26)

(DE81-030807; CONF-810965-1)

Avail: NTIS

HC A02/MF A01

The idea that society can have a free lunch in the form of a risk-free energy system is rapidly fading away. All energy systems have some risk to human health, and for some it can be substantial. Nuclear power seems to have both a low occupational and public risk compared to other forms. In addition to this, research is presented with calculations on some of the risk associated with sealing up houses to keep heat in. When the effects of the accumulated radon are included, the risk per unit energy saved for this form of conservation can be great. Indeed, it appears to be much greater than the public risk of nuclear power. DOE

N82-16510# Department of Energy, Washington, D. C. Assistant Secretary for International Affairs.

ENERGY INDUSTRIES ABROAD

Sep 1981 299 p refs

(DE82-001896; DOE/IA-0012)

Avail: NTIS

HC A13/MF A01

The relationships between foreign governments and energy industries in many of the world's most important energy producing and consuming nations are examined. The history of hydrocarbon exploration and production is traced and the concessionary and other contractual arrangements entered into by foreign governments and international oil companies are reviewed. Petroleum legislation that was enacted, how government institutions gradually assumed more responsibility for energy matters, and how the former concessionaires adapted to accommodate this increased government participation in the energy sector is described. DOE

N82-16513# Arizona Univ., Tucson Engineering Experiment Station

CHOICE AND UTILIZATION OF ENERGY-USING DURABLES

Electric Power Research Inst. Aug. 1981 349 p refs Workshop held in Boston, 1-2 Nov 1979 Sponsored by Electric Power Research Inst.

(EPRI Proj. 1050)

(DE81-904228; EPRI-EA-1961; CONF-7911154) Avail: NTIS HC A15/MF A01

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

The adequacy of state of the art methods to analyze the choice and utilization of energy using durables by households is assessed. The long run adjustment process of households to higher energy prices is characterized in large part by their choice of type and efficiency of new energy using durables (e.g., major appliances and automobiles). Trade-offs must be made between original purchase price and future operating costs, the latter depending not only on prospective energy costs but on expected levels of utilization. Considerable progress has been made in modeling these important factors and their interactions. DOE

N82-16514# Pacific Northwest Lab., Richland, Wash. **ANALYSIS TO DEVELOP A PROGRAM FOR ENERGY-INTEGRATED FARM SYSTEMS**

D. E. Eakin, M. A. Clark, L. K. Inaba, and K. I. Johnson Sep. 1981 127 p refs
(Contract DE-AC06-76RL-01830)

(DE82-000318, PNL-3981) Avail: NTIS HC A07/MF A01

A program to use renewable energy resources and possibly develop decentralization of energy systems for agriculture is discussed. The program's objective is determined by: (1) an analysis of the technologies that could be utilized to transform renewable farm resources to energy by the year 2000, (2) the quantity of renewable farm resources that are available, and (3) current energy-use patterns. Individual research, development, and demonstration projects are fit into a national program of energy-integrated farm systems on the basis of market need, conversion potential, technological opportunities, and acceptability. Quantification of these factors for the purpose of establishing program guidelines is conducted using the following four precepts: (1) market need is identified by current use of energy for agricultural production; (2) conversion potential is determined by the availability of renewable resources; and (3) technological opportunities are determined by the state-of-the-art methods, techniques, and processes that can convert renewable resources into farm energy. DOE

N82-16516# Oak Ridge National Lab., Tenn. Engineering Technology Div.

ASSESSMENT OF SEASONAL-EFFICIENCY MODELS FOR NATURAL-GAS FIRED RESIDENTIAL FURNACES

N. Domingo and E. G. Keshock Sep 1981 81 p refs
(DE82-000499; ORNL-5801) Avail: NTIS HC A05/MF A01

Several methods for determining the seasonal efficiency and operating costs of residential fossil-fuel-fired heating systems are discussed. Four computer models for determining such efficiency, the Honeywell HFLAME model, the National Bureau of Standards DEPAF model, the Institute of Gas Technology SPACE-FI model, and the Carrier Corporation model, are separately described, discussed, and evaluated in relation to their use in predicting seasonal performance of residential gas-fired heating systems. A general conclusion is that purely analytical estimations of seasonal furnace efficiencies are not generally reliable principally because of (1) a variety of furnace designs; and (2) the different infiltration characteristics of homes. DOE

N82-16523# Argonne National Lab., Ill. Energy and Environment Systems Div.

ANALYSIS OF STATE-ENERGY-PROGRAM CAPABILITIES

John Tatar, Donald Clifford, Forrest Gunnison (Science Applications, Inc.), and Barbara Humphrey May 1981 62 p refs
(Contract W-31-109-eng-38)

(DE82-001963, ANL/CNSV-TM-82) Avail: NTIS HC A04/MF A01

The potential effects on state energy programs of a reduction in the financial assistance available through the state and local assistance programs and the distribution of those effects are assessed. The assessment is based on a survey of nine state energy offices (SEOs), which were selected on the basis of state support of energy programs weighted by state energy consumption. The nine SEOs surveyed were the Arizona Energy Office, Arkansas Department of Energy, California Energy Commission, Florida Governor's Energy Office, Illinois Institute of Natural Resources, Minnesota Energy Agency, New Jersey Department of Energy, South Carolina Governor's Division of Energy Resources, and Washington State Energy Office. T.M.

N82-16537# Alabama Energy Management Board, Montgomery. **OPELIKA RESOURCE RECOVERY PROJECT: REPORT ON THE TECHNOLOGICAL AND ECONOMIC EVALUATION**

Jul 1981 127 p refs

(Contract DE-FG01-79CS-20243)

(DE81-030098; DOE/CS-20243/1)

Avail: NTIS

HC A07/MF A01

A resource recovery facility for the city of Opelika, Alabama was investigated and surrounding areas were examined for waste stream characteristics. Technological options for waste disposal were examined. The technological options were ranked according to specific criteria of market characteristics, compatibility, and commercial viability. A particular resource recovery system applicable to Opelika was identified and an economic analysis performed to compare its relative costs to that of landfilling. DOE

N82-16546# Groupe Centrale des Villes Nouvelles, Paris (France). **A COMPARISON OF ENERGY TECHNOLOGIES AND THEIR USE IN URBAN PLANNING**

Claud Martinand and Eric Pebeyrotte Oct. 1980 21 p Presented at the 4th Ann. Conf of the Intern. New Towns Assoc., Cairo, 6-14 Oct. 1980

(PB81-239592) Avail: NTIS HC A02/MF A01 CSCL 10A

A view of the new energy sources used in construction of new towns in France is given. The energies discussed include solar, geothermal, wind, refuse incineration, and cogeneration; the energy technologies outlined include heat pumps and load shedding. GRA

N82-16549# Little (Arthur D.), Inc., Cambridge, Mass.

NEW YORK STATE PLAN TO ENCOURAGE COMMERCIALIZATION OF MORE EFFICIENT GAS TECHNOLOGIES

Aug 1981 189 p refs Sponsored by New York State Energy Research and Development Authority and New York Gas Group (PB81-249997; NYSERDA-81-15) Avail: NTIS

HC A09/MF A01 CSCL 10A

The results of a study to determine what field testing demonstration projects would be required to encourage commercialization of more efficient gas technologies and appliances in New York State are given as well as the elements of a plan to carry out the tests and demonstrations. The present status of over 50 energy-saving gas technologies applicable to space conditioning, water heating, and cooking is examined. Three of the most promising technologies for commercialization were found to be: condensing furnaces and boilers; waste heat recovery, and fuel cells. GRA

N82-16550# General Accounting Office, Washington, D. C. **RESIDENTIAL ENERGY CONSERVATION OUTREACH ACTIVITIES: A NEW FEDERAL APPROACH**

11 Feb. 1981 40 p refs

(PB81-242349; EMD-81-8) Avail: NTIS HC A03/MF A01 CSCL 10A

An evaluation of the Department of Energy's residential energy conservation outreach activities is presented. The contribution that outreach can make in achieving energy conservation is examined. The effectiveness of alternative techniques and DOE's current program and management are also examined. GRA

N82-16559# Argonne National Lab., Ill. Integrated Assessments and Policy Evaluation Group.

FLUE-GAS DESULFURIZATION: REVIEW OF SELECTED COMMERCIAL AND ADVANCED TECHNOLOGIES

Jerry L. Gillette and Shen-Yann Chiu Feb 1981 187 p refs
(Contract W-31-109-eng-38)

(DE82-001960, ANL/FE-81-51)

Avail: NTIS

HC A09/MF A01

Selected technologies for the desulfurization of flue gas are reviewed and evaluated. One of the technologies, wet scrubbing of the gas with a slurry containing either lime or limestone, has attained widespread commercial usage and for this reason is presented as the base case against which 10 second-generation systems of flue-gas desulfurization (FGD) are compared. The new technology include chemical-treatment, or scrubbing, processes and processes that combine scrubbing and filtering of the flue gas. The two combination processes use baghouse filters, with the SO₂-collecting material either injected dry or sprayed into the system. The eight straight-scrubbing processes use either wet or dry collecting materials and are identified as follows: aqueous-carbonate, copper-oxide, Bergbau-Forschung, sodium-sulfite-based double-alkali, DOA double-alkali, Chiyoda-121, magnesia, and Wellman-Lord. DOE

N82-16562# Department of Energy, Morgantown, W. Va
ADVANCED ENVIRONMENTAL CONTROL TECHNOLOGY PROGRAM

Aug. 1981 32 p refs
 (DE82-000898; DOE/METC/SP-187) Avail: NTIS
 HC A03/MF A01

The Department of Energy has established the Advanced Environmental Control Technology Program to protect the environment while supporting the development of more efficient and acceptable technologies utilizing domestic fossil fuels. This program consolidates cleanup efforts in ongoing technology specific DOE programs (such as combustion and gasification, and cleanup projects transferred from EPA to DOE) with new project initiatives into a coordinated program that addresses cleanup technology development. There are numerous problems associated with using coal to replace oil and gas as a primary fuel. Sulfur, nitrogen, alkali and halogen compounds, and mineral particulate matter, all found in varying proportions in the domestic coals, are released during gasification and combustion. These contaminants of coal, as well as the soot and tars produced by incomplete combustion or gasification, can potentially degrade the performance of the energy producing system. DOE

N82-16563# Pacific Northwest Lab., Richland, Wash
ASSESSMENT OF ENVIRONMENTAL HEALTH AND SAFETY ISSUES ASSOCIATED WITH THE COMMERCIALIZATION OF UNCONVENTIONAL GAS RECOVERY: DEVONIAN SHALE

Sep. 1981 88 p refs
 (Contract DE-AC06-76RL-01830)
 (DE82-001047, PNL-3848) Avail: NTIS HC A05/MF A01

Potential public health and safety issues and the potential environmental impacts from recovery of natural gas from Devonian age shale are identified. The resource and the DOE eastern gas shales project are described. The new and developing recovery technologies associated with Devonian shale are described. An assessment of the environment, health and safety impacts associated with a typical field is presented. The typical field for this assessment occupies ten square miles and is developed on a 40-acre spacing (that is, there is a well in each 40-acre grid). This field thus has a total of 160 wells. Finally, conclusions and recommendations are presented. A reference list is provided to give a greater plant. Based on the estimated plant cost and the various cases of operating income, an economic analysis was performed employing a profitability index criterion of discounted cash flow to determine an interest rate of return on the plant investment. DOE

N82-16565# Urban Systems Research and Engineering, Inc., Cambridge, Mass
ENERGY AND ENVIRONMENTAL QUALITY: CASE HISTORIES OF IMPACT MANAGEMENT

Jun. 1981 117 p
 (Contract DE-AC01-79EV-10012)
 (DE81-028435, DOE/EP-10012/1) Avail: NTIS
 HC A06/MF A01

A discussion of energy source developments and environmental protection dealing with impacts, and legal aspects of pollution controls and resource management, and case history studies of major energy projects is presented. DOE

N82-16566# Argonne National Lab., Ill. Integrated Assessments and Policy Evaluation Group.
PUBLIC HEALTH HAZARDS OF LURGI/FISCHER TROPSCH COAL LIQUEFACTION

J. R. Gasper and S. E. Rosenberg Jan. 1981 63 p refs
 (Contract W-31-109-eng-38)
 (DE82-001617, ANL-EES-TM-153) Avail: NTIS
 HC A04/MF A01

The public hazards of wastes from Lurgi/Fischer-Tropsch coal liquefaction were identified. Data on dose response and synergism are not available for many of the waste chemicals from this process. This approach employs two measures of hazards: (1) body burdens that result from exposure to Lurgi/Fischer-Tropsch wastes are compared to body burdens from other sources of the same chemicals; (2) ambient concentrations of pollutants from Lurgi/Fischer-Tropsch operations are projected and compared to various air and water quality standards. DOE

N82-16568# Idaho Univ., Moscow Dept. of Chemistry
SULFUR GAS EMISSIONS FROM STORED FLUE GAS

DESULFURIZATION SOLIDS Final Report

D. F. Adams Oct 1981 87 p refs Sponsored by Electric Power Research Inst
 (EPRI Proj 856-2)
 (DE82-000859; EPRI-EA-2067) Avail: NTIS
 HC A05/MF A01

The emissions of volatile, sulfur-containing compounds from the surfaces of 13 flue gas desulfurization (FGD) solids field storage sites were characterized. The sulfur gas emissions from these storage surfaces were determined by measuring the sulfur gas enhancement of sulfur-free sweep air passing through a dynamic emission flux chamber placed over selected sampling areas. Samples of the enclosure sweep air were cryogenically concentrated in surface-deactivated Pyrex U traps. Analyses were conducted by wall-coated, open-tubular, capillary column, cryogenic, temperature-programmed gas chromatography using a sulfur-selective flame photometric detector. Several major variables associated with FGD sludge production processes were examined in relation to the measured range and variations in sulfur fluxes including: the sulfur dioxide scrubbing reagent used, sludge sulfite oxidation, unfixed or stabilized (fixed) RGD solids, and ponding or landfill storage. The composition and concentration of the measured sulfur gas emissions were found to vary with the type of solids, the effectiveness of rainwater drainage from the landfill surface, the method of impoundment, and the sulfate/sulfite ratio of the solids. DOE

N82-16586# Environmental Protection Agency, Ann Arbor, Mich. Test and Evaluation Branch
EXHAUST EMISSIONS FROM HIGH-MILEAGE CATALYST-EQUIPPED PASSENGER CARS

Gary T. Jones Jul 1981 15 p refs
 (PB82-103326; EPA-AA-TEB-81-20) Avail: NTIS
 HC A02/MF A01 CSCL 13B

Vehicles from the 1975 through 1981 model years were used to examine the effect of 'high mileage' on levels of exhaust emissions. The emission levels from the vehicles involved were examined from four basic views: (1) 'as received' results of the top 15% (by odometer) versus similar results from the bottom 15% and 85%; (2) 'as received' results of vehicles with over 50,000 miles versus those with under 50,000; (3) the effects of restorative maintenance on high mileage vehicles; and (4) the effects of catalyst replacement on high mileage vehicles. The results show that the high mileage vehicles exhibit higher average HC and CO emissions than the lower mileage vehicles. It was also found that on the average, catalytic converters remain active beyond a vehicle's statutory 'useful life' of 50,000 miles and that restorative maintenance is an effective method to reduce average emission levels. GRA

N82-16595# Environmental Protection Agency, Ann Arbor, Mich. Emission Control Technology Div.
FUEL ECONOMY AND EXHAUST EMISSIONS OF A METHANOL-FUEL CHEVETTE

H. Anthony Ashby May 1981 7 p refs
 (PB82-101783; EPA-AA-TEB-81-23) Avail: NTIS
 HC A02/MF A01 CSCL 13F

The results of a series of tests conducted over a period of several months on a 1979 Chevrolet Chevette powered by anhydrous methanol are presented. Baseline tests with gasoline were also conducted about three months before the methanol test series began. The exhaust emissions from this car were greatly affected by air-fuel ratio and state of tune. Driveability was not good during most tests when CO met Federal standards. The best optimized adjustments gave a 10 percent better energy efficiency on pure methanol than on gasoline with approximately similar exhaust emission levels. GRA

N82-16607# Environmental Protection Agency, Dallas, Tex.
WASTEWATER TREATMENT FACILITIES, TWINING WATER AND SANITATION DISTRICT, TAOS COUNTY, NEW MEXICO Draft Environmental Impact Statement

Aug 1981 284 p refs
 (PB82-104670; EPA-906/9-81-002) Avail: NTIS
 HC A13/MF A01 CSCL 13B

The Twining Water and Sanitation District has considered alternatives for wastewater management which would solve a pollution problem in the high-quality Rio Hondo watershed of northern New Mexico. The district proposes construction of a new advanced treatment plant with a capacity of 95,000 gallons per day. A major alternative is to rehabilitate the existing plant.

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and provide only the capacity needed to treat existing wastewater flows (83,000 gallons per day) EPA is considering approval and funding of either alternative (as well as providing no funding) Many complex issues bear on EPA's decision, including impacts on water quality, water supply, and socio-economic conditions.

GRA

N82-16610# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Chemical and Biochemical Engineering
OIL SLICK DISPERSAL MECHANICS Final Report
Chukwuka A. Osamor and Robert C. Ahlert Sep. 1981 238 p refs
(Grant EPA-R-805901)
(PB82-105560; EPA-600/2-81-199) Avail: NTIS
HC A11/MF A01 CSCL 13B

The spreading and dissolution behavior of small oil slicks formed from spills of 12 oils was investigated. The increases in area covered by the oils during spreading experiments were determined using photographic techniques. The rate of dissolution of the oils in tap water at 25 C were investigated by equilibrating oils with water in open static tests. Limits of solubilities were established for the oils from equilibration in closed vessels. Six oils were also equilibrated with salt water. A segmented mathematical model was derived and used to correlate experimental data. The primary mechanisms are quantified by analogy to homogeneous and heterogeneous catalysis and detergency. Parameters investigated include oil and dispersant types, oil to dispersant ratios, degree of agitation, and the effect of salt water.

GRA

N82-16614# Bureau of Mines, Salt Lake City, Utah
HYDROGEN SULFIDE GENERATION BY REACTION OF NATURAL GAS, SULFUR AND STEAM Report of Investigations, Jul. 1981

S. R. Crane, Laird Crocker, and W. I. Nissen Jul. 1981 61 p refs
(PB82-106998; BM-RI-8539) Avail: NTIS HC A04/MF A01
CSCL 13B

A regenerable flue gas desulfurization process was developed. The citrate process uses a buffered weak acid solution to absorb SO₂ from the waste gas. The absorbed SO₂ is reacted with H₂S to precipitate elemental sulfur and regenerate the solution for recycle. The H₂S feedstock for the process may be produced by reacting two-thirds of the recovered elemental sulfur with natural gas and steam. Laboratory investigations and pilot plant operations were conducted by the Bureau to determine if H₂S from the natural gas, sulfur, and steam reaction was suitable for the citrate process. The laboratory investigations, in which an H₂S generator was integrated with other citrate process operations, provided a basis for design and operation of the pilot plant. The objective was to provide H₂S for citrate process pilot plant.

GRA

N82-16618# Versar, Inc., Springfield, Va.
ENVIRONMENTAL ASSESSMENT, SOURCE TEST AND EVALUATION REPORT: COAL PREPARATION PLANT NO. 2 Final Report, Sep. 1979 - Mar. 1981

J. Buroff, J. Strauss, A. Jung, and L. McGilvray Apr. 1981 304 p refs
(Contract EPA-68-02-3136)
(PB82-103573; EPA-600/7-81-071B) Avail: NTIS
HC A14/MF A01 CSCL 06F

Results and conclusions are given of a source test and evaluation program at a coal preparation plant, representing cleaning plants that process run of mine coal with high pyritic sulfur content, use high technology coal cleaning processes, operate in a high rainfall environment, and have a low soil neutralization potential. The major objective of the program was to perform an environmental assessment on the plant's waste streams and fugitive emissions. Chemical analysis results indicated that all streams, except fugitive particulates, contained constituents which may have a potentially harmful health and/or ecological effect. For streams showing potential for ecological effects, Mn was of concern for streams showing a potentially harmful health effect, Mn and Or were of prime concern. Contrary to previous studies, high Ni-13 concentrations were observed in the leachate. Further investigation of the Ni-13 source is warranted. Bioassays for fugitive particulates, sedimentation pond waters, and fine refuse slurry solid samples indicated moderate biological effects.

GRA

N82-16767# Control Data Corp., Rockville, Md.

QUSER USER'S GUIDE

Mark D. Buck Sep. 1981 77 p refs
(Contract DE-AC01-80EI-11975)
(DE81-030681; DOE/EIA-11975/T1) Avail: NTIS
HC A05/MF A01

The QUSER program functions as the controlling routine of the Midterm Energy Market Model (MEMM). In MEMM, a linear program (LP) is solved iteratively until QUSER determines that all convergence criteria have been met. After each iteration, QUSER is called to calculate new input prices and demands for the next iteration of the LP. The LP solution is considered to be a converged solution when the prices and demands input to the last iteration and the prices and demands from the LP solution differ by less than two percent. QUSER's other main function is to model energy pricing regulations for natural gas and electricity. These policies are based on average prices while the LP solution gives marginal prices. The program uses FORTRAN language.

DOE

N82-16845# Battelle Pacific Northwest Labs., Richland, Wash.
NUCLEAR WASTE MANAGEMENT Quarterly Progress Report, Apr. - Jun. 1981

T. D. Chikalla and J. A. Powell Sep. 1981 136 p refs
(Contract DE-AC06-76RL-01830)
(DE82-001605; PNL-3000-10) Avail: NTIS
HC A07/MF A01

Reports and summaries are presented for the following: high-level waste process development; alternative waste forms; TMI zeolite vitrification demonstration program; nuclear waste materials characterization center; TRU waste immobilization; TRU waste decontamination; krypton implantation; thermal outgassing; iodine-129 fixation; NWVP off-gas analysis; monitoring and physical characterization of unsaturated zone transport; well-logging instrumentation development; verification instrument development; mobility of organic complexes of radionuclides in soils; handbook of methods to decrease the generation of low-level waste; waste management system studies; waste management safety studies; assessment of effectiveness of geologic isolation systems; waste/rock interactions technology program; high-level waste form preparation; development of backfill materials; development of structural engineered barriers; disposal charge analysis; and analysis of spent fuel policy implementation.

DOE

N82-16846# Piedmont Engineers, Greenville, S.C.
NUCLEAR ENERGY CENTER CONCEPTUAL STUDY, PHASE 3: SITE SPECIFIC EVALUATION - ENVIRONMENTAL RECREATION USE AND PHYSICAL CHARACTERISTICS OF LAKE HARTWELL

Jan. 1981 265 p refs
(Contract DE-AS05-78CR-06074)
(DE81-027337; DOE/OR-06074/1-Vol-3) Avail: NTIS
HC A12/MF A01

Socio-economic factors related to the proposed siting of a 15000 MW, twelve-unit nuclear energy center in Anderson County, South Carolina, are presented. Topics included recreational use of Lake Hartwell, terrestrial and aquatic ecology, and atmospheric studies.

DOE

N82-16935# Battelle Pacific Northwest Labs., Richland, Wash.
ANALYSIS OF FEDERAL INCENTIVES USED TO STIMULATE ENERGY CONSUMPTION

R. J. Cole, B. W. Cone, J. C. Emery, M. Huelshoff, D. E. Lenerz, A. Marcus, F. A. Morris, W. J. Sheppard, and P. Sommers Aug. 1981 266 p refs
(Contract DE-AC06-76RL-01830)
(DE81-031928; PNL-3558) Avail: NTIS HC A12/MF A01

Federal incentives that have increased the consumption of coal, oil, natural gas and electricity are identified. The stimulus comes through changing values of variables included in energy demand functions, thereby inducing energy consumers to move along the function in the direction of greater quantity of energy demanded, or through inducing a shift of the function to a position where more energy will be demanded at a given price. The demand variables fall into one of six categories: price of the energy form, price of complements, price of substitutes, preferences, income, and technology. The government can provide such incentives using six different policy instruments: taxation, disbursements, requirements, nontraditional services, traditional services, and market activity. The four major energy forms were examined. Six energy consuming sectors were examined:

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residential, commercial, industrial, agricultural, transportation, and public. DOE

N82-16942# San Bernardino Valley Municipal Water District, Calif.

FEASIBILITY OF GEOTHERMAL HEAT USE IN THE SAN BERNARDINO MUNICIPAL WASTEWATER TREATMENT PLANT Final Report, Sep. 1980 - Jun. 1981

W. C. Racine, T. C. Larson, C. A. Stewart, and H. B. Wessel 1981 115 p refs Prepared in cooperation with Science Applications, Inc., La Jolla, Calif., and Stewart (Coulter) and Associates, Inc., Davis, Calif.

(Contract DE-FG03-80SF-11442)
(DE81-030968; DOE/SF-11442/T2) Avail: NTIS
HC A06/MF A01

A system was developed for utilizing nearby low temperature geothermal energy to heat two high rate primary anaerobic digesters. The geothermal fluid would replace the methane currently burned to fuel the digesters. The design and operation of the facility are examined and potentially viable applications selected for additional study. Results of these investigations and system descriptions and equipment specifications for utilizing geothermal energy in the selected processes are presented. The economic analyses conducted on the six engineering design cases are discussed. The environmental setting of the project and an analysis of the environmental impacts that will result from construction and operation of the geothermal heating system are discussed. DOE

N82-16943# Oak Ridge National Lab., Tenn.
ELECTRIC CAR: IS IT STILL THE VEHICLE OF THE FUTURE

R. L. Graves, C. D. West, and E. C. Fox Aug 1981 29 p refs

(Contract W-7405-eng-26)
(DE81-030437; ORNL/TM-7904) Avail: NTIS
HC A03/MF A01

An analysis of electric and internal combustion engine (ICE) cars of equivalent performance shows that, even with advanced batteries, the electric vehicle would be much more costly to run (23 cents/mile vs 16 cents/mile) than the ICE car. The electric vehicle, of course, would not use gasoline, thus reducing the nation's dependence on imported oil; however, the cost of oil saved in this way would be about \$190/bbl, and the same result could be achieved at about one quarter the cost by manufacturing synfuels from domestic coal or oil shale. A similar analysis of some proposed hybrid electric vehicles indicates that they are also more costly to operate than an equivalent conventional vehicle, although by a smaller margin. The cost of oil saved by the use of hybrid vehicles is also lower, although it is still much more than the projected cost of synthetic fuels. The key to improving the economics of the electric vehicle is to increase battery life or lower battery costs. DOE

N82-16946# McElroy (Ralph) Co., Austin, Tex

TRANSPORT AND ENERGY

Arturo Abriani Sep 1981 17 p Transl. into ENGLISH from the Symp on Evaluation and Reinforcement of Pavements and Energy in Transportation (Argentina), 1980 p 103-109 Symp held in San Miguel de Tucuman, Argentina, 4-6 Sep 1980, sponsored by the Argentine Congresses of Highway Administration and Traffic. Prepared jointly with Argonne National Lab.

(DE81-030287; ANL-Trans-1198) Avail: NTIS
HC A02/MF A01

Energy sources used and the growth of energy consumption in the transportation sector in Argentina are discussed. Energy consumption by the transportation sector in some other major countries of the world are briefly noted. Optimizing transportation energy consumption by means of energy conservation is mentioned. Comparisons are made of energy consumed by rail and road vehicles in urban and interurban areas for freight and passenger transport. DOE

N82-16947# South Coast Technology, Inc., Dearborn, Mich.
AUGMENTATION OF RESEARCH AND ANALYSIS CAPABILITIES FOR TIMELY SUPPORT OF AUTOMOTIVE FUEL ECONOMY ACTIVITIES Final Report, Oct. 1977 - Jan. 1978

Harold M. Siegel, R. Schwarz, J. Andon, T. Gerstenberger, R. Renner, K. C. Kececioglu, W. Morgan, L. Mercer, and A. Cattaneo Mar 1981 412 p refs

(Contract DOT-HS-7-01790)
(PB81-247553; DOT-HS-805956) Avail: NTIS
HC A18/MF A01 CSCL 13F

A series of studies was conducted in support of the Office of Research and Development of the NHTSA in areas of automotive design and technology that could affect fuel economy. Nine such studies were carried out and included assessments of spark ignition engine; fuel economy improvement potential; potential of changes in rolling resistance, aerodynamic drag, accessory load and lubricants. Other studies included a study of the potential of alternative engines, a compilation of literature, and a preliminary assessment of diesel particulates. In addition to conducting studies based on a literature review and analysis, there were two hardware studies conducted in the form of teardown studies of selected passenger car (Ford Fairmont) and light truck (Chevy Luv) models. GRA

N82-16948# Market Facts, Inc., Arlington, Va. Public Sector Research Group.

CONSUMER BEHAVIOR TOWARDS FUEL EFFICIENT VEHICLES, VOLUME 2 Final Report, Oct. 1977 - Mar. 1981

James T. Heisler and Sid Groeneman Mar. 1981 127 p
(Contract DOT-HS-7-01781)

(PB81-246654; DOT-HS-805937-Vol-2) Avail: NTIS
HC A07/MF A01 CSCL 10A

Information on likely market response to various vehicle design and performance changes is studied to minimize the possibility of market rejection. The report is based on focus group discussions and consumer experiments with drivers in different vehicle size classes. Analysis focuses on the believability of the energy crisis and concern about its effects, the acceptability of possible fuel economy options, consumer preferences with respect to vehicles embodying selected design and engineering changes, and predicted purchase and usage patterns under different future scenarios. GRA

N82-16950# Energy and Environmental Analysis, Inc., Arlington, Va

DEVELOPMENT OF ADJUSTMENT FACTORS FOR ON ROAD FUEL ECONOMY Final Report

Robert Crawford, Peter Forshay, and Robert Dulla Mar 1981 219 p refs

(Contract EPA-68-03-2888)
(PB81-241986; EPA-460/3-81-003) Avail: NTIS
HC A10/MF A01 CSCL 13F

The differences between EPA test-measured and actual on-road fuel economy were evaluated. It is expected that the methodology and the adjustment factors developed will form the basis for a labeling system that in future model years, will discount the EPA test measurements of new cars to estimate on road fuel economy. Because new cars employ a growing percentage of fuel efficient technologies having distinctly lower levels of shortfall than traditional ones, this analysis has carefully evaluated and to the extent that available data permit, quantified the shortfall of the alternative technologies. GRA

N82-16953# Transportation Systems Center, Cambridge, Mass.
AN INVESTIGATION OF TRUCK SIZE AND WEIGHT LIMITS: TECHNICAL SUPPLEMENT, VOLUME 3: TRUCK AND RAIL FUEL EFFECTS OF TRUCK SIZE AND WEIGHT LIMITS Final Report, Oct. 1978 - Jun. 1981

David A. Knapton Jul 1981 142 p refs
(PB82-100538; DOT-TSC-OST-81-2) Avail: NTIS
HC A07/MF A01 CSCL 13E

Data and analytical methods to estimate probable changes in direct and indirect fuel consumption for new truck size and weight limits are presented. These effects are examined in terms of changes in the competitive relationships between highway and rail services. The method for estimating fuel consumption includes line haul and access fuel and makes allowance for the system fuel requirements of empty backhaul and circuitry. Single unit trucks, conventional tractor-semi-trailer, Western Doubles, Turnpike Doubles, and Triple Trailer combination rigs as well as the competitive carload boxcar and TOFC rail services are considered. Truck service (i.e., van, reefer, household moving van, flat bed, tanker and dump), and the competitive rail services are disaggregated. Author

N82-16958# Environmental Protection Agency, Ann Arbor, Mich.
Test and Evaluation Branch

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EVALUATION OF THE MOLECULETOR FUEL ENERGIZER UNDER SECTION 511 OF THE MOTOR VEHICLE INFORMATION AND COST SAVINGS ACT

Gary T Jones May 1981 121 p refs
(PB81-247942; EPA-AA-TEB-511-81-11) Avail: NTIS
HC A06/MF A01 CSCL 13F

Results of an evaluation of a fuel saving device known as the Fuel Energizer Moleculetator are presented. The device is designed to be installed in the fuel line between the fuel tank and fuel pump. The applicant claims that as the fuel passes through the device, it becomes energized, burns more efficiently and therefore, provides improved fuel economy. GRA

N82-16959# Environmental Protection Agency, Ann Arbor, Mich. Office of Mobile Source Air Pollution Control. EVALUATION OF THE IMPACT ON EMISSIONS AND FUEL ECONOMY OF CONVERTING TWO VEHICLES TO COMPRESSED NATURAL GAS FUEL

Thomas J Penninga Jun 1981 18 p
(PB81-245714; EPA-AA-TEB-81-19) Avail: NTIS
HC A02/MF A01 CSCL 13F

The EPA was requested by the Department of Energy to perform testing on two late model vehicles which were converted with on-the-market systems to run on compressed natural gas (CNG). The EPA was requested to measure vehicle emissions, fuel economy, and acceleration characteristics of the vehicles in stock configuration, modified running on gasoline, and modified-running on natural gas. The testing was run over a three week period with triplicate tests run in each condition. The results of the testing are reported. It does not attempt to analyze the feasibility of CNG powered vehicles in the market place. GRA

N82-16965# Booz-Allen and Hamilton, Inc., Philadelphia, Pa. National Analysis, Inc.

CONSUMER ORIENTATIONS TOWARD FUEL EFFICIENT VEHICLES: EXECUTIVE SUMMARY Final Report, Feb. 1978 - Nov. 1980

Robert Kernish Mar. 1981 25 p
(Contract DOT-HS-7-01782)
(PB81-245359; Rept-1-037-78-ES, DOT-HS-805939) Avail:
NTIS HC A02/MF A01 CSCL 21G

Consumer reactions both to specific vehicle design changes, and more generally, to the Corporate Average Fuel Economy (CAFE) regulations were investigated. The energy supply situation which motivated their implementation is also discussed in terms of consumer reactions. M.D.K.

N82-16966# Booz-Allen and Hamilton, Inc., Philadelphia, Pa. National Analysts, Inc.

CONSUMER ORIENTATIONS TOWARD FUEL EFFICIENT VEHICLES Final Report, Feb. 1978 - Nov. 1980

Robert Kernish Mar. 1981 118 p
(Contract DOT-HS-7-01782)
(PB81-245367; Rept-1-037-78-F, DOT-HS-805938) Avail:
NTIS HC A06/MF A01 CSCL 21G

Consumer reactions to the energy supply situation and to the Corporate Average Fuel Economy (CAFE) regulations were considered. Reactions to specific vehicle design changes were also investigated and are summarized. M.D.K.

N82-17174*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group

CF6 JET ENGINE PERFORMANCE IMPROVEMENT: HIGH PRESSURE TURBINE ROUNDNESS

W. D. Howard and W. A. Fasching Jan 1982 136 p refs
(Contract NAS3-20629)
(NASA-CR-165555; R82AEB115) Avail: NTIS
HC A07/MF A01 CSCL 21E

An improved high pressure turbine stator reducing fuel consumption in current CF6-50 turbofan engines was developed. The feasibility of the roundness and clearance response improvements was demonstrated. Application of these improvements will result in a cruise SFC reduction of 0.22 percent for new engines. For high time engines, the improved roundness and response characteristics results in an 0.5 percent reduction in cruise SFC. A basic life capability of the improved HP turbine stator in over 800 simulated flight cycles without any sign of significant distress is shown. E.A.K.

N82-17407# Michigan Univ., Ann Arbor. Architectural Research Lab.

SOLARIZATION/CONSERVATION TECHNOLOGY DEVELOPMENT FOR EXISTING HOUSING Progress Report

W Oberdick 1 Jun. 1981 34 p
(Contract DE-FG02-80R5-10227)
(DE82-002175; DOE/R5-10227/2) Avail: NTIS
HC A03/MF A01

The project objectives were to develop a method for evaluating existing residences for their energy solarization/conservation potential as well as carrying out the solarization/conservation work within context of the Community Development program; and to demonstrate appropriate methods of utilizing solar energy in existing Ann Arbor residences beyond that obtainable in a good conservation program. A general progress update is presented covering tasks related to community solarization/conservation characteristics and community system analysis and development. The process of selection and technical evaluation of houses for solarization/conservation project directed retrofit is described. A detailed report on the survey of utility data and a report on the solarization/conservation site audits are included. A detailed comparison of the audit data for both the audit and control group are appended. DOE

N82-17512# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.

ROLLING RESISTANCE MEASUREMENTS 106 PASSENGER CAR TIRES

Gayle Klemer Aug. 1981 44 p refs
(PB82-116625; EPA-AA-SDSB-81-3) Avail: NTIS
HC A03/MF A01 CSCL 13F

A diverse range of tires currently available on the replacement passenger car tire market is investigated. One hundred-six tires from fifty different lines were tested. The rolling resistance of these tires are analyzed against other tire characteristics (tire construction, new versus retread, etc.) to gain insight as to the effects of these characteristics on vehicle fuel economy. GRA

N82-17581# Nevada Univ System, Reno. Water Resources Center

WATER FOR NON-NUCLEAR ENERGY DEVELOPMENT IN THE GREAT BASIN

Sep. 1981 344 p refs. Sponsored in part by Water Resources Council, Washington, D.C.
(PB82-116781) Avail: NTIS HC A15/MF A01 CSCL 13B

The availability of water to support conventional and emerging non-nuclear energy technologies under certain hypothetical world oil prices was assessed and major effects that these levels of energy development could have on the regions water resources were identified in an effort to aid national and regional energy supply planning and decision making. GRA

N82-17584# Energy Resources Co., Inc., Cambridge, Mass. MONITORING TO DETECT GROUNDWATER PROBLEMS RESULTING FROM ENHANCED OIL RECOVERY Final Report

Ron Beck, Bernard Aboba, Douglas Miller, and Ivor Kaklins Oct 1981 146 p refs
(Contract EPA-68-03-2648)
(PB82-119074; EPA-600/2-81-241) Avail: NTIS
HC A07/MF A01 CSCL 08H

A four stage monitoring program to detect groundwater contamination events that may potentially result from enhanced oil recovery (EOR) projects was developed. The monitoring system is based on a statistical analysis evolving from a series of equations that model subsurface transport of EOR spills. Results of the design include spatial and frequency monitoring intervals that depend on properties of the local geology and dispersion characteristics of the potential contaminants. GRA

N82-17585# Ohio River Basin Commission, Cincinnati. CUMBERLAND RIVER BASIN; REGIONAL WATER AND LAND RESOURCES PLAN

Jun. 1981 384 p refs. Sponsored in part by Water Resources Council
(PB82-111501) Avail: NTIS HC A17/MF A01 CSCL 08H

The report is on the regional water resources management plan for the Cumberland River Basin in Virginia, Kentucky and Tennessee. An executive summary, recommended plans, and directions for the future are presented. M.D.K.

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N82-17594# Pennsylvania State Univ., University Park Inst. for Research on Land and Water Resources.

REVEGETATING STRIP-MINED LAND WITH MUNICIPAL SEWAGE SLUDGE Final Report, Nov. 1976 - Oct. 1979
William E. Sopper and Sonja N. Kerr Sep. 1981 162 p refs
Prepared in cooperation with Pennsylvania Dept. of Environmental Resources

(Grant EPA-S-804511)

(PB82-102484; EPA-600/2-81-182) Avail: NTIS HC A08/MF A01 CSCL 081

Three sites representative of abandoned barren bituminous and anthracite mines were treated with various types of municipal sludge at high and low application rates and broadcast seeded with a mixture of greases and legumes. A monitoring system was installed at each demonstration site to determine the effects of the sludge applications on groundwater and soil percolate water chemical and bacteriological quality, chemical properties of the soil, and quality and growth of vegetative cover. GRA

N82-17616# Los Alamos Scientific Lab., N Mex
DOE-2 VERIFICATION PROJECT, PHASE 1 Interim Report
Stephen C. Diamond, Bruce D. Hunn, and Charlene C. Cappiello
Apr 1981 74 p refs

(Contract W-7405-eng-36)

(LA-8295-MS) Avail: NTIS HC A04/MF A01

Phase 1, an analytical and empirical verification of DOE-2 as computational algorithms, is reported. DOE-2 is a computer program developed to provide architect/engineers with a public domain tool for energy analysis buildings. Results of a comparison of plant equipment performance default values with manufacturer's data, and results of a series of comparisons of DOE-2 solar simulator predictions with predictions of other solar system simulation computer programs. Results of empirical tests of the full DOE-2 program are also presented, including comparisons with measured monthly and annual energy consumption for seven commercial buildings located in seven different cities and for nine elementary schools. Comparisons of predicted results of several building energy analysis computer programs are reported. E A K

N82-17619# Regensburg Univ. (West Germany). Inst fuer Physik

ASSESSMENT OF TECHNICAL POTENTIAL: PROBLEMS, METHODS AND RESULTS

G. Obemair. In Kernforschungsanlage Implementing Agreement for a Program of Res and Develop on Wind Energy Conversion Systems. Apr 1981 p 17-28 (For primary document see N82-17617 08-44)

Avail: NTIS HC A06/MF A01

The technical and economic problems posed by the integration of wind energy into the electric power supply system are considered. Stability and control requirements, the efficiency of wind converters and the exclusion of technically inaccessible areas are applied to the stochastic wind field over the total area. The resulting technical potential is then reduced to an economic potential by applying an economic filter which involves competitiveness measured against other energy sources, comparative social costs and socio-economic preferences, and the actual cost and existing use of land for wind energy parks. J D H

N82-17620# Regensburg Univ. (West Germany) Inst fuer Volkswirtschaft

ECONOMIC EVALUATION

L. Hoffman. In Kernforschungsanlage Implementing Agreement for a Program of Res and Develop on Wind Energy Conversion Systems. Apr 1981 p 28-37 (For primary document see N82-17617 08-44)

Avail: NTIS HC A06/MF A01

The economic significance of wind energy is assessed on the basis of its potential contribution to Germany's energy supply, its competitiveness vis-a-vis other energy sources, and its social desirability, measured by its contribution to the realization of general socio-economic goals. J D H

N82-17634# Argonne National Lab., Ill. Energy and Environmental Systems Div

CUSTOMER ATTITUDES TOWARD THERMAL-ENERGY-STORAGE HEATING

H. N. Hersh Jun 1981 74 p refs

(Contract W-31-109-eng-38)

(DE82-003010; ANL-SPG-17) Avail: NTIS HC A04/MF A01

Attitudes among users of thermal energy storage (TES) heating systems were studied. A customer acceptance survey exploring attitudes and levels of satisfaction, face to face contacts between utility representatives and users, and a survey of pertinent published information are investigated. It is found that: (1) TES heating systems are installed for economic reasons by customers who can afford higher initial costs and understand the concept of lower total cost, and (2) attitudes toward TES are positive. The TES systems are not regarded more favorably than conventional systems, however, and it is likely that lower electric heating bills are responsible for the favorable perceptions of most TES users. DOE

N82-17654*# Old Dominion Univ., Norfolk, Va Dept of Economics

ENERGY ENVIRONMENT STUDY Final Report, 16 May 1980 - 15 Mar. 1981

Raymond Strangways Dec 1981 123 p refs

(Contract NAG 1-66)

(NASA-CR-168458) Avail: NTIS HC A06/MF A01 CSCL 13B

The international demand for and supply of oil between the years 1980 and 2000 is assessed and future world oil prices and their implications for the price of jet fuel are estimated. Three critical questions are investigated: (1) how long will the world supply of oil continue to keep pace with its demand under likely trends in its use and discovery, (2) at what price will demand and supply clear the world oil market; (3) what does the analysis imply about the price of jet fuel. Projection of oil price is based upon supply and demand, which is consistent with microeconomic analysis. E A K

N82-17664# Rockwell International Corp., Newbury Park, Calif Environmental Monitoring and Services Center

ASSESSMENT OF OIL PRODUCTION VOLATILE ORGANIC COMPOUND SOURCES Final Report, Jan. - Sep. 1980

W. S. Eaton, G. R. Schneider, W. Unterberg, and F. G. Bush, III
Sep 1981 75 p

(Contract EPA-68-03-2648)

(PB82-108176; EPA-600/2-81-197) Avail: NTIS HC A04/MF A01 CSCL 13B

Oil and gas exploration and production drilling technology are described with emphasis on the makeup, use, and disposal of drilling fluids. A model for assessment of volatile organic compounds (VOC) emissions accompanying drilling is presented, along with an estimation of the potential VOC emissions associated with drilling activities. Emissions of volatile organic compounds from oil production in new fields were estimated, based on three types of information: (1) extent of new oil and gas fields (those that started production after 1974) in the contiguous 48 states, (2) drilling techniques used for oil and gas exploration and production wells (and their VOC potential), with specific emphasis on the drilling fluids; and (3) equipment and techniques for oil and gas production in new fields and their potential VOC sources. GRA

N82-17669# TRW, Inc., Research Triangle Park, N.C. Environmental Engineering Div

PERFORMANCE EVALUATION OF AN INDUSTRIAL SPRAY DRYER FOR SO2 CONTROL Final Report, Mar. 1980 - Jun. 1981

James A. Kezerle, Steve W. Mulligan, Dave-Paul Dayton, and Patricia J. Perry Aug 1981 274 p refs
Prepared in cooperation with Celanese Fibers Company, Cumberland, Md and Rockwell International, Downey, Calif., and Wheelabrator-Frye, Inc., Pittsburgh, Pa.

(Contract EPA-68-02-3174)

(PB82-110701; EPA-600/7-81-143) Avail: NTIS HC A12/MF A01 CSCL 13B

Results of a test to evaluate the SO2 removal performance of the lime-spray-dryer/fabric-filter system treating flue gas from the stoker-coal-fired boiler are presented. Continuous monitors were used to collect data according to EPA procedures for compliance testing. Data were collected for 23 days with the boiler operating at about half load. In addition to evaluating SO2 removal by dry flue gas desulfurization, operating experience with the boiler and spray-dryer/baghouse system was obtained for 5 months. Data were reduced to express SO2 removal on a mass per unit energy input basis as prescribed by EPA. Test

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results showed the mean SO₂ removal efficiency to be 70% (standard deviation of + or - 9%) when the sulfur content of the bituminous coal averaged 2%. T M

N82-17672# Louisville Gas and Electric Co., Ky
PILOT FIELD STUDIES OF FGD WASTE DISPOSAL AT LOUISVILLE GAS AND ELECTRIC Final Report, May 1976 - Aug. 1979

R P VanNess, A L Plumley (Combustion Engineering, Inc., Windsor, Conn.), N. C. Mohn (Combustion Engineering, Inc., Windsor, Conn.), C R Ulrich (Louisville Univ., Kentucky), and D. J. Hagerty (Louisville Univ., Kentucky) 1981 314 p refs (Contract EPA-68-02-2143)
(PB82-105479; EPA-600/7-81-155) Avail: NTIS HC A14/MF A01 CSCL 13B

The gas desulfurization (FGD) waste disposal was studied. It is shown that properly prepared landfill from FGD sludge/fly ash mixtures prevents trace element contamination of underlying groundwater. Small synthetically lined, above ground impoundments has higher concentrations of trace contaminants than subsurface impoundments. Most sites developed compressive strengths greater than the minimum required for recreational or light structural landfill. Water samples from beneath larger subsurface impoundments indicated that the filtering action of soil aids in decreasing the concentration of contaminants reaching the ground water supply. Certain mixtures under fixation reaction, reducing the permeability and minimizing the release of moisture and/or contaminants to the surrounding soil. GRA

N82-17678# Illinois Univ at Urbana-Champaign.
POTENTIAL WATER QUANTITY AND WATER QUALITY IMPACTS OF POWER PLANT DEVELOPMENT SCENARIOS ON MAJOR RIVERS IN THE OHIO BASIN

E Downey Brill, Jr., Shouu-Yuh Chang, Robert W. Fuesle, and Randolph M Lyon Apr. 1981 225 p refs (Grant EPA-R-805588)
(PB82-102401; EPA-600/7-81-045) Avail: NTIS HC A10/MF A01 CSCL 13B

Water consumption levels associated with power plant cooling were estimated for different energy development scenarios for the Ohio River Basin potential impacts of power plant consumption and pollutant emissions on ambient water quality were also estimated. Cumulative water consumption was compared to the 7 day 10 year low flow values for various locations along the tributaries and main stem of the Ohio River. The total potential consumption associated with projected municipal and non power industrial was evaluated. Potential water quality impacts were estimated. Potential impacts on water quality result mainly from plant consumption are generally small in comparison to background levels. GRA

N82-17684# Tennessee Valley Authority, Muscle Shoals, Ala. Div. of Energy Demonstrations and Technology
DEFINITIVE SO_x CONTROL PROCESS EVALUATIONS: AQUEOUS CARBONATE AND WELLMAN-LORD (ACID, ALLIED CHEMICAL, AND RESOX) FGD (FLUE GAS DESULFURIZATION) TECHNOLOGIES Final Report, Apr. 1978 - Apr. 1981

J. R. Byrd, K. D. Anderson, S V Tomlinson, and R L Torstrick Jun. 1981 319 p refs (Contract EPA-IAG-D9-3721-81)
(PB82-118670; EPA-600/7-81-099, EDT-121) Avail: NTIS HC A14/MF A01 CSCL 13B

Economic evaluations of two processes: (1) the aqueous carbonate process (ACP) and the Wellman-Lord process, applied to a sulfuric acid plant, (2) the Resox process, and the coal reduction process, all for sulfur production are reported. The ACP uses a spray dryer flue gas desulfurization (FGD) system and molten salt reduction with coal to make sulfur. The ACP has a major cost advantage because it incorporates final fly ash and chloride removal as process functions. The ACP has a major advantage in annual revenue requirements because it does not need process or reheat steam. Wellman-Lord process costs are the same for all three applications. GRA

N82-17742 Illinois Univ at Urbana-Champaign.
CLIMATIC INFLUENCES OF RESIDENTIAL ENERGY CONSUMPTION Ph.D. Thesis

Stewart Jay Cohen 1981 193 p
Avail. Univ. Microfilms Order No 8127570

A climatic index, applicable to the estimation of residential energy consumption was developed. The index is based on seasonal frequencies of upper-air (500-mb height) circulation patterns. A multivariate static technique, principal component analysis with oblique rotation of eigenvectors was used to classify 33 years of daily 500-mb height anomaly, patterns into 30 components. Each component represents two modes, positive and inverse, thereby resulting in sixty 500-mb types. Additional aggregation procedures reduced the number of types to 48. 78% of all days were categorized by this method. Two sets of regression analyses were performed on the data base, one set using 500-mb type frequencies, the other using population weighted heating degree days (POPHDD) and unweighted heating degree days (HDD). Results show that the 500-mb type frequency is a better climatic index of long term residential natural gas consumption than either HDD or POPHDD. Dissert. Abstr.

N82-17763# Stockholm Univ (Sweden) Dept. of Meteorology.

INCREASE OF ATMOSPHERIC CO₂ AND POSSIBLE CLIMATIC CHANGES

Bert Bolin *In* WMO Tech. Conf. on Climate: Asia and Western Pacific 1981 p 227-238 refs

Avail. NTIS MF A01; print copy available at WMO, Geneva SwFr 28

Numerous surveys of man's impact on climate, particularly the possible effects of an increasing concentration of atmospheric CO₂ were made. A brief account summarizing the state of knowledge in this regard is made. Consideration is given to: (1) the characteristics of the carbon cycle and its response to man-made emissions to the atmosphere; (2) the climatic change that may be induced by an increasing amount of CO₂ in the atmosphere; and (3) the likely developments over the next 50 years as a result of man's increasing exploitation of the global resources of fossil fuels and the terrestrial ecosystems. Analysis of the way in which the carbon cycle responds to disturbances due to man, i.e., fossil fuel combustion, deforestation and expansion of agriculture is considered to be of particular importance. M.D.K

N82-17764# Leeds Univ (England) School of Geography.
ENERGY AND CLIMATE IN SOUTH-EAST ASIA AND THE WESTERN PACIFIC

G J. Lockwood *In* WMO Tech. Conf. on Climate Asia and Western Pacific 1981 p 239-263 refs

Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 28

Regional and global aspects of energy use were reviewed. The combined results of population increases, changing patterns of population densities, and escalating per capita energy consumption has concentrated in some regions of the world very large energy fluxes per unit area (energy flux density) when compared with the world average; consequences are considered. Climate is discussed as related to increasing energy use in three major areas: (1) climate as an energy source, (2) pollution of the atmosphere by energy use (waste heat and aerosols); and (3) climatic controls on energy use and the effects of climatic variations. Long term climatic changes and the attendant economic consequences of increased atmospheric carbon dioxide are discussed. Utilization of wind, water, and solar power as climate related energy sources is also considered. M.D.K.

N82-17765# National Oceanic and Atmospheric Administration, Rockville, Md National Climate Program Office
APPLICATIONS OF CLIMATE INFORMATION AND THE UNITED STATES NATIONAL CLIMATE PROGRAM

Edward S. Epstein *In* WMO Tech. Conf. on Climate, Asia and Western Pacific 1981 p 264-266

Avail. NTIS MF A01; print copy available at WMO, Geneva SwFr 28

The United States National Climate Program established with the purpose of assisting the Nation and the world to understand and respond to natural and man-induced climate processes and their implications is discussed. The basic strategy of the program is to emphasize early production of useful data and information based on existing knowledge of climate, while simultaneously expanding understanding of climate and its impacts on society. Three areas discussed in which progress should be made are:

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(1) understanding climate; (2) responding to impacts and policy implications of climate; and (3) providing climate products. The generation, dissemination and application of climate information and the creation and utilization of national data inventory and clearinghouse is also discussed. A summation of current activity areas within the program is presented
M.D.K.

N82-17766# World Meteorological Organization, Geneva (Switzerland).

STUDY OF CLIMATE AND ITS APPLIED ASPECTS

E. P. Borisenkov (USSR) and N. V. Kobysheva (USSR) *In its* Tech. Conf on Climate. Asia and Western Pacific 1981 p 267-273

Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 28

The need for a reliable scientific basis for estimating the climate effect on the economic, biological and social aspects of society is considered. The foundation of this basis should include knowledge of the general statistical characteristics of climate and its changeability for different regions and the whole globe and the methods for their consideration when forming a long-term plan of production development, and knowledge of the effect of climatic extremes on different aspects of economic and social life. The effect of climatic change on agriculture, on agricultural energy consumption, energy production, water resource management, and consequences of climatic variations on fish industry and human health is discussed. Methods for optimal consideration of future climate in planning man's economic activities are also discussed
M D K

N82-18066*# Jet Propulsion Lab., California Inst of Tech., Pasadena.

VEHICLE TEST REPORT: ELECTRIC VEHICLE ASSOCIATES ELECTRIC CONVERSION OF AN AMC PACER

Theodore W. Price, Vincent A. Wirth, Jr., and Michael F. Pompa 15 Oct 1981 61 p refs
(Contracts NAS7-100, DE-AI01-78CS-54209)

(NASA-CR-168425, JPL-Pub-81-97; DOE/CS-54209/4) Avail: NTIS HC A04/ A01 CSCL 13F

Tests were performed to characterize certain parameters of the EVA Pacer and to provide baseline data that can be used for the comparison of improved batteries that may be incorporated into the vehicle at a later time. The vehicle tests were concentrated on the electrical drive subsystem; i.e., the batteries, controller and motor. The tests included coastdowns to characterize the road load, and range evaluations for both cyclic and constant speed conditions. A qualitative evaluation of the vehicle's performance was made by comparing its constant speed range performance with other electric and hybrid vehicles. The Pacer performance was approximately equal to the majority of those vehicles assessed in 1977
A R.H.

N82-18068*# Department of Transportation, Cambridge, Mass
FUEL ECONOMY AND EXHAUST EMISSIONS CHARACTERISTICS OF DIESEL VEHICLES: TEST RESULTS OF A PROTOTYPE FIAT 131TC 2.4 LITER AUTOMOBILE

S. S. Quayle Jan 1982 58 p refs
(NASA Order C-32817-D; Contract DE-AI01-80CS-50194)
(NASA-CR-165535, DOE/NASA/2817-2;

DOT-TSC-NASA-81-2) Avail: NTIS HC A04/MF A01 CSCL 13F

The results obtained from fuel economy and emission tests conducted on a prototype Fiat 131 turbocharged diesel vehicle are presented. The vehicle was tested on a chassis dynamometer over selected drive cycles and steady-state conditions. Two fuels were used, a United States number 2 diesel and a European diesel fuel. Particulate emission rates were calculated from dilution tunnel measurements and large volume particulate samples were collected for biological and chemical analysis. It was determined that turbocharging accompanied by complementary modifications results in small but substantial improvements in regulated emissions, fuel economy, and performance. Notably, particulate levels were reduced by 30 percent
Author

N82-18070# Open Univ., Milton (England). Energy Research Group.

COMMUNICATION AND INTEGRATION WITHIN THE AGRICULTURE WATER, WASTE, AND ENERGY INDUSTRIES

D. C. Andrews Sep 1980 28 p refs

(ERG-033) Avail: NTIS HC A03/MF A01

The special area of interest lies in the possible benefits of integrating and coordinating the activities of the agriculture, water, waste and energy (AWWE) sectors, where large cash and energy savings seem possible. The integration of the AWWE sectors is a specific example, but the comments and methods suggested are general in their application to complex problem-solving areas. A general method is described which, compared with conventional research, makes the collection of information on potential integration and coordination of any complex activities much easier. It also makes it more likely that the information is relevant and correct but, above all, the method ensures that any useful results of the research will be brought to the attention of relevant policy makers, with therefore a better chance that such results will be acted upon. Lateral access networks are proposed as a general means of achieving these practical benefits
J.M.S.

N82-18071# McElroy (Ralph) Co., Austin, Tex.

POSSIBILITY FOR ENERGY CONSERVATION IN TRANSPORTING FREIGHT BY TRUCK

M. Millar Sep. 1981 20 p Transl into ENGLISH from Symp. on Evaluation and Reinforcement of Pavements and Energy in Transportation, Argentina, 1980 p 121-30 Symp held in San Miguel de Tucuman, Argentina, 4-6 Sep. 1980 Prepared for Argonne National Lab., Ill.

(Contract W-31-109-eng-38)

(DE81-030072; ANL-Trans-1199)

Avail: NTIS

HC A02/MF A01

Increasing energy efficiency in transporting freight by truck in interurban areas is discussed. Technical parameters to improve fuel economy are: (1) efficiency of the engine and drive train; (2) rolling resistance; (3) gross weight of the vehicle; (4) accessory load; and (5) aerodynamic resistance. Operating procedures to improve fuel economy are also discussed. Savings obtained up to the present in the USA due to the use of these various devices are summarized.
DOE

N82-18073# Open Univ., Milton (England) Energy Research Group.

ELECTRIC VEHICLE REFUELLING INFRASTRUCTURE

Mike Baker Oct. 1981 69 p refs

(ERG-038) Avail: NTIS HC A04/MF A01; Secy. Energy Research Group, Milton Keynes, England

Energy and economic aspects of refueling infrastructures required in 2025 by complete fleets of electric battery and coal derived liquid fuel powered road vehicles are compared. Data are drawn from a study of the United Kingdom. The electric car is cheaper than the liquid powered one. If battery exchange is discounted, all electric vehicles have lower fuel costs than their equivalent. The electric vehicle alternative shows a very large saving in both primary energy and running cost. It requires a much smaller installed electricity generating capacity whose load factor is such that it can be totally nuclear
Author (ESA)

N82-18078# Federal Highway Administration, Washington, D.C. Office of Research and Development.

A METHOD FOR ESTIMATING FUEL CONSUMPTION AND VEHICLE EMISSIONS ON URBAN ARTERIALS AND NETWORKS

Juri Raus Apr. 1981 60 p refs

(PB82-108523; FHWA/TS-81/210)

Avail: NTIS

HC A04/MF A01 CSCL 13F

A method to estimate motor vehicle fuel consumption and vehicle emissions in an urban driving environment which requires a minimum of field data collection and processing effort was developed. Average transient speed measured by travel time is a good composite parameter reflecting stops and slowdowns and is closely correlated with fuel consumption and vehicle emission rates. Data were obtained for fuel speed and emission speed profiles for a 1980 typical mix of passenger cars, single unit trucks, tractor trailers and busses. Data and computational procedure provide an approach for estimating fuel consumption and emissions and can be used to gain insight into existing traffic operations and the merits of proposed or actual flow improvements
GRA

N82-18120# Southampton Univ (England). Dept of Aeronautics and Astronautics.

DEVELOPMENTS IN ROTARY WING AIRCRAFT AERODY-

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NAMICS

I C. Cheeseman /n DGLR Seventh European Rotorcraft and Powered Lift Aircraft Forum 1981 27 p refs

Avail: NTIS HC A99/MF A01

Developments in helicopter aerodynamics are reviewed, including new blade sections and planforms. Computer modelling of the flow and the need for further work in predicting oscillating loadings are considered. The greater attention being given to the need to reduce drag in forward flight due to extended range and fuel conservation costs is recognized. A forecast of advances is made. N.W.

N82-18134# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

COMPONENT DESIGN AND DEVELOPMENT FOR FUTURE HELICOPTER ENGINES

Jean Hourmouziadis and Horst B. Kreiner /n DGLR Seventh European Rotorcraft and Powered Lift Aircraft Forum 1981 19 p refs

Avail: NTIS HC A99/MF A01

Advances achieved today and results available from both rig and demonstrator test programs for present and future helicopter engines are discussed. These will form the basis for further component improvement required to yield a successful next generation engine. The significance of reduced fuel consumption, improved overall system performance, and reliability are considered in relation to design activity and reaction to changing customer needs. M.D.K.

N82-18174# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany)

[AVIATION AND SPACE FLIGHT RESEARCH ACTIVITIES] Annual Report, 1980 [JAHRESBEREICH 1980]

Sep 1981 176 p refs In GERMAN

Avail: NTIS HC A09/MF A01

Results on the main research projects conducted in 1980 are described in the areas of transport and communication systems, airplanes, space flight techniques, exploration techniques, and energy and turbomachinery techniques. The improvement of reliability and security in transportation is a common feature of all projects. Aviation research is focussed on projects such as AIRBUS, fighter aircraft, and helicopters. Spacelab and the development of suitable payloads are the central issues of the space research effort with emphasis on material and processing techniques as well as biophysics and biomedicine. Data acquisition, using sensors and processing of satellite and Spacelab data is actively pursued. Recent developments in the domain of turbomachinery, nonnuclear energy research, energy conservation, and high energy laser techniques are also discussed.

Author (ESA)

N82-18207# General Accounting Office, Washington, D. C. **POTENTIAL REDUCTIONS IN AIRCRAFT OPERATION AND MAINTENANCE COSTS BY USING THRUST COMPUTING SUPPORT EQUIPMENT** Report to the Honorable Joseph P. Addabbo, Chairman, Subcommittee on Defense, Committee on Appropriations, House of Representatives

27 Oct. 1981 17 p

(AD-A108463, GAO/PLRD-82-4)

Avail: NTIS

HC A02/MF A01 CSCL 01/2

This report addresses the evaluation of thrust measuring equipment. We interviewed Air Force officials and contractor representatives, reviewed documentation pertaining to the key events in the evaluation of the thrust computing system program, reviewed test data and analyses by Air Force and contractor engineers, and observed the operation of the thrust computing system. Our analyses show that the accurate measurement and setting of thrust for installed jet engines is of vital importance not only for aircraft readiness and safety but also for operation and maintenance cost reductions. Although test results indicate that a system is available that can perform such measurements, the services have not been using it. The Air Force has conducted extensive tests that will measure thrust for installed J85-5 engines, but has not implemented a system. The Navy has not performed any tests to determine whether its aircraft jet engines might benefit from such a system. GRA

N82-18305# Office of Technology Assessment, Washington, D. C.

SOLAR POWER SATELLITES, SUMMARY

Aug. 1981 22 p

(OTA-E-145) Avail: NTIS HC A02/MF A01

The energy potential of the solar power satellite (SPS) was assessed. The preliminary nature of SPS technology was taken into account by comparing four alternative SPS systems across a broad range of issues: their technical characteristics, long term energy supply potential, international and military implications, environmental impacts, and institutional effects. The SPS options were also compared to potentially competitive energy technologies in order to identify how choices among them might be made. In addition, a set of Federal research and funding options were developed to address the central questions and uncertainties identified in the report. S.L.

N82-18333# Cambridge Univ (England). Dept. of Engineering

MICROMECHANISMS OF FRACTURE AND HYPOTHERMAL AGING OF FIBROUS COMPOSITES

 Final Report, 1 Aug. 1978 - 31 Dec. 1980

Peter W R Beaumont 28 Feb. 1981 73 p refs

(Grant AF-AFOSR-3644-78, AF Proj 2307)

(PB82-121369, CUED/C-MAT/TR-76-181) Avail: NTIS HC A04/MF A01 CSCL 11D

The micromechanisms of crack extension of carbon fibers, glass fibers, and hybrid composites containing glass fibers, and carbon fibers in epoxy and polyester resins were studied. A new collection of failure data based on observations of fibers debonding, snapping and pulling out was summarized in cumulative probability diagrams and analyzed using Weibull distribution parameters. This data, together with models of failure processes and information of work of fracture, is used to construct fracture mechanism diagrams. These diagrams, together with the Weibull parameters may help in distinguishing between mechanisms of fracture give guidance in selecting a material system and in isolating aging and environmental effects. Author (GRA)

N82-18338 Illinois Univ. at Urbana-Champaign

SELECTIVE JET PLATING

 Ph.D. Thesis

Tan-Jen Chen 1981 204 p

Avail: Univ. Microfilms Order No. 8127565

The use of an un submerged impinging jet system for selective plating is proposed. A theoretical analysis, which accounted for the charge transfer, mass transfer, and ohmic resistance effects, was developed to predict the current distributions along the cathode. Three electrochemical systems were employed in an experimental jet plating cell to demonstrate the validity of the model. The current distributions were measured with controlled variation of jet Reynolds number, nozzle-to-cathode distance, solution specific conductivity, and reactant concentration. Upon demonstrated to be valid, the theoretical model was used to predict the cell performance under a wide range of parameter values. Dissert. Abstr.

N82-18340 Minnesota Univ., Minneapolis.

EXPERIMENTAL AND THEORETICAL STUDIES ON GAS CYCLONE SEPARATORS OPERATING AT HIGH EFFICIENCY

 Ph.D. Thesis

Thinh Van Tran 1981 161 p

Avail: Univ. Microfilms Order No. 8126034

It was shown that wall friction has negligible effect on particle motion, but dust particles on the wall move much more slowly than the surrounding gas, due to crowding. It was found that re-entrainment of particles in the region near the cone apex of a cyclone is a significant factor affecting collection efficiency of low and moderate efficiency cyclones. A theory on the secondary flow along the cone wall was developed. Short circuit flow on the top of a cyclone was also studied. The effect of this flow on efficiency was also studied. The secondary flow velocity was found to be dependent on inlet geometry and is of order of 15% that of the main flow. A simplified theory was developed to give the flow field in gas cyclones. It was shown that the particle volume fraction inside the dust spiral on a cyclone wall is of the same order as the emulsion phase in fluidized systems. Dissert. Abstr.

N82-18341 Louisiana State Univ. and A&M Coll., Baton Rouge

FREQUENCY RESPONSE ANALYSIS OF DISTILLATION COLUMN INTERACTION

 Ph.D. Thesis

Chien Wang 1981 338 p

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Avail: Univ. Microfilms Order No. 8126983

A dynamic pressure model of multicomponent distillation is developed in the frequency domain. The model consists of a set of linearized overall and component balances, enthalpy balance, pressure relationship, hydraulic equation and equilibrium relationships for each tray, the condenser and the reboiler of a general column. A numerical method consisting of total scaled pivoting Gaussian elimination with the method of residues is worked out for solving the model in the frequency domain to obtain all of the desired transfer functions. As a result, this analysis can be useful in defining the control problem and predicting interaction difficulties. The computer program developed can be used to study the effect of different model simplifying assumptions. The models studied were pressure model, enthalpy model and quimolar overflow model. A steady state program and a mechanical design program were also developed.

Dissert. Abstr.

N82-18342# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Earth Sciences Branch
IDENTIFYING AND DETERMINING HALOCARBONS IN WATER USING HEADSPACE GAS CHROMATOGRAPHY
Daniel C. Leggett Oct. 1981 17 p refs
(Proj. CWIS-31281)
(AD-A108345; CRREL-SR-81-26) Avail. NTIS
HC A02/MF A01 CSCL 07/4

Since the discovery that chloroform and other haloforms are produced during water chlorination, methods have been needed for their routine analysis. This report describes the application of the multiple equilibration headspace technique for the determination of halocarbons in water. This method has certain advantages over solvent extraction and direct injection techniques, including greater sensitivity because of the favorable gas/liquid distribution ratios. It is simpler and faster than purge and trap and resin sorption methods and gives more information about compound identity than single headspace analysis because gas/liquid distribution ratios are determined experimentally. The method is absolute, unlike solvent extraction, resin sorption, purge and trap, and conventional headspace analysis, which require standard additions to correct for incomplete recovery. The use of the technique to analyze chlorinated water samples for haloforms revealed a potential problem in their analysis. Haloforms continued to form for 24 hours, even after destruction of chlorine residuals with thiosulfate. Maximum haloform concentrations were observed in undechlorinated samples only after a 48 hour aging period. GRA

N82-18552# Ferngas Nordbayern G.m.b.H., Bamberg (West Germany)
REPORT ON THE EXPERIENCES WITH THE GAS COMPRESSION HEAT PUMP SYSTEM OF THE SCHOOL AND SPORTS CENTER AT ALTENKUNSTADT Final Report, Dec. 1980
Fritz Tschertner Bonn Bundesministerium fuer Forschung und Technologie Oct. 1981 109 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-175; ISSN-0340-7608) Avail. NTIS
HC A06/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 23.10

Three years of operation of a 1200 kw natural gas boiler system supplemented by a 800 kw gas heat pump system are evaluated and the savings in primary energy are assessed. Setup, control system and measuring instrumentation are described. The proximity of a river allows an hybrid operation whereby 100% of the heat is produced by the gas powdered heat pump for any river temperature above 3 C whereas below that temperature the gas boiler takes over completely. Annual heat pump heating figures between 1.66 and 1.72 were obtained, thus yielding a saving in primary energy between 36% and 47%, in good agreement with the design values. The cost analysis shows that the savings thus achieved cover the operating costs specific to the heat pump
Author (ESA)

N82-18553# Thermo Electron Corp., Waltham, Mass.
OPEN-CYCLE VAPOR COMPRESSION HEAT PUMP Annual Progress Report, 1980
Ravi Sakhuja and Frederick E. Becker 5 May 1981 54 p
(Contract GRI-5011-342-0094)
(PB82-110503, TE4224-243-81, GRI-80/0064) Avail. NTIS
HC A04/MF A01 CSCL 13A

Recovery and upgrading of low-grade steam or waste heat sources offers a great potential of energy conservation. Thermo Electron is developing an open cycle vapor compression steam heat pump to meet this objective. The system utilizes excess low-pressure steam or that produced from an industrial excess heat source with a waste heat boiler and compresses this steam to the desired pressure level for process use. The compressor is driven by a prime mover such as a gas turbine, gas engine, etc. The prime mover exhaust heat also can be recovered to generate additional process steam. The fuel consumption of this system can be as low as 30 to 50 percent in comparison to a direct-fired boiler, over the expected range of process conditions. Simple payback periods as low as one year can be achieved. GRA

N82-18568# Rockwell International Corp., Newbury Park, Calif. Environmental Monitoring and Services Center.
DEVELOPMENT OF A MULTIDETECTOR PETROLEUM OIL IN WATER MONITOR Final Report, May 1978 - Jan. 1981
Robert W. Melvold Sep 1981 90 p refs
(Contract EPA-68-03-2648)
(PB82-105206; EPA-600/2-81-206) Avail. NTIS
HC A05/MF A01 CSCL 14B

A prototype petroleum oil-in-water monitoring system that continuously measures oil (whether free, suspended, dissolved, or emulsified) in water carrying a variety of potential interfering substances was developed. An extensive desk-top survey of commercially available oil monitors was carried out. Three devices were selected for thorough laboratory evaluation: (1) Sigrist Fluorescence Monitor Model FLJ, (2) CE Invalco D O.W. Monitor, and (3) Horiba OCMA-25 Oil Content Monitor. The construction of a flow loop and its operation, the installation of the selected detectors in the breadboard system, the development of a data retrieval system, the calibration methodology employed, the initial checkout of the detectors, and the extensive multidetector evaluation of each detector's performance for quantifying petroleum oil in the presence of impurities and other interferents are described. GRA

N82-18679# Indiana Univ., Bloomington School of Public and Environmental Affairs
A LAND USE ANALYSIS OF EXISTING AND POTENTIAL COAL SURFACE MINING AREAS IN THE OHIO RIVER BASIN ENERGY STUDY REGION
Daniel E. Willard, Michael A. Ewert, Mary Ellen Hogan, and Jeffrey D. Martin Apr 1981 136 p refs
(Contract EPA-R-805588)
(PB82-105172; EPA-600/7-81-068) Avail. NTIS
HC A07/MF A01 CSCL 08I

The land use changes resulting from the surface mining of coal in the Ohio River Basin, which depend on the distribution of the coal, the economic attractiveness of the coal demand, rigor and effectiveness of regulatory mechanisms, and the resilience of the existing ecosystems are reported. The three levels of coal demand assumed are taken from ORBES scenarios. The study analyzes existing industrial and governmental data on distribution, availability, and extraction of strippable coal. The history of reclamation enforcement and compliance is examined, and several potential land use results of the Federal Surface Mining Control and Reclamation Act of 1977 are analyzed. All of these factors are compared to existing patterns of topography, agriculture, and forestry. GRA

N82-18680# Kentucky Univ., Lexington Inst for Mining and Minerals Research
COAL MINE SITING FOR THE OHIO RIVER BASIN ENERGY STUDY
Donald A. Blome Sep 1981 180 p refs
(Grant EPA-R-805590)
(PB82-108119; EPA-600/7-81-116) Avail. NTIS
HC A09/MF A01 CSCL 08I

In part 1, an overview of the ORBES region coal industry is presented. (The region consists of all of Kentucky, most of West Virginia, and substantial portions of Illinois, Indiana, Ohio, and Pennsylvania.) Topics include coal production, mine types, reserves, selected coal properties, coal markets, employment, working conditions, wages, and quality of life. In part 2, the procedures for siting coal mines under the ORBES energy development scenarios are set forth. The coal mine siting analysis projects at the county level the number and type of new coal mines that would be opened in the ORBES region through the year 2000.

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under various scenario conditions and constraints. Among these conditions and constraints are the locational siting pattern of additional power plants in each scenario, the total coal production specified for the year 2000 by the ORBES energy demand model, and the sources of high and low sulfur coal, by mine type, specified by the ORBES coal supply analysis. GRA

N82-18700# Friends of the Earth, San Francisco, Calif.
ENERGY POLICIES FOR RESILIENCE AND NATIONAL SECURITY Final Report

Amory B. Lovins and L. Hunter Lovins Oct 1981 322 p refs
(Contract DCPA01-79-C-0317)

(AD-A108263) Avail. NTIS HC A14/MF A01 CSCL 15/3

The vulnerabilities of the U.S. energy system to accidental or deliberate disruptions are analyzed generically and specifically and shown to be disturbingly large. Since they arise from reliance on highly centralized technologies, increasing such reliance is likely to increase national energy vulnerability. A more efficient, diverse, dispersed, renewable energy system is shown to be inherently more resilient, to make major failures impossible, and to be compatible with consistent adherence to free-market principles. Author (GRA)

N82-18701# Central Wayne County Sanitation Authority, Dearborn Heights, Mich

FEASIBILITY STUDY ON ENERGY RECOVERY AND COGENERATION FROM AN EXISTING MUNICIPAL INCINERATOR, PHASE 1 Final Report

Jul 1981 458 p refs
(Contract DE-FG01-79CS-20232)

(DE82-001143, DOE/CS-20232/1) Avail: NTIS
HC A20/MF A01

A feasibility study of recovering and converting incinerator waste heat energy into steam and electricity for use in the facility with excess electricity being sold to the local utility was made. Energy recovery would be accomplished by retrofitting each furnace with a waste heat boiler and producing steam for heating and for driving steam turbine electric generators. Preliminary designs, economic analyses, and financial plans were prepared. The quantity of municipal refuse was identified and the electric revenues needed for project justification were calculated. For the purpose of obtaining accurate design data, field tests were carried out on the actual refuse and combustion process. DOE

N82-18707# Service de la Programmation de la Politique Scientifique, Brussels (Belgium)

NATIONAL ENERGY RESEARCH AND DEVELOPMENT PROGRAM [PROGRAMME NATIONAL DE RECHERCHE-DEVELOPPEMENT DANS LE DOMAINE DE L'ENERGIE]

1980 23 p In FRENCH
Avail. NTIS HC A02/MF A01

This bibliography cites 24 reports generated by a program designed to study the national energy system, possibilities for energy conservation, and the use of new energy sources in Belgium. Topics covered include a mathematical model of the energy system; social impacts; regional aspects; the energy infrastructure, compatibilities, energy consumption in buildings and industries, the use of solar energy, heat recovery and storage; and the use of fossil fuels. Transl. by A.R.H.

N82-18708# Technische Hogeschool, Delft (Netherlands) Lab. for Thermal Power Engineering

CYCLE: A GENERAL COMPUTER CODE FOR THERMODYNAMIC CYCLE COMPUTATIONS. STUDIES OF COGENERATION IN DISTRICT HEATING SYSTEMS

J. A. Miedema Sep 1981 272 p refs
(WTHD-135) Avail. NTIS HC A12/MF A01

Computer programs which determine the energy consumption of heat power units, calculate the energy consumed by large scale district heating systems, compute the energy consumption per unit heat (f factor), and estimate the effect of dual purpose units on energy production/consumption of a regional scale power network were developed. District heating systems were assessed, using the programs. Systems with steam and gas units have lowest f factors. Regional power production efficiency is influenced by dual purpose units. The influence must be calculated for each case separately. Accurate computation of the f factor is urged since it is directly linked to the benefits/cost ratio. Author (ESA)

N82-18724# National Bureau of Standards, Washington, D.C. Center for Building Technology

ENERGY MANAGEMENT AND CONTROL SYSTEMS (EMCS) USER SATISFACTION STUDY

Gary W. Dickinson Aug 1981 20 p refs Sponsored in part by DOE, Washington, D.C.

(PB82-103656; NBSIR-81-2346) Avail. NTIS
HC A02/MF A01 CSCL 13A

A study of 86 energy management and control systems (EMCS) was made. Users' satisfaction and perceived system reliability was determined. GRA

N82-18728# National Bureau of Standards, Washington, D.C. Center for Building Technology.

PERFORMANCE OF THE NORRIS COTTON FEDERAL OFFICE BUILDING FOR THE FIRST 3 YEARS OF OPERATION Final Building Sciences Series

James E. Hill, William B. May, Jr., Thomas E. Richtmyer, Jacqueline Elder, Robert L. Tibbott, Gary T. Yonemura, Charles M. Hunt, and Phillip T. Chen Aug 1981 143 p refs Sponsored in part by DOE, Washington, D.C.

(PB82-105487; NBS-BSS-133; LC-81-600082) Avail: NTIS
HC A07/MF A01 CSCL 13A

The Norris Cotton Federal Office Building, designed to demonstrate a number of energy saving concepts, is discussed. Some of the major energy conserving features of the Building are the use of solar collectors; heavy masonry construction with exterior insulation; small overall window area; heat recovery from heat pumps, chillers, a natural gas-powered engine/generator, and the ventilation system; modular boilers; thermal storage tanks; and a variety of energy conserving lighting systems. GRA

N82-18731# Midland-Ross Corp., Toledo, Ohio Thermal Systems Technical Center.

INDUSTRIAL BURNER AND PROCESS EFFICIENCY PROGRAM Annual Report, Jan. - Dec. 1980

S. R. Huebner and S. N. Prakash Mar. 1981 96 p refs
(GRI Proj 5011-342-0148)

(PB82-115486, GRI-80/0059, Rept-1228) Avail: NTIS
HC A05/MF A01 CSCL 13A

A laboratory prototype burner which is compatible with a FM (frequency modulation) combustion control system where temperature control is accomplished by regulating the ratio of burner on-time to burner off-time was developed. This multifuel (natural gas and No. 2 fuel oil) high velocity burner is capable of repeated pulse ignition at maximum rated capability (1 million Btu-hour) with preheated air (from ambient to 1100F). A digital control in the FM mode was developed. Experimental data from tests in a laboratory furnace indicated that when applied to a batch type thermal process where appreciable turndown is presently obtained by excess air operation, the FM combustion system provides improvements in process fuel efficiency and gains in productivity. Author

N82-18732# Carltech Associates, Columbia, Md

GEOHERMAL ENERGY MARKET STUDY ON THE ATLANTIC COASTAL PLAIN: TECHNICAL FEASIBILITY OF USE OF EASTERN GEOHERMAL ENERGY IN VACUUM DISTILLATION OF ETHANOL FUEL

J. Carl Uhrmacher Apr 1981 35 p refs Prepared for APL, Laurel, Md.

(Contracts EX-78-A38-1008; DE-AI01-79FT-27025; N00024-81-C-5301)

(PB82-123001; JHU/APL/QM-81-066) Avail: NTIS
HC A03/MF A01 CSCL 07A

The application of modest temperature geothermal water in combination with a vacuum system for the distillation of fuel grade ethanol is analyzed. The case analyzed was for geothermal water temperatures typical of what might be found on the Atlantic Coastal Plain, i.e., 150 F, and a vacuum of 130 mm Hg, i.e., currently in use in a farm scale vacuum distillation system in Ohio. GRA

N82-18733# National Oceanic and Atmospheric Administration, Washington, D.C.

COMMERCIAL OCEAN THERMAL ENERGY CONVERSION (OTEC) LICENSING FINAL ENVIRONMENT IMPACT STATEMENT Final Environmental Impact Statement

Jul. 1981 284 p refs
(PB82-117532; NOAA-81082705) Avail. NTIS

HC A13/MF A01 CSCL 10B

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The effects of licensing commercial ocean thermal energy conversion (OTEC) development on human activities and the atmospheric, marine and terrestrial environments are identified and assessed. Alternate regulatory approaches for mitigating adverse environmental impacts associated with siting, design, and operation of commercial OTEC plants are evaluated, and the preferred regulatory alternative identified Author (GRA)

N82-18734# Illinois Univ. at Chicago Circle, Chicago.
ENERGY CONSUMPTION PATTERNS: ILLINOIS, INDIANA, KENTUCKY, OHIO, PENNSYLVANIA, AND WEST VIRGINIA (1975)

James P. Hartnett and Jan L. Saper Apr. 1981 80 p refs
(Grant EPA-R-805588)
(PB82-101478; EPA-600/7-81-066) Avail. NTIS
HC A05/MF A01 CSCL 10A

Energy consumption data for the year 1975 for the states of Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia, as well as for the United States as a whole is presented. Energy use is examined both by consuming sector and by fuel source. The principal components of each sector are described briefly, and detailed comparisons are made among national, six-state, and individual state consumption patterns for 1975. Preliminary estimates are given for total energy consumption in the United States, the six states, and individual states for the years 1976, 1977, and 1978. GRA

N82-18735# Purdue Univ., Lafayette, Ind
OHIO RIVER BASIN ENERGY STUDY: SOCIAL VALUES AND ENERGY POLICY

Harry R. Potter and Heather J. Norville Apr. 1981 152 p refs
Prepared in cooperation with Ohio River Basin Energy Study
(Grants EPA-R-806451; EPA-R-805585)
(PB82-101494; EPA-600/7-81-053) Avail. NTIS
HC A08/MF A01 CSCL 10A

American social values and their relationship to energy production and use within the the Ohio River Basin area are identified and analyzed. The major topics are (1) an overview of social values and energy policy, (2) an identification of values implicit in the Ohio River Basin Energy Study scenarios, (3) a secondary analysis of survey data, and (4) a discussion of variations in social values by social and demographic characteristics GRA

N82-18736# West Virginia Univ., Morgantown Bureau of Business Research
AN ECONOMIC ANALYSIS OF THE ELECTRIC UTILITY SECTOR IN THE OHIO RIVER BASIN REGION

Patrick C. Mann and Tom S. Witt Apr. 1981 106 p refs
Prepared in cooperation with Ohio River Basin Energy Study
(Grant EPA-R-805585)
(PB82-103268; EPA-600/7-81-047) Avail. NTIS
HC A06/MF A01 CSCL 10A

The potential effects of different pricing mechanisms on capacity requirements, load factors, and fuel costs are discussed, with particular attention paid to their implications for the Ohio River Basin Region. Two sets of estimates for various elasticities of demands are presented. Regulatory policy and its effect upon electricity demand and pricing are studied GRA

N82-18739# West Virginia Univ., Morgantown Bureau of Business Research
ENERGY CONSUMPTION IN THE OHIO RIVER BASIN ENERGY STUDY REGION, 1974, BY END USER AND FUEL TYPE

Walter P. Page Apr. 1981 66 p refs
Prepared in cooperation with Ohio River Basin Energy Study
(Grant EPA-R-805585)
(PB82-104811; EPA-600/7-81-048) Avail. NTIS
HC A04/MF A01 CSCL 10A

Energy consumption as of 1974 is calculated for the Ohio River Basin region (substantial parts of Illinois, Indiana, and Ohio, all of Kentucky, most of West Virginia, and southwestern Pennsylvania). Substate energy consumption information is obtained at the Bureau of Economic Analysis (BEA) level and aggregated across BEA areas for an approximation to the Ohio River Basin Energy Study (ORBES) region, a set of factors is applied to allocate partial BEA area energy consumption to the ORBES portion of a given BEA area. Comparisons also are made between regional energy consumption and energy consumption in the six-state area and the United States. GRA

N82-18740# Illinois Univ. at Chicago Circle, Chicago
THE OHIO RIVER BASIN ENERGY FACILITY SITING MODEL. VOLUME 1: METHODOLOGY

Gary L. Fowler, Robert E. Bailey (Ohio State Univ., Columbus), Steven I. Gordon (Ohio State Univ., Columbus), Steven D. Jansen, J. C. Randolph (Indiana Univ., Bloomington), and W. W. Jones (Indiana Univ., Bloomington) Apr. 1981 196 p refs
(Grants EPA-R-805588, EPA-R-805589; EPA-R-805609)
(PB82-102591; EPA-600/7-81-042) Avail. NTIS
HC A09/MF A01 CSCL 10B

The siting model developed for ORBES is specifically designed for regional policy analysis. The region includes 423 counties in an area that consists of all of Kentucky and substantial portions of Illinois, Indiana, Ohio, Pennsylvania, and West Virginia GRA

N82-18749# National Academy of Sciences - National Research Council, Washington, D. C.

ENERGY AND THE FATE OF ECOSYSTEMS: STUDY OF NUCLEAR AND ALTERNATIVE ENERGY SYSTEMS. SUPPORTING PAPER 8

Oct. 1980 420 p refs
(PB82-113747; ISBN-0-309-03098-6; LC-80-83687) Avail.
NTIS HC A18/MF A01 CSCL 06F

The Ecosystem Impacts Resource Group of the Risk and Impact Panel has attempted to identify the unresolved energy policy decisions whose future resolution will have the greatest effect in determining the fate of vulnerable ecosystems, and to assess the likelihood and consequences of undesirable modifications of these systems. GRA

N82-18751# Radian Corp., Austin, Tex.
ENVIRONMENTAL ASSESSMENT, SOURCE TEST AND EVALUATION REPORT: LURGI (KOSOVO) MEDIUM-Btu GASIFICATION Final Report, Mar. 1976 - Mar. 1981

K. W. Lee, W. S. Seames, R. V. Collins, K. J. Bombaugh, and G. C. Page Aug. 1981 325 p refs
(Contracts EPA-68-02-3137, EPA-68-02-2147)
(PB82-114075; EPA-600/7-81-142) Avail. NTIS
HC A14/MF A01 CSCL 13B

An environmental data acquisition program involving a commercial scale, medium Btu, Lurgi gasification plant in the Kosovo region of Yugoslavia is described. The objective of the program was to characterize potential environmental problems associated with coal gasification in a Lurgi plant. The primary conclusion of the environmental assessment mode is that the process exhibits a significant potential for pollution. All discharge streams are potential vehicles for pollutant transfer from the process to the environment. The streams with the highest priority for control based on their potential for adverse health effects in the three discharge media, are the H₂S rich waste gas, phenolic wastewater, and heavy tar GRA

N82-18753# TRW, Inc., Redondo Beach, Calif. Environmental Engineering Div.

EMISSIONS ASSESSMENT OF CONVENTIONAL STATIONARY COMBUSTION SYSTEMS: SUMMARY REPORT Final Report, Sep. 1976 - Jul. 1981

C. C. Shih and A. M. Takata Sep. 1981 77 p refs
(Contract EPA-68-02-2197)
(PB82-109414; EPA-600/7-81-003D) Avail. NTIS
HC A05/MF A01 CSCL 13B

Results of a characterization of multi-media emissions from 39 source categories of conventional stationary combustion systems are reported. In the assessment, existing emissions data were first examined to determine the adequacy of the data base. This was followed by a measurement program to fill identified data gaps. Emissions data obtained from the sampling and analysis program were combined with existing emissions data to provide estimates of emission levels, and to define the need for additional data. Study results indicate that flue gas emissions of NO_x, SO₂, and particulate matter from the 39 source categories account for approximately 86, 66, and 36%, respectively, of the emissions of these pollutants from all stationary sources. Additionally, flue gas emissions of sulfates and several trace elements from coal- and oil-fired combustion sources also require further attention. GRA

N82-18757# Scott Environmental Technology, Inc., San Bernardino, Calif.

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INVENTORY OF EMISSIONS FROM MARINE OPERATIONS WITHIN THE CALIFORNIA COASTAL WATERS Final Report

W. C. Kelly, L. R. Reckner, and G. D. Maines 26 Jun. 1981
222 p refs

(Contract ARB-A6-209-30)

(PB82-105099; Rept-2581-01-0681; ARB-R-81/40) Avail.
NTIS HC A10/MF A01 CSCL 13B

The magnitude of air polluting emissions from marine vessels and marine related activities in the coastal waters and ports of California is studied. Major sources of emissions included the operation of marine engines and auxiliary power plants, the transport, handling, storage and transfer of petroleum and petroleum products, and the ballasting and lightering associated with tanker vessel operations. The record of activity of every commercial vessel operating in the waters of California was traced and the emissions were calculated for each activity of these vessels. The average daily emissions were - NOx 41.4 tons per day (tpd), CO 8.3 tpd, SO₂ 79.2 tpd, hydrocarbons 21.5 tpd, and particulates 7.6 tpd. GRA

N82-18766# PEDCo-Environmental, Inc., Cincinnati, Ohio.

EPA UTILITY FGD (FLUE GAS DESULFURIZATION) SURVEY Final Report, Apr. - Jun. 1981

M. Smith, M. Melia, N. Gregory, and R. McKibben Aug 1981
335 p

(Contract EPA-68-02-3173)

(PB82-115858, EPA-600/7-81-012D) Avail. NTIS
HC A15/MF A01 CSCL 13B

A survey of operational and planned domestic utility flue gas desulfurization (FGD) systems, operational domestic particle scrubbers, and Japanese coal-fired utility FGD installations is presented. It summarizes information contributed by the utility industry, system and equipment suppliers, systems designers, research organizations and regulatory agencies. It presents data on system design, fuel characteristics, operating history, and actual performance. Unit by unit dependability parameters are included and problems and solutions associated with the boilers, scrubbers, and FGD systems are discussed. The domestic FGD systems are tabulated alphabetically by development status (operational, under construction, or in the planning stages), utility company, system supplier, process, waste disposal practice, and regulatory class. Author

N82-19103*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va. Technology Utilization Office

NASA TECHNOLOGY UTILIZATION HOUSE TECHNICAL SUPPORT PACKAGE SUMMARY OF RESULTS AND HOUSE DESCRIPTION Final Report

Aug 1979 83 p

(NASA-TM-X-74686) Avail. NTIS HC A05/MF A01 CSCL 13M

The Technology Utilization House (Tech House) was designed and constructed to demonstrate to the building industry and the public the benefits of aerospace technology and other new technology that are presently available or will be in very near future. Use of solar energy, conservation of energy and of water, safety, and security were incorporated in the design of the house. The terms to be incorporated into the house and to assist in the design of the house were evaluated. An architectural engineering team was employed to investigate energy conservation ideas, determine cost effectiveness of new materials and systems, and prepare specifications and drawings for the house. The Tech House was constructed during the spring of 1976. All the systems were monitored to insure proper operation, and data were collected during a one year occupancy. Results obtained during the family live-in period, comments on the acceptance of the various energy-saving systems by the family, and suggestions for improvement of the systems are presented. NW

N82-19108# International New Towns Association, Hague (Netherlands).

FOURTH ANNUAL COMMUNITY PLANNING AND DEVELOPMENT CHALLENGES: ENERGY, ENVIRONMENT, WATER

Columbia, S.C. Mar. 1981 95 p refs Proceedings of Conf. held in Cairo, 6-14 Oct. 1980
(Grant HUD-H-5371RG)

(PB82-125790; HUD-0002055) Avail. NTIS
HC A05/MF A01 CSCL 13B

The Egyptian government's commitment to a massive new towns program was noted. Free standing new towns, solely dependent upon employment growth, were discussed. National energy conservation policies were seen as effective only through price mechanisms. Research and development programs on new technologies were considered more effective on smaller rather than larger scales. Governments were seen as not facing up to the political problems of rapid urbanization. The capacity of the infrastructure of existing cities was seen as not keeping up with growing demand in developing countries. GRA

N82-19398# Bureau of Reclamation, Boulder City, Nev. WATER ASSESSMENT FOR THE LOWER COLORADO RIVER REGION-EMERGING ENERGY TECHNOLOGY DEVELOPMENT

Aug 1981 170 p Sponsored in part by Water Resources Council

(PB82-110107) Avail. NTIS HC A08/MF A01 CSCL 13B

Water supply availability for two hypothetical levels of emerging energy technology development are assessed. The water and related land resources implications of such hypothetical developments are evaluated. Water requirement, the effects on water quality, costs of water supplies, costs of disposal of wastewaters, and the environmental, economic and social impacts are determined, providing information for the development of non-nuclear energy research. GRA

N82-19542*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CONVENTIONAL ENGINE TECHNOLOGY, VOLUME 1: STATUS OF OTTO CYCLE ENGINE TECHNOLOGY

M. W. Dowdy 15 Dec. 1981 216 p refs

(Contracts NAS7-100; DE-AI01-80CS-50194)

(NASA-CR-168643; JPL-Pub-81-65-Vol-1, DOE/CS-50194/1)
Avail: NTIS HC A10/MF A01 CSCL 21A

Federally-mandated emissions standards have led to major changes in automotive technology during the last decade. Efforts to satisfy the new standards were directed more toward the use of add-on devices, such as catalytic converters, turbochargers, and improved fuel metering, than toward complete engine redesign. The resulting changes are described and the improvement brought about by them in fuel economy and emissions levels are fully documented. Four specific categories of gasoline-powered internal combustion engines are covered, including subsystem and total engine development. Also included are the results of fuel economy and exhaust emissions tests performed on representative vehicles from each category. Author

N82-19543*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CONVENTIONAL ENGINE TECHNOLOGY, VOLUME 2: STATUS OF DIESEL ENGINE TECHNOLOGY

H. W. Schneider 15 Dec 1981 191 p refs

(Contracts NAS7-100; DE-AI01-80CS-50194)

(NASA-CR-168644; JPL-Pub-81-65-Vol-2; DOE/CS-50194/1)
Avail: NTIS HC A09/MF A01 CSCL 21A

The engines of diesel cars marketed in the United States were examined. Prominent design features, performance characteristics, fuel economy and emissions data were compared. Specific problems, in particular those of NO and smoke emissions, the effects of increasing dieselization on diesel fuel price and availability, current R&D work and advanced diesel concepts are discussed. Diesel cars currently have a fuel economy advantage over gasoline engine powered cars. Diesel drawbacks (noise and odor) were reduced to a less objectionable level. An equivalent gasoline engine driveability was obtained with turbocharging. Diesel manufacturers see a growth in the diesel market for the next ten years. Uncertainties regarding future emission regulation may inhibit future diesel production investments. With spark ignition engine technology advancing in the direction of high compression ratios, the fuel economy advantages of the diesel car is expected to diminish. To return its fuel economy lead, the diesel's potential for future improvement must be used. Author

N82-19544*# Jet Propulsion Lab., California Inst. of Tech., Pasadena

CONVENTIONAL ENGINE TECHNOLOGY, VOLUME 3: COMPARISONS AND FUTURE POTENTIAL

M. W. Dowdy 15 Dec. 1981 32 p ref
(Contracts NAST-100; DE-A101-80CS-50194)
(NASA-CR-168645; JPL-Pub-81-Vol-3; DOE/CS-50194/1)
Avail: NTIS HC A03/MF A01 CSCL 21A

The status of five conventional automobile engine technologies was assessed and the future potential for increasing fuel economy and reducing exhaust emission was discussed, using the 1980 EPA California emissions standards as a comparative basis. By 1986, the fuel economy of a uniform charge Otto engine with a three-way catalyst is expected to increase 10%, while vehicles with lean burn (fast burn) engines should show a 20% fuel economy increase. Although vehicles with stratified-charge engines and rotary engines are expected to improve, their fuel economy will remain inferior to the other engine types. When adequate NO emissions control methods are implemented to meet the EPA requirements, vehicles with prechamber diesel engines are expected to yield a fuel economy advantage of about 15%. While successful introduction of direct injection diesel engine technology will provide a fuel savings of 30 to 35%, the planned regulation of exhaust particulates could seriously hinder this technology, because it is expected that only the smallest diesel engine vehicles could meet the proposed particulate requirements
A.R.H.

N82-19660# Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo

SOCIAL AND ENVIRONMENTAL CONSEQUENCES OF NATURAL RESOURCES POLICIES WITH SPECIAL EMPHASIS ON BIOSPHERE RESERVES Final General Technical Report

Peter F. Ffolliott (Arizona Univ., Tucson) and Gonzalo Halffter (Inst. of Ecology, Mexico) 22 Sep 1981 63 p refs Seminar held at Durango, Mexico, 8-13 Apr 1980
(PB82-113937, FSGTR/RM-88) Avail NTIS
HC A04/MF A01 CSCL 02F

A seminar to promote international cooperation among natural resources policy makers, scientists, and educators, within the framework of the international Man and the Biosphere Program is discussed. Papers on a variety of topics relating to natural resources policies formed a basis for formal and informal discussions among the participants. Proceedings are discussed
GRA

N82-19664 Department of Energy, London (England). Transport Working Group

REVIEW OF THE UK TRANSPORT ENERGY OUTLOOK: AND POLICY RECOMMENDATIONS

1981 43 p refs
(EP-47, ACEC-Paper-11) Copyright. Avail Issuing Activity, HMSO £4 + postage, PHI

Liquid fuel consumption for transport (excluding international bunkers for ships) in 1979 is analyzed and used to forecast the position at the end of the century. Car population is expected to increase by 6 million to over 20 million, but fuel saving designs mean that fuel consumption increases only slightly. Truck fuel consumption stays the same. Fuel consumption by UK airlines is expected to double. The proportion of a barrel of crude oil which is refined as transport fuel must be increased
Author (ESA)

N82-19665 Department of Energy, London (England) Buildings Working Group.

ENERGY CONSERVATION IN THE PRODUCTION OF DOMESTIC HOT WATER

1981 23 p refs
(EP-48, ACEC-Paper-12) Copyright. Avail. Issuing Activity; HMSO £2.80 + postage, PHI

Improvements in energy efficiency in existing buildings and the construction of energy efficient buildings are discussed with emphasis on water heating. Cost effective measures proposed include fitting an 80-mm insulating jacket to the hot water storage cylinder, using time switches, fitting thermostatic control systems to boiler based central heating, and storing domestic hot water at a lower temperature. Research into the recovery of heat from waste water, the use of cold water detergents, and the use of heat pumps is urged
Author (ESA)

N82-19666 Department of Energy, London (England) Severn Barrage Committee

TIDAL POWER FROM THE SEVERN ESTUARY, VOLUME 1

1981 125 p refs Original contains color illustrations 2 Vol. (EP-46-Vol-1, ISBN-0-11-410916-8) Copyright. Avail Issuing Activity, HMSO £9.80 + postage, PHI

Environmental, energy, and economic factors associated with building a tidal power barrage in the Bristol channel were studied. An ebb generation scheme is recommended since it minimizes the unit cost of electricity generation and has less effect on ports than flood or two way generation. The economic justification for a barrage depends on factors which are not known when the decision on whether to build is taken, e.g. the extent of nuclear generation, or the price of coal in the first third of the next century. Further study of the environmental consequences of the barrage is required. An inner barrage is recommended since the larger output of an outer barrage does not outweigh engineering, environmental and economic disadvantages
Author (ESA)

N82-19697# Commerce Dept., Washington, D C Economic Policy Staff

US ENERGY FOR THE REST OF THE CENTURY Annual Report

Joseph F. Gustafiero 2 Jul 1981 36 p
(PB82-115866) Avail NTIS HC A03/MF A01 CSCL 10A

The basic quantitative results of U.S. Commerce Department forecasting efforts in the energy area are summarized. The data cover the entire spectrum of U.S. energy requirements and focus on the end-use of energy for operational purposes, e.g. highway transportation, space heating, lighting, and road construction. The tables provide data on fuel consumption by types and BTU content for 1980 and as projected for the year 2000.
GRA

N82-19701 International Institute for Applied Systems Analysis, Laxenburg (Austria)

LIFE ON A WARMER EARTH: POSSIBLE CLIMATIC CONSEQUENCES OF MAN MADE GLOBAL WARMING

H Flohn 1981 80 p refs
(ER-3) Copyright. Avail. Issuing Activity

The interaction between energy and climate is explored, including the impact on global climate of three main energy sources: solar, nuclear and fossil fuels. The global warming problem is introduced. Comprehensive analogies with warmer times are made. From the best models available, the future global average surface temperature is found and modified, describing the global warming effects caused by greenhouse effect caused by gases other than carbon dioxide, released into the atmosphere by man, i.e. nitrous oxide, methane, ammonia, and the chlorofluoromethanes. Paleoclimatic scenarios are reviewed, showing possible effects of global warming. An 800 to 1100 ppm CO₂ concentration causes irreversible Arctic melting, leading to displacement of present climatic zones by 400 to 800 km
Author (ESA)

N82-19704# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)

PRELIMINARY RESULTS OF A STUDY OF MAPPING THERMAL DISCHARGE IN THE OCEAN, USING REMOTE SENSING DATA

Merritt Raymond Stevenson, Carlos Alberto Steffen, and Hector Manual Inostroza Villagra Sep 1981 23 p refs In PORTUGUESE; ENGLISH summary Presented at 33d Ann Meeting of SBPC, Salvador, 8-15 Jul 1981
(INPE-2229-PRE/021) Avail. NTIS HC A02/MF A01

The spatial and temporal variations of the sea surface temperature, utilizing data obtained from sea surface, aircraft and satellite platforms were studied. The objective of the study is the evaluation and mapping of small scale variations in the sea surface temperature, caused by the thermal discharge from a nuclear power plant at Angra dos Reis, Brazil. Evaluation of data from ANGRA 01, the first experiment made on December 19, 1980, showed the surface temperature to be quite isothermal. Temperature from the aircraft and satellite radiometers were about 0.6 C and 5.0 C cooler, respectively, than the temperatures measured from the boat. These thermal offsets are readily accounted for by differences in emissivities of the sea surface and the intervening water vapor in the lower atmosphere.
Author

N82-20025# National Research Council of Canada, Ottawa (Ontario) Div of Mechanical Engineering.

URBAN TRAFFIC SIGNAL CONTROL FOR FUEL ECONOMY, PART 2: EXTENSION TO SMALL CARS

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G. S. Messenger Nov. 1981 13 p refs
(AD-A109393, DME-ME-249, NRC-19846) Avail: NTIS
HC A02/MF A01 CSCL 13/6

Use of a small car's characteristics in a simulation program utilizing velocity profiles obtained in a traffic study by the Metropolitan Toronto Roads and Traffic Department and the Engine Laboratory at the National Research Council Canada has shown that trends shown in fuel consumption in NRC, Division of Mechanical Engineering Report No ME-247 are similar for a small-engined vehicle. NRC, DME Report No. ME-247 showed that under the TRANSYT timing plan vehicles encountered fewer stops, saved time and used a slightly smaller amount of fuel than under the existing timing plan In the above mentioned report, a large vehicle's fuel consumption was calculated using a computer model of the vehicle which used velocity profiles obtained from an instrumented floating car GRA

N82-20027# Market Facts, Inc., Arlington, Va. Public Sector Research Group.

CONSUMER BEHAVIOR TOWARDS FUEL EFFICIENT VEHICLES. VOLUME 1: EXECUTIVE SUMMARY Final Report Oct. 1977 - Mar. 1981

James T. Heisler and Sid Groeneman Mar. 1981 22 p
(Contract DOT-HS-7-01781)
(PB82-103300; DOT-HS-805936) Avail: NTIS
HC A02/MF A01 CSCL 10A

Information on likely market response to various vehicle design and performance collected to minimize the possibility of market rejection is discussed Group discussion and consumer experiments with drivers in different vehicle size classes were used. Analysis focuses on the believability of the energy crisis and concern about its effects, the acceptability of possible fuel economy options, consumer preference with respect to vehicles embodying selected design and engineering changes, and predicted purchase and usage patterns under different future scenarios. GRA

N82-20277# Physical Sciences, Inc., Woburn, Mass
SYNTHETIC-FUEL COMBUSTION: POLLUTANT FORMATION. SOOT-INITIATION MECHANISMS IN BURNING AROMATICS Fourth Quarterly Report, 1 Jul. - 30 Sep. 1981

W T Rawlins, S P Schertzer, and T Tanzawa Nov 1981
43 p refs
(Contract DE-AC22-80PC-30292)
(DE82-002566; DOE/PC-30292/4, PSI-TR-291) Avail NTIS
HC A03/MF A01

The pyrolysis rates, free radical kinetics, and soot and NO/sub x/ formation mechanisms for a variety of aromatic families such as those of benzene, anisole, phenol, and nitrogen heterocyclics were examined The processes are studied in shock tubes, where combustion temperatures is attained almost instantly without wall effects and under well controlled flow conditions Experiments are performed in incident shock waves, using optical absorption and emission diagnostics in the ultraviolet, visible, and infrared It is indicated that soot formation is minimal for pyridine and proceeds rapidly for toluene, and a bimodal mechanism above 2000 K is shown. Comparison of ultraviolet and visible attenuation signals indicates that the mean size of the soot particles causing the attenuation is considerably larger than previously assumed, and requires the use of complete Mie theory rather than the Rayleigh limit in data interpretation DOE

N82-20328# Committee on Governmental Affairs (U S. Senate)
INTERNATIONAL ALCOHOL FUELS

Washington GPO 1981 383 p Hearing before the Subcomm on Energy, Nuclear Proliferation, and Govt Processes of the Comm. on Governmental Affairs, 97th Congr., 1st Sess., 24 Mar 1981
(GPO-78-681) Avail Subcomm. on Energy Nuclear Proliferation, and Govt Processes

The production of alcohol fuels and other nonpetroleum-based liquid fuels is discussed in the context of problems caused by U.S. dependence upon imported petroleum fuels Biomass energy production and coal liquefaction are considered Gasohol production and utilization are emphasized Economic factors influencing private investments in alternative energy enterprises are discussed The impact of increased alcohol fuel production on agriculture is considered R.J.F

N82-20329# Committee on Science and Technology (U. S. House)

THE NATURAL GAS OPTION: NEW RESOURCES AND NEW TECHNOLOGIES

Washington GPO 1981 176 p Hearing before the Subcomm. on Energy Development and Applications of the Comm on Sci and Technol., 97th Congr., 1st Sess., No 28, 22 Jul. 1981 (GPO-85-052) Avail Subcomm. on Energy Development and Applications

The ability of the gas industry to develop new technology for gas production and efficient gas use is examined. Syntfuel/production coal gasification, coal liquefaction, and other alternative fuel technologies are discussed. The gas energy supply outlook for 1980 to 2000 is discussed R J F

N82-20359# Long Island Appropriate Technology Group, Wantagh, N.Y.

RESIDENTIAL HEATING AND ENERGY CONSERVATION STUDY, NORTHPORT, NEW YORK. PHASE 1: CITIZEN'S HANDBOOK Progress Report, 1 Jan. - 31 Mar. 1978

Clarence N. Freeman Mar. 1978 65 p refs 2 Vol.
(Grant NSF OSS-77-23950)
(PB82-100454; NSF/RA-780905) Avail: NTIS
HC A04/MF A01 CSCL 13A

Subjects on home energy conservation are presented in nontechnical terms Topics include the behavior of heat and heat exchangers; human comfort; home heating, development of a home heating and maintenance manual, infiltration of cold air, sources of combustion air, dangers of a house which is too airtight, operation of the home during the heating season, condensation problems resulting from re-insulation; heating system maintenance, and possible improvements in hot air, hot water, and steam, gas-fired or oil-fired heating systems. Heat conservation through changing living patterns and rearranging furniture is also discussed References are provided on the topics of energy conservation, home weatherizing, residential construction, heating systems, emergency situations, weather, and climate GRA

N82-20360# Long Island Appropriate Technology Group, Wantagh, N.Y.

RESIDENTIAL HEATING AND ENERGY CONSERVATION STUDY, NORTHPORT, NEW YORK. PHASE 2: CITIZEN'S HANDBOOK Progress Report, 1 Oct. - 31 Dec. 1978

Clarence N. Freeman 1978 68 p refs 2 Vol
(Contract NSF OSS-77-23950)
(PB82-100462; NSF/RA-780906) Avail: NTIS
HC A04/MF A01 CSCL 13A

Energy conservation, energy laws of New York State and the United States Government, energy audits in the home, and tax credits are discussed The behavior of heat and heat exchangers; energy conservation upgrading of the home, methods of taking advantage of heating effects of the Sun, and improving air circulation are discussed Supplementary energy conservation topics, including a discussion of gas savings resulting from lowering thermostats at night, and a description of an air deflector for baseboard heaters are discussed Lists of references cover general energy conservation, heat behavior and human comfort, home weatherization, residential construction, heating systems, emergency home heating, and carbon monoxide poisoning from blocked furnace flues References on climate and degree days are also listed GRA

N82-20476# Bonneville Power Administration, Portland, Oreg. Mechanical Section

HEAT PUMP WATER HEATER: MIDWAY RESIDENTIAL COMMUNITY Final Report

J. R. Aguilar and Jon R Bremer Oct 1981 63 p refs Sponsored by DOE
(DE82-003548; DOE/BP-53) Avail NTIS HC A04/MF A01

A prototype heat pump water heater was tested. Five heat pump water heaters were installed in a residential community at Midway, Washington, and their performance was monitored between September 1979 and January 1981. The objectives of the project were to evaluate performance, to assess equipment reliability, and to determine energy savings Results were also used to assess the heat pump water heater's potential contribution to energy conservation in the Pacific Northwest. The coefficient of performance (COP) and energy savings compared to an electric resistance water heater are 1.66 and 40%, respectively. Because the COP of a heat pump water heater varies with the ambient temperature, performance of a unit affected by seasonal and climatic variation The energy savings of individual heat pump

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water heaters will vary from 41 to 56% in the Pacific Northwest, depending on climatic conditions DOE

N82-20476# United Technologies Research Center, East Hartford, Conn

PARAMETRIC PERFORMANCE STUDIES ON FLUIDIZED-BED HEAT EXCHANGERS Quarterly Technical Progress Report, 28 Jul. - 30 Sep. 1981

R C. Stoffler 29 Oct 1981 9 p refs
(Contract DE-AC22-81PC-40280)
(DE82-002124; DOE/PC-40280/T1, R81-915729-3) Avail.
NTIS HC A02/MF A01

The performance of single and multistage shallow fluidized beds for possible application to the recovery of heat from sources as waste heat, and coal combustion or coal gasification were investigated. The following tests are investigated: (1) the effects of fouling due to liquid condensate in the gas stream of fluidized beds which are staged using baffle plates, and (3) the effects of different heat exchanger surface geometries. The conditions fouling by a liquid condensate are selected. Modifications are made to the fluidized bed heat exchanger facility for the fouling experiments DOE

N82-20616# Committee on Energy and Natural Resources (U S Senate)

PROPOSED 5-YEAR PLAN OIL AND GAS DEVELOPMENT IN THE OUTER CONTINENTAL SHELF

Washington GPO 1981 170 p refs Hearing before the Subcomm on Energy Conservation and Supply of the Comm. on Energy and Natural Resources, 97th Congr., 1st Sess., 6 Oct. 1981

(Publ-97-43; GPO-86-955) Avail Subcomm on Energy Conservation and Supply

A proposed 5-year plan for offshore oil and gas exploration and development is discussed. The program calls for 42 lease sales covering nearly 1 billion acres. Whether the proposed lease sales could be detrimental to the protection of environmentally sensitive areas and fishing ground is discussed. Oil spills and transport problems are investigated R J F

N82-20658# Committee on Energy and Natural Resources (U.S. Senate)

POTENTIAL FOR HYDROELECTRIC DEVELOPMENT IN ALASKA

Washington GPO 1981 64 p Hearing before the Subcomm on Water and Power of the Comm on Energy and Nat Resources, 97th Congr., 1st Sess., 17 Aug 1981

(GPO-84-559; Publ-97-31) Avail Subcommittee on Water and Power

Testimony concerning Alaskan hydroelectricity development is presented. Various public and private organizations were represented N W

N82-20659# Committee on Energy and Natural Resources (U.S. Senate)

HYDROELECTRIC DEVELOPMENT IN NEW ENGLAND

Washington GPO 1981 233 p Hearing before the Subcomm on Energy Regulation of the Comm on Energy and Natural Resources, 97th Congr., 1st Sess., 7 Aug 1981

(GPO-84-558, Publ-97-40) Avail Subcomm on Energy Regulation

Hydroelectric power development in New England is examined and the Federal licensing process is presented from different perspectives. State officials, hydrodevelopers, conservation and recreation interests, and power marketers are represented. S L

N82-20660# Committee on Energy and Natural Resources (U S Senate)

OCEAN THERMAL ENERGY CONVERSION RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT

Washington GPO 1980 124 p Hearing on S. 1830 before the Subcomm on Energy Res and Development of the Comm on Energy and Natural Resources, 96th Congr., 1st Sess., 15 Oct 1979

(GPO-56-801, Publ-96-77) Avail Subcomm on Energy Res and Development

A research, development, demonstration, and commercialization program in ocean thermal energy conversion is presented. A national commercialization goal is established and preparation of a plan to accomplish is addressed S L

N82-20666# Committee on Science and Technology (U S House).

ENERGY DEMAND FORECASTING

Washington GPO 1981 366 p Hearings before the Subcomm on Investigations and Oversight of the Comm. on Sci and Technol., 97th Congr., 1st Sess., No. 14, 1-2 Jun. 1981

(GPO-83-115) Avail Subcomm. on Investigations and Oversight

Energy demand forecasting and its connection with national energy policies and decisions is examined in light of recent, sharply revised estimates of future energy requirements. Techniques of economic projects are examined. Modeling of energy demands is discussed. Renewable energy sources are discussed. The shift away from reliance of domestic users on oil and natural gas toward electricity as a primary energy resource is examined in the context of the need to conserve energy and expand generating capacity in order to avoid a significant electricity shortfall R J F

N82-20679# Kaiser Engineers, Oakland, Calif

INDUSTRIAL UTILIZATION OF WASTE-DERIVED ENERGY. VOLUME 2: APPENDICES 1 AND 2

Sep 1981 201 p refs

(Contract DE-AC03-78CS-20030)

(DE82-003287, DOE/CS-20030/2) Avail NTIS
HC A10/MF A01

The economic and technical feasibility of producing medium Btu fuel gas in a partial oxidation unit (Purox System) from a combination of both rural and urban wastes was determined. Institutional aspects, a review of alternative technologies and a program recommendation are presented DOE

N82-20690# Environmental Protection Agency, Ann Arbor, Mich Standards Development and Support Branch.

AN ENERGY DEMAND MODEL FOR LIGHT-DUTY VEHICLES, WITH CONCEPTS FOR ESTIMATING FUEL CONSUMPTION

Terry Newell Apr. 1981 34 p refs

(PB82-102468, EPA-AA-SDSB-81-2) Avail NTIS
HC A03/MF A01 CSCL 10A

The development of the energy demand modeling program, the use of the program, and the verification of using the energy demand concept to estimate vehicle fuel consumption are described. In addition, several applications of the model are presented and other potential applications are discussed. GRA

N82-20693# California Univ., Irvine. Sanitary Engineering and Environmental Health Research Lab

ENVIRONMENTAL QUALITY RESEARCH-FATE OF TOXIC JET FUEL COMPONENTS IN AQUATIC SYSTEMS Annual Report, 1 Jun. 1980 - 31 May 1981

Robert C. Cooper, Leon Hunter, P C Ulrichs, and Robert Okazaki Wright-Patterson AFB, Ohio Air Force Aerospace Medical Research Lab Dec. 1981 61 p refs

(Contract F33615-80-C-0512; AF Proj 6302)
(AD-A109790; AFAMRL-TR-81-101) Avail NTIS
HC A04/MF A01 CSCL 06/2

This report contains the results of an investigation of the potential toxic effects of the jet fuel JP-4 (petroleum-based and shale-based) on the aqueous environment. Composition of different JP-4 samples and their water extracts are compared. Techniques for the formation and analysis of water soluble extracts of JP-4 are described together with preliminary bioassay procedures using the aquatic organisms, *Daphnia magna* and *Artemia salina*. The first steps in the development of a mathematical model designed to describe and predict the effects of jet fuel spills are reported. Author (GRA)

N82-20699# State Univ of New York, Stony Brook. Marine Sciences Research Center

COAL WASTE ARTIFICIAL REEF PROGRAM, PHASE 3. VOLUME 1: SUMMARY REPORT Interim Report, Oct. 1981

J H Parker, P M J. Woodhead, I W Duedall, and H R Carleton Oct 1981 79 p refs Sponsored by Electric Power Research Institute

(EPRI Proj. 1341-1)
(DE82-900854, EPRI-CS-2009-Vol-1) Avail NTIS
HC A05/MF A01

The technical feasibility and the environmental effects of a method for ocean disposal of fly ash and scrubber sludge were

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explored Techniques were developed for coal waste block fabrication utilizing machines and equipment from the concrete block industry. Accelerated steam curing procedures developed block strengths adequate for industrial handling and stacking. The new fabrication techniques were successfully established at commercial block factories and 450 metric tons (500 short tons) of stabilized wastes were processed into about 15,000 reef-blocks. Two waste materials were used with fly ash to sludge ratios of 4:1 and 1.5:1 respectively. Small numbers of blocks were made separately from fluidized bed combustion residues. In laboratory bioassays and in field tests, the material did not appear to be toxic in the sea. These results all suggested that the blocks are compatible with the marine environment. T M.

N82-20700# General Electric Co., Schenectady, N. Y.
ELECTROCYCLONE DEVELOPMENT PROGRAM Quarterly Technical Report, Feb. - Apr. 1981
1981 43 p
(Contract DE-AC21-80ET-17091)
(DE81-025062; DOE/ET-17091/T2, FE-7091-10) Avail NTIS
HC A03/MF A01

In response to the need for a high efficiency, high throughput gas cleanup device for pressurized fluidized bed application, General Electric experimented with an electrostatically augmented cyclone. A principal advantage of the GE Electrocyclone concept is that a 12 ft dia unit can be built with performance comparable to a 10 in conventional cyclone. The use of large Electrocyklones will avoid the plugging and flow imbalance problems which plagued the use of multicyclones. The development work is being continued under the present Electrocyclone Development Program. The Electrocyclone Development Program addresses three critical development areas: performance scaleup, performance at high temperature and pressure, and corona charging. The scaleup of Electrocyclone performance will be demonstrated experimentally by cold flow testing of a 36 in-dia unit geometrically similar to the earlier 18-in model. DOE

N82-20701# Hoffman-Holt, Inc., Silver Spring, Md
ENVIRONMENTAL AND ECONOMIC ASPECTS OF INDIRECT COAL LIQUEFACTION PROCESSES: A REPORT EMPHASIZING THE RELATIONSHIP BETWEEN PRODUCT MIX AND EFFICIENCY
Lawrence Hoffman Sep 1981 40 p refs
(Contract EPA-68-02-3671)
(PB82-103581, EPA-600/7-81-153) Avail. NTIS
HC A03/MF A01 CSCL 07A

Environmental and economic aspects of three indirect liquefaction processes are reported. The following are addressed: US coal resources, indirect coal liquefaction processes, and environmental and economic aspects associated with the considered processes. The conservation of coal resources would be affected by conversion efficiencies, which vary with process and product mix. For the processes considered, for similar liquid to gas ratio values (product mix), the coal to methanol is the most efficient while the Fischer Tropsch is the least efficient. For these processes, the cost per Btu of product at reasonable equivalent liquid/gas ratios is greatest for Fischer Tropsch and the least for the coal to methanol process. GRA

N82-20702# Wyoming Game and Fish Dept., Cheyenne.
WETLAND VEGETATION, ENVIRONMENTAL FACTORS, AND THEIR INTERACTION IN STRIP MINE PONDS, STOCKDAMS, AND NATURAL WETLANDS Final Forest Service General Technical Report
Richard A Olson Ft. Collins, Colo Rocky Mountain Forest and Range Experiment Station 21 Sep. 1981 25 p refs
(PB82-113218, FSGTR/RM-85) Avail: NTIS
HC A02/MF A01 CSCL 06F

Water regime, chemical features, temperature factors, light penetration, substrate properties, and physical characteristics are described for Northern Great Plains strip mine ponds and stockdams, followed by a discussion of how their interaction determines wetland plant community composition and resulting wildlife habitat quality for consumptive and nonconsumptive resource utilization. GRA

N82-21208# Rolls-Royce Ltd., Derby (England)
ENGINES FOR AIR TRANSPORT
A G Newton 1981 52 p
(PNR-90066) Avail NTIS HC A04/MF A01

The status and trends of commercial aircraft transportation systems were reviewed. The characteristics and specific consumption of aviation fuel are emphasized. It is shown that in the next 15 years the fuel consumption of current large fan engines can be reduced by 15%. The quality of fuel will deteriorate relative to today, which will place greater demands on engine design. Further improvements in fuel economy using engines designed for lower specific thrust appear feasible. The development of a full authority digital control system and its effects on fuel consumption are also discussed. Author (ESA)

N82-21350# Environmental Protection Agency, Ann Arbor, Mich
Test and Evaluation Branch.
TESTING OF 6 ENGINE OILS IN ACCORDANCE WITH THE EPA RECOMMENDED PRACTICE FOR TESTING, GRADING AND LABELING THE FUEL EFFICIENCY OF MOTOR VEHICLE ENGINE OILS

F Peter Hutchins and Thomas J Penninga May 1981 97 p
(PB81-244980, EPA-AA-TEB-81-16) Avail NTIS
HC A05/MF A01 CSCL 07H

In January/February 1980, the EPA assembled the 'EPA Recommended Practice for Evaluating, Grading and Labeling the Fuel Efficiency of Motor Vehicle Engine Oils'. This procedure used the ASTM approach for carryover oils and incorporated four fuel economy grades for engine oils as well as a label for identification. In March 1980, the EPA initiated a testing program in accordance with the EPA recommended procedure, using two sets of test vehicles to evaluate the feasibility of the procedure. The results of that testing are covered. GRA

N82-21448# California Energy Commission, Sacramento
ENERGY BUILDING REGULATIONS FOR NEW RESIDENTIAL AND NONRESIDENTIAL BUILDINGS
15 Jul. 1981 73 p refs
(PB82-117813, CAEC-400-81-005) Avail. NTIS
HC A04/MF A01 CSCL 13L

The proposed regulations as submitted to the State Building Standards Commission of California are presented. They are divided into four parts: applying to all occupancies, technical regulations; technical regulations applicable for ducts only, and table of contents of existing building regulations which identifies which sections will be repealed when the new regulations take effect. GRA

N82-21728# Energy Information Administration, Washington, D C
Statistics Branch
STATE ENERGY DATA REPORT SUPPLEMENT
27 Oct 1981 73 p
(DE82-002996, DOE/EIA-0214/79-S) Avail NTIS
HC A04/MF A01

Selected summaries and percent changes of energy consumption by state, by principal energy sources, and by major end-use sectors are presented. DOE

N82-21760# Oak Ridge Associated Universities, Inc., Washington, D C
CENTER FOR ENERGY RESEARCH AND TECHNOLOGICAL RESOURCES FOR PUERTO RICO Ph.D. Thesis - Univ. de Puerto Rico
Petro A MunizRivera 1981 184 p refs in SPANISH and ENGLISH
(Contract DE-AC05-76OR-00033)
(DE81-031987, DOE/TIC-11493) Avail NTIS
HC A09/MF A01

The design of an energy-efficient building is presented. Justification for the building is explained. Technical aspects of passive solar design and policies dealing with solar design are described. The layout of the building, and functions and uses of various areas of the building, are detailed. DOE

N82-21770# Resource Planning Associates, Inc., Washington, D C
CONSUMPTION TREND ANALYSIS IN THE INDUSTRIAL SECTOR: EXISTING FORECASTS Final Report, Nov. 1980 - Aug. 1981
Aug 1981 72 p
(Contract GRI-5014-310-0238)
(PB82-137829; GRI-80/0090, RPA-RA-80-0429-3) Avail
NTIS HC A04/MF A01 CSCL 10A

The Gas Research Institute (GRI) is engaged in medium- to

long-range research and development in various sectors of the economy that depend on gasing technologies and equipment. To assess the potential demand for natural gas in the industrial sector, forecasts available from private and public sources were compared and analyzed. More than 20 projections were examined, and 10 of the most appropriate long-range demand forecasts were analyzed and compared with respect to the various assumptions, methodologies and criteria on which each was based. GRA

N82-21781# California Univ., Livermore Lawrence Livermore Lab

SEDIMENTATION PLAN TO ASSESS THE IMPACT GEOTHERMAL ACTIVITIES TO THE AQUATIC ECOSYSTEM IN THE GEYSERS CALISTOGA KGRA

Robert R. Ireland 19 May 1981 45 p
(Contract W-7405-eng-48)

(DE82-001688, UCID-19059) Avail NTIS HC A03/MF A01

The prevention of sedimentation or siltation in aquatic ecosystems is always a key environmental issue in the development and operation of power plant units. A field program, which will assess the amount of sedimentation in the streams and tributaries of the Geysers-Calistoga Known Geothermal Resource Area (KGRA) due to development-related or other site-specific activities. This sediment plan is one part of a four part venture - the others are water quality, benthic invertebrates and fisheries studies. Included are the cost breakdowns for each phase, maps and rationale of the sampling sites, the methodology for the laboratory sample processing, and examples of the type of graphic and tabular output expected. T.M

N82-21782# California Univ., Livermore Lawrence Livermore Lab.

BASELINE HEALTH EFFECTS DATA APPLICABLE TO ANTICIPATED GEOTHERMAL RESOURCE DEVELOPMENT IN IMPERIAL COUNTY Final Report

Margaret Deane and Jeffrey L. Hahn Jun 1981 17 p Prepared in cooperation with California Dept of Health Services
(Contract W-7405-eng-48)

(DE82-001669, UCRL-15391) Avail NTIS HC A02/MF A01

The effects of budget cuts on the original contract proposal are described. A task by task description of the program is presented including results and outcome of the task. DOE

N82-21783# California Univ., Livermore Lawrence Livermore Lab

IMPERIAL COUNTY BASELINE HEALTH SURVEY POTENTIAL IMPACT OF GEOTHERMAL ENERGY

Margaret Deane (Calif. State Dept of Health Services) Jun 1981 169 p
(Contract W-7405-eng-48)

(DE82-001672; UCRL-15392) Avail NTIS HC A08/MF A01

The survey purpose, methods, and statistical methods are presented. Results are discussed according to area differences in background variables, area differences in health variables, area differences in annoyance reactions, and comparison of symptom frequencies with age, smoking, and drinking. Included are tables of data, enumeration forms, the questionnaire, interviewer cards, and interviewer instructions. T.M

N82-21786# Systems Applications, Inc., San Rafael, Calif
NO SUB X REGULATORY CHANGES AND THE ELECTRIC UTILITY: A GUIDANCE MANUAL FOR AIR QUALITY MODELING IN PLANNING, SITING, AND EMISSIONS CONTROL Final Report

S. R. Hayes, P. D. Gutfreund, S. D. Reynolds (KVB, Inc., Irvine, Calif.), R. Pease (KVB, Inc., Irvine, Calif.), and L. Muzio Sep 1981 149 p refs Sponsored by Electric Power Research Inst.

(EPRI Proj 1375)

(DE82-900966, EPRI-EA-2050) Avail NTIS HC A07/MF A01

Several regulatory changes that are likely to influence requirements for the control of nitrogen oxide emissions from power plants are discussed. The possible requirement for a short-term ambient standard for NO₂, prevention of significant deterioration rules for NO₂, and visibility protection regulations are also discussed. A guidance manual, a reference document designed primarily for the utility reader, is presented. The potential implications of the possible NO/sub x/-related regulations,

current regulatory and permitting requirements, and surveys of NO/sub x/ control technology costs and capability are evaluated. The conduct of a NO₂ air quality impact analysis is also discussed. Other topics presented include: a modeling strategy, screening analysis, and selection of appropriate models, data requirements, and costs. M D K

N82-22020# Department of Energy, Mines and Resources, Ottawa (Ontario), Mining Research Labs.

GEOLOGICAL DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES

D. F. Coates, G. Larocque, and L. Geller 1980 23 p
(CANMET-79-29) Avail NTIS (US Sales Only)
HC A02/MF A01; DOE Depository Libraries

The problem of safe disposal of various types of radioactive wastes from nuclear power plants is discussed. Mining waste and mill tailings containing toxic radium are produced in large quantities. It is believed about 80 million tons have already accumulated at Elliot Lake, Ontario, alone and that this may increase by the year 2000 to several hundred million tons. These tailings are in bulk but relatively low in radioactivity. Wastes from nuclear generating stations, on the contrary, are highly radioactive but relatively small in volume. A brief overview of how electricity is generated by means of nuclear power, and reasons which render safe disposal of high-level nuclear wastes a particularly difficult and multifaceted problem are discussed. It is suggested that under Canadian conditions deep underground burial of these wastes in mined-out facilities in igneous rocks is the most acceptable solution. M D K

N82-22082# Committee on Science and Technology (U. S. House)

RISK: ASSESSMENT, ACCEPTABILITY AND MANAGEMENT

Washington GPO 1981 122 p Rept. presented to the Subcomm on Sci., Res. and Technol. Transmitted to the Comm on Sci and Technol., 97th Congr., 1st Sess., Nov 1981 Prepared by Congressional Research Service, Library of Congress

(GPO-87-593) Avail Subcomm on Sci., Res. and Technol

Risk assessment, particularly of risks to the public health resulting from government and industry decisions, is discussed. Cost/benefit analysis as applied to such situations as human deaths and the contracting of cancer by humans is discussed. The role of government regulations and standards is discussed. R J F

N82-22106# National Physical Lab., Teddington (England) Div of Numerical Analysis and Computer Science

OPTIMIZATION PROGRAMS FOR ECONOMIC ENERGY MODELLING PROBLEMS

Susan M. Hodson Oct 1981 43 p refs

(Contract EEC-680-79-1-EM-UK)

(NPL-DNACS-51/81, EUR-7548-EN, ISSN-0143-7348) Avail NTIS HC A03/MF A01

The use of MINOS and MINOS/AUGMENTED programs in linear programming and nonlinear optimal control models is described. The programs take advantage of general sparsity in the matrix of first derivatives of the constraints, which allows the solution of large problems, like finding the optimal fuel-mix and investment proposals to minimize the overall discounted cost covering all the supply utilization sectors of the energy system on a multinational, multiperiod scale. A model is used which predicts aggregate final energy demand and aggregate costs for the European economies over a 10 yr period. Author (ESA)

N82-22111# Public Technology, Inc., Washington, D. C.

URBAN CONSORTIUM Final Report

J. K. Parker 1981 10 p

(Grant NSF ISP-78-12729)

(PB82-122789, NSF/ISP-81020)

Avail NTIS

HC A02/MF A01 CSCL 13B

Needs and priorities were assessed for the areas of transportation, community and economic development, and management, finance and personnel were evaluated. Workshops were conducted to (1) assess the condition of urban infrastructure and developing future policies; and (2) study the use of emerging energy technologies in urban management. A study of multi-year revenue and expenditure forecasting and a study on the use of fire data were made. City-led research projects included evaluating landfill gas as an energy source; developing methodol-

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ogy for energy impact analysis of community development projects, developing a primary urban energy planning methodology handbook, and retrofitting municipal buildings with solar energy systems

GRA

SOLAR ENERGY

Includes solar collectors, solar cells, solar heating and cooling systems, and solar generators.

A82-18890 Combined photovoltaic/thermal solar array DC electrical model. J. S. Krikorian, Jr. *IEEE Circuits and Systems Magazine*, vol. 3, Dec. 1981, p. 7-13. 6 refs. Contract No. DE-AC03-79CS-30205.

An electrical model of a combined photovoltaic/thermal solar array has been developed to predict the steady state behavior of the line currents, power output and array voltage. The effects of temperature on the solar cell characteristics is included in the analysis. The model includes line isolation diodes and 'open cell' bypass diodes. A numerical procedure based on the Contraction Mapping Fixed Point Theorem is used to solve the associated nonlinear equations. (Author)

A82-19295 Performance of collector/storage solar water heaters - Arbitrary demand pattern. M. S. Sodha, P. K. Bansal, and N. D. Kaushik (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management*, vol. 21, no. 4, 1981, p. 229-238. 8 refs.

A82-19296 Selective blacks for enhanced photothermal solar energy conversion. R. C. Agarwal and P. K. C. Pillai (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management*, vol. 21, no. 4, 1981, p. 239-251. 112 refs.

The optical and physical requirements of selective surfaces for maximum absorption of solar thermal energy are reviewed, along with processes to fabricate the selective coatings. Noting that the solar energy which reaches the ground is usually in wavelengths of 0.3-2 microns, the desired qualities of coatings are listed as stability of performance, good adherence to the substrate, ease of application, low emissivity above two microns, and economical fabrication. Selective surfaces comprise absorber-reflector tandems, which allow or reflect IR passage, multilayer interference stacks, which involve successive deposition of metallic coatings, and controlled surface morphology, which entails either geometric irregularities, Mie scattering films, corrugated surfaces, or wire mesh surfaces. Preparation can be by electrodeposition, chemical conversion, spray pyrolysis, paint coatings, vacuum deposition, and chemical vapor deposition (CVD), which is stressed as offering the most attractive option for economical large scale coating of solar selective surfaces. M.S.K.

A82-19298 Model evaluation and optimum collector slope for a tropical country. H. P. Garg and S. N. Garg (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management*, vol. 21, no. 4, 1981, p. 299-312. 13 refs.

Various models for predicting the radiation on an inclined surface are compared and an anisotropic model is used to determine an optimum solar collector slope based on the maximum solar energy availability. The effectiveness of operating a receiver in three modes was examined: facing south with a variable tilt, a fixed tilt and azimuthal sun tracking, and sun-following with maintenance of normal incidence. Three pyranometers were employed to simulate receivers in the different modes. A single tilt equal to the latitude of the location was found to be optimum for a fixed tilt collector, while partially tracking collectors show no dependence on latitude. Partially tracking and fully tracking surfaces received 16-20% more radiation than fixed surfaces, although the gain with fully tracking surfaces exceeded the partially tracking by only 2.5%, which led to a recommendation for the partially tracking configuration. M.S.K.

A82-19448 Solar energy storage and thermal use of an unconfined aquifer. H. Umemiya, E. Haga, R. Miyazawa, and M. Urushidani (Yamagata University, Yonezawa, Japan). *Energy Developments in Japan*, vol. 4, July 1981, p. 15-30. Translation.

An experiment using a large area, shallow aquifer for seasonal

thermal storage is discussed. Two wells were drilled 70 m apart and water was pumped up from one well during the winter, and drained over a rooftop to melt snow before running back into another well-bore. During the summer, the well water is pumped up from the cool well, through a solar collector (the rooftop), and back into the warm well. A collection efficiency of 70% was determined for the summer cycle, and winter use from March-December revealed a water temperature of 8.5 C with a total injected volume of 14,700 cu m. The subsequent discovery that water returned to the ground quickly rose 4 C in temperature was taken as proof that the unconfined aquifer washed out the cooler water, implying that a one-well system is sufficient as a snow melter and collector fluid source in the winter. M.S.K.

A82-19825 † Solar-energy perspectives (Perspektivy solnechnoi energetiki). Iu. S. Bortnikov, N. S. Lidorenko, G. F. Muchnik, S. V. Riabikov, and D. S. Strebkov. *Akademiia Nauk SSSR, Izvestia, Energetika i Transport*, Nov.-Dec. 1981, p. 3-12. In Russian.

The current status and perspectives of solar energy utilization are briefly reviewed. Optimal techniques for the design and application of solar energy converters are described, and the possible contribution of solar energy to the future energy economy is assessed. Particular consideration is given to the role of satellite solar power stations. B.J.

A82-19876 Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, December 2-4, 1980, Proceedings. Conference sponsored by the Japan Society of Applied Physics and Science Council of Japan. *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2. 244 p.

The state-of-the-art in amorphous solar cells is reviewed in terms of polycrystalline silicon solar cells, single crystal silicon solar cells, and methods of characterizing solar cells, including dielectric liquid immersion to increase cell efficiency. Compound semiconductor solar cells are explored, and new structures and advanced solar cell materials are discussed. Film deposition techniques for fabricating amorphous solar cells are presented, and the characterization, in addition to the physics and the performance, of amorphous solar cells are examined. M.S.K.

A82-19877 Invited - Recent progress in amorphous silicon research and photovoltaic applications in the U.S.A. J. L. Stone (Solar Energy Research Institute, Golden, CO). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 1-7. 19 refs.

The progress in the development of amorphous silicon solar cells is traced from 1969-1980, including ongoing research projects, divisions of research, and directions and techniques. Contracted studies are being undertaken of advanced amorphous materials, physical phenomena in amorphous materials, and new materials and techniques. Principal attention is being given to hydrogenated and fluorinated amorphous Si, amorphous B-H, amorphous Si-C, Si-Ge alloys, amorphous GaAs, and other modifiers. Thin film preparation methods such as glow discharge plasma deposition, reactive sputtering, CVD, and ion plating are being investigated. Efficiencies of 6% have been reached, and problems of dopant-Si alloy forming are discussed with a view to improving the conductivity of the doped layers by using fluorinated materials. A realistic goal of 8% is predicted in the near term, and 10% in the 1990's. M.S.K.

A82-19878 An analysis of EBIC response of ITO/poly-Si solar cells. N. Inoue, T. Miyakawa (Defence Academy, Yokosuka, Japan), and C. W. Wilmsen (Colorado State University, Fort Collins, CO). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 11-15. 6 refs. Contract No. XS-9-8232-1.

An EBIC technique is applied to the grain boundaries of an ITO/poly-Si solar cell in order to investigate the effect of grain boundaries on solar cell output. The results are well explained by solving a three-dimensional diffusion equation. It is found that the

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regions with reduced EBIC signals around the grain boundaries are much smaller than the bulk diffusion length. The difference between the EBIC profile and that of local cell photoresponse is pointed out and a way to estimate the latter is proposed based on the information from the EBIC profile. (Author)

A82-19879 **Rapid characterization of solar cell performances.** H. Takakura, T. Nishino, and Y. Hamakawa (Osaka University, Toyonaka, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 17-21. 6 refs.

A new technique of computer-assisted automated measurements and analyses for solar cell output characteristics has been developed. A curve-fitting method developed in this work permits the estimation of solar cell parameters such as the saturation current, n-value, etc. A quantitative correlation between these parameters and fabrication conditions is discussed. This automated system also enables the user to calculate the real photocurrent from output characteristics. More precise analyses of the solar cell output parameters are discussed.

(Author)

A82-19880 **Characterization of 3-inch solar cells fabricated from granular silicon obtained in a fluidized-bed reactor.** T. Warabisako, S. Matsubara, H. Itoh, T. Saitoh, T. Tokuyama (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Tokyo, Japan), K. Matsukuma (Hitachi Ltd., Hitachi Works, Hitachi, Ibaraki, Japan), and N. Hasegawa (Shin-Etsu Chemical Co., Ltd., Research and Development Laboratory, Niigata, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 23-27. 5 refs. Research supported by the Ministry of International Trade and Industry.

Industrial feasibility of a solar-grade silicon material for use in terrestrial solar cells is demonstrated through the fabrication of practical size, 3 in. diameter, solar cells. The granular silicon prepared in a fluidized-bed reactor consumes less energy than the current Siemens process. A polycrystalline ingot obtained by the Czochralski method is described as a function of ingot length in terms of electrical properties and solar cell performance. Impurity gettering is also attempted through the application of a phosphorus diffusion process. The possibility of realizing a conversion efficiency higher than 8% for an entire ingot is revealed.

(Author)

A82-19881 **Fabrication and properties of silicon solar cells using squarely shaped crystals.** E. Kuroda, S. Matsubara, T. Saitoh, and T. Tokuyama (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Tokyo, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 31-37. 10 refs. Research supported by the Ministry of the International Trade and Industry.

Square single crystal silicon ingots with 3-inch sides are grown by producing uniform melt temperature distribution in the crucible. The growth of square ingots is described in a model where supercooling is present at the growth interface, and where growth rates vary for different faces. A relatively high conversion efficiency of 12-13% is obtained from square solar cells. Inhomogeneities in the solar cells are revealed by studying laser-beam induced current images and crystal defect density distribution. The packing density in modules increases up to the 0.93-0.95 level. As a result, modular efficiency also increased by 20%, compared with when using circular wafers.

(Author)

A82-19883 **Junction and bulk region characteristics of the laser annealed Si solar cells.** A. Usami and H. Nishioka (Nagoya Institute of Technology, Nagoya, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 45-49. 7 refs.

The diffusion length in the bulk region and carrier lifetime near the junction in laser annealed Si solar cells are presented. The excess

currents in the low forward bias region and the reverse currents of the laser annealed cells were observed to be larger than those in an 800 deg C furnace annealed cell, implying the existence of residual defects near the junction in the laser prepared cells. The spectral response of the laser annealed cell was equal to that of the furnace annealed cell, while the minority carrier diffusion length in the laser annealed cells was three times that of the furnace annealed cell, which means a better response at higher wavelengths for the laser annealed crystals. Degradation in the solar cells was noted to occur when the laser pulse energy was above 1.5 J/sq cm. M.S.K.

A82-19884 **Fundamental properties of MIS solar cells using Mg-p Si system.** H. Matura, S. Nishino, and H. Matsunami (Kyoto University, Kyoto, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 51-55. 8 refs.

Existence of an inversion layer at the surface of Si in an MIS diode using the Mg-p Si system is confirmed by the analysis of C(-2)V characteristics and charges in the inversion layer are estimated. The diode is thought to behave like a p-n junction diode, since minority carrier current is dominant in I-V characteristics. Effects of oxidation time on the C(-2)-V and I-V characteristics are studied. Photovoltaic properties of this inversion type MIS diode are measured.

(Author)

A82-19885 **A large active area Be-Si MIS solar cell with textured surface.** Y. Maeda (Hoxan Corp., Research Laboratories, Sapporo, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 57-60. 5 refs.

Experiments on an MIS solar cell using Be as a barrier metal are reported. A Be layer was deposited on boron doped Si wafers by a vacuum deposition technique, resulting in a layer 100-250 Å thick. The resulting Be-Si MIS cell displayed an open circuit voltage of 0.5 V, short circuit current density equal to 27.3 mA/sq cm, a fill factor of 0.62, and an efficiency of 8.5%. The preparation of large active area cells is described for 4 sq cm cells, including the electron beam induced vapor deposition at a rate of 15 Å/sec. Efficiencies of about 7% were obtained for several cells, with an optimum angle of incidence between 70 and 80 deg. The angular dependence was discovered to be a result of pyramidal shadowing in the deposited layer. Finally, it is noted that a double layered grid electrode consisting of the Be and aluminum contact metal was fabricated, which prevented leakage between the front contact and the textured Si surface. M.S.K.

A82-19888 **Parallel- and radial-current stream-line type metal-contacts of solar cell.** K. Yonei (Shibaura Institute of Technology, Tokyo, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 73-76. 5 refs.

The relation of the window-side metal contact structure to loss in the transparent-conduction region of a solar cell is analytically described. It is assumed that the current is perpendicular to the boundary of the transparent-conduction region, and a basic equation is formulated to define the parallel current and radial current streamlines extending to the metal-contact structures in the back of the cell. It is shown that the larger the surface resistivity of the transparent-conduction region becomes, the larger the difference between the values of the power density of the parallel and radial current streamlines becomes. It is concluded that the chance of losing the window-side metal contact leads to a necessity of fabricating the cells into radial current streamline cells, which have a surface resistivity one order of magnitude lower than the parallel current streamline cells. M.S.K.

A82-19889 **Efficiency increase of solar cells operated in dielectric liquid.** T. Ugomori and M. Ikeya (Yamaguchi University, Ube, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied*

Physics, vol. 20, 1981, Supplement 20-2, p. 77-80. 6 refs.

Light collection by means of refraction and inner reflection by solar cells immersed in dielectric liquids is investigated, along with the adsorption of polarizable molecules in the liquid. Solar cells with varying p-n junction depths were used to examine the adsorption effect, and current-voltage characteristics and depletion layer capacitance were measured to ascertain the effect of the polarizable molecules. The cells were illuminated by laser light in baths of benzene, ethyl ether, acetone, ethyl alcohol, and methyl alcohol. The photocurrent increased with an increase in the wavelength of the laser light, while the voltage did not increase as quickly. The polarizable molecules are interpreted as suppressing the surface recombination, a factor which overshadows any changes due to reflection. The molecules are thought to adsorb into the antireflection coatings of the cells.

M.S.K.

A82-19891 High efficiency MOS solar cells by anodic oxidation processes. H. Yamamoto, M. Moniwa, T. Sawada, and H. Hasegawa (Hokkaido University, Sapporo, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 87-91. 14 refs.

Preparation of GaAs, InP and Si single-crystal MOS solar cells by anodization in various modes is investigated. Both passive and active modes of anodization are found to increase the open-circuit voltage with respect to that of the bare Schottky cell. The best result is obtained by active anodization of n-GaAs. Passive anodization with a high formation voltage results in an anomalous reduction in photocurrent. A detailed analysis of cell current-voltage characteristics indicates that cell behavior is dominated by interface-states.

(Author)

A82-19893 A new structure for high efficiency and humidity resistant AlGaAs/GaAs solar cells. K. Mitsui, S. Yoshida, T. Oda, Y. Yukimoto, and K. Shirahata (Mitsubishi Electric Corp., Itami, Hyogo, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 99-103. 7 refs.

A82-19894 Performance of 1 kWp AlGaAs/GaAs terrestrial concentrator solar cell array. S. Yoshida, K. Mitsui, T. Oda, Y. Yukimoto, and K. Shirahata (Mitsubishi Electric Corp., Itami, Hyogo, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 105-108. 6 refs.

A 1 kWp (electrical output power at 100 mw/sq cm incident power density) concentrating photovoltaic array with 180 square Fresnel lenses and AlGaAs/GaAs concentrator solar cells has been constructed. The AlGaAs/GaAs concentrator solar cells consist of p-AlGaAs/p-GaAs/n-GaAs with an area of 2 x 2 sq cm. The p-GaAs layer thickness is set at 3-5 microns so as to keep the spreading resistance low. The concentrator cells are passively cooled by natural convection. The maximum output power from the best concentrator cell is 9.1 with an efficiency of 22.6% at about 125 suns. An array output power of 977 W has been obtained at 125 suns.

(Author)

A82-19895 Photovoltaic effect in monoclinic ZnP₂. K. Ito, Y. Matsuura, T. Nakazawa, and H. Takenouchi (Shinshu University, Nagano, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 109-112. 5 refs.

Heterojunction diodes consisting of n type In₂O₃ film and p type monoclinic ZnP₂ single crystal were formed. Spectral response of monoclinic ZnP₂ was measured on these diodes using polarized monochromatic light. At wavelengths around 0.76 micrometer, the response for the electric vector of plane polarized light parallel to the c-axis was considerably larger than that for the light polarized perpendicular to c. The anisotropy of the response corresponds to an intense dichroism observed in the absorption spectrum of monoclinic ZnP₂. The overall response observed within the 0.35-0.86 micrometer range matches with the solar spectrum.

(Author)

A82-19896 Growth and evaluation of n-CdS/n-InP/p-InP heteroface solar cell. A. Yoshikawa, S. Yamaga, and H. Kasai (Chiba University, Chiba, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 113-117. 15 refs.

Fabrication and electrical and optical characteristics of an n-CdS/n-InP/p-InP heteroface solar cell are described. The cell was fabricated by two growth steps, i.e., first, a thin n-InP layer was grown on a p-InP substrate by a conventional LPE technique, then a thin n-CdS layer was grown on the n-InP layer by the close-spaced technique. It is shown that the photoresponse of an n-InP/p-InP homojunction cell is remarkably improved by applying a CdS layer on the n-InP because the surface recombination velocity on the n-InP reduces after a CdS growth. Furthermore, the reverse saturation current and the built-in voltage of the InP homojunction are also improved after a CdS growth. The conversion efficiency of the heteroface solar cell with no AR coating was 10.4% under AM2 conditions. The lower observed efficiency than that expected theoretically is attributed to a poor electrical characteristic of the n-InP/p-InP homojunction.

(Author)

A82-19897 InGaAsP/InP wavelength division solar cells. N. Ito, S. Hattori (Nagoya University, Nagoya, Japan), T. Uesugi, S. Sakai, and M. Urano (Nagoya Institute of Technology, Nagoya, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 121-125. 9 refs.

Two types of InGaAsP/InP wavelength division solar cells are fabricated. One of them includes a shallow homojunction and the other has a heteroface structure. A combination of the present cell and a conventional high efficiency GaAlAs/GaAs cell is proposed in this paper. The fabricated first type of cell exhibited a conversion efficiency of 11% for total solar illumination and 18.5% for filtered illumination with GaAs crystal. Neglecting the optical loss in filter material, the possibility that a 26% conversion efficiency will be obtained in the proposed system is demonstrated. The initial results on the second type of cell are presented and an 8.71% conversion efficiency was obtained with a single p-n junction InGaAsP/InP heteroface solar cell.

(Author)

A82-19898 Design and performances of a triple /GaAs, Si, and Ge/- solar-cell system with multi-layered spectrum splitters. H. Sakaki, T. Tanoue, K. Yokoyama, Y. Sekiguchi (Tokyo University, Tokyo, Japan), D. C. Sun (Mitsubishi Electric Corp., Itami, Hyogo, Japan), and Y. Yukimoto. (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 127-133. 6 refs.

A calculation has been performed to predict the ultimate conversion efficiency of various split-spectrum multiple-solar cell systems. Based on this analysis, a triple-cell system is designed and fabricated in which the solar radiation is divided by multilayered filters into three beams of different spectral bands, the beams are then converted separately by a GaAs-, an Si-, and a Ge-cell. A total conversion efficiency of 22.7% is achieved. The factors determining the efficiency are examined to clarify possible methods of attaining higher efficiencies.

(Author)

A82-19902 Effect of fluorine on the photovoltaic properties of amorphous silicon prepared by dc glow discharge. K. Nishihata, M. Konagai, K. Takahashi (Tokyo Institute of Technology, Tokyo, Japan), and K. Komori (Showa Oil Co., Tokyo, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 151-155. 14 refs. Research supported by the Ministry of International Trade and Industry.

Amorphous Si-F-H films were prepared by dc glow discharge in an atmosphere of SiF₄ + H₂. The electrical and optical properties have been described. Infrared spectra of amorphous Si-F-H have been studied for various deposition pressures. In the n-type doping characteristics, the maximum conductivity obtained is 10.0/ohm-cm

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with the addition of 500 vppm PH₃. The Schottky barrier a-Si:F-H solar cell shows an efficiency of 3.5% under AM1, 100 mW/sq cm insolation. (Author)

A82-19903 Properties of amorphous Si:F:H film and its photovoltaic characteristics. Y. Kuwano, M. Ohnishi, H. Nishiwaki, S. Tsuda, and H. Shibuya (Sanyo Electric Co., Ltd., Research Center, Hirakata, Osaka, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 157-162. 9 refs. Research supported by the Ministry of International Trade and Industry.

The optical and electrical characteristics of a-Si:F:H films deposited by RF glow discharge and the photovoltaic properties of the a-Si cells using the films are discussed, in addition to the presentation of a new phenomenon in a-Si solar cells. Glow discharge deposition of a-Si:H and a-Si:F:H films in SiH₄ and SiF₄ + SiH₄, respectively, were accomplished by an RF capacitive system at a pressure of 0.4 Torr. Glass/ITO/p-i-n cells were also fabricated with a boron doped p-layer of about 50-800 Å, an undoped layer of 1000-20,000 Å, and a phosphorus doped n-layer 100-1500 Å thick on an ITO transparent film deposited on glass. Investigation of the properties of the a-Si:F:H films in terms of IR transmittance revealed a peak at 830/cm, implying that the deposited film contains fluorine. A decrease in efficiency with an increase in light intensity was observed to be less than that which occurs in a-Si:H cells. M.S.K.

A82-19905 Dependence of RF power on the content and configuration of hydrogen in amorphous hydrogenated silicon by reactive sputtering. T. Imura, K. Ushita, K. Mogi, and A. Hiraki (Osaka University, Suita, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 171-174. 10 refs.

Infrared absorption spectra at stretching bands of Si-H were investigated in hydrogenated amorphous silicon fabricated by reactive sputtering in the atmosphere of Ar and H₂ (10 mole%) at various input RF powers in the range from 0.8 to 3.8 W/sq cm. Hydrogen content mainly due to the configuration of Si = H₂ in the film increased with the decreasing RF power, as the deposition rate was decreased. On the other hand, the quantity of the monohydride (Si-H) configuration depended less on the power. Attachment of hydrogen molecules onto the fresh and reactive surface of silicon deposited successively was proposed for possible process of hydrogen inclusion into amorphous silicon resulting in Si = H₂ configuration. The photoconductivity increased as the input power became higher, when the deposition rate also increased linearly with the power. (Author)

A82-19909 Interpretation of characteristics in a-Si:H solar cells. Y. Uchida, H. Sakai, and M. Nishiura (Fuji Electric Corporate Research and Development, Ltd., Yokosuka, Kanagawa, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 191-194. 12 refs. Research supported by the Ministry of International Trade and Industry.

Current versus voltage characteristics in an illuminated a-Si:H solar cell which shows conversion efficiency of 4.3% (cell area of 1.0 sq cm) are interpreted by assuming a simplified junction model and a distribution of the density of states in the band gap. Since the width of the depletion region relates to this distribution, a depletion width (W) versus bias voltage (V) relation can be calculated from this distribution. Also, another W-V relation is obtained from light-generated current data on the basis of a few assumptions. These two different estimations of the W-V relation excellently agree when one assumes a hyperbolic distribution of the density of states in the band gap which is symmetric with respect to the middle of the energy band gap and has a density of mid-gap states of 8.3×10 to the 15th per cu cm eV. This values are comparable to the minimum density of states in a-Si:F:H reported by Czubyj et al. (1980). (Author)

A82-19911 Schottky barrier solar cells of weakly hydrogenated CVD amorphous silicon. T. Nakashita, M. Hirose, and Y. Osaka (Hiroshima University, Hiroshima, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 201-204. 9 refs.

Electronic properties of CVD a-Si were remarkably improved by hydrogen plasma annealing. As a result, the Schottky-barrier solar cells without an antireflection coating have provided a conversion efficiency of 2.7% at 100 mW/sq cm, and no Staebler-Wronski effect has been observed in the hydrogenated CVD a-Si cell. It is also found that the fill factor is dependent on incident light intensity, because of changes in its series and parallel resistances by light illumination. (Author)

A82-19912 Characteristics of Schottky barrier diodes in reactively sputtered amorphous Si:H. H. Okushi, K. Nakagawa, H. Yamamoto, A. Matsuda, K. Tanaka, S. Izima (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan), S. Yamasaki, and M. Matsumura (TOA Nenryo Kogyo KK, Tokyo, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 205-209. 6 refs.

Experiments with Schottky barrier diodes in reactivity sputtered a-Si:H films to investigate the diode characteristics on the basis of film properties are reported. The H content, optical gap, activation energy, spin density, and diode characteristics such as I-V, C-V, and photovoltaic properties are discussed in terms of the bonded H-content. The samples were prepared in a diode sputtering system and the H₂ content was varied, with the Schottky diodes in an n+ crystalline Si configuration having Au contacts. The bonded H and median wave number were determined by film thickness and IR absorption spectroscopy. The effective density of gap states was found to decrease with increasing H content, and discussions are presented of the transient current characteristics and the illuminated diode characteristics. M.S.K.

A82-19913 A new integrated type amorphous Si solar cell. Y. Kuwano, S. Tsuda, M. Ohnishi, H. Nishiwaki, H. Shibuya, S. Nakano, and T. Imai (Sanyo Electric Co., Ltd., Research Center, Hirakata, Osaka, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 213-218. 7 refs. Research supported by the Ministry of International Trade and Industry.

The conversion efficiencies of amorphous silicon (a-Si) solar cells were found to decrease with an increase of the cell size. The cause of this effect was investigated, and a part of the cause was indicated by a distributed constant model. In order to enlarge the size of a solar cell with high efficiency, an integrated structure has been developed for the a-Si solar cell module. The best conversion efficiency of this module with a size of 10 x 10 sq cm was 3.4% in sunlight. (Author)

A82-19914 Optimizations of the film deposition parameters for the hydrogenated amorphous silicon solar cell. Y. Tawada, T. Yamaguchi, S. Nonomura, H. Okamoto, Y. Hamakawa (Osaka University, Toyonaka, Japan), and S. Hotta. (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 219-225. 12 refs.

A82-19915 Broadening of spectral response width by a-Si/a-SiGe p-i-n type solar cells. G. Nakamura, K. Sato, Y. Yukimoto, and K. Shirahata (Mitsubishi Electric Corp., LSI Research and Development Laboratory, Itami, Hyogo, Japan). (*Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.*) *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 227-232. 11 refs. Research supported by the Ministry of International Trade and Industry.

A82-19948 **Turbomachinery for small solar power plants.** K. Bammert (Hannover, Universität, Hanover, West Germany), H. Heikal (Helwan University, Cairo, Egypt), and A. Mobarak (Cairo University, Cairo, Egypt). *Forschung im Ingenieurwesen*, vol. 47, no. 6, 1981, p. 169-178. 5 refs.

The considered investigation is concerned with the selection of turbomachinery for a thermodynamic cycle involving the employment of working fluids at different maximum process temperatures, taking into account the power range from 10 to 500 kW. Approaches for determining system efficiency are discussed. It is pointed out that in selecting the thermodynamic cycle and the working fluid for a solar power plant, the primary consideration must be related to the necessity to obtain a simple, reliable system which meets also the efficiency requirements. The Rankine cycle and the Brayton cycle are described, and the design of suitable turbines and compressors is considered. It is found that solar farm plants using parabolic troughs or bowls are best suited for process temperatures in the range from 200 to 300 C and for power outputs up to 500 kW. For the considered conditions, steam and toluene are the most suitable working fluids in a Rankine system. G.R.

A82-20066 **Macroscopic surface roughness in metal-dielectric composite films - Photothermal absorber applications.** A. Nyberg and R. A. Buhman (Cornell University, Ithaca, NY). *Applied Physics Letters*, vol. 40, Jan. 15, 1982, p. 129-131. 9 refs. NSF-supported research; Contract No. DE-FG02-80CS-83113.

Previous studies have shown that coevaporated metal-dielectric composite films are quite smooth. But a substantially higher deposition temperature results in the surface roughness of Mo/Al₂O₃ composite films becoming larger than the mean film thickness. This effect was applied to photothermal solar absorbers where, for the first time, a stable selective absorber was produced which absorbs over 99% of the solar spectrum. These results have implications for other surface roughness dependent effects. (Author)

A82-20070 **Silicon-silicon interfaces.** D. Redfield (RCA Laboratories, Princeton, NJ). *Applied Physics Letters*, vol. 40, Jan. 15, 1982, p. 163-165. 14 refs. Research supported by RCA; Contract No. DE-AC01-79ET-23108.

A wide variety of measurements on silicon grain boundaries shows that the electronic properties of such boundaries are much like those of Si surfaces in all essential respects. Moreover, the properties of 'clean' surfaces and lightly contaminated surfaces can be studied on many crystallographic orientations of the interfaces without the need for vacuum measurements. Such grain boundaries may therefore be regarded as Si-Si interfaces in the sense used in surface physics. It is shown that the thermal history and the dissolved oxygen of the silicon play major roles in determining the interface properties. (Author)

A82-20136 * **Solar/hydrogen systems for the 1985-2000 time frame - A review and assessment.** J. A. Hanson (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), R. W. Foster, W. J. D. Escher, and R. R. Tison (Escher-Foster Technology Associates, Inc., St. Johns, MI). *International Journal of Hydrogen Energy*, vol. 7, no. 1, 1982, p. 3-20. Research sponsored by the U.S. Department of Energy and NASA.

A comprehensive state-of-the-art review of solar/hydrogen technologies has been conducted. From this, solar/hydrogen production systems which could be commercialized by the year 2000 have been characterized technically and economically. Incentives and disincentives for the early commercialization of four solar/hydrogen systems have been explored, conclusions drawn and recommendations made. (Author)

A82-20139 * **Urban air pollution and solar energy.** R. B. Gammon (New South Wales, Energy Authority, Sydney, Australia), J. R. Huning, M. S. Reid, and J. H. Smith (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *International Journal of Ambient Energy*, vol. 2, Oct. 1981, p. 183-195. 49 refs. Contract No. NAS7-100.

The design and performance of solar energy systems for many potential applications (industrial/residential heat, electricity generation by solar concentration and photovoltaics) will be critically

affected by local insolation conditions. The effects of urban air pollution are considered and reviewed. A study of insolation data for Alhambra, California (9 km south of Pasadena) shows that, during a recent second-stage photochemical smog alert (greater than or equal to 0.35 ppm ozone), the direct-beam insolation at solar noon was reduced by 40%, and the total global by 15%, from clean air values. Similar effects have been observed in Pasadena, and are attributable primarily to air pollution. Effects due to advecting smog have been detected 200 km away, in the Mojave Desert. Preliminary performance and economic simulations of solar thermal and photovoltaic power systems indicate increasing nonlinear sensitivity of life cycle plant cost to reductions in insolation levels due to pollution.

(Author)

A82-20165 **SHAC - A nation turns to the sun.** N. Lihach. *EPRI Journal*, vol. 6, Dec. 1981, p. 13-17.

The state-of-the-art and applications of solar heating and cooling are discussed. Domestic hot water heating is considered as a currently viable, commercially acceptable technique, with progress moving rapidly in the area of building heat. Storage systems, when combined with solar heating systems, are asserted to be a valid method of levelling off utility heating energy supply loads, and studies by the Electric Power Research Institute to identify site specific active solar systems are outlined. The insulation of storage tanks has been found to be a critical factor in solar system economics, with single tank storage being more efficient than multiple tank methods; careful management of the stored hot water use extended a system's effectiveness. Other findings showed that hot air collectors gathered more thermal energy than liquid filled collectors, liquid storage is more efficient than rock storage, and passive systems are most likely to be used on new houses. M.S.K.

A82-20167 **Solar-thermal electric - Focal point for the desert sun.** D. Van Atta. *EPRI Journal*, vol. 6, Dec. 1981, p. 37-41, 43. 6 refs.

The applications of solar thermal systems are explored, including flat plate and line-focus collectors, and parabolic and heliostat point focus electrical generators. The first U.S. 10MWe solar tower power plant, Solar One, is due to begin operational testing in 1982, while five other projects are under way in Europe and Japan. Mention is made of the use of solar thermal generators as repowering plants, used to preheat steam for conventional gas and oil fueled power plants. Thermal storage methods, such as molten salt, hot rocks, and hot oil are reviewed, as are Brayton and Rankine cycle heat transfer systems. The Brayton cycle will be tested in a hybrid scheme with a fossil fuel burning gas generator which will supplement the output from the solar thermal section. M.S.K.

A82-20168 **Photovoltaics - A question of efficiency.** R. Whitaker. *EPRI Journal*, vol. 6, Dec. 1981, p. 45-51. 11 refs.

The current state and requirements for large scale use of photovoltaic cells are examined. Annual sales are presently 4 MW, going primarily to remote communications installations, railway controls, navigation aids, and communications equipment on offshore oil platforms. With a goal of mass-production of cells yielding power at 0.70 cents/W, research programs are investigating crystalline Si, thin film CdS cells, amorphous Si films, etc. Cell module losses include defective cells, faulty wiring, uneven production quality, and losses in efficiency at higher temperatures. Higher efficiencies using cheaper cells are being investigated by doping amorphous cells with hydrogen, by laser recrystallization of thin film surfaces, or by employing more expensive cells in concentrator configurations. Utility applications are examined, noting that the ultimate goal is for modular units for home use. M.S.K.

A82-20169 **Sea, soil, sky - Testing solar's limits.** J. Hopkinson. *EPRI Journal*, vol. 6, Dec. 1981, p. 55-61. 6 refs.

The potentials and actualities of large scale biomass, ocean thermal, and satellite solar power systems are discussed. Biomass is an energy already on-line in installations ranging from home-sized wood-burning stoves to utility sized generators fueled by sawdust and forest residue. Uses of wheat straw, fast-growing trees such as eucalyptus and alder, and euphorbia as biofuels are examined, noting restrictions imposed by land use limitations and the necessity for genetic engineering for more suitable plants. Pyrolysis and thermochemical gasification of biomass to form gaseous, solid, and liquid

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fuels are explored, and mention is made of utility refuse and sewage incineration for power generation. OTEC, satellite solar power systems, and tidal generator plants are considered as promising for further investigation and perhaps useful in limited applications, while solar pond power plants require extremely large areas to be effective.

M.S.K.

A82-20205 **Fabrication of thick narrow electrodes on concentrator solar cells.** A. Blakers, P. B. Kosel, M. R. Willison, and M. A. Green (New South Wales, University, Kensington, Australia). *Journal of Vacuum Science and Technology*, vol. 20, Jan. 1982, p. 13-15. 5 refs. Research supported by the National Energy Research Development and Demonstration Council.

Narrow electrodes of thickness greater than 15 microns have been fabricated on concentrator solar cells by the PMTP (photoresist-metal-thick photoresist) process. This technique provides grid lines of low series resistance while minimizing the active area of silicon covered by electrodes, both advantages which increase the conversion efficiency of concentrator solar cells. In addition, as this technique is a 'liftoff' technique, it allows the use of composite or alloy metals which normally suffer in the course of chemical etching. Finally, the thick photoresist layer smooths out short range surface roughness and allows this technique to be used equally effectively on polycrystalline, textured or amorphous surfaces. (Author)

A82-20457 * **Photovoltaic investigation of minority carrier lifetime in the heavily-doped emitter layer of silicon junction solar cell.** C.-T. Ho (Mobil Tyco Solar Energy Corp., Waltham, MA). *Journal of Applied Physics*, vol. 53, Jan. 1982, p. 507-513. 21 refs. Research supported by the U.S. Department of Energy; Contracts No. NAS7-100; No. JPL-954355.

The results of experiments on the recombination lifetime in a phosphorus diffused N(+) layer of a silicon solar cell are reported. The cells studied comprised three groups of Czochralski grown crystals: boron doped to one ohm-cm, boron doped to 6 ohm-cm, and aluminum doped to one ohm-cm, all with a shunt resistance exceeding 500 kilo-ohms. The characteristic bulk diffusion length of a cell sample was determined from the short circuit current response to light at a wavelength of one micron. The recombination rates were obtained by measurement of the open circuit voltage as a function of the photogeneration rate. The recombination rate was found to be dependent on the photoinjection level, and is positive-field controlled at low photoinjection, positive-field influence Auger recombination at a medium photoinjection level, and negative-field controlled Auger recombination at a high photoinjection level. M.S.K.

A82-20463 **Some properties of dc glow discharge amorphous silicon solar cells.** H. Wiesmann, C. Coleman (Plasma Physics Corp., Locust Valley, NY), and A. Ghosh (Brookhaven National Laboratory, Upton, NY). *Journal of Applied Physics*, vol. 53, Jan. 1982, p. 703-707. 22 refs. Contract No. DE-AC02-76CH-00016.

A study of the internal yield, depletion width and absorption constant is presented for dc glow discharge P-I-N amorphous silicon films. Internal yields of approximately 0.9 at 475 nm and depletion widths as large as 0.37 microns were observed at low illumination levels and were characteristic of the better cells. The absorption constant as a function of wavelength showed no anomalies and was comparable to RF glow discharge films with an optical gap of 1.68 eV. A unique aspect of these cells is that the top P layer is amorphous boron. (Author)

A82-20464 **Improved efficiency of n-CdSe thin-film photoelectrodes by zinc surface treatment.** J. Reichman and M. A. Russak (Grumman Aerospace Corp., Research Dept., Bethpage, NY). *Journal of Applied Physics*, vol. 53, Jan. 1982, p. 709-711. 15 refs. Contract No. XP9-8002-8.

The open circuit voltage, fill factor, and power conversion efficiency of n-CdSe thin-film electrodes for photoelectrochemical solar cells have been improved by treating the surface with Zn(+2) ions. The overall efficiency of these electrodes was increased from approximately 5% to as high as 6.5% with a soaking treatment in 1 M ZnCl₂. Photoelectrochemical measurement and Auger spectroscopy indicated the observed improvements were the result of a shift in the flat-band potential to more negative values to the incorporation of zinc into the surface region of the CdSe thin film. (Author)

A82-20574 **The silicon solar satellite power system - A net energy analysis.** B. Hannon and J. P. Naughton (Illinois, University, Urbana, IL). *Energy Systems and Policy*, vol. 5, no. 4, 1981, p. 319-343. 17 refs. Research supported by the National Academy of Sciences.

The physical aspects and net energy balance of a Satellite Solar Power System (SSPS) are examined. The feasibility of operating with or without laser annealing for the cells, possible variations in the total system costs, the projected worth of the energy, and the R&D costs are explored. The energy needed to mine, refine, fabricate, manufacture, launch, and maintain the SSPS materials and structures are included in the energy analysis, and cost-to-energy ratio of energy used to energy produced graphs are provided for the cases of the use or non-use of laser annealing for radiation protection for the solar cells. The resulting energy ratios indicate that the reference SSPS compares unfavorably with coal or nuclear earth-based plants, although further research is necessary to determine what level of technology is actually required for construction of the SSPS. M.S.K.

A82-20642 * # **Cost and sizing sensitivities for the solar power satellite.** L. Monford, G. D. Arndt, and J. W. Seyl (NASA, Johnson Space Center, Houston, TX). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 48.3.1-48.3.5.

A summary is provided of the characteristics and error parameters of the reference microwave transmission system for the solar power satellite (SPS). The relative importance of electrical and mechanical tolerances upon scattered microwave power and electrical costs is investigated. It is found that small increases in efficiency and/or reduction of losses (less than one percent) can improve the revenue from a single satellite over its 30-year lifetime by several hundred million dollars. Attention is given to a system definition, cost sensitivities for the reference system, the klystron dc-RF conversion efficiency, the transmitting antenna, the rectenna collection efficiency, system sizing tradeoffs, a cost analysis, and multiple antennas. G.R.

A82-20708 * # **Solid-state alternatives for the Solar Power Satellite.** L. Leopold and G. D. Arndt (NASA, Johnson Space Center, Houston, TX). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 72.1.1-72.1.5.

A solid-state transmitter at S-band frequencies will allow many low-power antenna array elements fed directly by the solid-state amplifier modules to combine power for transmission to earth in space. Two configurations, one the separate antenna and the other a sandwich concept are discussed. The results of two small hardware development studies are presented. (Author)

A82-20722 **A high efficiency single-crystal CdSe photoelectrochemical solar cell and an associated loss mechanism.** K. W. Frese, Jr. (SRI International, Menlo Park, CA). *Applied Physics Letters*, vol. 40, Feb. 1, 1982, p. 275-277. 13 refs.

The properties of n-CdSe photoelectrochemical solar cells using aqueous alkaline K₃Fe(CN)₆/K₄Fe(CN)₆ as the redox couple are examined. Such cells are shown to have a peak conversion efficiency of 12.4% at 13 mA/sq cm and 0.85V, when a solution with pH 13.4 is used. The pH of the solution is found to be very important for obtaining high-efficiency cells. Cell degradation due to selenium corrosion is discussed in terms of a simple model where the dominant degradation mechanism is attributed to light absorption by Se. V.L.

A82-20881 **Technological approach towards future large solar arrays.** B. Georgens (Telefunken AG, Wedel, West Germany). In: Space in the 1980's and beyond; Proceedings of the Seventeenth European Space Symposium, London, England, June 4-6, 1980. San Diego, CA, American Astronautical Society; Univert, Inc., 1981, p. 229-250. 5 refs. (AAS 80-323)

Three generations of solar arrays are described, the first being characterized by body mounted arrays, the second by rigid paddle arrays, and the third by the direct bonding of solar cells on thin,

flexible plastic foils. It is pointed out that the use of solar arrays as power sources could significantly increase the capabilities of the Shuttle and Spacelab. Since the capacity for manufacturing solar cells in Europe has been increased to the required level, attention must now be directed to increasing cell efficiency and decreasing cell thickness toward 100 microns. Detailed development is also required in order to meet the retractability and high-voltage requirements in blanket technology. C.R.

A82-20968 **Coupling to solar energy: Sensitized photo-reactions - The primary source of self-organization.** P. Decker (Hannover, Tierärztliche Hochschule, Hanover, West Germany). In: Origin of life; Proceedings of the Third ISSOL Meeting and Sixth ICOL Meeting, Jerusalem, Israel, June 22-27, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 529-536. 31 refs.

Life is modelled as a thermodynamically dissipative mechanism, and the chemical reactions most amenable to the formation of 'boids' which form and change from one generation to the next are examined. The self-organization is assumed to occur on a planetary surface exposed to 6000 deg light quanta, in the availability of reactive chemicals, with nonenzymatic catalysts being present, and with macromolecules able to mediate the reactivity through catalytic concentration of metal ions. The model is taken to indicate that experimentation should look for photochemical reactions with autocatalytic feedback which yield an organization into cycles in a steady state scenario. The oxidation of methane is mentioned for the production of formaldehyde and the autocatalytic formation of sugars from the formaldehyde, and experiments on a nonenzymatic photophosphorylation is described as an example of the synthesis of energy rich intermediates. M.S.K.

A82-21147 **Silicon solar cells with reduced temperature sensitivity.** M. A. Green (Solar Energy Research Institute, Golden, CO.; New South Wales, University, Kensington, Australia), K. Emery (Solar Energy Research Institute, Golden, CO), and A. W. Blakers (New South Wales, University, Kensington, Australia). *Electronics Letters*, vol. 18, Jan. 21, 1982, p. 97, 98. 6 refs. Research supported by the Solar Energy Research Institute and Australian National Energy Research Development and Demonstration Council.

As the open-circuit voltage of silicon solar cells continues to improve, one resulting advantage, not widely appreciated, is reduced temperature sensitivity of device performance. Recently a new type of silicon solar cell has been described which has resulted in a significant increase in open circuit voltage. Experimental results are described for these devices which demonstrate the lowest temperature sensitivity ever reported for silicon cells under unconcentrated sunlight. With further improvements in voltage, it should be possible to approach the relative temperature insensitivity of some high performance GaAs devices. (Author)

A82-21149 **A comparison of the solar-gas and solar-electric interface.** G. G. Mannella (Mechanical Technology, Inc., Latham, NY). *Energy* (UK), vol. 7, Jan. 1982, p. 31-37. 15 refs.

The introduction of large-scale solar-derived gas, electricity, and home heat into the national pipeline, electric grid, and fuel supply systems is discussed. Natural gas is shown to be substitutable for most other energy sources, having a lower cost per energy unit than electricity or oil, and able to be augmented by biomass derived methane or solar derived hydrogen. The latter is perceived as an unproven technology, both economically and technically. Solar home heating systems will lower the utilities' rate base and lead to minimum charge rates for solar customers and higher rates for regular customers unless utilities are permitted to enter the solar heating business as an extension of their role as a service institution. Dispersed solar electric systems are seen to be the least economical use of solar systems, while the solar-gas system offers the greatest potential as a bridge for solar technologies into residential, institutional, and commercial markets. M.S.K.

A82-21150 **Solar energy/utility interface - The technical issues.** R. D. Tabors and D. C. White (MIT, Cambridge, MA). *Energy* (UK), vol. 7, Jan. 1982, p. 39-48. 10 refs.

The technical and economic factors affecting an interface between solar/wind power sources and utilities are examined.

Photovoltaic, solar thermal, and wind powered systems are subject to stochastic local climatic variations and as such may require full back-up services from utilities, which are then in a position of having reserve generating power and power lines and equipment which are used only part time. The low reliability which has degraded some economies of scale formerly associated with large, centralized power plants, and the lowered rate of the increase in electricity usage is taken to commend the inclusion of power sources with a modular nature such as is available from solar derived electrical generation. Technical issues for maintaining the quality of grid power and also effectively metering purchased and supplied back-up power as part of a homeostatic system of energy control are discussed. It is concluded that economic considerations, rather than technical issues, bear the most difficulty in integrating solar technologies into the utility network. M.S.K.

A82-21253 **Use of photovoltage for electrodeposition in solar cell processing technology.** V. K. Jain (Solid State Physics Laboratory, Delhi, India) and A. R. Kulshreshtha (Indian Space Research Organization, Satellite Centre, Bangalore, India). *Journal of Physics D - Applied Physics*, vol. 14, Dec. 14, 1981, p. 2327-2331. 6 refs.

This paper reports the development of a new technology for the electrolytic deposition of a metal on a solar cell, without employing an external electric bias field, but by using the internal photo-induced voltage of the solar cell itself. The experimental details of depositing silver over the existing metallized contact structure of the cell and a transparent conducting oxide coating over the entire solar cell front surface are discussed. The proposed technique reduces the consumption of the processing materials and makes the fabrication procedure less expensive and simpler. (Author)

A82-21363 **Bandpass filters for thermophotovoltaic conversion systems.** F. Demichelis, E. Minetti-Mezzetti, M. Agnello, and V. Perotto (Torino, Politecnico, Turin, Italy). *Solar Cells*, vol. 5, Jan. 1982, p. 135-141. 9 refs. Research supported by the Fiat Aviazione S.p.A.

The design of dielectric-metal-dielectric filters especially suitable for use as wide bandpass filters with a high visible and a low IR transmittance is described. A refining method is applied to optimize the transmittance in the part of the spectrum corresponding to the spectral response of the solar cells and at the same time to preserve a high reflectance at longer wavelengths. These filters can provide a considerable transmittance over a wide band of the spectrum with a very low transmittance in the rejection regions. (Author)

A82-21364 **Effect of the back-surface field on the open-circuit voltages of p+/n-n+/ and n+/p-p+/ silicon solar cells.** S. N. Singh and G. C. Jain (National Physical Laboratory of India, New Delhi, India). *Solar Cells*, vol. 5, Jan. 1982, p. 143-172. 30 refs.

The means by which a back surface field (BSF) improves the open-circuit voltage for solar cells are investigated analytically. Minority carrier blocking, back reflection, and back-contact recombination velocity are discussed, and the effect of a BSF on cell performance is evaluated by defining an effective recombination velocity of minority carriers at the L-H junction end of the bulk region. Low and high energy level conditions in the bulk region are determined, and whereas at low levels the increase is due to the back reflection of minority carriers, at high levels the contribution of minority carrier blocking becomes significant too. The analysis is valid for front-illuminated silicon solar cells if both front and back junctions are shallow. M.S.K.

A82-21365 **Optimum operating conditions of a solar cell panel and prediction of solar radiation in Sanaa, Yemen.** A. Khogali and M. R. I. Ramadan (Sana, University, Sana, Yemen). *Solar Cells*, vol. 5, Jan. 1982, p. 173-181. 9 refs.

Results of a study of the performance of solar cells under nominal operating conditions in Yemen are reported. The solar cell panel comprised 14 Si cells of .003 sq m surface area each, and was mounted on a rooftop with the solar radiation being measured by a pyranometer. Further monitoring was performed of the panel surface temperature, the ambient air temperature, and potentiometer readings of the panel output. Current-voltage characteristics were recorded at 14 intensities during the day for references to determine

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other operating parameters. Efficiency varied as an inverse of the internal cell temperature, ranging from 21.7-17.5% at temperatures of 19 and 28.5 C, respectively. An average of daily irradiation of 21.2 MJ/sq m was calculated for 8.9 hr of sunlight/day and an increase of 16% in output was achieved in the winter by tilting the panel toward the equator. M.S.K.

A82-21366 Effect of shunt resistance and bypass diodes on the shadow tolerance of solar cell modules. M. S. Swaleh and M. A. Green (New South Wales, University, Kensington, Australia). *Solar Cells*, vol. 5, Jan. 1982, p. 183-198. 7 refs.

In the field, solar cell arrays are subjected to shadows from both predictable sources and such unpredictable sources as bird droppings or fallen leaves. The most obvious result of a shadow is a decrease in power output from the solar cell array. However, a more serious problem that can arise is the degradation and eventual failure of the array due to localized overheating. These difficulties can be avoided either by incorporating a relatively small shunt resistance in the solar cell design or by incorporating bypass diodes. In this paper we analyse these techniques and compare their effectiveness. (Author)

A82-21838 The effect of the I sub 01/I sub 02 ratio on the open circuit voltage of solar cells. A. Prasad (Bharat Electronics, Ltd., Bangalore, India). *Solid-State Electronics*, vol. 25, Jan. 1982, p. 80-82.

The relationship between the open-circuit voltage of a solar cell and the value of the ratio I sub 01/I sub 02 is investigated, I sub 01 and I sub 02 being the two leakage currents used in describing the dark characteristics of a solar cell by the two-exponential model. The voltage is found to decrease as the ratio becomes smaller. This reduction in voltage, however, is more pronounced for higher values of I sub 01. The reduction is also found to depend on the mode of variation of the space charge recombination current with applied voltage. C.R.

A82-21949 High-efficiency electrodeposited cadmium telluride solar cells. G. Fulop, M. Doty, P. Meyers, J. Betz, and C. H. Liu (Ametek, Inc., Harleysville, PA). *Applied Physics Letters*, vol. 40, Feb. 15, 1982, p. 327, 328. 10 refs.

Thin-film CdTe Schottky-barrier solar cells with efficiencies in excess of 8% have been produced by electrodeposition from an aqueous solution. The most efficient Au/CdTe solar cell developed to date had an efficiency of 8.65% (under 100 mW/sq cm illumination), and open-circuit voltage of 0.723 V, a short-circuit current density of 18.7 mA/sq cm, and a fill factor of 0.64. Even higher values of these parameters have been obtained individually on other cells. The maximum values measured to date are a short-circuit current of 21.3 mA/sq cm, an open-circuit voltage of 739 mV, and a fill factor of 0.69. V.L.

A82-22040 # Design and construction of a concentrating photovoltaic total energy system in Hawaii. D. Rafinejad and R. Spencer (Acurex Corp., Mountain View, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0069*. 8 p.

Design and construction of Hawaii's largest solar energy system are described. The project was sponsored by the U.S. Department of Energy and the State of Hawaii and was designed and constructed by Acurex Corporation. The system generates 35 kW of DC power at 1,000 W/sqm insolation. The major subsystems are the collector field, thermal energy subsystem, and electrical power generation. The photovoltaic (PV) collector field consists of 4,800 sq ft of parabolic linear focus concentrators. The linear receiver is populated with PV cells and is actively cooled. Project construction is complete and the system is currently being commissioned. (Author)

A82-22190 Effect of absorbed water on an indium oxide-insulator /BeO.SiO₂-p-silicon solar cell. K. Ito and T. Nakazawa (Shinshu University, Nagano, Japan). *Journal of Applied Physics*, vol. 53, Feb. 1982, p. 1110-1114. 30 refs.

Results are presented of a study of the output characteristics of an In₂O₃/p-Si heterojunction solar cell with an insulating layer of beryllium-treated silicon oxide applied between the indium oxide and the silicon. The cell was fabricated on single crystalline p-type silicon wafers thermally oxidized in O₂ by the vacuum evaporation

of beryllium and the deposition of indium oxide films. Results of reflection electron diffraction, Auger electron spectroscopy and observations of the beryllium thickness dependence of the heterojunction dark forward currents support the nature of the evaporated beryllium as an insulating oxide. Current-voltage curves of cells under illumination reveal increases in short-circuit current density, fill factor and open-circuit voltage with operating time, which correspond to increases in conversion efficiency from 1.1 to 9.7% in 2800 min. Experiments in which the cell was exposed to flows of various gases reveal this effect to be due to the absorption of water vapor, which introduces traps which assist electron tunneling through the composite oxide layer. A.L.W.

A82-22191 Laser processing for high-efficiency Si solar cells. R. T. Young and R. F. Wood (Oak Ridge National Laboratory, Oak Ridge, TN). *Journal of Applied Physics*, vol. 53, Feb. 1982, p. 1178-1189. 30 refs. Contract No. W-7405-eng-26.

Experiments on the optimal conditions for the laser-annealing of ion-implanted silicon solar cells to obtain cells of high efficiency are presented. Measurements of emitter region electrical characteristics, emitter dopant profiles, junction characteristics and back surface fields at various implantation energies and doses, laser energy densities, and substrate temperatures reveal the highest efficiency p(+)/n and p(+)/nn(+) cells to be obtained by shallow implantation (5 keV) with high surface concentrations followed by annealing with 1.2 J/sq cm laser pulses with beam homogenization. Substrate heating is also observed to improve the open-circuit voltage. It is also found that efficiencies of over 16% AM1 may be obtained with the use of laser gettering to enhance the minority carrier diffusion length and laser-induced diffusion to incorporate back surface fields in combination with ion implantation and laser annealing. A.L.W.

A82-22230 † Thermoelectric film receivers of radiant energy (Termoelektricheskie plenochnye priemniki luchistoi energii). S. Iazliev (Turkmenkii Gosudarstvennyi Universitet, Ashkhabad, Turkmen SSR). *Akademiia Nauk Turkmenkoi SSR, Izvestiia, Seriya Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 6, 1981, p. 33-36. In Russian.

It is noted that, since concentrating systems have come into their own in solar power engineering, a thorough investigation of the heat fields (or concentration coefficient) in the focal and near-focal regions of these systems has become necessary. What is needed is a quantitative determination of the energy concentration in a receiver placed at the focal point of a concentrating system. The use of micromodular thermoelectric film receivers as sensors of power and radiant flux in the focal and near-focal plane of single- and multielement concentrating systems is shown to be theoretically possible. C.R.

A82-23356 Effects of grain boundaries on the current-voltage characteristics of polycrystalline silicon solar cells. A. Neugroschel (Florida, University, Gainesville, FL) and J. A. Mazer (Harris Semiconductor, Inc., Palm Bay, FL). *IEEE Transactions on Electron Devices*, vol. ED-29, Feb. 1982, p. 225-236. 25 refs. Contract No. XS-9-8275-1.

A82-23362 Intensity enhancement in textured optical sheets for solar cells. E. Yablonovitch and G. D. Cody (Exxon, Corporate Research-Science Laboratories, Linden, NJ). *IEEE Transactions on Electron Devices*, vol. ED-29, Feb. 1982, p. 300-305. 8 refs.

A statistical mechanical approach toward the optics of textured and inhomogeneous optical sheets adopted. As a general rule, the local light intensity in such a medium will tend to be 2n-squared(x) times greater than the externally incident light intensity, where n(x) is the local index of refraction in the sheet. This enhancement can contribute toward a 4n-squared(x) increase in the effective absorption of indirect-gap semiconductors like crystalline silicon. (Author)

A82-23391 The effect of length on absorption for a trapezoidal groove collector. V. M. Puri (Solar Energy Research Institute, Golden, CO). *Solar Energy*, vol. 27, no. 6, 1981, p. 463-467. 8 refs.

In practice, the collection efficiency or concentration ratio associated with a finite collector will significantly differ from the

predicted values using infinite collector correlations. In the present investigation nomographs have been developed showing the beam radiation collection efficiency as a function of different sun-collector relative positions with the nondimensional collector length, and base-to-depth ratio of the V-groove collector as parameter. The nondimensional lengths selected are based upon the most commonly available collector module sizes. Ray tracing technique is used for the evaluation of beam radiation augmentation. Only the direct component of solar radiation is treated in the investigation. However, to determine the effect of reflectors on the diffuse radiation interception, methodology of Dale et al. (1981) or Bannerot and Howell (1977, 1979) or Grimmer et al. (1978) can be followed. G.R.

A82-23393 Durability of porous silica antireflection coatings for solar collector cover plates. K. J. Cathro, D. C. Constable and T. Solaga (Commonwealth Scientific and Industrial Research Organization, Div. of Mineral Chemistry, Melbourne, Australia). *Solar Energy*, vol. 27, no. 6, 1981, p. 491-496. 16 refs. Research supported by the National Energy Research Development and Demonstration Council.

A82-23395 Performance and economics of annual storage solar heating systems. S. Sillman (Solar Energy Research Institute, Golden, CO). *Solar Energy*, vol. 27, no. 6, 1981, p. 513-528. 16 refs. Research supported by the U.S. Department of Energy.

Annual storage is a means of both improving the technical efficiency of active solar systems by allowing solar heat to be collected in summer, and extending the capability of active solar systems to meet nearly 100 per cent of the load. Annual storage systems rely on a large storage tank which usually uses water as the storage medium. The winter load is met partly from day-to-day collection of solar heat, as in a conventional active solar heating system, and partly from heat stored during the summer. A description is presented of the findings from a study of the design trade-offs in annual storage systems, giving particular attention to the trade-off between collector and storage sizes. It was found that system performance increases linearly as storage volume is increased up to the point of 'unconstrained operation' where the storage tank is large enough to store all heat collected in summer. 'Unconstrained operation' is the likely economic optimum. G.R.

A82-23397 * New technologies for solar energy silicon - Cost analysis of dichlorosilane process. C. L. Yaws, K.-Y. Li, T. C. T. Chu (Lamar University, Beaumont, TX), C. S. Fang (Southwestern Louisiana University, Lafayette, LA), R. Lutwack, and A. Briglio, Jr. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Solar Energy*, vol. 27, no. 6, 1981, p. 539-546. 46 refs. Research supported by the U.S. Department of Energy and NASA.

A reduction in the cost of silicon for solar cells is an important objective in a project concerned with the reduction of the cost of electricity produced with solar cells. The cost goal for the silicon material is about \$14 per kg (1980 dollars). The process which is currently employed to produce semiconductor grade silicon from trichlorosilane is not suited for meeting this cost goal. Other processes for producing silicon are, therefore, being investigated. A description is presented of results obtained for the DCS process which involves the production of dichlorosilane as a silicon source material for solar energy silicon. Major benefits of dichlorosilane as a silicon source material include faster reaction rates for chemical vapor deposition of silicon. The DCS process involves the reaction 2SiHCl_3 yields reversibly $\text{SiH}_2\text{Cl}_2 + \text{SiCl}_4$. The results of a cost analysis indicate a total product cost without profit of \$1.29/kg of SiH_2Cl_2 . G.R.

A82-23399 Simplified method for predicting photovoltaic array output. D. L. Evans (Arizona State University, Tempe, AZ). *Solar Energy*, vol. 27, no. 6, 1981, p. 555-560. 10 refs. Research supported by the U.S. Department of Energy.

A simplified procedure for predicting the long term, monthly average electrical output of photovoltaic arrays is presented. It is restricted to passively cooled, max-power tracked arrays, but is applicable to both south facing, fixed flat arrays and 2-D tracked concentrators. The procedure combines basic parameters characterizing the array with the local monthly mean temperature and the

monthly Kt (ratio of the total radiation on the horizontal to the extraterrestrial radiation) to yield a monthly average array efficiency which, when multiplied by the monthly array insolation gives the electrical energy output. (Author)

A82-23575 Spray-deposited black nickel selective absorber surfaces for solar thermal conversion. M. Madhusudana and H. K. Sehgal (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 10, Jan. 1982, p. 65-74. 8 refs.

A low cost, single-step process employing spray pyrolysis has been developed to deposit selective black nickel coatings on commercially available aluminium and galvanised iron substrates. Parameters for growth have been optimised by a comparative study of the structural, optothermal and optical properties of these films. Optimised films of black nickel on aluminium have $\alpha = 0.92$ and emittance (100 C) = 0.14 whereas those on galvanised iron have $\alpha = 0.90$ and emittance (100 C) = 0.13. The films are seen to be extremely adherent to the substrates and to have stable operational characteristics under temperature cycling up to 280 C in low humidity environments. (Author)

A82-23654 # Evaluation of reliability of operational solar-energy systems. J. Mavec, R. Wolosewicz (Argonne National Laboratory, Argonne, IL), and E. Waite (Argonne National Laboratory, Idaho Falls, ID). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 104, Feb. 1982, p. 41-45. 9 refs. Research supported by the U.S. Department of Energy.

This paper presents a reliability study of two solar-energy systems using air as the heat-transfer medium. Failure modes and effects analysis are used to examine the controls of the systems for three operating modes. Principal components are identified for each mode, and a fault tree and reliability block diagram are constructed to structure the fault or failed sequence. Established failure rates are assigned to each component, and an exponential failure distribution is assumed. For components operating on demand at a given average frequency, the adjusted demand and normal operating failure rates are combined to reflect the total contribution. Representative operational times and component frequencies are found for each operating mode. A fault-tree computer code is used to determine minimal outsets to the top event, remove redundant events, and perform necessary calculations. The computer code obtains results at each level (component, cutset, and tree) using repairable and nonrepairable models. (Author)

A82-23656 # Performance of a parallel solar heat pump system. A. F. G. Bedinger, J. Tomlinson, R. L. Reid, and D. J. Chaffin (Tennessee University, Knoxville, TN). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 104, Feb. 1982, p. 52-55. Research supported by the Tennessee Valley Authority.

The equipment, operations, operating parameters, and performance of a solar heat pump/resistance heated thermal storage bed house heating system are reported. A set of 12 solar air flat plate collectors is mounted on the roof for house heat when solar energy is available, and further heating is available from a heat pump system, with supplemental energy furnished by a limestone pebble storage tank which is charged by 15 kW resistance heating during off-peak hours. Data is provided for one winter's operation, with an analysis for combined and paired or single system performance as opposed to purchased power for a back-up conventional heating system and the power necessary to run the compressors, heating coils, and fans. An additional simulation was devised to be measured against the recorded performance. Significant energy conservation capability was observed for the solar augmented heat pump system without off-peak capability. M.S.K.

A82-23659 * # Heat transfer from combustion gases to a single row of closely spaced tubes in a swirl crossflow Stirling engine heater. C. P. Bankston and L. H. Back (California Institute of Technology, Jet Propulsion Laboratory, Energy and Materials Research Section, Pasadena, CA). *ASME, Transactions, Journal of Heat Transfer*, vol. 104, Feb. 1982, p. 55-61. 9 refs. Research sponsored by the U.S. Department of Energy and NASA.

This paper describes an experimental program to determine the heat-transfer characteristics of a combustor and heat-exchanger system in a hybrid solar receiver which utilizes a Stirling engine. The

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system consists of a swirl combustor with a crossflow heat exchanger composed of a single row of 48 closely spaced curved tubes. In the present study, heat-transfer characteristics of the combustor/heat-exchanger system without a Stirling engine have been studied over a range of operating conditions and output levels using water as the working fluid. Nondimensional heat-transfer coefficients based on total heat transfer have been obtained and are compared with available literature data. The results show significantly enhanced heat transfer for the present geometry and test conditions. Also, heat transfer along the length of the tubes is found to vary, the effect depending upon test condition. (Author)

A82-23700 **Photovoltaics - Down to earth at last.** J. R. Burke (Solar Energy Research Institute, Golden, CO). *Sun at Work in Britain*, no. 12-13, 1981, p. 30-38.

The growth of terrestrial applications of solar cells is examined, with attention paid to the cost, materials, and fabrication methods now in existence. Current prices are the \$10,000/kW range, with U.S. government research goals intending a reduction to less than \$1000/kW by 1986. Solar Energy Research Institute studies are pursuing production cost decreases through a reduction in the number of required manufacturing steps. Efforts to directly electrochemically reduce quartz to solar-grade Si are outlined, as are the development of Si sheet manufacturing methods using porous carbon substrates or graphite filaments capped by a seed. Polycrystalline materials offer cost reductions through the acceptance of many crystals in the cells instead of a monocrystalline configuration, and hydrogenation or casting methods have reduced parasitic power losses caused by recombinations along the grain boundaries. M.S.K.

A82-23703 * **Space platforms - A cost effective evolution of Spacelab operation.** A. J. Stofan (NASA, Office of Space Science, Washington, DC). (*International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980.*) *Acta Astronautica*, vol. 8, Nov.-Dec. 1981, p. 1299-1310. 7 refs.

The capabilities added to the Shuttle/Spacelab configuration by the addition of the Power Extension Package (PEP), the Power System (PS), and the Science and Applications Space Platforms (SASP) are reviewed with an emphasis on SASP. SASP are intended for placement in orbit by the Shuttle to test new instruments and systems, for clustering of instrumentation, and for servicing, refurbishment, repair, or augmentation by the Shuttle. The PEP permits extended stays in orbit (30 days), and the PS is an orbital solar array and energy storage system acting as a free flying spacecraft. The Shuttle can deliver payloads to the PS or attach to it for extension of the Spacelab operations. Applications of SASP for long term space-based biological experiments are outlined, and the fact that SASP do not increase the required Shuttle in-orbit time is stressed. M.S.K.

A82-23788 **Charge collection microscopy on p-WSe₂ - Recombination sites and minority carrier diffusion length.** H. J. Leuwerenz, S. D. Ferris, C. J. Doherty, and H. J. Leamy (Bell Telephone Laboratories, Inc., Murray Hill, NJ). *Electrochemical Society, Journal*, vol. 129, Feb. 1982, p. 418-423. 34 refs.

Charge collection microscopy of the layered semiconductor WSe₂ is reported. Steps on the surfaces of layered material, bulk dislocations, and growth irregularities are identified as recombination sites. The minority carrier diffusion length perpendicular to the layer structure is determined to be 1.6 + or - 0.2 microns on a smooth surface. The results demonstrate a correlation between step-like surface structures and loss of current collection efficiency in solar energy-converting devices made from layered semiconductors.

(Author)

A82-23818 **Thermodynamics of solar collectors (Zur Thermodynamik des Solarkollektors).** F. Bosnjakovic (Stuttgart, Universität, Stuttgart, West Germany). *Brennstoff-Wärme-Kraft*, vol. 33, Oct. 1981, p. 425, 426. In German.

A82-23872 **Second-stage CEC concentrator.** E. M. Kritchman (Chicago, University, Chicago, IL). *Applied Optics*, vol. 21, Feb. 15, 1982, p. 751-754. 5 refs.

The employment of a second-stage compound elliptical concentrator (CEC) designed from the principles of nonimaging optics has been proposed for the enhancement of the concentrating capability of a point focus solar concentrator and for the partial compensation of its nonideal behavior. The CEC is to be installed just behind the focal plane of the first (or primary) concentrator. Operational conditions for a 2-D and a 3-D case are considered, and an investigation based on the use of a ray tracing technique is conducted. Despite its skew-ray loss, the 3-D combination of a paraboloidal primary and a CEC second stage was found to be an almost ideal concentrator. For high reflectances the CEC two stage shows even higher efficiency than the trumpet two stage, especially for lower-grade primaries. G.R.

A82-24019 # **Second-generation parabolic trough solar energy systems optimization analysis.** R. R. Peters (Sandia National Laboratory, Albuquerque, NM). *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 147-154. 8 refs. Research supported by the U.S. Department of Energy.

In the near future high-efficiency, low-cost, parabolic trough collectors will probably become available. The economic feasibility of these parabolic trough solar-energy systems is affected by many parameters which include component cost, load shape, fraction of the load supplied by solar energy, average temperature of the collector field and its axis of rotation, and for solar Rankine cogeneration systems, the electrical-to-thermal energy output ratio. The sensitivity of economic feasibility and system design to changes in these and other relevant parameters is discussed. System design and economics generally were found to be sensitive to component cost. They were also found to be quite sensitive to some of the other parameters in restricted ranges. (Author)

A82-24101 **Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.** Conference sponsored by the Commission of the European Communities. Edited by W. Palz (Commission of the European Communities, Brussels, Belgium). Dordrecht, D. Reidel Publishing Co., 1981. 1178 p. In English and French. \$81.50.

The materials, design, fabrication, testing, applications, and instrumentation of solar cells and solar cell systems were discussed. Goals, markets, and obstacles in the near and medium term were examined, as were applications in developing countries, methods of cost reductions, and the development of Si and cell module production systems. Alternate materials were investigated for the cells, along with concentrator devices and systems, and current installations were reviewed. Attention was given to advanced systems and future applications, to cell processing, ion implantation, and testing and standards, and the implementation of CdS, amorphous Si, and MIS solar cells was explored. Fundamental work on solar cells was outlined, in conjunction with specific cells in concentrator conditions. M.S.K.

A82-24102 **Sunshine Project solar photovoltaic program and recent R & D activities in Japan.** Y. Hamakawa (Osaka University, Toyonaka, Japan). In: *Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.* Dordrecht, D. Reidel Publishing Co., 1981, p. 22-29. 38 refs.

A82-24103 **Photovoltaic activities and its applications in China.** Y.-Z. Wei, X.-W. Li, Y. Lie, W.-Z. Li, and P.-N. Yu (Tianjin Institute of Power Sources, Tianjin, People's Republic of China). In: *Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.* Dordrecht, D. Reidel Publishing Co., 1981, p. 66-70.

A82-24104 **U.S. photovoltaic application experiments and market development.** H. L. Macomber (MONEGON, Ltd., Gaithersburg, MD). In: *Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.* Dordrecht, D. Reidel Publishing Co., 1981, p. 71-78.

A82-24105 U.S. Department of Energy collector cost reduction program. L. M. Magid (U.S. Department of Energy, Div. of Photovoltaic Energy Systems, Washington, DC). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 158-165.

A program conducted by the United States Department of Energy that focuses on the basic research and technology development required to reduce the price of photovoltaic collectors is reviewed. Analysis of the current status of the flat-plate and concentrating collectors and projected status of the photovoltaic collector cost reduction efforts, both for flat-plate and concentrating collectors indicates that the photovoltaic industry should easily be able to meet the 1982 goal of \$2.80/Wp collectors. Significant progress is also apparent toward the longer-range \$0.70/Wp and \$0.15-0.40/Wp goals. V.L.

A82-24106 The solar material market - Projections, needs and commitments. W. Freisleben (Wacker-Chemitronic GmbH, Burghausen, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 166-170.

A82-24107 A strategy for cost reduction from the point of view of a French industrialist (Stratégie de réduction des coûts point de vue d'un industriel français). J. P. Gomis (Photowatt International, S.A., Argenteuil, Val-d'Oise, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 171-177. In French.

Strategies for improving the cost-performance of solar cell modules, the cells, and applications systems are reviewed, along with a summary of current research and development goals and procedures. Research is noted to concentrate intensive work on a particular cell type, on mass production methods, or to cover all methods and materials possible, and then proceed forward with all candidates showing equal promise. Noting that the DOE goals for commercially-ready prices in 1986 rest on a fall in the cost of high grade silicon, on mass production, and a projected life of 20 yr, efforts to optimize the production steps are indicated. Savings are noted to be possible in all facets of module construction, and optimization studies are recommended for coupling the solar systems to different loads for different purposes. M.S.K.

A82-24108 Industrialization of photovoltaics. J. Lindmayer (Solarex Corp.; Semix, Inc., Rockville, MD). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 178-185.

The technological, economical, and financial aspects of the industrialization of photovoltaics are briefly reviewed. Topics discussed include the role of photovoltaics in general energy production, research and development efforts, financial resources available for industrial development, marketing policies, sources of raw material, and applications. V.L.

A82-24109 Research on photovoltaic conversion - A guarantee of efficiency for the European solar energy program. M. Rodot (CNRS, Paris, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 186-193. 30 refs.

Research goals in the field of photovoltaic conversion are discussed with emphasis on the silicon material problem and the architecture of photovoltaic generators. Consideration is given to the optimal use of photovoltaic generators in the context of specific applications, integration of solar cells and storage systems, and relation between photovoltaic research and photochemical-photobiochemical research. Managerial and organizational problems in European photovoltaic research and development are also briefly discussed. V.L.

A82-24110 Research options as seen from U.S.A. J. J. Loferski (Brown University, Providence, RI). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 194-198. 12 refs.

Current work, and in particular theoretical research, in the area of new cell designs and tandem cells is reviewed. Three main directions of research are identified. These are: (1) improvement of solar cell efficiency by design modifications such as incorporation of minority-carrier mirrors and optical mirrors; (2) development of super-efficiency single crystal solar cells by resort to tandem solar cell systems consisting of stacks of individually optimized cells with minority-carrier and optical mirrors; and (3) development of thin film cells with the use of minority-carrier and optical mirrors. V.L.

A82-24111 Photovoltaic R&D program overview. D. L. Feucht (Solar Energy Research Institute, Golden, CO). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. D. Reidel Publishing Co., 1981, p. 199-203. 25 refs.

The current status of a research and development program conducted under contract to the U.S. Department of Energy to develop low cost solar cells (\$0.15-0.40/Wp modules in 1980\$) is reviewed. The emphasis of the program is on thin film and electrochemical cells with conversion efficiencies greater than 10% and multijunction cells with conversion efficiencies greater than 30%. The R&D efforts include research on polycrystalline silicon, amorphous materials, cadmium sulfide cells, gallium arsenide cells, emerging materials, and advanced concentrator and cell concepts. V.L.

A82-24112 * A U.S. view of silicon production processes. R. Lutwack (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 220-227. Research sponsored by the U.S. Department of Energy and NASA.

One of the objectives of the Low-Cost Solar Array Project is the demonstration of the practicality of processes for producing silicon, suitable for fabricating solar cells for terrestrial applications, at prices less than \$14/kg. Approaches being investigated are related to a metallurgical silicon/silane/silicon process, a metallurgical silicon/dichlorosilane/Siemens-type process, and a silicon tetrachloride-zinc reduction process. There is a great probability that the first process will yield semiconductor grade Si at a price less than \$14/kg. The second process appears to be capable of providing polysilicon with a purity equivalent to the present commercial semiconductor grade silicon at a price of about \$20/kg. An important part of the program is the investigation of the effects of impurities on the performance of solar cells. G.R.

A82-24113 * Progress toward goals in silicon sheet development. K. M. Koliwad and M. H. Leipold (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 228-235. 5 refs. Research supported by the U.S. Department of Energy; Contract No. NAS7-100.

One of the goals of the national photovoltaic program in the U.S. is the establishment of an industry producing photovoltaic material which can be sold at a price not exceeding \$0.70/W by 1986. A key element concerning the achievement of this goal is the development and utilization of improved methods for producing silicon sheet. Specific technologies being investigated in this connection can be divided into two categories. Methods of one category are based on a utilization of sheet growth techniques including film-fed growth, dendritic web, and silicon-on-ceramic processes. The approaches used by methods of the second category involve ingot and wafering processes, including Czochralski growth, the heat exchanger method, multiblade procedures, and the use of a fixed abrasive multiwire. It is found that using \$84/kg silicon, most sheet technologies would yield module prices in the \$2.00/Wp to \$3.00/Wp range. G.R.

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A82-24114 **The Wacker approach to low-cost silicon material technology.** E. Sirtl (Heliotronic GmbH, Burghausen, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 236-243. 11 refs. Research supported by the Bundesministerium für Forschung und Technologie.

Proprietary, long-term materials research programs concerned with processes having high cost/energy-saving potential for the production of high-purity solar cell silicon are discussed. Program goals include the development of rugged, high-throughput rate production equipment, and impurity handling, or defect engineering standards, which will yield photovoltaic solar energy conversion efficiencies of a minimum of 10%. Different starting materials for a variety of low-cost crystallization techniques, the machining and slicing of silicon, and such diagnostic techniques as topographic methods, multielement analysis, identification of point defects, and photovoltaic evaluation, are discussed. O.C.

A82-24115 **Ribbons and sheets as an alternative to ingots in solar cell technology.** E. Fabre and C. Belouet (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 244-251. 30 refs.

Silicon sheet-shaping techniques which rely on meniscus-controlled growth are presented, and their characteristics are discussed in the scope of their economic competitiveness against the Czochralski growth for a mass production of low-cost solar cells. The current achievement differs in most of the processes, which may be due to differences in their respective maturity and level of effort, rather than in their ultimate potentialities. The dendritic WEB technique is found to have high efficiency and low throughput, and in the long range, the processes are expected to yield shaped materials with similar photovoltaic characteristics which will be an economic alternative to ingot technologies. The RAD growth technique is also discussed. D.L.G.

A82-24116 **Directional solidification of MG silicon by Heat Exchanger Method /HEM/ for photovoltaic applications.** F. Schmid, M. Basaran, and C. P. Khattak (Crystal Systems, Inc., Salem, MA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 252-256. 19 refs. Contract No. XS0-9171-1.

A82-24117 **Advances in silicon solar cell processing.** R. J. Van Overstraeten (Leuven, Katholieke Universiteit, Heverlee, Belgium). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 257-262. 16 refs.

The various technologies that are used or are under study in solar cell production are reviewed with emphasis on technologies compatible with a cost objective of \$1 per peak watt. The discussion includes analysis of the design parameters based on the physics of the cells as well as the various processing steps, such as surface preparation, front junction formation, low-high junction formation for a back surface field, formation of front and back ohmic contacts, elimination of edge effects, and application of an antireflective coating. The specific objectives and criteria for every processing step are discussed and the most viable processes are identified. V.L.

A82-24118 **Comparison of solar cells from nonsingle and single crystalline silicon in a pilot production line.** K. Roy and W. Pschunder (Telefunken AG, Heilbronn, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 263-269. Research supported by the Bundesministerium für Forschung und Technologie.

An economical process has been developed for the production of solar cells for terrestrial application from low-cost cast polycrystalline silicon. The process makes it possible to produce 10 x 10 cm cells with conversion efficiencies of 9-10%, as compared with 12-13%

for single-crystal cells, with yields as high as for single-crystal silicon. Ways to further optimize the process are discussed. V.L.

A82-24120 * **Low-cost solar array project progress and plans.** W. T. Callaghan (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 279-286. Research sponsored by the U.S. Department of Energy.

The considered project is part of the DOE Photovoltaic Technology and Market Development Program. This program is concerned with the development and the utilization of cost-competitive photovoltaic systems. The project has the objective to develop, by 1986, the national capability to manufacture low-cost, long-life photovoltaic arrays at production rates that will realize economies of scale, and at a price of less than \$0.70/watt. The array performance objectives include an efficiency greater than 10% and an operating lifetime longer than 20 years. The objective of the silicon material task is to establish the practicality of processes for producing silicon suitable for terrestrial photovoltaic applications at a price of \$14/kg. The large-area sheet task is concerned with the development of process technology for sheet formation. Low-cost encapsulation material systems are being developed in connection with the encapsulation task. Another project goal is related to the development of economical process sequences. G.R.

A82-24121 **Photovoltaic testing in the European communities.** K. H. Krebs and E. Rossi-Gianoli (Commission of the European Communities, Joint Research Centre, Ispra, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 287-292.

The facilities and testing procedures for establishing the viability of solar cells as an energy source and standards for testing and use in the European community are described for the case of the Ispra ESTI installation. Testing is carried out to determine new device performance in relation to proven devices and production methods. Because the photovoltaics industry is in its infancy, tests are functional instead of prescriptive, and indoor testing is used to verify manufacturer's performance claims, and to achieve durability under specified stress levels. Trials are also performed with solar cell modules to verify continued operation and integrity under severe environmental conditions, with projections of useful life of 10 yr. The durability is noted to be crucial to guaranteeing a satisfactory energy payback. M.S.K.

A82-24122 **The development of amorphous silicon solar cells.** W. E. Spear (Dundee, University, Dundee, Scotland). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 302-308. 24 refs. Research supported by the Commission of the European Communities.

The short circuit current is considered in a discussion of the limits of achievable conversion efficiency set by the electronic properties of presently available materials in developing amorphous silicon cells. Photogeneration and geminate recombination are discussed, and lifetime measurements on p-i-n junctions are made to show that the collection region is determined by the hole drift distance. The mechanism of hole transport and the possibility of improving it are considered, and it is concluded that volume recombination provides the main limitation in current a-Si cells. D.L.G.

A82-24123 **Development of amorphous Si solar cells in Japan.** Y. Kuwano and M. Ohnishi (Sanyo Electric Co., Ltd., Research Center, Hirakata, Osaka, Japan). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 309-316. 39 refs. Research supported by the Agency of Industrial Science and Technology.

The development of a-Si solar cells in Japan is reviewed with discussions on fabrication techniques, cell structures, and perfor-

mances of a-Si solar cells. Recent advances in the field are characterized by conversion efficiencies of 3.4-5.2% for a-Si:H, and 1.3-2.7% for a-Si:F:H, both of which are on small cells of not greater than about 1 sq cm. Large area cells up to 10 x 10 sq cm have been developed with conversion efficiencies of up to about 3.6%. New types of high output voltage photovoltaic devices have also been developed, which are constructed of multilayered and cascade-type solar cells. D.L.G.

A82-24124 Post-hydrogenation of CVD amorphous silicon - A promising preparation process for solar cells. N. Szydlo, D. Kaplan, and R. Poirier (Thomson-CSF, Laboratoire Central de Recherches, Orsay, Essonne, France). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 317-321 7 refs.

Properties of Si solar cells prepared by CVD with a low hydrogen content and subsequent treatment in a hydrogen plasma to add a controlled amount of hydrogen are reviewed, along with a study of the mechanisms of carrier collection in Schottky barrier cells. Phosphorus doping was accomplished by means of its addition in the silane gas mixture, and precisely controlled hydrogenation yielded higher cell efficiencies than undoped glow-discharge produced cells, although the optical absorption was not significantly altered. A correlation was found in undoped layers between the carrier collection length and space charge width. The quantum yield was independent of doping and applied negative bias. No evidence was observed of a strong electric field dependence in the Schottky barrier structures, implying that carrier mobility and/or built-in electric fields induced separation of the hole pairs. M.S.K.

A82-24125 Properties of fluorinated amorphous silicon solar cells. M. Moeller, R. D. Plaetner, W. Stetter, and B. Rauscher (Siemens AG, Forschungslaboratorien, Munich, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 322-326. 5 refs. Research supported by the Bundesministerium für Forschung und Technologie.

The photovoltaic performance of hydrogenated-fluorinated, hydrogenated a-Si, Pt-Schottky, MIS, and p-i-n solar cells were compared, along with the effects of dc and RF processes for preparing fluorinated Si solar cells. Increases of 10% in the mole fraction of F were observed after the dc glow discharge over the RF formation of a-Si:F:H cells. An upward shift in the peak intensity by about 60 MeV in the fluorinated cells was concluded to be due to the concentration of F, with a bandgap increase of 0.4 MeV with the mole fraction of F augmented from 1.5-6%. AM1 illumination tests of the cells showed that the Schottky a-Si:F:H cells showed lower short-circuit currents than the a-Si:H cells, with an open-circuit current which could be increased by the formation of an oxide layer after heating in moist oxygen. The a-Si:H p-i-n cells were observed to have properties of long-term stability. M.S.K.

A82-24126 Sprayed cadmium sulphide solar cells. G. A. Roderick (Photon Power, Inc., El Paso, TX). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 327-334.

A spray process for the production of thin-film (5 microns) Cd/Cu(x)S solar cells is discussed and typical results are presented for the resulting cells. Plans for long-term very-large-scale production of cadmium sulfide cells are examined together with projected cost data and basic design criteria. A schematic representation of the cell, spray process, and an I/V curve are given. V.L.

A82-24127 Cu₂S-CdS sprayed solar cells. G. Bordure, C. Linares, J. Bougnot, M. Perotin, H. Luquet, S. Belgacem, and M. Savelli (Montpellier II, Université, Montpellier, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 335-339. 11 refs. Research supported by the Centre National de la Recherche Scientifique and Commission of the European Communities.

Cu₂S-CdS solar cells fabricated by spraying and dipping techniques are characterized with respect to their electrical and optical properties. It is shown that the current response of heat treated cells is limited only by the light absorption in Cu₂S, with collection efficiency of the junction being close to unity. Losses during treatment and early degradation which are smoothly sensitive to wavelength, are mainly related to the collection efficiency of the junction. Results suggest that the open circuit voltage was the greatest potential for improvement. V.L.

A82-24128 Evaporated CdS-Cu(x)S solar cells. W. H. Bloss, F. Pfisterer, and H.-W. Schock (Stuttgart, Universität, Stuttgart, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 340-347. 8 refs. Bundesministerium für Forschung und Technologie Contract No. ET-4045-B; Commission of the European Communities Contract No. ESC-R-003-D

Large-area CdS-Cu(x)S solar cells produced by evaporation of CdS and by applying the wet process are discussed with reference to technological procedures and performance characteristics. The I-V curve is presented for a cell with an active area of 42 sq cm. A conversion efficiency of 7.3% has been achieved without using antireflection coatings. A simple procedure for preparing integrated generators, 15 x 30 sq cm, is presented; the generator efficiency of eight cells connected in series amounts to 4%. V.L.

A82-24129 The need for photovoltaic unit operations experimentation. T. W. F. Russell, B. N. Baron, and R. E. Rocheleau (Delaware, University, Newark, DE). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 348-352. 5 refs.

It is shown that unit operations experimentation is necessary for the further development of the photovoltaics industry, and the formulation of a commercial-scale process design for the deposition of cadmium sulfide-copper sulfide solar cell active semiconductor layers is described as an illustration. Coupled heat and mass balance equations were developed to model the evaporation of cadmium sulfide and, after verification at the bench scale, the model was used in the design of a continuous, reel-to-reel vacuum coater for cadmium sulfide deposition. The results of initial experiments with this vacuum deposition unit are presented. O.C.

A82-24130 Operational, reliability, and maintenance experience with photovoltaic concentrator arrays. E. L. Burgess and B. D. Shafer (Sandia National Laboratory, Albuquerque, NM). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 360-367. 11 refs. Research supported by the U.S. Department of Energy.

The status of photovoltaic concentrator technology in the United States is discussed. Operational experience in addition to component reliability and system maintenance are discussed, including the applicable solar thermal concentrator reliability and maintenance experience. Efficiencies have increased from 6-7% to 12% for silicon arrays, and initial data for a gallium arsenide array yield 13-15%. No unsolvable reliability or maintenance problems are expected. D.L.G.

A82-24131 Sun tracking controller for multi-kW photovoltaic concentrator system. R. P. Semma and M. S. Imamura (Martin Marietta Aerospace, Denver, CO). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 375-380.

A two-axis suntracking controller is presented, which is designed to achieve low cost, high performance reliability, and operational flexibility for multi-kW to multihundred-kW photovoltaic concentrator applications. The controller is based on an active sun sensing approach, allows an array assembly to track the sun within five arcmin, and has the capability to stow the array at night or during inclement weather conditions, communicate with an external computer, and provide autonomous operation and diagnostic monitoring. This third generation design represents a significant improvement

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over the two earlier generations, which were based on hard-wire logic.
D.L.G.

A82-24132 **The Sophocle program (Le programme Sophocle).** M. Claverie, A. Dupas (CNRS, Paris, France), and D. Esteve (CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes, Toulouse, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 381-390. In French.

The development of a standardized tracking and concentrating solar cell power generating system suitable for industrial production is reviewed. A 1 kW module was fabricated for Si cells under 45 suns concentration, and with a cooling system to maintain cell efficiency. Fresnel lenses provide the concentration, and tracking is accomplished on an altazimuth tracking stand, which limits the area of capture to 50 sq m, corresponding to about 5 kW. Characteristics of the system include 4 sq cm Si solar cells, concentration efficiencies of 75 percent, surface areas ranging from 6-50 sq m, tracking accuracy to within 4 mrad, and natural convective cooling over an aluminum trough with channeled sides. Units have been deployed in India, Algeria, Senegal, Mexico, Brazil, and Gabon to gather operational data.
M.S.K.

A82-24133 **New concepts for static concentration of direct and diffuse radiation.** A. Luque, J. Eguren, J. M. Ruiz, A. Cuevas, J. del Alamo, J. M. Gomez, M. Acuña, and G. Sala (Escuela Técnica Superior de Ingenieros de Telecomunicación, Madrid, Spain). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 396-400.

Rules for casting maximum energy on a cell placed in a static concentrator of minimum entry aperture are derived in an investigation of the feasibility of static concentrators and their operating limits. A concentration of 9.13 is found to be the upper bound for collecting the direct sunbeam throughout the year, and a concentration of 4.5 is the upper bound for collecting diffuse light. A prototype concentrator with bifacial cells is fabricated, which is fully static and accepts a part of the diffuse radiation so that it may be handled in a manner similar to that of a conventional flat panel. A panel efficiency of 9.1 percent is predicted in an improved panel, with a cost estimate for medium size production of \$3.19 W/peak.
D.L.G.

A82-24134 **Advanced concepts for photovoltaic concentration.** W. H. Bloss, M. Griesinger, and E. R. Reinhardt (Stuttgart, Universität, Stuttgart, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 401-407. 6 refs.

A dispersive concentrating system is presented, which is based on phase holograms exhibiting only minimum absorption, and allows high concentration and simultaneous splitting of the spectral regions. Local hardening effects can be achieved by spatial variation of high light intensity in dichromated gelatin films on glass substrates, which leads to optical density profiles and results in a selective Bragg reflection at direct illumination. The diffraction efficiency and the spectral sensitivity of these transmission volume holograms are described. Efficiencies of over 30% can be obtained in connection with different solar cell systems matched to the spectral regions.
D.L.G.

A82-24135 **Growth and characterization of cascade solar cells.** S. M. Bedair, M. L. Timmons, and M. Simons (Research Triangle Institute, Research Triangle Park, NC). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 408-412. 5 refs. Research supported by the U.S. Department of Energy.

Monolithic, two-junction cascade solar cells are fabricated in two different III-V materials systems: Al-Ga-As and Al-Ga-As-Sb. The Al-Ga-As system employs a GaAs low bandgap cell and a 1.9 eV AlGaAs high bandgap cell connected by an AlGaAs tunnel junction, and although the cell does not possess the optimum bandgap values

for maximum efficiency, it is attractive from a developmental standpoint since it employs a proven materials system closely lattice matched throughout its compositional range. The Al-Ga-As-Sb system offers an optimum bandgap combination for concentrator applications, although experimental devices suffer from a low open circuit voltage problem.
D.L.G.

A82-24136 **On the conversion of solar radiation with fluorescent planar concentrators /FPCs/.** A. Zastrow, K. Heidler, R. E. Sah, V. Wittwer, A. Goetzberger (Fraunhofer-Institut für angewandte Festkörperphysik, Freiburg im Breisgau, West Germany). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 413-417. 14 refs. Bundesministerium für Forschung und Technologie Contract No. ET-4190-A.

The utilization of infrared fluorescent dyes in fluorescent planar concentrators is discussed in an investigation of 30 infrared laser dyes. It is shown theoretically that quantum yields and stability will be lower in the infrared region than in the shorter wavelength region. The quantum yields of fluorescence may depend strongly on solvent viscosity and temperature in several cases, and since solvent viscosity also decreases with increasing temperature, the degradation of efficiency may be due to change in viscosity more likely than to change in temperature. The suppression of radiationless processes by deuteration of NH₂-groups in oxazine dyes significantly enhances quantum yields.
D.L.G.

A82-24137 **Measurement of the spectral response of silicon solar cells under highly illuminated conditions.** B. C. Chambers and C. E. Backus (Arizona State University, Tempe, AZ). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 418-422. U.S. Department of Energy Contract No. 49-1510.

In an investigation of the behavior of photovoltaic devices under concentrated sunlight, the spectral response of several silicon solar cells was measured under illumination levels varying from approximately 1 mW/sq cm to 12,500 mW/sq cm for 11 wavelengths distributed over the solar spectrum. The spectral response was found to increase with increasing concentration for each of the wavelengths, and the spectral response for the shorter wavelengths increased by 1-40% while the response increased by 4-90% for the longer wavelengths. It is concluded that the filling of recombination centers with increased illumination could result in increasing the observed current output.
D.L.G.

A82-24138 **Solar energy applications in telecommunications (Les applications de l'énergie solaire dans les télécommunications).** J. Girard (CNET, Issy-les-Moulineaux, Hauts-de-Seine, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 424-434. In French.

The results of a half-decade of a coupled wind-photovoltaic powered, remotely sited telecommunications installation called 'Aerosolec' are reported. A station is examined which was situated at 500 m altitude between Nice and Monaco and comprised a 4 module solar cell plant generating 180 W, a 300 W windpowered generator, and a battery bank. The batteries were linked by a diode, charged by the photovoltaics only when load was met, and provided voltage when the wind/solar cell configuration failed to produce enough power to meet demand. Output of the generators and meteorological parameters were recorded for two years. The station drew a nominal 180W, which was met by the power systems, and involved an actual extra discharge of excess energy. Other, similar stations are outlined, and the use of coupled wind/solar systems for telephone service in remote sites, for optic fiber repeaters, and for telephone relay station are recommended. Cost advantages are seen with the solar/wind systems over liquid hydrocarbon fueled generator systems for low power demand installations.
M.S.K.

A82-24139 **Experience acquired in the field of low power photovoltaic application to educational television.** Y. Houssin (Bureau Yves Houssin, Paris, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference,

Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 435-438.

Low-power photovoltaic applications in certain African regions lacking electrification are discussed in an investigation to determine the extent of silicon surface required for various geographical areas. Experience acquired in Africa using solar energy for the power supply of audiovisual receivers is discussed. A definition of the best performing equipment with the lowest power consumption is obtained, taking maintenance into consideration. A high level of reliability has been reached with, for example, an average breakdown of less than 1 unit every two years for the 20,000 television receivers installed in the Ivory Coast.

D.L.G.

A82-24140 The application of photovoltaics to water pumping and irrigation in Africa. B. Verspieren (Société Mali Aqua Viva, San, Mali). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 439-445. In French.

A82-24143 * Survey of residential and intermediate photovoltaic applications. J. L. Hesse (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 498-504. Research sponsored by the U.S. Department of Energy and NASA.

The construction and operation of residential and intermediate size photovoltaic power systems as performed by the DOE Photovoltaics Program are reviewed. The program is directed toward the development of economically competitive, commercially available, photovoltaic power systems to provide safe and reliable energy for a wide range of applications. Systems which are currently operational or in construction range in size from 5 kWp to 225 kWp, and real-world testing is being pursued with residential, industrial, institutional, and commercial systems to establish their feasibility and readiness for commercialization.

D.L.G.

A82-24144 Analysis of a 60 kW photovoltaic power plant after the first year of operation. D. J. Roesler (U.S. Department of Energy, Washington, DC), D. D. Faehn (U.S. Army, Mobility Equipment Research and Development Command, Fort Belvoir, VA), and L. R. Suelzle (Helionetics, Inc., San Diego, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 505-512.

The performance of the 60 kW photovoltaic system at Mt Laguna Air Force Station was analyzed after the first year of operation. The 60 kW system met or exceeded nearly all of the technical requirements originally established, generating nearly 100,000 kWh and operating about 3400 hours. The downtime was extremely low, and a 16% reduction in maximum available power of the array was experienced, which is attributed to module engineering problems. All observations to date support the belief that a dc-ac photovoltaic energy conversion system without on-site energy storage can effectively augment a utility grid, even in a remote location.

D.L.G.

A82-24145 Photovoltaic pilot projects in the European community. F. C. Treble, G. Grassi, and W. Schnell (Commission of the European Communities, Brussels, Belgium). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 513-520.

The paper presents proposals received for the construction of photovoltaic pilot plants as part of the Commission of the European Communities' second 4-year solar energy R and D program. The proposed plants range from 30 to 300 kWp and cover a variety of applications including rural electrification, water pumping, desalination, dairy farming, factories, hospitals, schools and vacation centers. Fifteen projects will be accepted with a total generating capacity of 1 MWp, with preference given to those projects involving the development of new techniques, components and systems.

D.L.G.

A82-24146 Photovoltaics in the context of off-grid small power systems. A. Gabriel (Shell International Petroleum Co., Ltd., London, England) and A. W. De Ruyter Van Steveninck (Shell International Petroleum Maatschappij, The Hague, Netherlands). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 521-525.

Practical criteria which determine the cost effectiveness in different applications of stand-alone off-grid continuous power systems up to 20 kW are examined. The analysis is limited to systems based on internal combustion engines and photovoltaic systems. It is shown that for nonmobile continuous power systems with offtakes above 20-25%, photovoltaic cost parity with 5 kW diesel systems is expected to occur in the second half of this decade or in the first half of the next decade, depending mainly on the fuel cost to the consumer. Larger diesel systems show improved costs due to scale benefits which are not available to photovoltaic systems.

V.L.

A82-24147 A 50 kW photovoltaic power plant coupled to the 15000 V electricity grid. J. L. Chenon and D. J. Denis (Société d'Optique, de Mécanique, d'Electricité et de Radio, Argenteuil, Val-d'Oise, France). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 526-530.

Plans and components for providing prototype photovoltaic power plants to several Greek islands are discussed. The systems will produce 50 kW, with power conditioning for interconnection with submarine cable supplied grid power or with battery storage where no interconnection exists. The plants will comprise 1500 modules, each producing 33 W, with seasonal adjustment of the tilt angle of each subarray. Battery storage, where necessary, will contain 250 kWh, and the 50 kW power output of the plants is intended to in every case be less than the power required by the users. It is noted that wind measurements have also been taken along with insolation data, and future uses of coupled wind/solar installations are indicated.

M.S.K.

A82-24148 Hardware simulation of a scaled down photovoltaic power system. R. Weiss and J. Appelbaum (Tel Aviv University, Tel Aviv, Israel). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 531-534.

A state of a photovoltaic power system study intermediate between the computer simulation (software simulation) and the final system realization is proposed. It involves a hardware construction and a real-time operation of a scaled-down system, built with real components that are normally included in a photovoltaic plant. In this way, detection and correction of system operation problems can be allowed for in the final full-scale design. Simulation and scaled down system operation contribute to the photovoltaic system design knowledge and complement each other.

C.R.

A82-24149 Status of the German terrestrial photovoltaic activities. R. Koepke and K. Ullrich (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 538-540.

The budget, laboratories involved, and research and development areas of the West German photovoltaic activities are outlined. Government funding extraneous to universities and private industry totaled 27.3 million Deutsche marks in 1979, with 80% of the funds devoted to Si cell development and applications. The formation of amorphous Si cells was explored in terms of glow discharge, plasma deposition, and CVD methods. Unconventional cells such as CdSe-MIS, Cu₂O/ZnO, Zn₃P₂, and WSe₂ cells have been investigated, along with fluorescent concentrators, polycrystalline Si wafers, as well as production line prototype CdS/Cu₂S thin film solar cells.

M.S.K.

A82-24150 * Current status of solar cell performance of unconventional silicon sheets. H. I. Yoo (Applied Solar Energy

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Corp., City of Industry, CA) and J. K. Liu (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 548-552. NASA-supported research.

It is pointed out that activities in recent years directed towards reduction in the cost of silicon solar cells for terrestrial photovoltaic applications have resulted in impressive advancements in the area of silicon sheet formation from melt. The techniques used in the process of sheet formation can be divided into two general categories. All approaches in one category require subsequent ingot wavering. The various procedures of the second category produce silicon in sheet form. The performance of baseline solar cells is discussed. The baseline process included identification marking, slicing to size, and surface treatment (etch-polishing) when needed. Attention is also given to the performance of cells with process variations, and the effects of sheet quality on performance and processing. G.R.

A82-24151 * Multiple EFG silicon ribbon technology as the basis for manufacturing low-cost terrestrial solar cells. B. Mackintosh, J. P. Kalejs, C. T. Ho, and F. V. Wald (Mobil Tyco Solar Energy Corp., Waltham, MA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 553-557. 5 refs. Contract No. JPL-954355.

Mackintosh et al. (1978) have reported on the development of a multiple ribbon furnace based on the 'edge defined film fed growth' (EFG) process for the fabrication of silicon ribbon. It has been demonstrated that this technology can meet the requirements for a silicon substrate material to be used in the manufacture of solar panels which can meet requirements regarding a selling price of \$0.70/Wp when certain goals in terms of throughput and quality are achieved. These goals for the multiple ribbon technology using 10 cm wide ribbon require simultaneous growth of 12 ribbons by one operator at average speeds of 4 to 4.5 cm/min, and 13% efficient solar cells. A description is presented of the progress made toward achieving these goals. It is concluded that the required performance levels have now been achieved. The separate aspects of technology must now be integrated into a single prototype furnace. G.R.

A82-24152 Progress in the growth and performance of RAD silicon sheets. C. Belouet, C. Belin, J. Schneider, and J. Paulin (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 558-562. 10 refs. Research sponsored by the Commission of the European Communities and Commissariat à l'Énergie Solaire

Polysilicon sheets up to 6 m in length have been grown continuously by the RAD process on carbon substrates coated with rough laminar polycarbon. The effective diffusion length in as-grown smooth layers reaches a maximum of 60 microns at pulling rates up to 10 cm/min. RAD solar cells with an antireflective coating made from continuous ribbons exhibit AM1 conversion efficiencies above 9 percent. V.L.

A82-24154 * Evaluation of silicon-on-ceramic material for low-cost solar cells. J. D. Zook (Honeywell Corporate Technology Center, Bloomington, MN). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 569-573. 8 refs. Research sponsored by the U.S. Department of Energy and NASA.

The silicon-on-ceramic (SOC) process produces thin layers of silicon on inexpensive ceramic substrates. The layers are produced by unidirectional solidification of molten silicon, and are polycrystalline. Solar cells made from SOC material have performed with a conversion efficiency of 10.5%. In connection with the objective to improve the efficiency of SOC solar cells, an investigation was conducted to assess the relative importance of grain boundaries and impurities. In order to separate the two effects, light-beam-induced current (LBIC) measurements of the short-circuit current were made using a micron-sized light beam from a monochromator. The LBIC

measurements are closely related to solar cell performance since the technique identifies the various spatial and spectral contributions to solar cell current. On the basis of the obtained results, it appears that structural defects are more important than chemical defects in limiting the performance of present SOC solar cells. G.R.

A82-24155 Epitaxial growth of silicon by CVD in a hot-wall furnace. J. Bloem, Y. S. Oei, J. Hanssen, and L. J. Gilling (Nijmegen, Katholieke Universiteit, Nijmegen, Netherlands). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 574-578.

A new method is proposed for growing epitaxial layers of silicon whereby silicon is deposited from the vapor phase in a reactor placed inside a furnace instead of being heated by an RF coil. The method produces silicon slices of high packing density and is characterized by low energy consumption. Epitaxial growth in a furnace can be realized without any deposition on the reactor walls. V.L.

A82-24157 Characterization of plasma-sprayed silicon layers as possible base material for solar cell fabrication. M. S. Alaei and T. Hashemi (Materials and Energy Research Centre, Teheran, Iran). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 584-588.

Plasma-sprayed silicon films were characterized using X-ray diffractometry, Auger electron spectroscopy, scanning electron microscopy, and secondary ion mass spectrometry. It is shown that plasma spraying of silicon powder makes it possible to obtain reproducible films with controlled thickness and impurity. The films are highly polycrystalline with crystallite sizes up to 100 microns. An attempt has been also made to dope the sprayed film to fabricate a p-n junction. Initial results show that a fairly well defined space-charge region can be formed. V.L.

A82-24160 Study of the elaboration of semicrystalline silicon ingots. J. Fally and C. Guenel (Compagnie Générale d'Electricité, Centre de Recherches, Marcoussis, Essonne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 598-602. Commissariat à l'Énergie Solaire Contract No. 78-015

The formation of semicrystalline Si ingots as a process competitive with ribbon-pulling methods of fabricating solar cells to achieve a 10-fold reduction in the cost of solar cells is described. A thermal gradient is established in a graphite furnace to ensure a directional characteristic in the crystallization. A p-type semicrystalline material is currently achievable using semiconductor-grade Si for the melt, and methods have been devised for reusing the crucible. Grains have a diameter less than 1 mm, while basaltic grains perpendicular to the plane of the wafer are in the 2-3 cm range. The presence of isolated dislocations, lineages, and twins in the grains have contributed to a low efficiency of 8.07 percent thus far although the inclusion of an AR coating is expected to raise the figure to over 10 percent. M.S.K.

A82-24161 * Development of large area, low-cost, solar cell processing sequence. S. Chitre (Photowatt International, Inc., Tempe, AZ) and J. Donon (Photowatt International, S.A., Argenteuil, Val-d'Oise, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 608-614. Contract No. JPL-954265.

A cost effective process based on state-of-the-art technology has been developed for the production of large-area (55 sq cm and larger) solar cells. The process is capable of providing silicon and polysilicon cell efficiencies in excess of 10% at an overall cost of 12 c/watt in 1980 dollars. The process provides large throughputs and is suitable for complete automation with high yields. Various stages of the process development are discussed. V.L.

A82-24164 Optimized diffusion parameters for cells made by columnar silicon. F. Ferraris, F. C. Matarotta (Genova, Università,

Genoa, Italy), S. Pidotella, and L. Sardi (Ansaldo Eltag/AE/, Genoa, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 625-629. 5 refs.

The behavior of phosphorus in a two-step diffusion process is examined in an investigation to find the best first-step diffusion conditions in order to obtain maximum cell efficiency. Results indicate that at 750 C for 9 h, a deeper junction depth can be made, increasing the dead layer and obtaining cells with over 12.5 percent efficiency. Lifetime and EBIC measurements show good correlation with short circuit current values by obtaining lifetime values between 1.1 and 2.8 microns. V.L.G.

A82-24165 Direct coupled microwave thermal processing for photovoltaic device fabrication. D. C. Guidici (Siltec Corp., Menlo Park, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 630-634. Research sponsored by the U.S. Department of Energy.

A microwave thermal processing technology has been developed which reduces cycle time and energy requirements for solar cell manufacture through the direct coupling of a tuned microwave field to the material processed. The microwave processing is shown to be feasible for both junction formation and metallization sintering; cells produced have an efficiency of 8%. Diffusion throughput is satisfactory if multiple wafer processing (coin stacks) is used. Metallization sintering throughput is, however, limited by the single wafer process capability, and another form of applicator would be necessary to make microwave heating economically attractive for this process. V.L.

A82-24167 Effects of special processing on diffusion lengths in polycrystalline silicon solar cells. W. A. Orr, G. Mabilia, and V. Paraggio (Napoli, Università, Naples, Italy). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 646-649. 5 refs. Consiglio Nazionale delle Ricerche Contract No. 79.01631.92.

The effects of process parameters on the characteristics of polycrystalline silicon solar cells have been investigated by localized spectral response measurements which permits independent determination of diffusion lengths in the grain bulk and near the boundary. It is found that the n-type prediffusion leads to a reduction in average diffusion length, whereas p-type prediffusion yields longer diffusion lengths in p-type substrates. The results are explained in terms of relative amounts of dopant preferentially diffused into grain boundaries. V.L.

A82-24168 Scanning spectral response measurements of large grain polysilicon solar cells for process optimization. M. Arienzo, A. Muleo (Solaris S.p.A., Florence, Italy), and W. A. Orr (Napoli, Università, Naples, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 650-653.

Solar cells fabricated from bicrystalline silicon wafers with (111) and (100) orientations have been characterized using scanning spectral response measurements with a view to optimize the cell production process. In particular, variations in the quantum yield of the cells with distance from the grain boundary have been analyzed. On the basis of the results obtained, an optimum Al sintering time of 60 sec has been selected. It has also been shown that even in silicon with short diffusion lengths, a BSF can be used to enhance cell output. V.L.

A82-24169 The influence of surface conditions on the open circuit voltage of silicon solar cells. J. Nijs, F. D'Hoore, R. Mertens, and R. Van Overstraeten (Leuven, Katholieke Universiteit, Louvain, Belgium). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 659-663. 6 refs. Research supported by the

Office of the Prime Minister and Nationale Fonds voor Wetenschappelijk Onderzoek.

A series of p(+)/nn(+) back-surface-field solar cells have been investigated with reference to the sensitivity of the open-circuit voltage to the surface recombination velocity. It is found that in p(+)/nn(+) cells with shallow, relatively low-doped emitters, the emitter is transparent to minority carriers, and the dark saturation current density due to injection of minority carriers is comparable with the bulk component. Thus, the open circuit voltage of these devices is sensitive to the surface condition. V.L.

A82-24170 Electrical properties of grain boundaries in nonsingle crystalline silicon solar cells. W. Schmidt, G. Friedrich, and K.-D. Rasch (Telefunken AG, Heilbronn, West Germany). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 664-673. 17 refs. Research supported by the Bundesministerium für Forschung und Technologie.

The paper investigates the effect of grain properties and boundaries on the performance of solar cells made from multicrystalline silicon, including fast-pulled Czochralski-grown silicon and cast silicon. Performance parameters include photovoltaic characteristics, spectral response, effective diffusion length and local photo-response. Cast silicon with base resistivity higher than 1 ohm cm exhibits a uniform photoresponse within the grains comparable to single crystalline silicon cells, and the photoresponse decrease at the grain boundaries is low, due to the predominance of the coherent grain boundaries. It is shown that the local photoresponse can be used as a parameter to characterize grain and grain boundaries. D.L.G.

A82-24171 * Screenable all-metal solar cell electrodes of nickel and copper. B. Ross (Bernd Ross Associates, San Diego, CA) and D. B. Bickler (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 674-678. 6 refs.

Screenable thick film solar cell electrodes are made using the all-metal electrode system, which eliminates the commonly used glass frit and substitutes an oxide scavenger such as silver fluoride. The low temperature firing copper metal systems give good results on solar cells obtaining cell efficiencies of 13% AM1, and adhering sintered structures are demonstrated with nickel systems. The potential effect of copper upon cell performance at elevated temperatures over long periods of time is determined, and it is found that the formation of a copper-silicon eutectic at 550 C produces needle-like structures with broad bases on the silicon, extending into and occasionally through the metallization layer. D.L.G.

A82-24172 Reliable screen-printed contacts on silicon solar cells. J. Michel, H. Baudry (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brevannes, Val-de-Marne, France), D. Diguet, and G. David (La Radiotechnique Compelec, Caen, France). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 679-683. 5 refs. Research supported by the Commissariat à l'Énergie Solaire.

A screen-printing process for phi 100 mm silicon solar cells is examined. The adherence of silver to silicon is obtained with a glass binder designed to be steam boiling water (SBW) resistant, and the dissolution of the silicon surface by the glass is analyzed. It is found that when the firing temperature of the screen-printed conductors increases, the mechanical and SBW resistance increase; and since the junction depth has to be increased at the same time, the cell output power decreases. A 0.5 micron junction depth and a firing temperature of 680 C appear to be the best trade off, leading to omega 100 mm cells with screen-printed contacts exhibiting good electrical performances, a 300 g standard tensile strength, and over 500 hours SBW lifetime. D.L.G.

A82-24173 * Silicon solar cells with nickel/solder metallization. R. C. Petersen (Solarex Corp., Rockville, MD) and A. Muleo (Solaris S.p.A., Florence, Italy). In: Photovoltaic Solar Energy

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Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 684-690. Research supported by the U.S. Department of Energy, Contract No. JPL-954854.

The use of nickel plus solder is shown to be feasible for contact metallization for silicon solar cells by offering a relatively inexpensive method of making electrical contact with the cell surfaces. Nickel is plated on silicon solar cells using an electroless chemical deposition method to give contacts with good adhesion, and in some cases where adhesion is poor initially, sintering under relatively mild conditions will dramatically improve the quality of the bond without harming the p-n junction of the cell. The cells can survive terrestrial environment stresses, which is demonstrated by a 1000 hour test at 85 C and 85% relative humidity under constant forward bias of 0.45 volt. D.L.G.

A82-24174 Status, technology and development of silicon solar cells at INER. S. S. Jao, H. H. Tseng, C. Cheng, Y. C. Tzeng, H. H. Chang, and H. L. Hwang (Institute of Nuclear Energy Research, Lungtan, Republic of China). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 691-695.

Test runs using 200 5-cm-diameter silicon wafers are carried out, yielding 87% with an AM1 conversion efficiency greater than 11.5%. The highest efficiency is 12.7%. Concentrator solar cells of 2 x 2 sq cm are made with an AM1 efficiency of 14%. Solar cells with a diameter of 7.5 cm have attained AM1 efficiencies of more than 11.3%, and texturized solar cells of the same diameter fabricated from rejected wafers show AM1 efficiencies of 9.5-10.5%. It is noted that solar panels comprising 68 cells with a maximum output power of 13.5 W have been manufactured. The results of a 6-month test of a photovoltaic charge station for electric motorcycles are reported. C.R.

A82-24175 * Application of laser annealing to solar cell junction formation. J. S. Katzeff, M. Lopez (Lockheed Missiles and Space Co., Inc., Advanced Manufacturing Technology Dept., Sunnyvale, CA), and R. H. Josephs (California Institute of Technology, Jet Propulsion Laboratory, Energy Conversion Systems Section, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 708-712. Research sponsored by the U.S. Department of Energy and NASA.

The possibility of using high-energy Q-switched Nd:glass lasers to form pn junctions in solar cells by annealing ion-implanted substrates is investigated. The properties of laser annealed cells are analyzed by electrical, transmission electron microscopy, Rutherford backscattering and secondary ion mass spectrometry techniques. Tests indicate the laser annealed substrates to be damage-free and electrically active. Similar reference analysis of ion-implanted furnace-annealed substrates reveals the presence of residual defects in the form of dislocation lines and loops with substantial impurity redistribution evident for some anneal temperature/time regimes. Fabricated laser annealed cells exhibit excellent conversion efficiency. It is noted that additional improvements are anticipated once the anneal parameters for a back surface field are optimized. C.R.

A82-24176 Laser-annealed silicon solar cells - A comparison between ion-beam and glow discharge implantation. J. Michel, C. Fages (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France), J. C. Muller, P. Siffert (CNRS, Centre de Recherches Nucléaires, Strasbourg, France), D. Hoonhout, T. de Jong, and F. W. Saris (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam, Netherlands). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 713-718. 7 refs. Research supported by the Commissariat à l'Énergie Solaire.

The goal is to define optimum parameters for the implantation and annealing procedure and to make a comparison between the two ways of implantation. It is noted that shallower implantations lead to

better solar cell performance. For low-energy implantations, the laser treatment becomes the dominant factor determining the layer characteristics. In addition, it is found that there is an optimum for the implanted dose and for the laser energy density applied. Relatively large leakage currents are observed, suggesting the presence of defects near the junction probably due to the laser treatment. Furnace annealing is found to be required in every case. C.R.

A82-24178 Comparative study of the thermal characteristics of various solar cell module structures. D. Diguët, J. Anguet (Radiotechnique Compelec, Caen, France), J. Francin, and J. J. Marchal (Société Nationale Industrielle Aérospatiale, Cannes, France). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 726-730. Commission of the European Communities Grant No. 488-78-3-ESF.

The heat dissipation mechanisms in various solar cell module configurations are analyzed both experimentally and theoretically. A cell in which there is less absorption of infrared sunlight is proposed. Attention is also given to the balance between the conductive and convective effect versus the module design, the room temperature, and the convection system. Temperature data are given for various cell and module designs. It is shown that the best trade-off is obtained from a module in which glass plates are used with specially designed low-infrared-absorbing cells, here, the system 'rejects' the sunlight that is inactive with regard to the electrical conversion efficiency. It is noted that this dissipating structure could be competitive if the cost sharing between cell and encapsulation were modified. C.R.

A82-24179 * Terrestrial photovoltaic performance reference conditions. R. G. Ross, Jr. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 731-735. Research supported by the U.S. Department of Energy and NASA.

The rationale behind the selection of key photovoltaic performance reference (reporting) conditions, including the standard Air Mass 1.5 solar spectrum and reference irradiance and cell temperature levels, is investigated. Besides providing a repeatable reference for performance comparisons, it is shown that the choice of reference conditions directly controls the accuracy of array energy output prediction calculations. Conclusions are drawn on the accuracy associated with present reference conditions, and recommendations are made concerning alternative reference conditions with improved accuracy. C.R.

A82-24182 Optical measurement of cell temperature in a solar array. B. Theys, P. Baruch, and J. Maire (Ecole Normale Supérieure, Paris, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 746-750. 7 refs. Commissariat à l'Énergie Solaire Contract No. 79-127.

A method is described for measuring the operating temperature of photovoltaic cells in an array. Here, use is made of the temperature shift of those optical parameters of the semiconductor which induce a variation in spectral response. This variation is found to be large for wavelengths near the cut-off wavelength. Also described is a method for measuring the voltages that arise at the panel terminals from illumination of a single cell by two monochromatic beams superposed on the solar illumination. C.R.

A82-24183 * Natural sunlight accelerated weathering of photovoltaic modules. G. A. Zerlaut, T. B. Anderson (DSET Laboratories, Inc., Phoenix, AZ), and J. C. Arnett (California Institute of Technology, Jet Propulsion Laboratory, Energy Technology Section, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 751-755. Research sponsored by the U.S. Department of Energy and NASA.

Photovoltaic modules are exposed to the equivalent of ten years of sunlight aging in an accelerated exposure testing and evaluation program, the objective being to determine the long-term durability characteristics of flat plate modules in comparatively short periods of time. The modules are illuminated with concentrated sunlight in a large, sun-tracking, Fresnel-reflecting solar concentrator. The effects of the accelerated exposure are assessed by performing periodic visual inspections and electrical measurements. It is found that field-experienced failure modes are duplicated, that acceleration factors of 6x to 8x are readily attainable, and that the test method is feasible as a predictive tool for photovoltaic module lifetime durability. C.R.

A82-24185 Surface properties of Cu₂-xS and its influence on the performance of frontwall Cu₂-xS-CdS thin film solar cells. F. Pfisterer, B. W. Schock, and J. Wörner (Stuttgart, Universität, Stuttgart, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 762-766. 6 refs.

For obtaining optimal efficiencies and high stability of Cu₂(2-x)S-CdS solar cells, a post-dipping treatment is found to be necessary. The principal features of this treatment are the production of an elemental copper layer on the surface of the cell and the subsequent oxidation of this layer to form a p(+)-Cu₂O-layer that acts as a window layer, thereby preventing surface recombination losses. The formation and proper operation of this surface layer is investigated by various methods, among them measurements of the spectral sensitivity, surface potential stoichiometry of the Cu₂(2-x)S-layer, electron beam induced current, and Auger-depth profiling. C.R.

A82-24186 An EBIC study of the CdS-Cu₂S photovoltaic cell. G. J. Russell, S. Oktik, and J. Woods (Durham, University, Durham, England). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 767-771. 7 refs.

Layers of copper sulfide are grown epitaxially on sulfur faces of single crystals of cadmium sulfide using a plating solution containing cuprous ions. The chosen plane corresponds to the preferred orientation of the surface of grains in the evaporated films used in large area devices. With single crystals, the complexities associated with grain boundaries can be eliminated and it becomes possible to investigate more closely the effects of other crystallographic features on cell performance. This is done using a scanning electron microscope in the electron beam induced current mode. C.R.

A82-24187 Transparent, conductive layers of sprayed indium tin oxide in backwall Cu₂S-CdS cells. C. Gril, R. Pommier, J. Marucchi, H. Luquet, M. Perotin, O. Maris, and M. Savelli (Montpellier II, Université, Montpellier, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 772-776.

Results obtained from experiments on the transparency and square resistance of a layer of indium tin oxide are reported. The variations in transparency and square resistance with the thickness of the layer are demonstrated. The influence of this transparency and resistance on cell efficiency is computed, and the thickness required to minimize the losses introduced by the indium tin oxide layer is deduced. C.R.

A82-24189 CdZnS-Cu₂S thin film solar cells. S. Martinuzzi, F. Z. Nataren, D. Vassilevski, B. Bouchikhı (Aix-Marseille III, Université, Marseille, France), M. Cadene, M. Moutaki, and M. Rolland (Montpellier II, Université, Montpellier, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 782-786. 7 refs. Commission of the European Communities Grant No. 431-78-1-ESF.

Ternary layers of CdZnS are made through single source evaporation of solid solutions and coevaporation. Photocells are then

made with these layers by a solid-state reaction with CuCl. It is noted that the observed photovoltage increases may be explained by an increase in the barrier height. The photocurrent values obtained for CdS-Cu₂S cells are conserved up to ZnS concentrations of about 8 percent. C.R.

A82-24190 Cu₂S/Zn_x/Cd/1-x/S heterojunction solar cells formed on sprayed Zn_x/Cd/1-x/S films. N. A. Reshamwala, W. B. Hsu, L. C. Burton (Virginia Polytechnic Institute and State University, Blacksburg, VA), and V. P. Singh (Photon Power, Inc., El Paso, TX). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 787-792. 10 refs.

Zn_xCd(1-x)S films (x greater than or equal to zero and less than or equal to one) are deposited on glass and tin oxide/glass substrates. The film composition is nominally the same as that of the spray solution. The films are found to have preferred C-axis orientations, with lattice parameter, resistivity and band gap variations similar to those of evaporated ZnCdS films. Wet and dry processed Cu₂S/ZnCdS junctions are fabricated. Open circuit voltages of more than 0.6 V are obtained with x greater than about 0.15, the maximum value measured being 0.75 V. C.R.

A82-24191 Heterojunction energy band lineups in Cd/1-x/Zn_x/S/Cu₂S solar cells. R. Bennaceur, R. B. Hall, and A. Rothwarf (Delaware, University, Newark, DE). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 793-797. 11 refs. Research supported by the U.S. Department of Energy.

A simple method of calculation is used in determining the energy-band lineups in the Cd(1-x)Zn(x)/Cu₂S junction. Since the Cu₂S has a complicated structure, the experimental value of delta E sub c for CdS/Cu₂S is used. It is noted that for other compounds, such as Cd(1-x)Zn(x)S/InP, the value of delta E sub c can be calculated; in addition, the effect of the dipole layer for different orientations of the interface can be evaluated. It is also shown that delta E sub c = 0 for x values between 20 and 40% corresponding to the maximum value of the open-circuit voltage with no decrease in the short-circuit current density. Other factors, such as resistivity associated with introducing high concentrations of zinc, can affect solar cell parameters and therefore the overall efficiency. C.R.

A82-24192 Integrated Cu_x/S-CdS thin film solar cell panels with higher output voltages. W. Arndt, G. Bilger, F. Pfisterer, H. W. Schock, J. Woerner, and W. H. Bloss (Stuttgart, Universität, Stuttgart, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 798-802. 6 refs. Bundesministerium für Forschung und Technologie Contract No. ET-4045-B; Commission of the European Communities Grant No. ESC-R-003-D.

Large-area production of solar cell modules is made possible by applying integration techniques to thin film Cu_x/S-CdS solar cells. It is noted that integrated modules with output voltages matched to various loads can be realized on a single substrate covered by a single front glass with an integrated front contact. The problem of hermetic sealing can thus be easily solved. It is thought that the thin film modules will be very reliable. Two different types of modules, both having outer dimensions of 29.5 x 14.5 sq cm, are fabricated. The first is made up of 8 cells connected in series with an output current of 0.5 A at 2.8 V, the other comprises 18 cells with an output current of 0.2 A at 6 V, related to AM 1.5 illumination (85 mW/sq cm). C.R.

A82-24194 Hydrogenated a-Si multi-junction solar cells and interference effects in the spectral response. M. Ondrijs and W. den Boer (Delft, Technische Hogeschool, Delft, Netherlands). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 809-814. 9 refs.

Hydrogenated amorphous silicon multijunction solar cells con-

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sisting of stacked p-i-h cells are fabricated. The individual cells are connected in series by means of very thin, highly doped p(+)-n(+) a-Si:H tunnel junctions. The cells are illuminated through a thin semitransparent metal layer acting as a Schottky barrier diode with an upper undoped a-Si:H layer in the case of Au, or as an ohmic contact with a negative barrier in the case of Mg. Highly reflective back contacts are used. It is found that a higher number of stacked cells does not result in higher conversion efficiencies. The open circuit voltage of n stacked cells is nearly equal to n times the open circuit voltage of one cell. Conversion efficiencies of 4% at 80 mW/sq cm sunlight are obtained for single and stacked p-i-n structures. C.R.

A82-24197 **Electrical properties of hydrogenated amorphous Si_{1-x}/Ge_x/ alloys.** N. Van Dong, T. H. Danh, and J. Y. Le Ny (Commissariat à l'Énergie Atomique, Laboratoire de Physique des Matériaux, Gif-sur-Yvette, Essonne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 830-834. 5 refs. Research supported by the Commissariat à l'Énergie Solaire.

A82-24198 **Amorphous Si_{1-x}/Ge_x/ for high performance solar cell.** G. Nakamura, K. Sato, Y. Yukimoto, and K. Shirahata (Mitsubishi Electric Corp., Itami, Japan). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 835-839. 6 refs.

It is noted that the optical gap energy can be controlled in the range between 1.95 eV and 1.14 eV by adding Ge to a-Si:H during the deposition process. As the Ge content in the film increases, however, the photoconductivity and carrier mobilities decrease. A preliminary study is carried out on the cell performance of various structures using an a-SiGe:H film. Spectral response at a wavelength region longer than about 0.6 micron is found to increase in the cells using the a-SiGe H film. C.R.

A82-24199 **Can recombination via interfacial states in MIS solar cells be of advantage.** P. T. Landsberg and C. M. H. Klompke (Southampton, University, Southampton, England). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 846-850. 12 refs.

It is noted that, in an MIS p-type solar cell with donor surface states, loss of photogenerated carriers can occur by band-band recombination via surface states. Depending on the thickness of the insulating layer, however, electrons captured by the surface states may also tunnel into the metal, thereby adding to the light-induced current. A subtle balance therefore exists between the adverse and beneficial effects of the capture of electrons by surface states. This balance is analyzed. C.R.

A82-24201 **Efficient solar cells on polycrystalline and highly defected substrates using ion sputtered indium tin oxide.** A. P. Genis, C. Osterwald, P. Smith, R. Singh, J. E. Mahan, J. B. DuBow (Colorado State University, Fort Collins, CO), and D. Mills (Hewlett Packard Corp., Loveland, CO). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 856-862. 17 refs.

Indium tin oxide (ITO)/silicon solar cells of practical size (approximately 4 sq cm) and efficiency (more than 11% total area) are fabricated using an optimized ion beam milling/sputter deposition and low pressure oxide growth process. Results for a single crystal silicon substrate and four possibly low-cost polycrystalline substrates are compared. Photovoltaic performance parameters of cells formed on the best polycrystalline material are found to be essentially identical to those of a representative single crystal device. C.R.

A82-24203 **Application of amorphous silicon nitride for MIS/inversion layer solar cells.** R. Hezel, R. Schörner, and T. Meisel (Erlangen-Nürnberg, Universität, Erlangen, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 866-870. 15 refs.

CVD Si-nitride is shown to exhibit outstanding properties as transparent dielectrics for MIS/inversion layer solar cells. Advantages include a very high density of fixed positive interface charges up to 7×10^{12} per sq cm, absolute stability up to the nitride deposition temperature of 640 C, low density of fast interface states, and good AR coating with easily adjustable properties. MIS/IL solar cells with AM1 efficiencies of 15% and excellent UV sensitivity are obtained without optimizing the MIS contact and grid structure, and it is concluded that the CVD Si-nitride represents a promising dielectric for the fabrication of MIS/IL solar cells with high efficiency and long term stability for single crystalline and polycrystalline silicon. D.L.G.

A82-24204 **Properties of CdSe-MIS solar cells.** E. Rickus and D. Bonnet (Battelle-Institut, Frankfurt am Main, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 871-875. Research sponsored by the Bundesministerium für Forschung und Technologie and Commission of the European Communities.

It is noted that, as evidenced from scanning electron microscopy and X-ray goniometer measurements, the short-circuit current density of CdSe-MIS cells is strongly influenced by the crystallographic properties of the CdSe layer. Spectral response measurements demonstrate that misorientations lead to a reduced collection efficiency of minority carriers. At the present stage of development, efficiencies near 4% can be realized under AM1 conditions using very simple, not-yet-optimized ZnS antireflection coatings. The extremely thin MIS structure permits cells to be fabricated with low material consumption; efficiencies of 9 to 10% should be possible with further improvements. C.R.

A82-24205 **Evaluation of electrodeposited cadmium telluride solar cells.** B. M. Basol, O. M. Stafsudd (California, University, Los Angeles, CA), R. L. Rod, and E. S. F. Tseng (Monosolar, Inc., Santa Monica, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 878-881. 7 refs. Contracts No. DE-AC04-79ET-23008; No. XS0-9152-1.

An evaluation is made of Schottky barrier solar cells formed on electrochemically deposited n-CdTe films. The important electro-deposition process variables, that is, tellurium concentration in the electrolyte and the deposition rest potential, are optimized for best solar cell operation. The solar cell parameters for the devices made on as-deposited films are as follows: short-circuit current density, 6 mA/sq cm; open-circuit voltage, 0.57 V; and fill factor, 0.6 (under 100 mW/sq cm illumination). Minority carrier diffusion length in these films is found to be 0.05-0.1 micron. A brief heat treatment in air of the CdTe films greatly improves the solar cell parameters. Cells with efficiencies of the order of 6% are obtained on such films. A larger diffusion length is shown to underlie this improvement. C.R.

A82-24206 **Theoretical and experimental study of quantum and energy conversion efficiency in CdTe p-n junctions.** D. Lincot, M. Barbe, G. Cohen Solal, and Y. Marfaing (CNRS, Laboratoire de Physique des Solides, Meudon, Hauts-de-Seine, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 882-886. 8 refs.

The quantum efficiency in CdTe p-n junction is calculated taking into account realistic electrical parameters. Experiments are in agreement with computations and show quantum efficiencies as high as 75% without antireflecting coating. The diode dark current is predominantly due to generation recombination in the space charge layer and increases in very shallow junctions. Conversion efficiency is presently limited by surface recombination velocity and low surface doping which leads to surface voltage drops and voltage dependent photocurrent. (Author)

A82-24207 **Solar cells based on indium phosphide.** N. M. Pearsall, T. J. Coutts, and E. Don (Newcastle-upon-Tyne Polytechnic,

Newcastle-upon-Tyne, England). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 887-891. 8 refs.

The fundamental physics of solar cells based on the nearly ideal solar material indium phosphide (InP) is discussed. The feasibility of sputter deposition of n-type window layers in connection with a program on all sputtered CdS/Cu₂S cells is demonstrated. It is pointed out that, in contrast to the InP/CdS combination, there are no obvious reasons for expecting high efficiencies for the ITO/InP device. However, AM1.5 efficiencies of nearly 8% are reported, and it is noted that considerable progress has been made in characterizing the device. C.R.

A82-24208 n ITO spray/p InP solar cells. L. Gouskov, C. Gril, A. Brenac, J. F. Bresse, C. Llinares, E. Monteil, and R. Pommier (Montpellier II, Université, Montpellier, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 892-896. 14 refs. Commissariat à l'Énergie Solaire Contract No. 79-132.

Solar cells are prepared by the fabrication method of ITO spray/InP p heterojunctions. Solar power conversion efficiency reaches 10 percent under AM1 conditions on 20 sq mm areas. Two p-type substrates are studied, with heat results obtained using the less doped InP, although the back contacts on the material are not perfectly controlled. The ITO-InP interface is investigated by EBIC profile measurements, and the junction is not localized at the metallurgical interface, but is around 0.8 micron deeper into InP. I-V measurements versus temperature show that two transport processes are competitive, and results agree with the proposed model of buried homojunction. D.L.G.

A82-24210 Characterization of n-CdS/p-Si heterojunction solar cells. L. De Angelis, F. Galluzzi, G. Maletta, E. Scafè, and R. Tomaciello (ASSORENI, Laboratorio di Ricerche di Base, Rome, Italy). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 906-910. 5 refs.

Electric and photoelectric characteristics of n-CdS/p-Si devices at various temperatures and illumination levels are reported. Heterojunctions between silicon and transparent semiconductors appear to be promising alternative solar cells, with n-CdS/p-Si junctions showing Voc up to 570 mV and overall efficiencies up to 10 percent. The transport mechanism is described as a multistep thermal assisted tunneling, which is unchanged by illumination, and photoresponses show the expected bandpass behavior with internal quantum yields of about 1. D.L.G.

A82-24211 Performance of ultra high efficiency thin germanium p-n junction solar cells intended for solar thermophotovoltaic application. E. S. Vera, J. J. Loferski, M. Spitzer, and J. Schewchun (Brown University, Providence, RI). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 911-919. 14 refs. NSF-Navy-supported research.

The theoretical upper limit conversion efficiency as a function of cell thickness and junction position is calculated for a germanium p-n junction solar cell. The cell structure is intended for solar thermophotovoltaic energy conversion, incorporating minority carrier mirrors and optical mirrors on both the front and back boundaries of the active part of the device. The role of non-ideal optical and minority carrier mirrors, and the effect of resistivity variations are studied. The theoretical efficiency exceeds 15% for an optimal structure 90 microns thick under 25 W/sq cm illumination from a 1500 C thermal source. This upper limit is higher than the calculated limit of 10% to the conversion efficiency of conventional germanium p-n junctions under the same conditions of illumination. D.L.G.

A82-24212 Thermodynamic limitations of direct solar energy conversion. P. Würfel and W. Ruppel (Karlsruhe, Universität,

Karlsruhe, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 922-926. 5 refs.

The paper presents an approach to the thermodynamics of radiation, which allows a straightforward and rigorous determination of the upper limit for the efficiency of converting solar energy into electrical energy. Solar energy is first converted into chemical energy of the electron-hole gas by cooling it to room temperature at a constant number of electron-hole pairs. The chemical energy, which is then converted into electrical energy, is not restricted by thermodynamics. The irreversibility of the cooling process limits the AMO for a single solar cell to a maximum of 0.29 for a bandgap of 1.3 eV, although it can be reduced considerably in more complex systems. D.L.G.

A82-24213 Thermodynamic limits to photovoltaic solar energy conversion efficiency. P. Baruch, C. Picard (Ecole Normale Supérieure, Paris, France), and R. M. Swanson (Stanford University, Stanford, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 927-932. 11 refs. Research supported by the Centre National de la Recherche Scientifique.

A derivation of the Carnot factor is discussed, using a two-level system as a model of a quantum converter. It is shown that in a 4-pi configuration, the thermodynamic limit can be reached in the case of purely radiative recombination. It is also demonstrated that in the usual configuration of a solar cell, a Carnot efficiency can still be used if the hot reservoir temperature is defined as the temperature the electronic population would reach if it were thermally uncoupled from the lattice. The use of simple thermodynamic quantities leads to simple computation of maximum theoretical efficiencies for photovoltaic conversion, and the introduction of source effective temperatures is convenient and allows the isolation of the irreversible processes limiting the efficiency. D.L.G.

A82-24219 Low resistance solar cells for the first Spanish concentrating photovoltaic array. G. L. Araujo, G. Sala, F. Chenlo, E. Sánchez, A. Luque, E. Lorenzo, and J. M. Ruiz (Escuela Técnica Superior de Ingenieros de Telecomunicación, Madrid, Spain). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 960-964. 6 refs.

A two-axis photovoltaic tracking array of 20.8 sq m aperture has been developed, which is equipped with monocrystalline silicon solar cells and hybrid silicone-glass Fresnel lenses, and is capable of yielding 1.5 KW peak under AM1 conditions. It is shown that the use of certain two-level metallization grids reduces the series resistance and improves the performance of concentration of solar cells. The series resistance values of n(+)/p silicon solar cells with a 5 cm diameter and an efficiency of 16.6 percent at AM1 are measured. The 6 C thermal drop between the cell and the cooling element for AM1 irradiance are also measured. D.L.G.

A82-24221 High efficiency large area AlGaAs/GaAs concentrator solar cells. S. Yoshida, K. Mitsui, T. Oda, Y. Yukimoto, and Y. Shirahata (Mitsubishi Electric Corp., LSI Research and Development Laboratory, Itami, Hyogo, Japan). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 970-974. 6 refs.

The design, construction, and performance of a 1 kW AlGaAs/GaAs solar cell array is described, along with problems associated with realization of the array. The array features two panels, each with 90 27 x 27 cm Fresnel lenses above 4 sq cm solar cells. The panels are mounted on a two axes tracking system, and cooling is supplied by an aluminum plate for natural convection. The lenses provide 125 suns concentration for the series-connected cells. The photovoltaics were grown by a liquid phase epitaxial growth technique which produced a 24 sq cm wafer, and a p-n homojunction was formed by diffusing Zn during the p-AlGaAs epitaxial growth. A maximum output of 9.1 W was achieved at 125 suns, and the cells

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were soldered to a ceramic base to furnish electrical isolation between the cells and the heat sink. An array power of 977 W was obtained at an efficiency of 14.2%, with losses due to tracking errors and lens-cell misalignment. M.S.K.

A82-24222 **Optical characteristics of the dispersion concentrator and its influence on photovoltaic systems.** G. Sassi (Milano, Università, Milan, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 981-985.

The realization of an optical dispersion concentrator for splitting solar radiation into the different wavelength components for deposition on solar cells sensitive to the deposited wavelengths is discussed. Problems due to scattering by the splitting and focussing lens are examined, including the distribution of wavelengths at the focal point. The solar cells are then arranged so that the light which strikes them exceed the individual energy gaps. Highest energy densities were found at the periphery of the focal zone, with UV rays striking the center, and the possibility of altering the shape of the focal zone to accord with individual requirements is mentioned. The cells can also be distributed in the focal zone so that series connections of cells responding to the identified wavelengths will produce equal outputs. Linear configurations with same apparatus are noted to necessitate lower concentration ratios for higher utilization, and therefore higher cost. M.S.K.

A82-24223 **Automated concentrator cell module assembly.** S. Olah and W. Sampson (Applied Solar Energy Corp., City of Industry, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 991-995.

The performance and features of linear concentrator photovoltaic arrays fabricated partially by an automated soldering machine are detailed. Float zone Si cells were mounted in five linear modules each 1.2 m long containing 48 cells. The cell strings were made up of 4 12-cell segments encapsulated in polyvinyl butyral, with two bypass diodes for every segment. An efficiency of 16.4% was achieved at 55 C, and humidity tests showed no performance degradation or cracks in an Al₂O₃ coating. The automatic soldering machine comprised a ribbon feeding system, an interconnect punch die, a solar cell feeder and soldering mechanism, a ribbon separation mechanism with cut-off die and outfeed, and a program control. The machine operated with low-line voltage, compressed air, and vacuum, and the processing of the cells is outlined, including cell soldering by a point contact method with a controlled immersion heater. Standardization of cell sizes is recommended to ensure flexibility of cells which can be handled. M.S.K.

A82-24224 **Construction and testing of experimental plants using solar cells and concentrators.** H. Pfeiffer (Maschinenfabrik Augsburg-Nürnberg AG, Munich, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 996-1000. 6 refs. Research supported by the Commission of the European Communities and Bundesministerium für Forschung und Technologie.

A82-24225 **Multibandgap cells in a thermophotovoltaic system.** F. Demichelis and E. Minetti-Mezzetti (Torino, Politecnico, Turin, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1006-1011. 9 refs. Research supported by Fiat S.p.A.

Designs for a thermophotovoltaic (TPV) converter which employs a Fresnel concentrating lens and a parabolic reflector as a collector are described. Solar radiation is concentrated onto two hollow hemispheres near the focus of two parabolic mirrors where low reradiated levels of the incoming flux are redirected by filters onto different cells. Symmetric coupled differential equations are developed to describe the time-dependence of the TPV converter, which uses multibandgap cells to achieve efficiencies of up to 45%. M.S.K.

A82-24226 **Description of a concentrating photovoltaic energy system for Wilcox Memorial Hospital on Kauai.** D. Rafinejad (Acurex Corp., Alternate Energy Div., Mountain View, CA). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1012-1015. Research sponsored by the U.S. Department of Energy.

A82-24227 **Community television reception centers with solar generator power supplies in Niger - Television retransmitters with alternative energy power supplies in France (Centres de réception communautaire de télévision alimentés par générateurs solaires au Niger - Réémetteurs de télévision alimentés par les énergies nouvelles en France).** S. Polgar (TéléDiffusion de France, Montrouge, Hauts-de-Seine, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1018-1022. In French.

A82-24228 **Solar cell/battery plants for telecommunication systems in Denmark - Development of a test facility.** J. Jensen (Odense, Universitet, Odense, Denmark). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1023-1027. Research supported by the Department of Energy of Denmark; European Economic Community Contract No. 315-78-EEDK.

A82-24229 **The 5 kW generator at the Alpine refuge 'Les Evettes' - Operating data.** L. Selles (SERI-Ranault Ingénierie, Bois-d'Arcy, Yvelines, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1028-1032. Commission of the European Communities Grant No. 463-78-1-ES-F

The components and performance of a remotely sited prototype solar cell power supply for a hotel with no grid connection are detailed. The array provides a peak output of 5 kW at 48-70 V dc and batteries comprising 120 lead-acid elements hold five days of power for nominal use. Power conditioning is accomplished by a 3 kVA inverter equipped with thyristors which perform at 80 percent with a full load and 67 percent at part load. Data recording consisted of 12 channels for irradiance, temperature, current, voltage, power, etc. The cells delivered an average of 28.2 kWh/day minimum in Aug. 1980. The use of voltage matching devices is recommended to increase solar cell efficiency, along with higher battery voltages in the inverter to cope with more widely varying loads. M.S.K.

A82-24230 **Optimization of the P.V. array-load energy transfer by means of an electronic adaptor.** J. Pivot, J. A. Roger (Lyon I, Université, Villeurbanne, Rhône, France), P. Gucher, B. Canut, and E. Descours (Lyon, Facultés Catholiques, Lyon, France). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1033-1037. Commissariat à l'Énergie Solaire Contracts No. 78-03192, No. 78-03292.

Operational characteristics and circuitry of adaptors for direct coupling of photovoltaics to loads are discussed. Direct coupling to load is noted to be the cheapest available method for utilization of solar cell-produced power, and necessitates dc-dc conversion to allow performance of cell modules at optimum levels in matching the load. Adaptors are necessarily powered by the power source, have high reliability in all climates, and respond to photovoltaic curve temperature shifts. A series adaptor is transistorized, with two capacitors charged and discharged in sequence in reference to a load capacitor designed for the required levels, and responding to light flux and cell temperature. A parallel adaptor has a blocking circuit of thyristors and a light flux follower to pilot a driving circuit to fix the working points at maximum power points of the array regardless of temperature and light flux. The series chopper is noted to be effective for powers lower than 1.5 kW. M.S.K.

A82-24231 **Interconnection of a photovoltaic power generation system with the grid.** R. Corbèfin and G. Vacelet (Société Nationale Industrielle Aérospatiale, Paris, France). In: Photovoltaic

Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980

Dordrecht, D. Reidel Publishing Co., 1981, p. 1038-1040. In French.

Converting photovoltaic system-generated power into a form compatible with grid-furnished power and simultaneously ensuring that maximal power is drawn from the solar system is discussed. A converter is interposed between the solar-derived electricity and the grid lines, allowing the user to apply the power to a load, feed excess power to the grid, and receive power from the grid when the photovoltaic output is too low to fill demand. A dc-ac converter is described, with microprocessor controlled transistorized switching to adapt the solar output to the load amplitude on demand, while maintaining constant voltage. An adaptor allows the converter to take its amplitude, phase, and frequency regulation from the grid, and also assures that power will flow only toward the grid. M.S.K.

A82-24232 Power conditioning unit for photovoltaic power systems. G. Beghin and V. T. Nguyen Phuoc (Précision Mécanique Labinal, S.A., Vandoeuvre, Seine-Saint-Denis, France). In: Photovoltaic Solar Energy Conference, Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1041-1045.

Operational features and components of a power conditioning unit for interconnecting solar cell module powers with a utility grid are outlined. The two-stage unit first modifies the voltage to desired levels on an internal dc link, then inverts the current in 2 power transformers connected to a vector summation control to neutralize harmonic distortion up to the 11th harmonic. The system operates in parallel with the grid with extra inductors to absorb line-to-line voltage and phase differences, and permits peak power use from the PV array. Reactive power is gained internally, and a power system controller monitors voltages, frequencies, and currents. A booster preregulator adjusts the input voltage from the array to provide voltage regulation for the inverter, and can commutate 450 amps. A total harmonic distortion of less than 5 percent is claimed, with a rating of 5 kVA, 50/60 Hz, 3-phase, and 4-wire. M.S.K.

A82-24233 New type of transformerless high efficiency inverter. G. J. Naaijer (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.

Dordrecht, D. Reidel Publishing Co., 1981, p. 1068-1072. Research supported by the Commissariat à l'Énergie Solaire.

Inverter architectures are presented which allow economical ac/dc switching for solar cell array and battery power use in domestic and industrial applications. The efficiencies of currently available inverters are examined and compared with a new 2.2 kW transformerless stepped wave inverter. The inverter has low no-load losses, amounting to 200 Wh/24 hr, and features voltage steps occurring 15-30 times/sine wave period. An example is provided for an array/battery/inverter assembly with the inverter control electronics activating or disconnecting the battery subassemblies based on the total number of activated subassemblies in relation to a reference sinewave, and the need to average the battery subassembly discharge rates. A total harmonic distortion of 6 percent was observed, and the system is noted to be usable as a battery charger. M.S.K.

A82-24234 Considerations on the feasibility of a 1 MWp central PV plant to be tied to the European electrical network. P. Bullo, S. Corsi, V. Piazza (Ente Nazionale per l'Energia Elettrica, Direzione Studi e Ricerche, Milan, Italy), G. Emanuele (Phoebus, Catania, Italy), G. Gelli (Officine Galileo S.p.A., Florence, Italy), and M. Giuffrida (Ansaldo Elsig /AE/, Genoa, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1076-1081. 6 refs.

A functional analysis of an optimized centralized photovoltaic power plant is presented. The incorporation of meteorological data, the anticipation of uneven cell performance, the avoidance of shadowing, and isolation of defective panels by using by-pass diodes are considered. An optical module consisting of a parabolic trough

with an aperture of 1.7 m with a focal distance of 750 mm was chosen, with provision made for tracking. The power conditioning unit comprised a dc/ac thyristor converter with natural commutation. Lightning protection is outlined, along with an optimal plant layout. Finally, cost considerations for land and the solar cell modules are discussed, including cost levels required to make the operation of a photovoltaic plant economical. M.S.K.

A82-24235 Thin-film polycrystalline /CdZnS/Cu₂S solar cells of 10% conversion efficiency. R. B. Hall, R. W. Birkmire, J. E. Phillips, and J. D. Meakin (Delaware University, Newark, DE). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1094-1096. 5 refs. Research supported by the U.S. Department of Energy.

An important limitation on the efficiency of CdS/Cu₂S solar cells is the open circuit voltage attainable with the CdS/Cu₂S heterojunction. The electron affinity mismatch between CdS and Cu₂S of approximately 0.2 eV limits the achievable open circuit voltage to about 0.5 V. A modified heterojunction using a mixed Cd-Zn sulfide that has been proposed as a means of achieving an open circuit voltage of about 0.7 V is tested. C.R.

A82-24293 The effects of elevated temperature exposure on the compatibility of glycol solutions with metals used in solar absorbers. E. F. Smith, III and E. Davis (Olin Metals Research Laboratories, New Haven, CT). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper*. 18 p. 6 refs. Research supported by the International Copper Research Association.

A laboratory study was conducted to evaluate the corrosion compatibility of various metals with water-glycol mixtures at temperatures reached in a stagnating solar collector. This initial scoping study examined the corrosion response of aluminum, copper, low carbon steel and a stainless steel alloy after elevated temperature exposure to a 50 v/o solution of reagent grade glycol in water. The test procedure included exposure to both liquid and vapor phases for periods of up to thirty days. These initial tests were performed to establish baseline performance data for both propylene and ethylene glycol solutions. In future studies, this baseline will be used to evaluate the effectiveness of various commercial additive packages to the water-glycol mixtures. (Author)

A82-24294 The effect of degradation of glycols on corrosion of metals used in non-concentrating solar collectors. J. A. Beavers and R. B. Diegle (Battelle Columbus Laboratories, Columbus, OH). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper*. 24 p. 8 refs. Contract No. DE-AC04-79CS-10510.

Chemical degradation of aqueous ethylene glycol and propylene glycol solutions has been investigated at 100 and 180 C in solutions containing metals currently considered for use in nonconcentrating solar collectors, namely, copper, steel, and aluminum. It is shown that degradation of ethylene glycol and propylene glycol during simulated solar collector operating conditions is catalyzed by the presence of metals, resulting in the formation of acidic byproducts and a reduction of pH. This, in turn, accelerates corrosion of the metals studied. It is concluded that corrosion inhibitors and buffering agents are necessary in order to attain a reasonable design life of 10 to 20 years for nonconcentrating solar collector systems. V.L.

A82-24298 * Development of an accelerated reliability test schedule for terrestrial solar cells. J. W. Lathrop and J. L. Prince (Clemson University, Clemson, SC). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper*. 20 p. Research sponsored by the U.S. Department of Energy and NASA.

An accelerated test schedule using a minimum amount of tests and a minimum number of cells has been developed on the basis of stress test results obtained from more than 1500 cells of seven different cell types. The proposed tests, which include bias-temperature, bias-temperature-humidity, power cycle, thermal cycle, and thermal shock tests, use as little as 10 and up to 25 cells, depending on the test type. V.L.

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A82-24299 * Atmospheric corrosion model and monitor for low cost solar arrays. D. H. Kaelble, F. B. Mansfeld, S. L. Jeanjaquet, and M. Kendig (Rockwell International Science Center, Thousand Oaks, CA). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper, 13 p.* 5 refs. Research sponsored by the U.S. Department of Energy, Contract No. JPL-954739.

An atmospheric corrosion model and corrosion monitoring system has been developed for low cost solar arrays (LSA). The corrosion model predicts that corrosion rate is the product of the surface condensation probability of water vapor and the diffusion controlled corrosion current. This corrosion model is verified by simultaneous monitoring of weather conditions and corrosion rates at the solar array test site at Mead, Nebraska. (Author)

A82-24589 * Forced convection heat transfer for two-phase helical flow in a solar receiver. J. R. Dunn and F. N. Vafaie (Texas Tech University, Lubbock, TX). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/HT-13.* 9 p. 9 refs. Members, \$2.00; nonmembers, \$4.00. Research supported by the U.S. Department of Energy.

The heat transfer characteristics of a single-tube, helically coiled receiver for a concentrating solar collector are presented. Heat transfer coefficients were measured for single- and two-phase water-stream flow in a helical coil subjected to radiant heating for a range of flow conditions and radiant flux levels. Results are presented for both the local and average heat transfer coefficients in several flow regimes and the results correlated with non-dimensional, geometric, fluid, and flow parameters. (Author)

A82-24605 : Method of testing solar collectors for determination of heat transfer parameters. A. R. Shouman and I. A. Tag (New Mexico State University, Las Cruces, NM). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-2* 5 p. 6 refs. Members, \$2.00; nonmembers, \$4.00. Research supported by the University of Petroleum and Minerals.

An experimental program is developed for including the temperature measurements of the absorber plate at the fluid inlet and outlet locations for inclusion in theoretical analyses of the heat transfer parameters of a flat plate solar collector. The steady-state one-dimensional equation for the fluid temperature, the actual plate temperature for a uniform flow collector, and a characteristic temperature for a uniform flow in the collector tubes are considered. The Hottel-Whillier, and Bliss solution (1958, 1959) is shown to neglect axial conduction in the fluid and the receiver, and a method is found for correct calculation for the effective transmittance-absorptance product, which is crucial for determining the efficiency of the collector. End losses are also observed to be significant, and it is recommended that measurements of inlet and outlet temperatures be performed in order to separate the heat transfer parameters.

M.S.K.

A82-24606 # On reducing convective losses from cover glazings of solar thermal collectors. P. Raghuraman and D. Kon (MIT, Lexington, MA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-3.* 8 p. 21 refs. Members, \$2.00; nonmembers, \$4.00. Research supported by the U.S. Department of Energy.

Convective heat losses from cover glazings of solar thermal collectors are reduced by forming perpendicular crisscross rectangular grooves on the glazing which cause the air flow to form recirculating zones in the grooves. Experiments on the effects of varying groove geometry show that the cover glazing convective heat transfer coefficient can be reduced by a factor of four or better. Results of the experimental and analytical work and a description of the design considerations in optimizing the groove geometry are presented. (Author)

A82-24607 # Heat transfer characteristics of a back-corrugated absorber surface for solar air collectors. K. A. Shockey, J. T. Pearson, and D. P. DeWitt (Purdue University, West Lafayette, IN). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-5.* 6

p. 8 refs. Members, \$2.00, nonmembers, \$4.00. Contract No. EM-78-C-04-5366.

The present study experimentally examines a back-corrugated absorber-convector comprised of a rectangularly corrugated plate attached to the back side of a flat absorber plate with a high temperature, high strength adhesive. The upper surface is subjected to a heat flux from a blanket-type electric heater simulating solar irradiation. The corrugated plate configuration creates two parallel airflow channel types. The two channels have different geometries and, therefore, may have different heat transfer characteristics. An apparatus was designed to determine the local convective heat transfer coefficients along each of the channels. The results show that the back-corrugated absorber-convector has much better thermal performance than the simple flat-plate absorber-convector, mainly because of the increased convective heat transfer area. (Author)

A82-24608 # On the weathering of thin plastic films. H. Cheng and R. B. Bannerot (Houston, University, Houston, TX). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-6.* 9 p. 11 refs. Members, \$2.00, nonmembers, \$4.00.

Results and procedures of an ongoing testing program to determine the weatherability of thin film plastic covers for use in flat plate solar collectors are reported. The program was designed to isolate the effects of the environment, insolation, i.e. UV radiation, thermal radiation, and mechanical forces. Actual outdoor operating conditions were used to avoid inaccuracies previously obtained using accelerated conditions or thick plastic sheets. Solar transmittance of collector candidate materials was determined from radiance monitoring, angle of incidence, spectral measurements, and consideration was given to synergistic effects of various weathering mechanisms. The design and fabrication of outdoor testing apparatus are described, with examples of trials of a 0.025 mm sheet of fluorinated copolymer FEP and a 0.1 mm thick sheet of polyvinyl fluoride. Samples were cut every month and analyzed. Thermal effects were found to contribute 80% of the transmittance degradation, with summer degradation showing the highest rates. UV radiation was found to have little effect on degradation rates. M.S.K.

A82-24609 # Actual versus predicted performance of an active solar heating system - A comparison using FCHART 4.0. P. E. Wetzel (Automation Industries, Inc., Silver Spring, MD). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-7.* 9 p. Members, \$2.00; nonmembers, \$4.00. Contract No. DE-AC01-79CS-30027.

The performance of an active solar heating system added to a house in Denver, CO was compared with predictions made by the FCHART 4.0 computer program. The house featured 43.23 sq m of collectors with an ethylene-glycol/water heat transfer fluid, and a 3.23 cu m storage tank. The house hot water was preheated in the storage tank, and home space heat was furnished whenever the storage water was above 32 C. Actual meteorological and heating demand data were used for the comparison, rather than long-term averages. Although monthly predictions by the FCHART program were found to diverge from measured data, the annual demand and supply predictions provided a good fit, i.e. within 9%, and were within 1% of the measured solar energy contributed to storage. M.S.K.

A82-24610 # Passive cooling measurements for a concentrating photovoltaic array. F. K. Deaver (Arkansas, University, Fayetteville, AR) and M. W. Edburn (Sandia National Laboratory, Albuquerque, NM). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-10.* 5 p. Members, \$2.00; nonmembers, \$4.00. Research supported by the U.S. Department of Energy.

Solar cells in a concentrating photovoltaic array absorb heat that must be removed. One method is to use a finned aluminum heat exchanger whose modeling requires estimating the coefficient of heat transfer from fins to surroundings; transfer depends on such parameters as wind speed and direction, and exchanger design. A transient analytical model has been constructed and applied to experimental data. Coefficients of heat transfer were calculated and correlated with wind speed and direction, which appear to have a definite effect on the overall coefficient. The transient model and

apparent relationships between wind speed and convective coefficients are described. (Author)

A82-24611 # Systematic rotation and receiver location error effects on parabolic trough annual performance. G. W. Treadwell and N. R. Grandjean (Sandia National Laboratory, Albuquerque, NM). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-12.* 5 p. 7 refs. Members, \$2.00; nonmembers, \$4.00.

The effects of systematic geometrical design errors and random optical errors on the accuracy and subsequent economic viability of solar parabolic trough concentrating collectors were studied to enable designers to choose and specify necessary design and material constraints. A three-dimensional numerical model of a parabolic trough was analyzed with the inclusion of errors of pointing and mechanical deformation, and data from a typical meteorological year. System errors determined as percentage standard deviations provided the range of a study for systematic rotation and receiver location errors. The two types of errors were found to produce compounded effects. It is concluded that the designer must choose performance levels which take into account existence of errors, must know to what level the errors can be eliminated and at what cost, and should make provisions for monitoring the day-to-day on-line focus of the troughs. M.S.K.

A82-24612 # Design, fabrication, and evaluation of an innovative woven-screen solar collector. J. A. Bryant, R. R. Clark (New Mexico State University, Las Cruces, NM), and I. A. Tag (Oak Ridge National Laboratory, Oak Ridge, TN). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-13.* 3 p. 6 refs. Members, \$2.00, nonmembers, \$4.00.

A low-cost woven screen solar air collector is described, and performance and costs are compared with conventional flat-plate collectors. A wire screen mesh is mounted in the center of a collector, between the glazing and the insulated back surface, and PVC pipe inlets allow air flow into the collector from above the mesh. A central outlet duct receives the heated air beneath the mesh. A 16.3 sq ft collector features an efficiency of nearly 50%, with a pressure drop of 0.5 in. at a mass flow rate of 279.4 lbm/hr. A lifetime of 5-7 yr is expected with a unit which costs \$150, with a per foot cost of \$9.10/sq ft as compared with currently marketed solar air collectors at \$15.90/sq ft. The lower pressure drop is noted to allow lower power requirements for a circulating fan. M.S.K.

A82-24613 # The effect of nonuniform fluid flow distribution on the thermal performance of solar collector. J. P. Chiu (Detroit, University, Detroit, MI). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-14.* 9 p. 20 refs. Members, \$2.00; nonmembers, \$4.00.

The effect of flow nonuniformities due to pipe clogging, misplaced pipe headers, and poor design of solar flat plate collectors is considered analytically for 16 different flow maldistributions. The inlet and outlet tubes are assumed to be connected to headers on the flat plates, resulting in a parallel flow in the fluid circuit. Governing equations are defined for the absorber plate and heat transfer fluid, along with suitable boundary conditions, and numerical solutions are obtained. Collector efficiency is determined for uniform and nonuniform flow condition to set a collector efficiency deterioration factor. The effect of longitudinal heat conduction was found to be negligible, and flow nonuniformities were observed to always cause performance deterioration in flat plate collectors, ranging from 2-20% of the thermal efficiency, and depending on the pattern of flow disturbance. M.S.K.

A82-24614 # Thermal analysis of a solar pond power plant operated with a direct contact boiler. A. Sonn and R. Letan (Negev, University, Beersheba, Israel). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-15.* 10 p. 11 refs. Members, \$2.00, nonmembers, \$4.00. Research supported by the Ministry of Energy of Israel.

A solar pond power plant operated with a direct contact boiler was thermally analyzed. A binary cycle system of concentrated brine, and an organic working fluid were considered. Brine temperature of 80 C, condensation at 30 C, a 75 percent efficient turbine,

and 70 percent efficient pumps were specified for the analysis. The current study involved six working fluids: butane, pentane, hexane, and freons R113, R114, R12. Each of these fluids exhibited a maximum efficiency of the system at characteristic operating conditions of the boiler. The system efficiency increased as the boiler pressure approached that of the pond. Net electrical outputs of 7-9 percent of the heat inputs were obtained for the low pressure fluids, such as pentane, hexane, and R113. Gravity flow of brine to boiler increased these values to 8-11 percent. Solute losses in brine by direct contact in boiler were estimated for pentane, as 125 kg per year per sq km of pond, or 63 kg/MWe-year. Similar orders of magnitude are obtained for the other fluids. (Author)

A82-24615 # Effects of friction and extraction on the stability of solar ponds. Y. S. Cha, W. T. Sha (Argonne National Laboratory, Argonne, IL), and S. L. Soo (Illinois, University, Urbana, IL). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-16.* 10 p. 23 refs. Members, \$2.00, nonmembers, \$4.00. Contract No. W-31-109-eng-38.

Theoretical stability analyses are compared with experimental and theoretical results on the effects of internal barriers and stratification on solar pond performance. Stability criteria are defined, and the use of walls in the gradient zone are demonstrated to permit lower salt concentrations with no loss in performance, although stable operating ranges were close to unstable levels. Additionally, the use of perforated walls is shown to increase internal friction, assuring a stable nonconvective gradient layer. The feasibility of withdrawal of heated liquid from the bottom layer is proven to not damage the longitudinal stability as long as the rate of withdrawal is within the ranges of laminar motion. An example is provided for the case of withdrawal in the absence of solar input, and it is concluded that the introduction of perforated boundaries may permit the operation of solar ponds without salt gradients. M.S.K.

A82-24616 # The potential economic benefit of using parabolic trough collectors to supplement power cycle boilers. W. P. Schimmel, Jr. and L. L. Lukens (Sandia National Laboratory, Albuquerque, NM). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-17.* 7 p. 9 refs. Members, \$2.00; nonmembers, \$4.00. Research supported by the U.S. Department of Energy.

An economic analysis is presented for a combined parabolic trough solar/fossil fuel hybrid power plant. Applications are considered for investor-owned utilities and industries with stockholders and bond purchasers. Annual levelized revenues are calculated, based on the capital cost of equipment, annual operations and maintenance, and a rising cost of fossil fuel. The units of heat are considered as equal in value from each source, and project return on equity for an American Southwest user of the hybrid systems are calculated to show an annual project return on equity of 21% for a utility and 25% for an industry in 1985. Analysis of the total fuel replaced by a solar reheat system for a gas-fueled boiler system shows that a 20% reduction in fuel costs can be obtained by a 10% increase in the plant costs to include the solar reheat system furnishing low-temperature heat in 1985. M.S.K.

A82-24617 # Comparison of test results for flat plate, transpired flat plate, corrugated, and transpired corrugated solar air heaters. S. J. Rhee and D. K. Edwards (California, University, Los Angeles, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-18.* 8 p. 26 refs. Members, \$2.00; nonmembers, \$4.00. Contract No. DE-FG04-77CS-34088.

Results from tests to demonstrate technical improvements from transpiring and/or corrugating a selective black absorber plate solar air collector are reported. A literature review is presented, and the specific working components of transpired and nontranspired flat and corrugated absorbers are provided, including transpiration through slots, a microperforated plate, a corrugated plate, and a transpired, slotted, corrugated plate. Inlet and outlet temperatures were monitored, and inlet air was controlled, with trials covering temperatures of 38, 60, 82, and 104 C to test the effect of maintaining the fluid temperature close to the collector temperature. No differences were observed in running the collectors with corrugations vertically instead of horizontally, and the collector with

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transpiration through slots was found to display the lowest pressure drop. M.S.K.

A82-24620 * # Rankine engine solar power generation, I - Performance and economic analysis. A. A. Gossler and J. E. Orrock (Honeywell Technology Strategy Center, Roseville, MN). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-22.* 5 p. 6 refs. Members, \$2.00; nonmembers, \$4.00. NASA-supported research.

Results of a computer simulation of the performance of a solar flat plate collector powered electrical generation system are presented. The simulation was configured to include locations in New Mexico, North Dakota, Tennessee, and Massachusetts, and considered a water-based heat-transfer fluid collector system with storage. The collectors also powered a Rankine-cycle boiler filled with a low temperature working fluid. The generator was considered to be run only when excess solar heat and full storage would otherwise require heat purging through the collectors. All power was directed into the utility grid. The solar powered generator unit addition was found to be dependent on site location and collector area, and reduced the effective solar cost with collector areas greater than 400-670 sq m. The sites were economically ranked, best to worst. New Mexico, North Dakota, Massachusetts, and Tennessee. M.S.K.

A82-24621 # Rankine engine solar power generation, II - The power generation module. W. D. Batton and R. E. Barber (Barber Nichols Engineering Co., Arvada, CO). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-23.* 8 p. 7 refs. Members, \$2.00; nonmembers, \$4.00.

The characteristics and performance of a solar flat plate collector powered low temperature power generation module (PGM) funded by NASA are described. The PGM uses a halogen refrigerant as a working fluid, which is pumped from a reservoir to a chamber where it is heated by exchangers filled with an ethylene-glycol fluid which has gained thermal energy from a collector array. The heated refrigerant is allowed to expand through turbine blades and exits through a regenerative heater to condensation into the original well. The PGM was built mainly from off-the-shelf components, except for the turbo-gearbox, which was fabricated specifically for the PGM and attains the design goal of 80% efficiency, producing 13.8 kW at the design point. The components and controls are detailed, including start-up and shutdown, and safety procedures. The testing program is outlined, and 6000 hours of operating experience has resulted in a 7.2% efficiency. M.S.K.

A82-24622 * # Ceramic technology for solar thermal receivers. A. A. Kudirka and R. H. Smoak (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-24.* 9 p. 10 refs. Members, \$2.00; nonmembers, \$4.00. Research sponsored by the U.S. Department of Energy and NASA.

The high-temperature capability, resistance to corrosive environments and non-strategic nature of ceramics have prompted applications in the solar thermal field whose advantages over metallic devices of comparable performance may begin to be assessed. It is shown by a survey of point-focusing receiver designs employing a variety of ceramic compositions and fabrication methods that the state-of-the-art in structural ceramics is not sufficiently advanced to fully realize the promised benefits of higher temperature capabilities at lower cost than metallic alternatives. The ceramics considered include alumina, beryllia, magnesia, stabilized zirconia, fused silica, silicon nitride, silicon carbide, mullite and cordierite, processed by such methods as isostatic pressing, dry pressing, slip casting, extrusion, calendaring and injection molding. O.C.

A82-24623 # Assessment of generic solar thermal systems for large power applications. W. J. Apley and S. P. Bird (Battelle Pacific Northwest Laboratories, Richland, WA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-25.* 9 p. 12 refs. Members, \$2.00; nonmembers, \$4.00. Research sponsored by the U.S. Department of Energy.

An assessment and ranking of solar thermal power systems capable of producing over 10 MWe is presented as a basis for decisions by the DOE on which systems to continue funding. The systems were organized generically into two-axis tracking, one-axis tracking, and nontracking systems. Configurations were ranked on the basis of lowest energy cost. Some form of concentration was found to be necessary for stationary collectors to achieve acceptable conversion efficiencies. Plant sizes of 50, 100, and 200 MWe, were analyzed with the energy output coupled to a plant capacity factor. Estimates included requirements of grid interconnection, strictly electric output, and using Barstow, CA climatological data summaries. The point focus central receiver with Rankine cycle displayed the highest ranking for electricity costs coupled with plant capacity factor, while the point focus distributed receiver with either Rankine or Brayton cycles were highest with no storage. M.S.K.

A82-24624 * # Comparison of electrochemical and thermal storage for hybrid parabolic dish solar power plants. H. L. Steele and L. Wen (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-27.* 8 p. 12 refs. Members, \$2.00; nonmembers, \$4.00. Research sponsored by the U.S. Department of Energy and NASA.

The economic and operating performance of a parabolic point focus array of solar electricity generators combined with either battery or thermal energy storage are examined. Noting that low-cost, mass-producible power generating units are under development for the point focus of distributed dishes, that Zn-CI battery tests will begin in 1981 and a 100 kWh Na-S battery in 1983, the state of thermal storage requires acceleration to reach the prototype status of the batteries. Under the assumptions of 10,000 units/yr with an expected 30 yr lifetime, cost comparisons are developed for 10 types of advanced batteries. A 5 MWe plant with full thermal or 80% battery storage discharge when demand occurs in conditions of no insolation is considered, specifically for Fe-Cr redox batteries. A necessity for the doubling of fuel prices from 1980 levels by 1990 is found in order to make the systems with batteries economically competitive. M.S.K.

A82-24625 # Optimization of a hybrid solar thermal power system. R. E. Irwin, D. A. Rodriguez, and R. L. Pons (Ford Aerospace and Communications Corp., Aeronutronic Div., Newport Beach, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-28.* 6 p. 6 refs. Members, \$2.00; nonmembers, \$4.00.

An optimized collector area/storage medium is modeled for applications of a 1 MWe solar electric plant for a prototype Community Solar Experiment power module. The battery storage system considered is the lead-acid and sodium-sulfur batteries, and an annualized capacity factor of unity is set as the goal for the combined system, including supplemental fuel burning. A total of 90 parabolic point focus dish concentrators were calculated to be necessary to achieve the unity goal with storage to maintain peak power through the night. A necessity of storing summer derived energy for the winter is noted, as is a substantial unit cost of power delivery reduction through the use of sodium-sulfur batteries. Site dependent studies were carried out for locations in Missouri, Nevada, and California, showing a significant cost of power increase for the MO site. Finally, it is concluded that maximum energy storage is not economical, while extra winter collectors are. M.S.K.

A82-24626 # Performance evaluation for a jet pump solar cooling system. F. Zeren and R. E. Holmes (Texas A & M University, College Station, TX). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-30.* 8 p. 20 refs. Members, \$2.00; nonmembers, \$4.00. Research supported by the Texas Energy and Natural Resources Advisory Council.

Features and performance of a solar flat-plate powered jet pump building cooling system are presented, along with a computer model of the system. Freon-12 is both primary and secondary fluid, and is mixed in the jet pump for routing through a condenser, after which separation occurs and fluid is routed back through the collectors and back to the room cooling loop. Thermodynamic properties of the Freon-12 coolant are incorporated into the computer model, along with weather data for the test program in College Station, TX. The

condenser, collector, and evaporator temperatures were found to be most important in the functioning of a jet pump cooling system, with a collector temperature range of 170-210 F providing the best performance. Lower condenser temperatures were found to increase the performance efficiency and minimize the required collector area.

M.S.K.

A82-24627 # Methodology to determine cost and performance goals for active solar cooling systems. M. L. Warren and M. Wahlig (California, University, Berkeley, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov, 15-20, 1981, Paper 81-WA/Sol-32*. 8 p. 13 refs. Members, \$2.00; nonmembers, \$4.00. Contract No. W-7405-eng-48.

Systems analysis is used to calculate the 20 yr. present value of energy savings of solar cooling systems located in Texas, Arizona, Florida, and Washington, DC, and methods of solar system development to meet the cost goals of economic operation are outlined. Solar cooling systems are projected to begin commercial entry in 1986 and reach 20% of the total cooling market by the year 2000, producing 0.14 quads of displaced energy. A numerical simulation was carried out for both residential and commercial solar cooling units with consideration for system cost goals, cost goals per unit collector area, and the cost goals per ton of cooling. System size was targeted as a 3 ton residential chiller and a 25 ton commercial absorption cooling unit. The costs for volume production are provided, along with trends for an incrementally decreasing need for tax incentives, ending in about 1994.

M.S.K.

A82-24628 * # Experimental simulation of latent heat thermal energy storage and heat pipe thermal transport for dish concentrator solar receiver. R. Narayanan, W. F. Zimmerman (General Electric Co., Advanced Energy Programs Dept., Cincinnati, OH), and P. T. Y. Poon (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov, 15-20, 1981, Paper 81-WA/Sol-34*. 6 p. 7 refs. Members, \$2.00, nonmembers, \$4.00. Research sponsored by the U.S. Department of Energy; Contract No. JPL-955388.

Test results on a modular simulation of the thermal transport and heat storage characteristics of a heat pipe solar receiver (HPSR) with thermal energy storage (TES) are presented. The HPSR features a 15-25 kWe Stirling engine power conversion system at the focal point of a parabolic dish concentrator operating at 827 C. The system collects and retrieves solar heat with sodium pipes and stores the heat in NaF-MgF₂ latent heat storage material. The trials were run with a single full scale heat pipe, three full scale TES containers, and an air-cooled heat extraction coil to replace the Stirling engine heat exchanger. Charging and discharging, constant temperature operation, mixed mode operation, thermal inertial, etc. were studied. The heat pipe performance was verified, as were the thermal energy storage and discharge rates and isothermal discharges.

M.S.K.

A82-24867 † 200-W solar photoelectric system based on AlGaAs heterostructure solar cells and mirror concentrators (Solnechnaia fotoelektricheskaia ustanovka moshchnost'iu 200Vt na osnove AlGaAs-geterofotoelementov i zerkal'nykh kohtsentratorov). Zh. I. Alferov, V. M. Andreev, Kh. K. Aripov, V. R. Larionov, and V. D. Rumiantsev (Akademiiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). *Geliotekhnika*, no. 6, 1981, p. 3-6. In Russian.

A 200-W solar system is described which uses nGaAs-pGaAs-pAl(x)Ga(1-x)As heterostructure cells, with an AlGaAs layer thickness of 25-30 microns. The concentrators used in the system are parabolic mirrors with a 50-cm focus. Results on the load volt-ampere characteristics for an individual module and for the system as a whole are presented. It is concluded that it should be possible to significantly increase the output power of such systems.

B.J.

A82-24868 † New possibilities for the development and optimization of cascade-type solar cells (O novykh vozmozhnostiakh postroeniia i optimizatsii kaskadnykh solnechnykh elementov). M. B. Kagan and T. L. Liubashevskaja (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotekhnika*, no. 6, 1981, p. 7-15. 16 refs. In Russian.

Various aspects of the development of cascade-type solar cells are discussed, including the optimal combination of semiconductor

materials and limits on the efficiency of cascade systems; and the development of cascade cells on the basis of optimized heterostructures. Particular attention is given to two cascade-type systems: the GaAs-Ge (pGa/1-x)Al(x)As-pGaAs-nGaAs-nGe-pGe system, and the three-cascade Ga(1-x)Al(x)-GaAs-Ge system.

B.J.

A82-24869 † Choice of design parameters for prism-type solar concentrators (Vybor konstruktivnykh parametrov prizmennykh kontsentratorov solnechnoi energii). E. V. Tver'ianovich (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotekhnika*, no. 6, 1981, p. 16-19. In Russian.

After a brief discussion of the operation of prism-type concentrators, the paper examines the choice of design parameters for them. Attention is given to such design parameters as the type of prism concentrator, the concentrator factor, the material, and the prism dimensions.

B.J.

A82-24870 † Investigation of the thermal-engineering characteristics of a solar collector with a selective coating and vacuum heat-insulation (Issledovanie teplotekhnicheskikh kharakteristik solnechnogo kolektora s selektivnym pokrytiem i vakuumnoi teploizliatsiei). T. Baimatov, N. Ch. Dursunov, G. Ia. Umarov, and U. Kh. Gaziev (Akademiiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 6, 1981, p. 25-27. 7 refs. In Russian.

Experimental results are presented on the characteristics of a solar collector with a selective coating and vacuum heat-insulation. The maximum temperature of the heat-transfer agent at the collector output was 131 C; the output power density was 320 W/sq m for an emissivity of the transparent screen of 0.9; the emissivity of the receiver with the selective coating was 0.1, the absorption coefficient of the receiver was 0.9; the maximum temperature drop at the ends of the heat exchangers was 10 C. The use of an aluminum foil placed below the receiver increased the temperature of the heat-transfer agent at the collector output by 10-13 C.

B.J.

A82-24871 † Investigation of the natural-climatic aging of the reflective films of mirrors by an electrical method (Issledovanie estestvenno-klimaticheskogo starenia otrazhaiushchikh plenok zerkal elektricheskim metodom). A. Ismanzhanov, L. A. Dubrovskii, and R. A. Zakhidov (Akademiiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). *Geliotekhnika*, no. 6, 1981, p. 37-40. 6 refs. In Russian.

Tests were performed to evaluate the natural-climatic aging of reflective aluminum films for solar mirrors. Electrical-resistance measurements were made on unprotected aluminum films and films protected by SiO(x), SiO₂, Al₂O₃, and lacquer coatings. This made it possible to determine the amount of age-related damage experienced by the reflective films, and, in particular, to examine the transition of the film from a matrix type system (where the undamaged part of the film serves as the matrix) to a statistical type system.

B.J.

A82-24940 A new look at the discrete ordinate method for radiative transfer calculations in anisotropically scattering atmospheres. II - Intensity computations. K. Stamnes and H. Dale (Alaska, University, Fairbanks, AK). *Journal of the Atmospheric Sciences*, vol. 38, Dec. 1981, p. 2696-2706. 9 refs. NSF Grants No. ATM-79-23266, No. ATM-79-26406.

The recently developed matrix method to solve the discrete ordinate approximation to the radiative transfer equation in plane parallel geometry is extended to compute the full azimuthal dependence of the intensity. Comparing computed intensities with those obtained by other established methods, it is found that for phase functions typical of atmospheric haze 32 streams are sufficient for better than 1% agreement, while 16 streams yield an accuracy of about 1-5% except for angles close to the forward and backward directions for which the error is about 10-15%. The results of the intensity computations are summarized by presenting three-dimensional stack plots of the intensity as a function of polar and azimuthal angles. (Author)

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A82-25110 Asymmetric second-stage concentrators. E. M. Kritchman (Chicago, University, Chicago, IL). *Applied Optics*, vol. 21, Mar. 1, 1982, p. 870-873. 7 refs.

It is demonstrated that asymmetric ideal second-stage concentrators may be designed for any given concentrator and absorber (within certain limits) and hence may be used in the field of solar energy to eliminate the shading of the primary by the secondary stage. An application involving an off-acceptance angle concentrator in which the primary is not shaded by the secondary from the illuminating source is examined. V.L.

A82-25223 Solar cells: Operating principles, technology, and system applications. M. A. Green (New South Wales, University, Kensington, Australia). Englewood Cliffs, NJ, Prentice-Hall, Inc., 1982. 288 p. 153 refs. \$28.

Solar cell theory, materials, fabrication, design, modules, and systems are discussed. The solar source of light energy is described and quantified, along with a review of semiconductor properties and the generation, recombination, and the basic equations of photovoltaic device physics. Particular attention is given to p-n junction diodes, including efficiency limits, losses, and measurements. Si solar cell technology is described for the production of solar-quality crystals and wafers, and design, improvements, and device structures are examined. Consideration is given to alternate semiconductor materials and applications in concentrating systems, storage, and the design and construction of stand-alone systems and systems for residential and centralized power generation. M.S.K.

A82-25237 Selective optical surfaces for solar energy converters. M. M. Koltun (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) New York, Allerton Press, Inc., 1981. 244 p. 213 refs. Translation. \$42.50.

Optical surfaces and coatings with selective spectral characteristics are studied with reference to solar cells and arrays for power generation in space and on the ground. Detailed optical, electrical, and thermal properties are given for solar energy concentrators, radiators, transparent thermoreflexive windows, and thermal collectors. It is shown that selective surfaces make it possible to collect up to 90% of the energy contained in the incident solar radiation and to increase the efficiency of photovoltaic generators by 50%. The service life of solar arrays can be increased through the use of selective coatings by a factor of up to several hundreds. V.L.

A82-25501 Optimization of the functional domain of flat plate collectors (Recherche du meilleur domaine d'utilisation des capteurs solaires plans usuels). G. Ritoux and J.-L. Irigaray (Clermont-Ferrand II, Université, Aubière, Puy-de-Dôme, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1981, p. 8-11. In French.

The variations of the extracted heat flux as function of the temperature of the heat transfer fluid in black and selective surface solar collectors are examined. The heat flux is calculated based on the difference of the initial to the stage of thermal equilibrium of the fluid. A nonlinear system of equations is developed and solved by a fast, iterative method to obtain the equilibrium temperatures. It is found that more flux can be extracted from the solar heat by a collector with only one glass cover than with more than one cover. The captured flux is proportional to the coefficient of transmission of the glass coverings, to the coefficient of absorption of the collector, and to the incident flux. Black painted surfaces were more absorbent than selective surfaces, and highest collection efficiencies were displayed by low temperature collectors. Charts of effective uses of the respective types of collectors for heating swimming pools, hot water, home heat, and for refrigeration and air-conditioning are provided. M.S.K.

A82-25503 Use of a photodiode array for the analysis of the solar profile intensity in concentrating collectors. C. Bellecci, G. Garofalo, C. Pontiggia (Calabria, Università, Cosenza, Italy), G. A. Rottigni, and R. Visentin (Genova, Università, Genoa, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1981, p. 29-32.

A photodiode array for measuring the light distribution in a cross section of the focal zone of solar concentrator assembly is presented. The photosensors are coupled to electronic circuits for conversion into a display on a CRT screen. The array consists of 24

photodiodes mounted linearly on a 10 cm strip, with each photodiode having an effective area of 9 sq mm. Light attenuators ranging up to 10,000 have been mounted on the photodiodes by vacuum deposition to avoid excess currents in the array, and circuitry switching allows photon counting for formation of histograms representing all 24 photodiodes. Examples are provided for applications with a biaxial parabolic mirror featuring aspirated reflecting lamina and a parabolic trough concentrator with a 2.5 m aperture. M.S.K.

A82-25504 REA, a solar breeder reactor with high energetic enhancement factor - Technoeconomic analysis. R. Visentin (Calabria, Università, Cosenza, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1981, p. 33-36.

Noting that the main character of a renewable energy system is a higher energy yield than the energy necessary to produce the system, a solar breeder installation, REA, is described. A numerical analysis is presented which determines the thermodynamic and climatological constraints which bound a satisfactory energy payback for a solar system. REA is composed of 20 linear parabolic concentrator collectors, each 52 m long, with 125 sq m collecting area. The system produces both electricity and thermal power, and the energy costs of the materials and processes needed to fabricate the system are compared to the energy payback of the system over its lifetime and the possibility of utilizing the materials at the end of the plant life. The comparison is made on the basis of 0.85 kW/sq m for at least one hr/day, showing a satisfactory energy payback with less than a total of 1000 hr insolation/yr. M.S.K.

A82-25505 Solar multiple purpose power plant in modular superlight weight construction. J. Kleinwachter. *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1981, p. 37-41. 9 refs.

The use of aluminized membranes to form low-cost low-weight solar parabolic concentrators for thermal power production is described, including the practice of covering the concentrators with a transparent enclosure for protection from the weather. Stretching the plane mirror foils over a hollow, drum-shaped body permits production of a slight under- or overpressure inside the drum to deform the foil into a suitable approximation of a parabolic dish. Electric fields and magnetic field have yielded results equivalent to the pneumatic method, and fluorine-based synthetics for the foil are showing the best durability and forming characteristics. Applications involving 3 m and 10 m dishes and a Sterling engine have produced 3.75 and 40.7 kWt at the hot spot, respectively. The optical performance is summarized as an 800 W/sq m flux reduced to 720 W/sq m after traversing the enclosure, and 518 W/sq m reflected from the paraboloid. M.S.K.

A82-25548 Solar cell performance with an inhomogeneous areal distribution but constant number of recombination centers. R. O. Bell (Mobil Tyco Solar Energy Corp., Waltham, MA). *Solid-State Electronics*, vol. 25, Feb. 1982, p. 175, 176.

The performance of a solar cell is dependent not only on the number of recombination sites but also on their areal distribution. Calculations show that, with a fixed number of sites, an inhomogeneous distribution can produce a cell with a higher efficiency than one in which the same centers are uniformly distributed. (Author)

A82-25664 * Solar-pumped electronic-to-vibrational energy transfer lasers. W. L. Harries (Old Dominion University, Norfolk, VA) and J. W. Wilson (NASA, Langley Research Center, Hampton, VA). *Space Solar Power Review*, vol. 2, no. 4, 1981, p. 367-381. 12 refs. Grant No. NsG-1568.

The possibility of using solar-pumped lasers as solar energy converters is examined. The absorbing media considered are halogens or halogen compounds, which are dissociated to yield excited atoms, which then hand over energy to a molecular lasing medium. Estimates of the temperature effects for a Br₂-CO₂-He system with He as the cooling gas are given. High temperatures can cause the lower energy levels of the CO₂ laser transition to be filled. The inverted populations are calculated and lasing should be possible. However, the efficiency is less than 0.001. Examination of other halogen-molecular lasing combinations (where the rate coefficients

are known) indicate efficiencies in all cases of less than 0.005.

(Author)

A82-25738 Photoelectrochemical performance of ZnSe/CdSe thin film electrodes in aqueous polysulfide electrolyte. M. A. Russak and J. Reichman (Grumman Aerospace Corp., Research Dept., Bethpage, NY). *Electrochemical Society, Journal*, vol. 129, Mar. 1982, p. 542-545. 19 refs. Contract No. XP9-8002-8.

ZnSe/CdSe heterostructure thin film electrodes were produced by ternary elemental vacuum evaporation. These electrodes behaved similarly to MIS type devices when tested photoelectrochemically. Auger depth profiling indicated the formation of an electrochemically generated ZnS interface layer that provided an enhanced open-circuit voltage compared to CdSe alone. Efficiencies as high as 5.4% under simulated AM2 conditions were recorded for these electrodes. (Author)

A82-25739 Study of stabilization and surface recombination on n-GaP photoelectrodes - Mechanisms and interrelation. D. Vanmaekelbergh, W. P. Gomes, and F. Cardon (Gent, Rijksuniversiteit, Ghent, Belgium). *Electrochemical Society, Journal*, vol. 129, Mar. 1982, p. 546-550. 10 refs.

The competition has been studied between three processes occurring with photogenerated holes at the n-GaP/aqueous electrolyte interface, i.e., reaction with Fe(2+) ions, reaction with GaP itself, and surface recombination. The experimental method used was the rotating ring-disk technique. The influence of the reducing agent concentration, of the light intensity, and of the electrode potential was investigated. The results can be interpreted on the basis of models, in which the stabilization process, and under certain circumstances also the recombination process, takes place through surface intermediates of the photoanodic decomposition reaction.

(Author)

A82-25741 Porous silicon oxide anti-reflection coating for solar cells. A. Prasad, S. Balakrishnan, S. K. Jain, and G. C. Jain (National Physical Laboratory of India, New Delhi, India). *Electrochemical Society, Journal*, vol. 129, Mar. 1982, p. 596-599. 12 refs.

A very useful anti-reflection (AR) coating, having characteristics quite similar to silicon monoxide, has been grown on P(+)-N solar cells by a simple technique. ESCA, infrared absorption, and ellipsometry analysis of the films indicated that they consist of silicon oxide with some bound hydrogen. Some added advantages of the new AR coating are described. (Author)

A82-25782 A study of water electrolysis with photovoltaic solar energy conversion. C. Carpetis (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). *International Journal of Hydrogen Energy*, vol. 7, no. 4, 1982, p. 287-310. 7 refs.

The performance of the hydrogen production system consisting of the photovoltaic array and the water electrolysis unit is studied. The results of the calculation are compared with available experimental data and the performance of a hydrogen production plant by means of photovoltaic solar energy conversion is determined for two typical locations. A method for the estimation of the power matching conditions of the system solar array electrolysis unit is formulated to allow conclusions of general validity. (Author)

A82-25973 † Automatic control of solar power plants (Automaticheskoe upravlenie solnechnymi elektrostantsiyami). V. S. Ermakov and V. M. Dubilovich. *Inzhenerno-Fizicheskii Zhurnal*, vol. 42, Feb. 1982, p. 320-327. In Russian.

The automatic control of the heliostat field of a 200-MW solar power plant is discussed. The advantages of the decentralized control principle with the solution of a number of individual problems in a single control center are emphasized. The basic requirements on heliostat construction are examined, and possible functional schemes for the automatic control of a heliostat field are described. It is proposed that groups of heliostats can be controlled from a single center and on the basis of a single algorithm. B.J.

A82-26022 Optimal geometries of plane mirror solar collectors. H. P. Garg, J. K. Sharma, and A. Dang (Indian Institute of

Technology, New Delhi, India). *International Journal of Energy Research*, vol. 6, Jan.-Mar. 1982, p. 11-20. 5 refs.

This paper presents an analytical study of a stationary plane mirror solar concentrator. It is composed of an array of east-west oriented trapezoidal channels with two sided reflecting walls and a tubular absorber as a receiver at the base. The most practical design parameters for a trough like concentrator have been analyzed and identified. The one- and two-faceted plane side wall configurations with tubular receiver at the base of the trough have been studied in detail. It has been concluded that large savings in reflecting surfaces are possible while sacrificing some reduction in concentration. A theoretical prediction for the dependence of absorber efficiency on temperature has been obtained. (Author)

A82-26024 Thermodynamic analysis of solar thermochemical energy absorption. O. M. Williams (Australian National University, Canberra, Australia). *International Journal of Energy Research*, vol. 6, Jan.-Mar. 1982, p. 61-71. 12 refs.

Thermochemical energy conversion is analyzed on a thermodynamic basis, with special attention given to obtaining guidance on solar thermochemical absorber design at an early stage of development (when technical and cost information is often unreliable). A previously used thermodynamic equivalence technique that is equally applicable to both endothermic and exothermic reactions has been developed to the point where it gives a clear insight into all sources of heat and work. The method is applied to separating those endothermic reactions of which ammonia dissociation is a prime example. A reversibility ratio is defined as the ratio of irreversible work to reversible work. It is shown that in a practical solar thermochemical absorber design, the reversibility ratio should be minimized, corresponding to reaction temperature minimization and thus to lower energy losses and to potential for use of lower cost reactor materials and more active catalysts. C.R.

A82-26330 A new look at long term collector performance and utilizability. D. L. Evans, T. T. Rule, and B. D. Wood (Arizona State University, Tempe, AZ). *Solar Energy*, vol. 28, no. 1, 1982, p. 13-23. 27 refs. Contract No. DE-AC03-79CS-30203.

A simple technique has been developed to calculate monthly collection efficiency or monthly utilizability for solar thermal flat-plate collectors. It is applicable to south facing tilted collectors operating with a fixed fluid inlet temperature although extensions to other more generalized uses of utilizability are discussed. The heart of the technique is an empirically determined performance map that makes possible quick evaluations of changes in collector design, geographic location and collector inlet temperature. The collector input variables are those that are commonly measured in most thermal test procedures, geographic input variables are the mean monthly temperature and the Liu and Jordan clearness factor. The procedure was developed for monthly optimum fixed tilts but a simple correction can be made to incorporate arbitrary monthly fixed tilts. The method gives good results compared to long term hourly simulation and makes it possible to determine the operating conditions under which collector performance begins to depend on site-to-site solar radiation/weather variability and the uncertainties that can be expected from its use. (Author)

A82-26331 Black cobalt selective coatings by spray pyrolysis for photothermal conversion of solar energy. C. Choudhury and H. K. Sehgal (Indian Institute of Technology, New Delhi, India). *Solar Energy*, vol. 28, no. 1, 1982, p. 25-31. 13 refs.

A82-26332 Convective heat transfer in vee-trough linear concentrators. B. A. Meyer, J. W. Mitchell, and M. M. El-Wakil (Wisconsin, University, Madison, WI). *Solar Energy*, vol. 28, no. 1, 1982, p. 33-40. 9 refs. Research supported by the U.S. Department of Energy and University of Wisconsin.

Natural convection heat-transfer coefficients have been experimentally determined for trough-type collectors. The effects of Rayleigh number, tilt angle, and ideal concentration ratio on the Nusselt number have been experimentally determined over ranges representative of collector operation. The Rayleigh number range tested was up to 10,000,000, the tilt angle was varied from 30-90 deg and ideal concentration ratios of 2, 3, 4 and 5 were tested. The experimental results are supported by finite element solutions to the governing equations. A method of extending the results to truncated

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trough collectors and CPC collectors is suggested. The convective losses are compared to those for conventional flat plate collectors. The critical Rayleigh number increases with concentration ratio. Nusselt number increases more rapidly at high concentration ratio than at low values. Correlation equations are developed over the range of parameters tested. These results are useful to designers of collectors of this type, and allow estimation of the thermal losses during operation. (Author)

A82-26333 **Solar collector based on whisker-shaped oxides grown on metallic substrates.** L. R. Chapman (Union Carbide Corp., Nuclear Div., Oak Ridge, TN) and G. L. Vaneman (GM Research Laboratories, Warren, MI). *Solar Energy*, vol. 28, no. 1, 1982, p. 77-79. 19 refs.

A82-26334 **Tert-butyl alcohol as a heat sink substance for solar thermoelectric generators.** S. Wenham and H. J. Goldsmid (New South Wales, University, Kensington, Australia). *Solar Energy*, vol. 28, no. 1, 1982, p. 81.

A82-26335 **An evaluation of a transverse slatted flat plate collector.** K. I. Guthrie and W. W. S. Charters (Melbourne, University, Parkville, Victoria, Australia). *Solar Energy*, vol. 28, no. 2, 1982, p. 89-97. 18 refs.

The design, fabrication, and experimental tests with parallel slat convection suppression devices for eliminating convective heat losses in solar flat plate collectors are detailed. Consideration is given to numerical modelling the natural convection in an inclined cell, and laboratory tests were made to compare collectors with and without a glass slat honeycomb. Further outdoor tests were made on the same plates at angles of 33, 40, and 60 deg in Melbourne, Australia. Significant improvements in the collector performance were found with the use of the slat honeycomb, with values of up to 40% with collectors without selective absorbing surfaces. The slatted collector required reorientation every two months to compensate for the interception of the oncoming radiation by the absorber slats. Further tests of materials suitable for the slats are recommended. M.S.K.

A82-26337 **Dynamic analysis and control of a solar power plant. I - Dynamic analysis and operation criteria. II - Control system design and simulation.** C. Maffezzoni and F. Parigi (Ente Nazionale per l'Energia Elettrica, Centro Ricerca di Automatica, Milan, Italy). *Solar Energy*, vol. 28, no. 2, 1982, p. 105-128. 14 refs. Research supported by the European Economic Community.

A82-26338 **Decay of thermal stratification in a water body for solar energy storage.** Y. Jaluria (Rutgers University, New Brunswick, NJ) and S. K. Gupta (Indian Institute of Technology, Delhi, India). *Solar Energy*, vol. 28, no. 2, 1982, p. 137-143. 10 refs.

A82-26468 # **Duplication of radome aerodynamic heating using the Central Receiver Test Facility solar furnace.** R. K. Frazer (Johns Hopkins University, Laurel, MD). In: Symposium on Electromagnetic Windows, 15th, Atlanta, GA, June 18-20, 1980, Proceedings. Atlanta, GA, Georgia Institute of Technology, 1980, p. 112-116. 5 refs.

An experiment has been conducted that used the solar furnace at the Central Receiver Test Facility (CRTF) in Albuquerque, NM, to create flight-like temperatures in three supersonic missile radomes. The radomes tested have a von Karman profile, are made of Pyroceram 9606 about 0.25 in. thick, and have a fineness ratio of 2.1 with a base diameter of 13.5 in. The purpose of this effort was to measure the changes in radome boresight error (BSE) caused by aerodynamic heating. This paper describes the thermal aspects of the experiment, including the facility selection, heat flux survey measurements, temperature measurements made on a calibration radome, and calibration of optical pyrometers. (Author)

A82-26615 **Heat transfer coefficient for constant flow solar collector/storage systems.** S. Singh, S. S. Bhardwas, and N. K. Bansal (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 10, Feb. 1982, p. 151-158.

A82-26807 **Amorphous silicon p-i-n solar cells fabricated by reactive sputtering.** T. D. Moustakas and R. Friedman (Exxon

Corporate Research Laboratory, Linden, NJ). *Applied Physics Letters*, vol. 40, Mar. 15, 1982, p. 515-517. 10 refs. Contract No. XZ-9-9219.

The fabrication of indium-tin-oxide p-i-n amorphous silicon solar cells by the reactive sputtering method is reported. The solar cells exhibit a power conversion efficiency of 4.0% under AM1 illumination, and evidence is presented that the efficiency of the devices can be further improved to values comparable to those of glow discharge amorphous silicon. The diode properties of the devices are investigated by studying the dark I-V or photocurrent-photovoltage characteristics, and the junction characteristics are discussed. D.L.G.

A82-26950 **Thermal energy storage for solar power generation - State of the art.** K. N. Shukla (Indian Space Research Organization, Vikram Sarabhai Space Centre, Trivandrum, India). *Heat Transfer Engineering*, vol. 3, Oct.-Dec. 1981, p. 62-72. 46 refs.

High temperature storage for applications in solar-thermal electric systems is considered. Noting that thermal storage is in either the form of latent, sensible or chemically stored heat, sensible heat storage is stressed as the most developed of the thermal storage technologies, spanning direct heating of a storage medium from 120-1250 C. Current methods involve solids, packed beds, fluidized beds, liquids, hot water, organic liquids, and inorganic liquids and molten salts. Latent heat storage comprises phase-change materials that move from solid to liquid with addition of heat and liquid to solid with the removal of heat. Metals or inorganic salts are candidates, and the energy balances are outlined. Finally, chemical heat storage is examined, showing possible high energy densities through catalytic, thermal dissociation reactions. M.S.K.

A82-27010 **Effect of phosphorous and boron impurities on amorphous silicon solar cells.** T. D. Moustakas, R. Friedman, and B. R. Weinberger (Exxon Corporate Research Laboratory, Linden, NJ). *Applied Physics Letters*, vol. 40, Apr. 1, 1982, p. 587, 588. 6 refs. Contract No. XZ-9-9219.

The effect of dopant impurities (P,B) on the performance of sputtered alpha-SiH(x) solar cells has been investigated. It is found for example, that during the deposition of the N(+) layer of N(+)-I-Pt Schottky barrier structures, the chamber is contaminated with phosphorous which subsequently degrades the intrinsic film. This effect may be eliminated by prolonged pumping of the chamber between N(+) and I layer depositions or by 'compensating' the effects of phosphorous in the I layer through the intentional addition of low levels of boron. (Author)

A82-27012 **Band tail recombination limit to the output voltage of amorphous silicon solar cells.** T. Tiedje (Exxon Corporate Research Laboratory, Linden, NJ). *Applied Physics Letters*, vol. 40, Apr. 1, 1982, p. 627-629. 14 refs.

Recombination mediated by band tail states is shown to substantially reduce the maximum achievable output voltage in amorphous silicon hydride solar cells. The maximum open circuit voltage calculated from measured density of states parameters and reasonable estimates for the localized state capture rates is 1.0 + or - 0.1 V. (Author)

A82-28170 **Concentration of solar radiation by white painted transparent plates.** G. Smestad and P. Hamill (Santa Clara, University, Santa Clara, CA). *Applied Optics*, vol. 21, Apr. 1, 1982, p. 1298-1306. 10 refs.

A flat-plate solar concentrator device is described which consists of a white-painted transparent plate, with a photovoltaic cell fixed to an unpainted area on the bottom of the plate so that light scattering off the white material is either lost or directed to the solar cell. Concentration factors of up to 1.9 times the incident solar flux have been achieved using white clays. Such factors approximate those predicted by theory for the parameters investigated. A theory of the operation of the device is developed, by means of which suggestions for system optimization are made. The concentrator's performance is independent of incidence angle, so that it requires no tracking system; it will concentrate on a cloudy day, and is easy to produce. O.C.

A82-28171 **Ideal second stages in tandem with parabolic concentrators.** E. M. Kritchman (Chicago, University, Chicago, IL).

Applied Optics, vol. 21, Apr. 1, 1982, p. 1307-1309. 15 refs.

It is shown through the derivation of expressions for the concentration capability of both point and linear focus parabolic reflectors, and their extension to include ideal, second-stage concentration, that the ultimate concentration of a primary reflector alone achieves only 1/2 of the ideal limit in two-dimensional, line focus geometry and 1/4 in three-dimensional, point focus geometry. By contrast, the two-stage configurations suggested for both parabolic concentrator geometries are shown to approach the ideal limit at large f/N os.

O.C.

A82-28385 Fundamentals and applications of solar energy. Part 2. Edited by I. H. Faraq (New Hampshire, University, Durham, NH) and S. S. Melsheimer (Clemson University, Clemson, SC). *AIChE Symposium Series*, vol. 77, no. 210, 1981. 103 p.

Applications of techniques of chemical engineering to the development of materials, production methods, and performance optimization and evaluation of solar energy systems are discussed. Solar thermal storage systems using phase change materials, liquid phase Diels-Alder reactions, aquifers, and hydrocarbon oil were examined. Solar electric systems were explored in terms of a chlorophyll solar cell, the nonequilibrium electric field effects developed at photoelectrode/electrolyte interfaces, and designs for commercial scale processing of solar cells using continuous thin-film coating production methods. Solar coal gasification processes were considered, along with multilayer absorber coatings for solar concentrator receivers, solar thermal industrial applications, the kinetics of anaerobic digestion of crop residues to produce methane, and a procedure for developing a computer simulation of a solar cooling system.

M.S.K.

A82-28386 A novel chlorophyll solar cell. J. C. Ludlow (West Virginia University, Morgantown, WV). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 22-26. 9 refs.

The photosynthetic process is reviewed in order to produce a design for a chlorophyll solar cell. In a leaf, antenna chlorophyll absorbs light energy and conducts it to an energy trap composed of a protein and two chlorophyll molecules, which perform the oxidation-reduction chemistry. The redox potential of the trap changes from 0.4 to -0.6 V, which is sufficient to reduce nearby molecules with redox potentials in that range. The reduction occurs by transfer of an electron, and a chlorophyll solar cell would direct the transferred electron to a current carrier. Chlorophyll antenna and traps are placed on a metallic support immersed in an electron acceptor solution, and resulting electrons from exposure to light are gathered by a metallic current collector. Spinach chlorophyll extracted, purified, and applied in a cell featuring a Pt collector and an octane water emulsion resulted in intensity independent voltages.

M.S.K.

A82-28387 Theoretical study of absorbed solar energy in multi-layer absorber coatings for receivers of solar concentrators. I - Radiation transfer analysis. I. S. Taha, M. A. Darwish, and M. M. Elsayed (King Abdulaziz University, Jeddah, Saudi Arabia). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 27-34.

An analysis of a model of short wave radiation interaction with a coating composed of a microlayer of low emittance substrate covered by a semiconductor layer and two absorbing microlayers is presented. The work is intended to maximize short wave radiation absorption in concentrating solar collector applications. Using multiple layers is noted to permit options of absorptance and material thickness. A numerical model is developed for a multilayer coating with two nonreflecting outermost coatings. Governing equations and boundary conditions are defined for behavior under a monochromatic flux. A solution is formulated for predicting the total amount and distribution of the energy absorbed in the outer layers, integrated over the spectrum of the incident flux. Further consideration is given to compromises in energy gains by absorption and long wave radiation losses from the coatings, in addition to the necessity of expanded studies of the different optical properties of selective surface coatings.

M.S.K.

A82-28388 Solar coal gasification - Plant design and economics. W. R. Aiman, C. B. Thorsness, and D. W. Gregg (California, University, Livermore, CA). *AIChE Symposium Series*,

vol. 77, no. 210, 1981, p. 36-46. 12 refs. Contract No. W-7405-eng-48.

A plant design and economic analysis is presented for solar coal gasification (SCG). Coal pyrolysis and char gasification to form the gasified product are reviewed, noting that the endothermic gasification reactions occur only at temperatures exceeding 1000 K, an energy input of 101-136 kJ/mol of char reformed. Use of solar heat offers the possibility of replacing fuels needed to perform the gasification and the oxygen necessary in order to produce a nitrogen-free product. Reactions, energetics, and byproducts from the gasification of subbituminous coal are modeled for a process analysis code used for the SCG plant. Gas generation is designed to occur in a unit exposed to the solar flux focus from a heliostat field. The SCG gas would have an H₂ content of 88%, compared to the 55% offered by the Lurgi process. Initial capital costs for the SCG plant are projected to be 4 times those with the Lurgi process, with equality being achieved when coal costs \$4/gj.

M.S.K.

A82-28389 A continuous two stage solar coal gasification system. V. K. Mathur, R. W. Breault (New Hampshire, University, Durham, NH), S. Lakshmanan, F. K. Manasse, and V. Venkataraman. *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 47-54. 12 refs.

The characteristics of a two-stage fluidized-bed hybrid coal gasification system to produce syngas from coal, lignite, and peat are described. Devolatilization heat of 823 K is supplied by recirculating gas heated by a solar receiver/coal heater. A second-stage gasifier maintained at 1227 K serves to crack remaining tar and light oil to yield a product free from tar and other condensables, and sulfur can be removed by hot clean-up processes. CO is minimized because the coal is not burned with oxygen, and the product gas contains 50% H₂. Bench scale reactors consist of a stage I unit 0.1 m in diam which is fed coal 200 microns in size. A stage II reactor has an inner diam of 0.36 m and serves to gasify the char from stage I. A solar power source of 10 kWt is required for the bench model, and will be obtained from a central receiver with quartz or heat pipe configurations for heat transfer.

M.S.K.

A82-28390 Commercial-scale process design for thin-film solar cells. T. W. F. Russell, B. N. Baron, and R. E. Rocheleau (Delaware, University, Newark, DE). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 70-77. 14 refs.

Process and manufacturing costs for commercial-scale production of thin-film solar cells are examined from the viewpoint of the chemical process industry, with emphasis on CdS/Cu₂S cells. The cells comprise opaque contact, collector/converter, absorber/generator, transparent contact, and encapsulation/antireflective coating layers. Each layer is deposited as a separate unit operation, through either continuous or batch processing methods. The scale-up of laboratory-verified cell manufacturing steps to commercial processing is detailed from the choice of a Zn-plated copper foil substrate to the bonding of a 1/16 in. tempered glass protective layer with polyvinyl butyral. The total product cost is calculated as a sum of raw materials, utilities, labor, and capital investment costs, using a cost/W for a 1 GW plant. Continuous processing results in a \$0.50/W cell with raw materials accounting for 38% of the total product cost.

M.S.K.

A82-28392 Computer simulation of solar cooling. M. M. Elsayed, I. S. Taha, and M. A. Darwish (King Abdulaziz University, Jeddah, Saudi Arabia). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 86-96. 9 refs.

A simplified technique for developing a simulation for analysis of a solar-powered H₂O/LiBr absorption cooling system is described. The system considered comprises a flat plate collector, a fluid-filled hot storage tank, an absorber which contains cooling water weak solution, and LiBr closed loops, a heat exchanger to transfer heat between the strong and weak solutions, a generator powered by hot water from the storage tank, a condenser, evaporator, a strong mixture and refrigerant expansion valves. Governing equations are defined for the properties of the binary solution, of the refrigerant, the solar flux, and the air temperature. The numerical performance simulation is detailed for sample winter and summer days, including heat and mass balances.

M.S.K.

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A82-28498 Efficient GaAs solar cells formed by UV laser chemical doping. T. F. Deutsch, J. C. C. Fan, D. J. Ehrlich, G. W. Turner, R. L. Chapman, and R. P. Gale (MIT, Lexington, MA). *Applied Physics Letters*, vol. 40, Apr. 15, 1982, p. 722-724. 10 refs. USAF-DARPA-Army-sponsored research.

GaAs p-n junctions have been formed by ArF and XeF excimer laser radiation, which releases S atoms by the dissociation of H₂S gas while simultaneously heating the substrate to allow incorporation of the S dopant. In addition to fabricating solar cells having AM1 efficiencies of 10.8% from these junctions, the process can produce doped GaAs layers with sheet resistances as low as 30 Ohms/square unit. This efficiency compares favorably with the 12% value obtained for ion-implanted, CW Nd:YAG laser-annealed GaAs solar cells of smaller area. O.C.

A82-28499 n-CuInSe₂/polysulfide photoelectrochemical solar cells. Y. Mirovsky and D. Cahen (Weizmann Institute of Science, Rehovot, Israel). *Applied Physics Letters*, vol. 40, Apr. 15, 1982, p. 727, 728. 15 refs. Research supported by the United States - Israel Binational Science Foundation.

Quantum efficiencies as high as 0.8-0.9 are exhibited by n-type single crystals of n-CuInSe₂ in aqueous polysulfide solution, over the 600-1150 nm wavelength region, when used as photoanodes in photoelectrochemical cells. Photocurrents corresponding to values of 40 mA/sq cm under AM1 conditions of 100 mW/sq cm sunlight have been measured, and the stability testing of n-CuInSe₂ photoanodes for the case of a 20,000 C/sq cm photocharge passage at short-circuit densities of 40 mA/sq cm have shown no deterioration of the measured photocurrents. O.C.

N82-16475* National Aeronautics and Space Administration. Pasadena Office, Calif.

SOLAR HEATED FLUIDIZED BED GASIFICATION SYSTEM Patent

Shaik A Qader, inventor (to NASA) (JPL, California Inst. of Technology Pasadena) Issued 22 Sep 1981 5 p Filed 15 May 1980 Supersedes N80-24747 (18 - 15, p 2002) Sponsored by NASA

(NASA-Case-NPO-15071-1. US-Patent-4,290,779; US-Patent-Appl-SN-150115. US-Patent-Class-48-89; US-Patent-Class-48-99; US-Patent-Class-126-438. US-Patent-Class-250-527) Avail US Patent and Trademark Office CSCL 10A

A solar-powered fluidized bed gasification system for gasifying carbonaceous material is presented. The system includes a solar gasifier which is heated by fluidizing gas and steam. Energy to heat the gas and steam is supplied by a high heat capacity refractory honeycomb which surrounds the fluid bed reactor zone. The high heat capacity refractory honeycomb is heated by solar energy focused on the honeycomb by solar concentrator through solar window. The fluid bed reaction zone is also heated directly and uniformly by thermal contact of the high heat capacity ceramic honeycomb with the walls of the fluidized bed reactor. Provisions are also made for recovering and recycling catalysts used in the gasification process. Back-up furnace is provided for start-up procedures and for supplying heat to the fluid bed reaction zone when adequate supplies of solar energy are not available.

Official Gazette of the U.S. Patent and Trademark Office

N82-16490*# Spire Corp., Bedford, Mass.

DEVELOPMENT AND FABRICATION OF A SOLAR CELL JUNCTION PROCESSING SYSTEM

S Bunker Oct 1981 30 p refs Sponsored in part by DOE Prepared for JPL

(Contracts NAS7-100; JPL-955640) (NASA-CR-163474, DOE/JPL-955640-81/7, JPL-9950-623; QR-10073-07; QR-7) Avail NTIS HC A03/MF A01 CSCL 10A

A solar cell junction processing system was developed and fabricated. A pulsed electron beam for the four inch wafers is being assembled and tested, wafers were successfully pulsed, and solar cells fabricated. Assembly of the transport locks is completed. The transport was operated successfully but not with sufficient reproducibility. An experiment test facility to examine potential scaleup problems associated with the proposed ion implanter design was constructed and operated. Cells were implanted and found to have efficiency identical to the normal Spire implant process. S.L.

N82-16491*# Motorola, Inc., Phoenix, Ariz. Semiconductor Group

PROCESSING EXPERIMENTS ON NON-CZOCHEWALSKI SILICON SHEET Final Report

R. A. Pryor, L. A. Grenon, N. G. Sakiotis, E. M. Pastirk, T. O. Sparks, and R. N. Legge Apr. 1981 221 p refs Sponsored in part by DOE Prepared for JPL (Contract JPL-955844)

(NASA-CR-163473; DOE/JPL-955844-81/2; JPL-9950-624) Avail. NTIS HC A10/MF A01 CSCL 10A

A program is described which supports and promotes the development of processing techniques which may be successfully and cost-effectively applied to low-cost sheets for solar cell fabrication. Results are reported in the areas of process technology, cell design, cell metallization, and production cost simulation. T.M.

N82-16492*# Boeing Engineering and Construction, Seattle, Wash. Solar Systems Group

A CONCEPTUAL DESIGN STUDY OF POINT FOCUSING THIN-FILM SOLAR CONCENTRATORS Final Report

11 Nov 1981 128 p refs Prepared for JPL

(Contract JPL-955804)

(NASA-CR-163472; JPL-9950-625) Avail NTIS HC A07/MF A01 CSCL 10A

Candidates for reflector panel design concepts, including materials and configurations, were identified. The large list of candidates was screened and reduced to the five most promising ones. Cost and technical factors were used in making the final choices for the panel conceptual design, which was a stiffened steel skin substrate with a bonded, acrylic overcoated, aluminumized polyester film reflective surface. Computer simulations were run for the concentrator optics using the selected panel design, and experimentally determined specularly and reflectivity values. Intercept factor curves and energy to the aperture curves were produced. These curves indicate that surface errors of 2 mrad (milliradians) or less would be required to capture the desired energy for a Brayton cycle 816 C case. Two test panels were fabricated to demonstrate manufacturability and optically tested for surface error. Surface errors in the range of 1.75 mrad and 2.2 mrad were measured. T.M.

N82-16499# Mid-American Solar Energy Complex, Minneapolis, Minn.

PASSIVE-SOLAR MULTI-FAMILY CONCEPTS

Aug 1981 88 p

(Contract DE-AC02-79CS-30150)

(DE82-000456; MASEC-PA-81-033) Avail: NTIS HC A05/MF A01

The potential for saving energy and money through the use of passive solar techniques in multi family buildings is examined. Seven designs for passive solar apartment/townhouse buildings are presented. Each design is described and illustrated. The buildings are sited in Indiana, Michigan, Missouri, Ohio, South Dakota, and Minnesota. DOE

N82-16500# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst

SIMPLE PREDICTIVE MODEL FOR PERFORMANCE OF DESICCANT BEDS FOR SOLAR DEHUMIDIFICATION

Robert S Barlow Aug. 1981 7 p refs Presented at the Intern. Passive and Hybrid Cooling Conf., Miami Beach, Fla., 11-13 Nov 1981, sponsored by the America Section of the International Solar Energy Society

(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE81-023606; SERI/TP-631-1329; CONF-811109-1) Avail. NTIS HC A02/MF A01

A computer model for the absorption/desorption process that predicts the performance of desiccant beds for solar regenerated dehumidification of passively cooled buildings is outlined. The model uses simple algebraic equations for steady state heat and mass exchangers. The validity and accuracy of the model is demonstrated. The physics of the adsorption process in two psychrometric process lines is discussed. DOE

N82-16505# Sandia Labs., Albuquerque, N. Mex. POTENTIAL FOR USING PARABOLIC TROUGH COLLECTORS TO SUPPLEMENT POWER CYCLE BOILERS

W P. Schimmel, Jr and L. L. Lukens 1981 17 p refs Presented at Winter Ann Meeting of the ASME Technol. and Soc. Div., Washington, D.C., 15 Nov. 1981

(Contract DE-AC04-76DP-00789)
(SAND-81-0572C; CONF-811101-3) Avail: NTIS
HC A02/MF A01

The advantage of such a system is that solar energy is used to heat the water in a steam Rankine cycle device up to the superheat regime, thus displacing the fossil fuel usually required. The temperature associated with this portion of the power cycle is typically on the order of 320 C or less, which makes it compatible with current parabolic trough collector systems. A system model which lends itself to optimization studies was constructed and exercised over a range of the multiparameter space involved. The collector field, storage, supplementary fossil boiler and superheater, and turbine/generator traded off to obtain a series of economically optimal systems for various years and solar fractions. DOE

N82-16511# Lincoln Lab., Mass. Inst. of Tech., Lexington.
REDUCING CONVECTIVE LOSSES FROM COVER GLAZINGS OF SOLAR-THERMAL COLLECTORS

Pattabiraman Raghuraman and Daniel Kon 1981 8 p refs
Presented at the Winter Ann. Meeting of the ASME Technol. and Soc. Div., Washington, D.C., 15-20 Nov 1981
(Contract DE-AC02-76ET-20279)
(DE81-025726; DOE/ET-20279/146; CONF-811101-9) Avail:
NTIS HC A02/MF A01

Convective heat losses from cover glazings of solar thermal collectors are reduced by forming perpendicular crisscross rectangular grooves on the glazing which cause the air flow to form recirculating zones in the grooves. Experiments on the effects of varying groove geometry show that the cover-glazing convective heat transfer coefficient can be reduced by a factor of four or better. Results of the experimental and analytical work and a description of the design considerations in optimizing the groove geometry are presented. DOE

N82-16518# Brookhaven National Lab., Upton, N. Y. Technology and Data Div.
MODELING SOLAR-ENERGY SYSTEMS FOR ECONOMIC OPTIMIZATION

Richard W. Leigh 1981 6 p refs Presented at the 4th World Eng. Congr., Atlanta, 12 Oct. 1981
(Contract DE-AC02-76CH-00016)
(DE81-030030; BNL-29963; CONF-811030-2) Avail: NTIS
HC A02/MF A01

A simple analytic model of solar energy systems is presented which can describe how the performance of the system depends on collector area and storage capacity with surprising accuracy. The model can then be used to determine easily the optimal (lower cost) configuration of collector area and storage capacity, and to see how this configuration will change under various possible fuel, collector, or storage costs. DOE

N82-16527# Battelle Pacific Northwest Labs., Richland, Wash.
DEVELOPMENT OF A LOW-COST BLACK-LIQUID SOLAR COLLECTOR, PHASE 2 Final Report, Sep. 1979 - Jul. 1981

D. K. Landstrom, S. G. Talbert, and V. D. McGinniss 30 Sep 1981 225 p refs
(Contract DE-AC04-79CS-30171)
(DE82-000033; DOE/CS-30171/3) Avail: NTIS
HC A10/MF A01

Research efforts were directed toward evaluating the long-term durability of various plastic materials and solar collector designs, obtaining sufficient outdoor performance data to design a full-scale demonstration of a black liquid solar collector for a commercial application; working closely with a company willing to investigate the possible commercialization of a black liquid plastic collector, and incorporating improved black liquid collectors with the identified plastic collector designs. Indoor weathering tests of various plastics have continued and two outdoor automated test facilities were constructed. One unit was installed at Columbus, Ohio, and the other unit was installed in Phoenix, Arizona. In addition, test facilities in Florida were utilized for static outdoor testing of candidate materials. Results indicate that the black liquid collector is a viable concept and the collectors manufactured during the course of this study were able to perform as theoretically predicted. There are some long-term durability problems still associated with the black liquid collector systems. However, current indications are that a suitable system can be built that should have an expected lifetime of up to

15 years with only marginal (less than 10%) performance degradation. DOE

N82-16528# Argonne National Lab., Ill.
DESIGN, CONSTRUCTION, AND INITIAL OPERATION OF THE ANL RESEARCH

Y. S. Cha, W. T. Sha, and J. R. Hull Aug 1981 50 p refs
(Contract W-31-109-eng-38)
(DE82-001961; ANL-81-55) Avail: NTIS HC A03/MF A01

The design consideration of a 1/4 acre research salt-gradient solar pond is described. Experience learned during the construction of the solar pond is presented. Initial operation of the pond indicates that the construction of the pond is sound and no leakage has occurred. The pond began to warm up during March of 1981. The maximum pond temperature reached 630 C at the end of July and it is still rising. All signs indicate that the operation of the well instrumented pond will be a success and the performance of the pond will be as expected, if not better. DOE

N82-16531# Winter (Steven) Associates, Inc., New York, N.Y.
CODE WORKBOOK FOR ACTIVE AND PASSIVE SOLAR DESIGN: SINGLE-FAMILY RESIDENTIAL CONSTRUCTION

Sep. 1981 109 p refs
(DE82-000637; MASEC-SCR-81-085) Avail: NTIS
HC A06/MF A01

Important codes and standards enforced or referenced in the Mid-American Solar Energy Complex region are described. Analyses of the basic codes written by major code agencies and those Federal agency guidelines which have a significant impact on building activity in the MASEC region are included. State and local codes and code agencies are identified. DOE

N82-16532# Mid-American Solar Energy Complex, Minneapolis, Minn.

CASE STUDIES OF RETROFIT APPLICATIONS OF SOLAR ENERGY IN THE MASEC REGION

Sep. 1981 11 p refs
(Contract DE-AC02-79CS-30150)
(DE82-001712; MASEC-R-81-081; A-101-6) Avail: NTIS
HC A02/MF A01

Six case studies are presented of residential solar retrofits. Each case study includes a photograph illustrating the type of retrofit, system description, siting orientation, system cost, energy savings, operational problems, and the homeowner's assessment of system performance and satisfaction. The retrofits presented cover a wide geographic area, and include active solar domestic hot water, greenhouses, and passive solar direct gain. DOE

N82-16533# Mid-American Solar Energy Complex, Minneapolis, Minn.

THE CLASS C PASSIVE PERFORMANCE EVALUATION PROGRAM Final Report

Sep 1981 24 p
(Contract DE-AC02-79CS-30150)
(DE82-000454; MASEC-R-81-014; P-101-2) Avail: NTIS
HC A02/MF A01

The Class-C performance which provides information on qualities of passive solar features which make them attractive to buyers was evaluated. The following topics are discussed: design of an audit form, design of regionally specific audit addenda, determination of site selection criteria, identification of sites; selection, training, and management of auditors; and packaging of materials of subcontractors for evaluation. Results and findings are presented as follows: demographic profile, passive solar home profile, cost, financing, and payback considerations, expectations, realizations, and satisfaction, and decisionmaking. DOE

N82-16538# Northeast Solar Energy Center, Boston, Mass. Dept. of Consumer Affairs

SOLAR CONSUMER ASSURANCE: AN ASSESSMENT OF MECHANISMS IN THE NORTHEAST

Roberta Ward Walsh May 1981 88 p
(Contract DE-AC02-80CS-30149)
(DE81-030052; NESEC-9) Avail: NTIS HC A05/MF A01

Results and analysis of assessments in the nine states served by the Northeast Solar Energy Center are reported. Mechanisms were categorized according to the following objectives: the informal

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consumer, the competent installer, assuring product quality and performance, and responsiveness to consumer grievances. DOE

N82-16540# Mid-American Solar Energy Complex, Minneapolis, Minn

PASSIVE SOLAR PRODUCTS CATALOG, 1981

M M Dotseth 1981 362 p
(Contract DE-AC02-79CS-30150)
(DE82-000292, MASEC-H-81-041) Avail: NTIS
HC A16/MF A01

The Passive Solar Products Catalog was compiled through contacts with over 500 manufacturers and distributors across the country. The product listings are from manufacturers who responded to requests for information and the descriptions are based on information contained in the product literature. Only those products which can be marketed at this time are listed in the 1981 catalog. The catalog contains over 300 product listings. The catalog is organized according to product function and application including passive solar components and design resonances and miscellaneous products. Manufacturer and product indexes are included as a cross reference in the back of the catalog. Distributors are not listed since most manufacturers prefer to have product inquiries initially directed to them. DOE

N82-16542# Houston Univ., Tex. Energy Lab.
SOLAR ENERGY SYSTEMS SIMULATION AND ANALYSIS
Quarterly Progress Report, 1 Nov. - 30 Dec. 1980

Loren L Vant-Hull 10 Jan 1981 36 p refs
(Contract DE-AC03-76SF-10763)
(DE81-026975, DOE/SF-10763/T10; QPR-5) Avail: NTIS
HC A03/MF A01

A subroutine to provide central receiver performance simulation code STEAEC with the capability of interpolating the UoFH NS code performance summary has been written and is documented herein. A call of this subroutine obviates the need to extrapolate day/hour output efficiencies to produce the elevation-azimuth field performance data, which often involves non-physical Sun locations. The changes are completely transparent to the user. The aspect ratio study was delayed while substantive improvements to the handling of heliostate spacing subject to mechanical limits were made. Mechanical limits play a definitive role as the aspect ratio increases. The improvements are described. Work on insolation modeling is being culminated with the development of a new procedure for accounting for atmospheric transmission losses between heliostat and receiver. A detailed interpolation/extrapolation procedure based on the LOWTRAN 3 analysis was developed. Subroutines to provide all the necessary input data were also generated. Work has begun on a tentative basis which will lead to a user compatible version of the IH code and to an accompanying users guide. DOE

N82-16543# RCA Labs., Princeton, N.J.
PHOTOVOLTAIC MECHANISMS IN POLYCRYSTALLINE
THIN-FILM SILICON SOLAR CELLS Final Report, 31 May
1979 - 30 May 1981

D. Redfield Jun 1981 79 p refs
(Contract DE-AC01-79ET-23108)
(DE82-000868, DOE/ET-23108/8) Avail: NTIS
HC A05/MF A01

The emphasis during this two-year program began with analysis of fundamental limitations to silicon solar-cell efficiency caused by heavy-doping effects. Near the middle, the emphasis shifted to explanation of the varied electronic properties of grain boundaries in Si. In the first area, and it was shown that all previous analyses which had neglected Auger recombination were necessarily invalid. Important consequences were also found for the strong gradients in dopant concentration that always occur in heavily doped diffused p-n junctions. When these new effects are combined, a simple, natural model results to explain limitations in Si solar-cell performance due to either front or base region effects on either $J_{sub} sc/$ or $V_{sub} oc/$. As part of this work, a new method was developed for accurate evaluation of the overall performance of AR coatings. DOE

N82-16544# National Mechanical Engineering Research Inst., Pretoria (South Africa)

DEVELOPMENTS IN SOLAR-POWERED AIR CONDITIONING: STATE-OF-THE-ART AND PROSPECTS FOR SOUTH AFRICA

A. Johannsen 1980 19 p refs Presented at Frigair Symp.

Pretoria, 17-18 Jun. 1980, sponsored by the South African Inst. of Refrigeration and Air Conditioning
(PB81-246076; CSIR-ME-436; Paper-10) Avail: NTIS
HC A02/MF A01 CSCL 13A

The state of the art of solar powered air conditioning is reviewed and its potential for South African conditions examined. Three basic cycles, namely the absorption cycle, the Rankine cycle, and desiccant cycle are discussed and their advantages and disadvantages compared. The open cycle type desiccant systems which appear to be well suited for South African conditions are discussed in greater detail. Included is a review of the various system configurations with solid and liquid desiccant and a comparison of their performance under different climatic conditions. Author

N82-16929# Mid-American Solar Energy Complex, Minneapolis, Minn

REGIONAL NEEDS REGARDING TECHNICAL INFORMATION

Jul. 1981 16 p refs
(Contract DE-AC02-79CS-30150)
(DE82-001772; MASEC-R-81-057, A-104-4) Avail: NTIS
HC A02/MF A01

Regional needs for technical information regarding solar systems and components are evaluated. The information requested from the MASEC Information Center can be separated into design, performance, and economic categories. The types of questions most frequently asked in each of these categories are listed. Comments by MASEC on the draft of the National Solar Data Network (NSDN) program are presented in the appendix. DOE

N82-17609# National Aeronautics and Space Administration
Lyndon B. Johnson Space Center, Houston, Tex

SATELLITE POWER SYSTEM. CONCEPT DEVELOPMENT AND EVALUATION PROGRAM, VOLUME 6: CONSTRUCTION AND OPERATIONS

Harold Benson and Lyle M Jenkins Apr. 1981 216 p refs
(NASA-TM-58233, JSC-17220-Vol-6) Avail: NTIS
HC A10/MF A01 CSCL 10A

The construction, operation, and maintenance requirements for a solar power satellite, including the space and ground systems, are reviewed. The basic construction guidelines are explained, and construction location options are discussed. The space construction tasks, equipment, and base configurations are discussed together with the operations required to place a solar power satellite in geosynchronous orbit. A rectenna construction technique is explained, and operation with the grid is defined. Maintenance requirements are summarized for the entire system. Key technology issues required for solar power satellite construction operations are defined. E A K

N82-17610# Jet Propulsion Lab., California Inst of Tech., Pasadena

RESULTS OF THE 1981 NASA/JPL BALLOON FLIGHT SOLAR CELL CALIBRATION PROGRAM

C. H Seaman and R S Weiss 15 Jan 1982 16 p refs
(Contract NAS7-100)
(NASA-CR-168442, JPL-Pub-81-115) Avail: NTIS
HC A02/MF A01 CSCL 10A

The calibration of the direct conversion of solar energy through use of solar cells at high altitudes by balloon flight is reported. Twenty seven modules were carried to an altitude of 35.4 kilometers. Silicon cells are stable for long periods of time and can be used as standards. It is demonstrated that the cell mounting cavity may be either black or white with equal validity in setting solar simulators. The calibrated cells can be used as reference standards in simulator testing of cells and arrays. E A K

N82-17611# Jet Propulsion Lab., California Inst. of Tech., Pasadena

SENSITIVITY ANALYSIS OF THE ADD-ON PRICE ESTIMATE FOR THE SILICON WEB GROWTH PROCESS

Anant R Mokashi 15 Dec. 1981 37 p refs
(Contracts NAS7-100, DE-AI01-76ET-20356, JPL Proj 5101-175)
(NASA-CR-168422, JPL-5101-175, DOE/JPL-1012-61) Avail: NTIS
HC A03/MF A01 CSCL 10A

The web growth process, a silicon-sheet technology option, developed for the flat plate solar array (FSA) project, was

examined Base case data for the technical and cost parameters for the technical and commercial readiness phase of the FSA project are projected. The process add on price, using the base case data for cost parameters such as equipment, space, direct labor, materials and utilities, and the production parameters such as growth rate and run length, using a computer program developed specifically to do the sensitivity analysis with improved price estimation are analyzed. Silicon price, sheet thickness and cell efficiency are also discussed E.A.K.

N82-17614*# Jet Propulsion Lab., California Inst of Tech., Pasadena.

THE 18TH PROJECT INTEGRATION MEETING Progress Report, Feb. - Jul. 1981

Jul 1981 577 p refs Meeting held at Pasadena, Calif. 15-16 Jul. 1981

(Contract NAS7-100; DE-AI01-76ET-20356)

(NASA-CR-168431; JPL-Pub-81-94, JPL-5101-186) Avail. NTIS HC A25/MF A01 CSCL 10A

Progress in the low cost solar array project during the period February to July 1981 is reported Included are: (1) project analysis and integration; (2) technology development in silicon material, large area silicon shear and encapsulation, (3) process development, (4) engineering, and operations E A K

N82-17628# Jydsk Telefon A/S Biblioteket, Aarhus-Tranbjerg J (Denmark).

SOLAR-CELL PROJECT Progress Report

B Mortensen and Johs Jensen (Odense Univ) Aug. 1980 42 p refs In DANISH

(DE82-901191; NP-2901191; PR-1) Avail: NTIS (US Sales Only) HC A03/MF A01, DOE Depository Libraries

Commercially available solar cells and battery systems were tested The details of the experimental solar cell/battery array placed on the roof of the Jutland Telephone telestation near Aarhus, Denmark are described A survey of module calculations and meteorological data in this region is given The systems tested, their components, solar cell arrays and mechanical and electrical equipment are described and measuring methods and data processing are outlined DOE

N82-17632# Seymour Community Schools, Wis.

COMMUNITY SOLAR DEMONSTRATION/DISSEMINATION CENTER Final Report

Richard Tepp 8 Jul. 1981 14 p

(Contract DE-FG02-80R5-10250)

(DE82-000994; DOE/R5-10250/T1) Avail: NTIS HC A02/MF A01

A passive/active solar heating demonstration component was constructed. A greenhouse was installed, and the active system was completed The fireplace was also completed. A direct gain 8 by 20 double glazed greenhouse system on concrete footings and masonry blocks was incorporated. The greenhouse includes a 4 in concrete slab with 2 in of thermal below grade insulation Other key elements include a 30 in. hinged entrance door, screens and motor-operated louver vents for summer ventilation. Manual operated dampers are built into the trombe wall, which was constructed as the backdrop of the greenhouse DOE

N82-17633# Texas Instruments, Inc., Dallas.

DEVELOPMENT OF A SOLAR-ENERGY SYSTEM Technical Summary Report

E. L. Johnson 3 Apr. 1981 23 p

(Contract DE-AC01-79ER-10000)

(DE81-030531; DOE/ER-10000/T2) Avail: NTIS HC A02/MF A01

Solar energy conversion by operation of small silicon solar cells immersed in an electrolyte is described. The current generated by the cells is used to separate the electrolyte into its constituent parts The system consists of a solar chemical converter in which the electrolyte is separated, hydrogen storage, a fuel cell, and a heat exchanger for recovering heat from the system. Fabrication of the solar cells used in the solar chemical converter and the storage of hydrogen as a metal hydride are discussed. DOE

N82-17644# World Meteorological Organization, Geneva (Switzerland).

METEOROLOGICAL ASPECTS OF THE UTILIZATION OF SOLAR RADIATION AS AN ENERGY SOURCE, PART 1

1981 311 p refs 2 Vol.

(WMO-557-Vol-1; WMO-TN-172-Vol-1; ISBN-92-63-10557-X) Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 50

Meteorological knowledge and activities related to the harnessing of solar energy are treated. The development of the utilization of various forms of energy by human society is reviewed along with WMO activities in support of the rational use of energy, with special regard to solar radiation. Specific actions by which meteorological services can contribute to the utilization of solar energy are pointed out. User requirements for meteorological data are set; how the data is presented and where it can be obtained are shown. Techniques for the measurement of solar radiation, including the calibration of instruments and quality control of data, are discussed while other meteorological parameters required (air temperature, wind speed, humidity, cloud amount, etc) are also considered The retrieval of past data, interpolation methods for the estimation of solar radiation, and publishing and archiving data are dealt with. Author (ESA)

N82-17645# World Meteorological Organization, Geneva (Switzerland).

METEOROLOGICAL ASPECTS OF THE UTILIZATION OF SOLAR RADIATION AS AN ENERGY SOURCE. PART 2: ANNEX. WORLD MAPS OF RELATIVE GLOBAL RADIATION

1981 33 p refs 2 Vol.

(WMO-557-Vol-2, WMO-TN-172-Vol-2) Avail: NTIS MF A01; print copy available at WMO, Geneva, SwFr 50

World maps are presented from which the monthly and annual global radiation can be derived, and an overall picture of the distribution of solar radiation as an energy source can be evolved The radiation reaching the surface of the Earth in the absence of clouds and the atmosphere was calculated from pure astronomical relationships Results are given in MJ/sq m by 5 deg of latitude The establishment of an empirical relationship between satellite brightness data and the relative global radiation (defined as the percentage ratio of actual surface global radiation to the astronomically possible global radiation), using available surface global radiation data as reference values, is suggested. Author (ESA)

N82-17647# Office of Technology Assessment, Washington, D C

SOLAR POWER SATELLITES

Aug 1981 300 p refs

(PB82-108846, OTA-E-144; LC-81-600129) Avail: NTIS HC A13/MF A01 CSCL 10B

The energy potential of the solar power satellite (SPS) was evaluated. The preliminary nature of SPS technology is considered by comparing four alternative SPS systems across a broad range of issues: their technical characteristics, long term energy supply potential, international and military implications, environmental impacts, and institutional effects. The SPS options are also compared to potentially competitive future energy technologies. GRA

N82-18437# National Bureau of Standards, Boulder, Colo. National Engineering Lab

PRELIMINARY GUIDELINES FOR CONDITION ASSESSMENT OF BUILDINGS BEING CONSIDERED FOR SOLAR RETROFIT

Frank H Lerchen, James H. Pielert, and Phillip T. Chen Jul. 1981 142 p refs Sponsored by DOE

(PB82-113259, NBSIR-81-2289) Avail: NTIS HC A07/MF A01 CSCL 13A

A general description of methods currently available for condition assessment of the structural heating, ventilating, and air conditioning (HVAC), electrical and plumbing systems of an existing building are reported The feasibility of rehabilitation for solar retrofit is determined GRA

N82-18529# Centro Informazioni Studi Esperienze, Milan (Italy) Servizio Documentazione

HIGH CONCENTRATION IN GaAs PHOTOVOLTAIC SYSTEMS [L'ALTA CONCENTRAZIONE NEI SISTEMI FOTVOLTAICI AL GaAs]

G. Guarini 1981 12 p refs In ITALIAN Presented at Giornate di Studio su Conversione Fotovoltaica dell'Energia Solare, Milan, 4-5 Jun. 1981

(CISE-1713) Avail: NTIS HC A02/MF A01

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The feasibility of a spectral separation method for increasing the efficiency of photovoltaic cells is considered. The technical state of the art of GaAs cells is reviewed. The structure of a 100 Wp high concentration system, comprised of a matrix of Fresnel lenses with as many spectral filters and pairs of cells is described. Operating results are analyzed. Transl. by J.D.H.

N82-18581*# Schafer (W J) Associates, Inc., Arlington, Va
INVESTIGATION OF POSSIBILITIES FOR SOLAR-POWERED HIGH-ENERGY LASERS IN SPACE
In NASA Langley Research Center Space Laser Power Transmission System Studies Feb. 1982 p 45-56

Avail: NTIS HC A10/MF A01 CSCL 20E

Solar pumped lasers were investigated. The literature was reviewed for possible solar laser candidates from optical pumping experiments. A baseline CO electric discharge laser system was shown to be technically feasible. The most promising direct solar pumped laser was identified to be CF3I. Using the 'STAG' solar laser concept and CF3I, it was found that such a system could be weight competitive with the baseline CO laser system. N.W.

N82-18582*# Mathematical Sciences Northwest, Inc., Bellevue, Wash

DESIGN INVESTIGATION OF SOLAR-POWERED LASERS FOR SPACE APPLICATIONS
In NASA Langley Research Center Space Laser Power Transmission System Studies Feb. 1982 p 77-84

Avail: NTIS HC A10/MF A01 CSCL 20E

The feasibility of using solar powered continuous wave (CW) lasers for space power transmission was investigated. Competing conceptual designs are considered. Optical pumping is summarized. Solar pumped Lasant type lasers are outlined. Indirect solar pumped lasers are considered. N.W.

N82-18686* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala
SOLAR ENERGY CONTROL SYSTEM Patent

James R Currie, inventor (to NASA) Issued 8 Dec 1981 9 p
Filed 20 Nov 1979 Supersedes N80-17544 (18 - 08, p 1023)

(NASA-Case-MFS-25287-1, US-Patent-4,304,219;
US-Patent-Appl-SN-098570, US-Patent-Class-126-422;
US-Patent-Class-126-429; US-Patent-Class-126-430) Avail US Patent and Trademark Office CSCL 10A

A solar energy control system for a hot air type solar energy heating system wherein thermocouples are arranged to sense the temperature of a solar collector, a space to be heated, and a top and bottom of a heat storage unit is disclosed. Pertinent thermocouples are differentially connected together, and these are employed to effect the operation of dampers, a fan, and an auxiliary heat source. In accomplishing this, the differential outputs from the thermocouples are amplified by a single amplifier by multiplexing techniques. Additionally, the amplifier is corrected as to offset by including as one multiplex channel a common reference signal.

Official Gazette of the U.S. Patent and Trademark Office

N82-18689*# Applied Solar Energy Corp., City of Industry, Calif

DEVELOPMENT OF THIN WRAPAROUND JUNCTION SILICON SOLAR CELLS Final Report, Sep. 1980 - Nov. 1981

F. Ho and P. A. Iles Nov. 1981 43 p refs

(Contract NAS3-22228)

(NASA-CR-165570) Avail: NTIS HC A03/MF A01 CSCL 10A

The state of the art technologies was applied to fabricate 50 micro thick 2x4 cm, coplanar back contact (CBC) solar cells with AMO efficiency above 12%. A requirement was that the cells have low solar absorptance. A wraparound junction (WAJ) with wraparound metallization was chosen. This WAJ approach avoided the need for very complex fixturing, especially during rotation of the cells for providing adequate contacts over dielectric edge layers. The contact adhesion to silicon was considered better than to an insulator. It is indicated that shunt resistance caused by poor WAJ diode quality, and series resistance from the WAJ contact, give good cell performance. The cells developed reached 14 percent AMO efficiency (at 25 C), with solar

absorptance values of 0.73. Space/cell environmental tests were performed on these cells and the thin CSC cells performed well. The optimized design configuration and process sequence were used to make 50 deliverable CBC cells. These cells were all above 12 percent efficiency and had an average efficiency of -13 percent. Results of environmental tests (humidity-temperature, thermal shock, and contact adherence) are also given. E A K

N82-18695*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va
THERMODYNAMIC LIMITS FOR SOLAR ENERGY CONVERSION BY A QUANTUM-THERMAL HYBRID SYSTEM

C. E. Byvik, A. M. Buoncrstiani, and B. T. Smith Nov 1981 20 p refs Prepared in cooperation with Christopher Newport Coll.

(NASA-TM-83229) Avail: NTIS HC A02/MF A01 CSCL 10A

The limits are presented for air mass 1.5 conditions. A maximum conversion efficiency of 74 percent is thermodynamically achievable for the quantum device operating at 3500 K and the heat engine in contact with a reservoir at 0 K. The efficiency drops to 56 percent for a cold reservoir at approximately room temperature conditions. Hybrid system efficiencies exceed 50 percent over receiver temperatures ranging from 1400 K to 4000 K, suggesting little benefit is gained in operating the system above 1400 K. The results are applied to a system consisting of a photovoltaic solar cell in series with a heat engine. T.M.

N82-18696*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va
THE ULTIMATE EFFICIENCY OF PHOTSENSITIVE SYSTEMS

A. M. Buoncrstiani, C. E. Byvik, and B. T. Smith Dec 1981 22 p refs Prepared in cooperation with Christopher Newport Coll.

(Grant NsG-1514)

(NASA-TM-83230) Avail: NTIS HC A02/MF A01 CSCL 10A

These systems have in common two important but not independent features: they can produce a storable fuel, and they are sensitive only to radiant energy with a characteristic absorption spectrum. General analyses of the conversion efficiencies were made using the operational characteristics of each particular system. An efficiency analysis of a generalized system consisting of a blackbody source, a radiant energy converter having a threshold energy and operating temperature, and a reservoir is reported. This analysis is based upon the first and second laws of thermodynamics, and leads to a determination of the limiting or ultimate efficiency for an energy conversion system having a characteristic threshold. T.M.

N82-18697*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

THERMODYNAMIC LIMITS TO THE EFFICIENCY OF SOLAR ENERGY CONVERSION BY QUANTUM DEVICES

A. M. Buoncrstiani, C. E. Byvik, and B. T. Smith (Christopher Newport College, Va) Nov 1981 14 p refs

(NASA-TM-83228) Avail: NTIS HC A02/MF A01 CSCL 10A

The second law of thermodynamics imposes a strict limitation to the energy converted from direct solar radiation to useful work by a quantum device. This limitation requires that the amount of energy converted to useful work (energy in any form other than heat) can be no greater than the change in free energy of the radiation fields. Furthermore, in any real energy conversion device, not all of this available free energy in the radiation field can be converted to work because of basic limitations inherent in the device itself. A thermodynamic analysis of solar energy conversion by a completely general prototypical quantum device is presented. This device is completely described by two parameters, its operating temperature $T_{sub R}$ and the energy threshold of its absorption spectrum. An expression for the maximum thermodynamic efficiency of a quantum solar converter was derived in terms of these two parameters and the incident radiation spectrum. Efficiency curves for assumed solar spectral irradiance corresponding to air mass zero and air mass 1.5 are presented. T.M.

N82-18698*# DHR, Inc., Washington, D.C.
MARKET ASSESSMENT OF PHOTOVOLTAIC POWER

SYSTEMS FOR AGRICULTURAL APPLICATIONS IN NIGERIA Final Report

David Staples, Henry Steingrass, and James Nolfi (ARD, Inc., Burlington, Vt.) Oct. 1981 115 p refs
(Contracts DEN3-180; DE-AI01-79ET-20485)
(NASA-CR-165511; DOE/NASA/O180-4; C4100-50) Avail:
NTIS HC A06/MF A01 CSCL 10A

The market potential for stand-alone photovoltaic systems in agriculture was studied. Information is presented on technical and economically feasible applications, and assessments of the business, government and financial climate for photovoltaic sales. It is concluded that the market for stand-alone systems will be large because of the availability of capital and the high premium placed on high reliability, low maintenance power systems. Various specific applications are described, mostly related to agriculture. R.J.F.

N82-18699# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

I-V CHARACTERIZATION OF SOLAR CELLS [CARACTERIZACAO I-V DE CELULAS SOLARES]

Nelson Veissid, R. Ranvaud, and F. J. Fonseca Jun 1981 12 p refs In PORTUGUESE, ENGLISH summary Presented at the 33rd Ann. Meeting of SBPC, Salvador, Brazil, 8-15 Jul 1981 Submitted for publication
(INPE-2141-RPE/363) Avail: NTIS HC A02/MF A01

Equivalent circuits were analysed and then I-V characteristics obtained from different solar cells were compared with those from the circuits. The measures were obtained under natural conditions and under artificial conditions (solar simulator made of easily obtained light sources and several filters). The identification of components in the equivalent circuit, together with the theory of photovoltaic conversion, is very important in the optimization of the cell design. A numeric method for determination of the series resistance is proposed. T.M.

N82-18702# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Lab

CONCEPTUAL DESIGN OF A SOLAR COGENERATION FACILITY INDUSTRIAL PROCESS HEAT. VOLUME 2: APPENDICES Final Report, 30 Sep. 1980 - 14 Aug. 1981
Patrick Joy, Martin Brzeczek, Harold Seilestad, Carl Silverman, and George Yenetchi Jul. 1981 412 p Prepared in cooperation with Badger Energy, Inc., Cambridge, Mass., and Martin Marietta Aerospace, Denver, Colo., and Pacific Gas and Electric Co., San Ramon, Calif.

(Contract DE-AC03-80SF-11438)
(DE82-001578; DOE/SF-11438/T1-Vol-2) Avail: NTIS
HC A18/MF A01

The cogeneration facility systems specification defines the characteristics, and design and environmental requirements for the facility and the performance, characteristics and economic data for the solar additions as well as design data for the existing facility. Climatological data are presented for the site. GRA

N82-18703# Nebraska Univ., Lincoln.
MONITORING OF THERMAL STRATIFICATION OF THE STORAGE TANK OF THE MABEL LEE HALL SOLAR-HOT-WATER FACILITY Final Technical Report, 15 Oct. 1979 - 30 Nov. 1980

E. E. Anderson May 1981 37 p refs
(Contract DE-AC02-79CS-30247)
(DE82-002110; DOE/CS-30247/1) Avail: NTIS
HC A03/MF A01

Measurements of temperatures and heat inputs for a large liquid solar storage unit were obtained with sufficient spatial and temporal resolution to permit verification of numerical models. Fourteen tests were conducted on the Mabel Lee Hall solar facility. During each two-day test, forty temperatures and three heat inputs were measured every 15 minutes. All the data were reported to DOE and are available for confirmation of numerical models of liquid solar storage units. Examination of the results of five of the tests including charging, discharging and simultaneous charge-discharge operational modes indicate that stratification was maintained in the tank. The data also show that several natural circulation modes develop depending upon the manner in which the system was operated. DOE

N82-18713# Messerschmitt-Boelkow-Blohm GmbH, Otterbrunn (West Germany). Unternehmensbereich Raumfahrt

A 100 kW_e SOLAR THERMAL POWER PLANT IN KUWAIT, PHASE 1 Final Report, Jun. 1980

Guenther Schmidt, Peter Schmid, Dietmar Wolf, and Helmut Zewen Bonn Bundesministerium fuer Forschung und Technology Oct. 1981 47 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology (BMFT-FB-T-81-178, ISSN-0340-7608) Avail: NTIS
HC A03/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 10,10

The assembly and test program of the main system components of the solar thermal power station are described. The installation is of the solar farm type and uses highly concentrating rotational symmetric paraboloid mirrors to achieve high efficiencies and Rankine cycle operating temperatures as high as 350 C. The working medium is toluene. Performance tests show proper functioning of the tracking system of the collectors, of the coneshaped absorbers and of the energy conversion system, including all control loops. Author (ESA)

N82-18714# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany)

CONSTRUCTION AND TESTING OF A TEST STAND FOR SOLAR CELLS AND CONCENTRATING COLLECTORS Final Report, Apr. 1980

Heinz Pfeiffer Bonn Bundesministerium fuer Forschung und Technology Nov 1981 131 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology (BMFT-FB-T-81-179; ISSN-0340-7608) Avail: NTIS
HC A07/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 27,70

A hybrid system consisting of photovoltaic cells and parabolic concentrators was built and tested in order to study the possible cost reduction of photovoltaic systems by concentration of sunlight. The test stand comprises four parabolic tracking reflectors, a cooling circuit, electrical and thermodynamical instrumentation and an electrical water pump as a load. The solar cells are mounted in the focal line of the collectors on a cooling channel designed for optimal heat transfer and their uniform illumination is carefully adjusted. The photovoltaic generator delivers electrical energy with 9.3% efficiency at 25 C. In the hybrid regime the thermal efficiency attains 45% at a temperature of 90 C, and the electrical efficiency 6%. Author (ESA)

N82-18715# Metallgesellschaft, A.G., Frankfurt am Main (West Germany)

DEVELOPMENT OF SELECTIVE SOLAR ABSORBERS ON THE BASIS OF ALUMINUM ROLL-BOND HEAT EXCHANGERS Final Report, Jun. 1980

Manfred Moeller Bonn Bundesministerium fuer Forschung und Technology Nov. 1981 44 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology (BMFT-FB-T-81-183, ISSN-0340-7608) Avail: NTIS
HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 9,25

A deposition technique comparable to two-stage anodizing and especially suited for solar absorber panels, using roll-bond Al 99.5 and AlMnZr alloys as a substrate, was developed. The coating is of the nickel structure filter type and provides average solar absorptivity values of 94% and thermal emission values of 14%. The setup of a production plant capable of coating surfaces up to 2 sq m is described as well as the development of corrosion resistant hermetically sealed collectors. By means of an appropriate surface treatment the same corrosion resistance was achieved for absorbers mounted in ventilated collectors. Author (ESA)

N82-18716# Metallgesellschaft, A.G., Frankfurt am Main (West Germany). Metall-Lab.

AIRTIGHT COLLECTOR CASINGS Final Report
Manfred Moeller Bonn Bundesministerium fuer Forschung und Technology Oct. 1981 71 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology (BMFT-FB-T-81-184, ISSN-0340-7608) Avail: NTIS
HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 15,20

The gas space between absorber and cover plates is hermetically sealed by means of a permanent elastic seal of the

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polysulfide or polyisobutylene type. The absorber-glass bond fits into a special frame to be manufactured and mounted industrially for easy assembly with titanium-zinc roof structures. The latter is made of prefabricated parts that can easily be joined by soldering. Adequate protection against penetration of rain, water, snow, and dust is provided for. The flat roof mounting is so designed that no boring through the cover is needed for fixing. Test results show high efficiency and long service life.

Author (ESA)

N82-18717# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany)

DEVELOPMENT OF SELECTIVE SOLAR ABSORBERS ON THE BASIS OF ALUMINUM ROLL-BOND HEAT EXCHANGERS Final Report, Dec. 1979

Werner Scherber and Bernhard Schroeder Bonn Bundesministerium fuer Forschung und Technology Oct. 1981 105 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology (BMFT-FB-T-81-186) Avail. NTIS HC A06/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 22.30

A deposition technique for selective coatings akin to two-stage anodizing and especially suited for aluminum solar absorber panels was developed. The coating consists of tiny, velvet-like arranged nickel whiskers and provides a solar absorptivity as high as 94% and a low thermal emissivity of 12% to 17%. The coating technique, the production setup, and the test program are described. The coating proves to be resistant to humidity cycle testing and may be used in ordinary ventilated collectors. After production in a pilot production plant of about 10,000 roll-band panels with outstanding optical quality, homogeneity and long-term stability, a series production plant with a 7 m bath length was started.

Author (ESA)

N82-18718# AEG-Telefunken, Wedel (West Germany) Fachbereich Neue Technologien, Raumfahrt.

DEVELOPMENT AND TESTS OF EXPERIMENTAL SOLAR GENERATORS FOR CONCENTRATING SYSTEMS Final Report, Mar. 1981

Hans Goehermann and Hubert Muehle Bonn Bundesministerium fuer Forschung und Technology Oct 1981 34 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology (BMFT-FB-T-81-193) Avail. NTIS HC A03/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 7.20

Terrestrial photovoltaic generators were developed for integration into a hybrid system designed to demonstrate cost reduction of photovoltaic systems by concentration of sunlight. The photovoltaic cells consist of monocrystalline silicon, n-p type, 5 by 5 sq cm large and 0.35 mm thick. The antireflection layer is made of TiO_x and the contact system of passivated Ti(Pd)Ag. Usage of low ohmic materials and decrease of contact resistance by deeper n-diffusion allows for maintaining cell efficiency almost constant for intensities up to 0.2 W per sq cm. The layout of several hybrid systems using parabolic reflectors is given and the mounting of the solar cells is illustrated.

Author (ESA)

N82-18722# National Mechanical Engineering Research Inst., Pretoria (South Africa). Heat Mechanics Div

EXPERIMENTAL INVESTIGATION OF HEAT AND MASS TRANSFER RATES IN REGENERATING TYPE SOLAR COLLECTOR

A Johannsen Apr. 1981 31 p refs (PB82-112244; CSIR-ME-1705; ISBN-00-7988-1475-6) Avail. NTIS HC A09/MF A01 CSCL 10A

Heat and mass transfer rates and air pressure drop in a regenerating type solar collector over the range of operating conditions expected in a real system were measured in a laboratory. The existence of analogy between heat and mass transfer in the collector was confirmed.

GRA

N82-18725# Booz-Allen and Hamilton, Inc., Bethesda, Md

EVALUATION OF RESIDENTIAL AND COMMERCIAL SOLAR/GAS HEATING AND COOLING TECHNOLOGIES. VOLUME 1: PROGRAM OVERVIEW Final Report, Dec. 1979 - Jan. 1981

Alan S. Hirschberg, Steven A. Haas, and Alan S. Jacobsen Dec. 1980 64 p 2 Vol.

(Contract GRI-5014-345-0280)

(PB82-103847; GRI-79/0105.1)

Avail. NTIS

HC A04/MF A01 CSCL 13A

The technologies and economics of solar/gas systems for application in the single-family residential market and in the small (individual building) commercial market were evaluated. The effects of solar industry maturity on system cost and the impact of solar incentives and natural gas price uncertainties on solar/gas system economics were studied. Projected solar/gas systems with advanced conventional gas equipment such as pulse combustion furnaces are discussed.

GRA

N82-18726# Booz-Allen and Hamilton, Inc., Bethesda, Md

EVALUATION OF RESIDENTIAL AND COMMERCIAL SOLAR/GAS HEATING AND COOLING TECHNOLOGIES, VOLUME 2 Final Report, Dec. 1979 - Jan. 1981

Alan S. Hirschberg, Steven A. Haas, and Alan S. Jacobsen Dec. 1980 287 p 2 Vol.

(Contract GRI-5014-345-0280)

(PB82-103854; GRI-79/0105.2)

Avail. NTIS

HC A13/MF A01 CSCL 13A

The economics of the most cost-effective solar/gas hybrid systems against a range of advanced gas-fired space conditioning equipment, including both conventional gas furnaces and pulse combustion gas furnaces were analyzed. In addition, the economic comparison considered improvements in performance and cost reduction for both solar/gas systems and advanced gas-fired equipment.

GRA

N82-18729# National Bureau of Standards, Washington, D.C. Center for Building Technology.

FEDSOL: PROGRAM USER'S MANUAL AND ECONOMIC OPTIMIZATION GUIDE FOR SOLAR FEDERAL BUILDING PROJECTS Final Report

Jeanne W. Powell and Richard C. Rodgers, Jr. Aug 1981 113 p refs Prepared in cooperation with Rodgers (Richard C.), Jr. Sponsored in part by DOE

(PB82-107012; NBSIR-81-2342)

Avail. NTIS

HC A06/MF A01 CSCL 13A

A user's manual for the FEDSOL computer program is provided. The FEDSOL program determines the economically optimal size of a solar energy system for a user-specified building, location, system type, and set of economic conditions; it conducts numerous breakeven and sensitivity analyses; and it calculates measures of economic performance as required under the Federal Rules. The economic model in the program is linked with the SLR (solar load ratio) design method developed to predict the performance of active systems. The economics portion of the program can, however, be used apart from the SLR method, with performance data provided by the user.

Author

N82-18764# Acurex Corp., Mountain View, Calif. Energy and Environmental Div.

SOLAR ENERGY FOR POLLUTION CONTROL Final Report, 1 Jun. - 31 Oct. 1978

P. Overly and C. Frankling Oct. 1981 103 p refs

(Contract EPA-68-03-2567; EPA Proj. 7396)

(PB82-116658; FR-80-39/EE; EPA-600/7-81-166) Avail.

NTIS HC A06/MF A01 CSCL 13B

A study was conducted to determine which existing or emerging pollution control processes are best suited to make use of solar energy input and to determine the potential benefits of such applications. Pollution control processes were matched with compatible solar energy systems, resulting in the following four combinations: anaerobic digestion/flat-plate collector; anaerobic digestion/parabolic trough concentrator; baghouse heating/parabolic trough concentrator; SO_x scrubbing/parabolic trough concentrator.

GRA

N82-19669*# Arizona State Univ., Tempe.

SOCIOECONOMIC IMPACT OF PHOTOVOLTAIC POWER AT SCHUCHULI, ARIZONA Final Report

Donald Bahr, Billy G. Garrett, and Carolyn Chrisman Oct 1980 161 p refs

(Contracts DEN3-50; DE-AI01-79ET-20485)

(NASA-CR-165551; DOE/NASA/0050-1)

Avail. NTIS

HC A08/MF A01 CSCL 10A

The social and economic impact of photovoltaic power on a small, remote native American village is studied. Village history, group life, energy use in general, and the use of photovoltaic-

powered appliances are discussed. No significant impacts due to the photovoltaic power system were observed. R J.F.

N82-19673*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

OPERATIONAL PERFORMANCE OF THE PHOTOVOLTAIC-POWERED GRAIN MILL AND WATER PUMP AT TANGAYE, UPPER VOLTA Summary Report, Mar. 1979 - Apr. 1981
James E. Martz, Anthony F. Ratajczak, and Richard DeLombard
Feb 1982 59 p refs Sponsored in part by Bureau for Development Support
(NASA-TM-82767, E-1089) Avail. NTIS HC A04/MF A01 CSCL 10B

The first two years of operation of a stand alone photovoltaic (PV) power system for the village of Tangaye, Upper Volta in West Africa are described. The purpose of the experiment was to demonstrate that PV systems could provide reliable electrical power for multiple use applications in remote areas where local technical expertise is limited. The 1.8 kW (peak) power system supplies 120-V (d.c.) electrical power to operate a grain mill, a water pump, and mill building lights for the village. The system was initially sized to pump a part of the village water requirements from an existing improved well, and to meet a portion of the village grain grinding requirements. The data, observations, experiences, and conclusions developed during the first two years of operation are discussed. Reports of tests of the mills used in the project are included. B W

N82-19675*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A REVIEW OF THE SALT-GRADIENT SOLAR POND TECHNOLOGY

E. I. H. Lin 30 Jan. 1982 60 p refs
(Contracts NAS7-100, DE-AI03-81SF-11552)
(NASA-CR-168635; JPL-Pub-81-116; JPL-5107-3;
DOE/SF-11552/1) Avail: NTIS HC A04/MF A01 CSCL 10A

The state of the salt-gradient solar pond technology is reviewed. Highlights of findings and experiences from existing ponds to date are presented, and the behavior, energy yield, operational features, and economics of solar ponds are examined. It is concluded that salt-gradient solar ponds represent a technically feasible, environmentally benign, and economically attractive energy producing alternative. In order to bring this emerging technology to maturity, however, much research and development effort remains to be undertaken. Specific R&D areas requiring the attention and action of technical workers and decision-makers are discussed, both from the perspectives of smaller, thermally-oriented ponds and larger, electricity generating ponds. Author

N82-19677*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A LOW-POWER PHOTOVOLTAIC SYSTEM WITH ENERGY STORAGE FOR RADIO COMMUNICATIONS: DESCRIPTION AND DESIGN METHODOLOGY

C. P. Chapman, Paul D. Chapman (Everest and Jennings, Los Angeles), and Alvin H. Lewison (Simpson Electric Co., Elgin, Ill.)
15 Jan. 1982 73 p refs
(Contracts NAS7-100, DE-A101-76ET-20356)
(NASA-CR-168640, JPL-Pub-82-2) Avail: NTIS
HC A04/MF A01 CSCL 10B

A low power photovoltaic system was constructed with approximately 500 amp hours of battery energy storage to provide power to an emergency amateur radio communications center. The system can power the communications center for about 72 hours of continuous nonsun operation. Complete construction details and a design methodology algorithm are given with abundant engineering data and adequate theory to allow similar systems to be constructed, scaled up or down, with minimum design effort. Author

N82-19683# New Mexico State Univ., Las Cruces.
DESIGN CALCULATION PROCEDURE FOR PASSIVE SOLAR HOUSES AT NAVY INSTALLATIONS IN REGIONS WITH COLD CLIMATE, VOLUME 1 Preliminary Report, Apr. 1980 - Sep. 1981

Monika Lumsdaine Port Hueneme, Calif NCEL Oct 1981
123 p refs 5 Vol
(Contract N62583-79-MR-585)
(AD-A108382; CEL-CR-82 002-Vol-1) Avail. NTIS

HC A06/MF A01 CSCL 13/1

A 'worksheet' approach is used in that the user may work through an example passive solar design by following the text in the report. Included are tables for heating degree days, solar heat gains, building R factors, orientation factors, roof overhang designs, etc. Performance is calculated on a monthly basis. The reports are presented for five geographical regions with content and text format similar, differing only in the appropriate regional factors. This volume gives appropriate designs for Navy installations in regions with cold climate. GRA

N82-19685# New Mexico State Univ., Las Cruces
DESIGN CALCULATION PROCEDURE FOR PASSIVE SOLAR HOUSES AT NAVY INSTALLATIONS IN REGIONS WITH WARM, HUMID CLIMATE, VOLUME 3 Preliminary Report, Apr. 1980 - Sep. 1981

Monika Lumsdaine Port Hueneme, Calif. NCEL Oct 1981
132 p refs 5 Vol.
(Contract N62583-79-MR-585)
(AD-A108384; CEL-CR-82 004-Vol-3) Avail: NTIS
HC A07/MF A01 CSCL 13/1

A 'worksheet' approach is used in that the user may work through an example passive solar design by following the text in the report. Included are tables for heating degree days, solar heat gains, building R factors, orientation factors, roof overhang designs, etc. Performance is calculated on a monthly basis. The reports are presented for five geographical regions with content and text format similar, differing only in the appropriate regional factors. This volume gives appropriate designs for Navy installations in regions with warm, humid climate. GRA

N82-19686# New Mexico State Univ., Las Cruces
DESIGN CALCULATION PROCEDURE FOR PASSIVE SOLAR HOUSES AT NAVY INSTALLATIONS IN THE PACIFIC NORTHWEST, VOLUME 4 Preliminary Report, Apr. 1980 - Sep. 1981

Monika Lumsdaine Port Hueneme, Calif. NCEL Oct 1981
120 p refs 5 Vol
(Contract N62583-79-MR-585)
(AD-A108385; CEL-CR-82 005-Vol-4) Avail: NTIS
HC A06/MF A01 CSCL 13/1

A 'worksheet' approach is used in that the user may work through an example passive solar design by following the text in the report. Included are tables for heating degree days, solar heat gains, building R factors, orientation factors, roof overhang designs, etc. Performance is calculated on a monthly basis. The reports are presented for five geographical regions with content and text format similar, differing only in the appropriate regional factors. This volume gives appropriate designs for Navy installations in the Pacific Northwest. GRA

N82-19687# New Mexico State Univ., Las Cruces
DESIGN CALCULATION PROCEDURE FOR PASSIVE SOLAR HOUSES AT NAVY INSTALLATIONS IN WARM CALIFORNIA CLIMATES, VOLUME 5 Preliminary Report, Apr. 1980 - Sep. 1981

Monika Lumsdaine and Edward Lumsdaine Port Hueneme, Calif.
NCEL Oct. 1981 121 p refs 5 Vol
(Contract N62583-79-MR-385)
(AD-A108386; CEL-CR-82 006) Avail: NTIS
HC A06/MF A01 CSCL 13/1

A 'worksheet' approach is used in that the user may work through an example passive solar design by following the text in the report. Included are tables for heating degree days, solar heat gains, building R factors, orientation factors, roof overhang designs, etc. Performance is calculated on a monthly basis. The reports are presented for five geographical regions with content and text format similar, differing only in the appropriate regional factors. This volume gives appropriate designs for Navy installations in warm California climates. GRA

N82-19688# Solarex Corp., Rockville, Md
DESIGN OF MOBILE PHOTOVOLTAIC POWER SYSTEMS: 0.5-3kW Final Report

Roy D. Gibson 1 Oct 1981 133 p
(Contract DAAK70-80-C-0147)
(AD-A108889) Avail: NTIS HC A07/MF A01 CSCL 10/2

This contract effort can be summarized by four technical tasks: Task 1 - Analysis of Engine-Generator Inventory and Use for a less than 5 kW system; Task 2 Parametric analysis of the Transportability of Photovoltaic System, i.e., the range of size

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and weight of transportable trailers and the associated PV generator size. Task 3 - Preliminary Cost Estimates for Photovoltaic Systems, and Task 4 - Preliminary Photovoltaic System Design. This report presents the results of Task 1 for the engine generator set planned inventory and characteristics. Task 1 also contained candidate photovoltaic system configurations which would be compared with the engine-generator characteristics identified in Task 1. A parametric study was made of sizing trade-offs between photovoltaic arrays and battery storage capacities which were capable of at least meeting the identified engine-generator characteristics and on structural designs for the photovoltaic array and storage battery for the two trailer configurations. The preliminary cost estimate support in Task 3 involved life cycle cost analysis for the system sizes studied in Task 1. The Task 4 preliminary system design support consisted of examining the results of Tasks 1, 2 and 3 and determining characteristics of transportable photovoltaic systems. GRA

N82-19690# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany) Abteilung Energietechnik.
DEVELOPMENT OF SIMPLE SOLAR COLLECTORS Final Report

Wilmar Fuhse, Karl Jaeger, and Hans-Peter Kleinemeier Bonn Bundesministerium fuer Forschung und Technologie Nov. 1981 314 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-T-81-174, ISSN-0340-7608) Avail: NTIS HC A14/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 47,90

The feasibility of simplifying solar energy systems, and the production techniques of their components, for usage in developing countries was investigated. The emphasis in those countries should not be so much on efficiency. Simplicity of construction and minimal reliance on imported components should be emphasized rather than efficiency because of favorable radiation conditions and high ambient temperatures. Several systems were tested consisting only of collectors, heat storage and a simple flow control. The construction of the collectors was reviewed for materials, heat vector, efficiency, construction and assembly techniques, and the material resources and climate of individual countries. As a result, a prototype collector was built and tested, satisfying the requirements. Author (ESA)

N82-19692# Dortmund Univ. (West Germany). Inst fuer Umweltschutz.

A SOLAR HIGH TEMPERATURE KILN Final Report

Norbert Huettenhoelscher and Konrad Bergmann Bonn Bundesministerium fuer Forschung und Technologie Nov 1981 93 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-T-81-181; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 19,75

The feasibility of using solar energy in developing countries for baking ceramic construction materials was investigated. The solar high temperature kiln is described. It uses two parabolic concentrators which direct available radiation into the baking chamber. The Sun tracker has only one axis. Preliminary test results with the prototype kiln were satisfactory. Author (ESA)

N82-19693# Messerschmitt-Boelkow-Blohm G.m.b.H., Otto-brunn (West Germany) Unternehmensbereich Raumfahrt.
JOINT INDIAN-GERMAN PROGRAM ON SOLAR ENERGY: PHASE 2 Final Report

Knut Berndorfer Bonn Bundesministerium fuer Forschung und Technologie Nov. 1981 99 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-T-81-182; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 21

Based on the analysis of the total energy needs of a typical Indian village and of the local sources: sun, wind and biomass, several energy supply concepts were analyzed. A project proposal for short and long-term development and testing of components and systems was elaborated. Test results and experience with the 10 kW solar power plant of Madras are presented, including recommendations for further work regarding low temperature systems. The work carried out on a parabolic dish test stand at Hyderabad is reported. Author (ESA)

N82-20638 Virginia Polytechnic Inst. and State Univ., Blacksburg.
STAGNATION TEMPERATURE TEST METHODS FOR DETERMINING SOLAR COLLECTOR THERMAL PERFORMANCE DEGRADATION Ph.D. Thesis
Aaron Grayson Dawson, III 1981 156 p
Avail: Univ. Microfilms Order No 8126252

An analytical and experimental investigation was undertaken to evaluate a proposed method for determining the thermal degradation of materials used in flat-plate solar collectors. The proposed method is based on measuring stagnation (no-flow) temperatures of the absorber plate. A comparison of the advantages and limitations of the proposed method is made with the conventionally used existing method which is based on measuring the energy output from the collector. Previous investigations show that the existing test method may not be sufficiently sensitive to detect expected changes in material properties, is influenced by the test environment, and is relatively expensive to perform. The material properties of interest are primarily the cover transmittance, the solar absorptance of the absorber, the infrared emittance of the absorber, and the thermal conductivity of insulation. Dissert Abstr

N82-20639 Virginia Polytechnic Inst. and State Univ., Blacksburg.
ANALYTICAL AND EXPERIMENTAL ANALYSIS OF PROCEDURES FOR TESTING SOLAR DOMESTIC HOT WATER SYSTEMS Ph.D. Thesis

Arthur Hunter Fanney, II 1981 181 p
Avail: Univ. Microfilms Order No 8126255

Three experimental techniques which allow the net thermal output of an irradiated solar collector array, without the use of a solar simulator, to be reproduced indoors are investigated. These techniques include use of an electric heat source only, use of a nonirradiated collector array in series with an electric heat source, and the use of electric strip heaters which are attached to the back of nonirradiated absorber plates. Expressions are developed to compute the input power required for each experimental technique. Solar collectors connected in parallel and series combinations are considered. Experiments conducted to determine the effect of storage tank, temperature stratification on system performance for a single tank direct solar hot water system are described. Dissert Abstr.

N82-20642*# AiResearch Mfg. Co. Torrance, Calif.
BUFFER THERMAL ENERGY STORAGE FOR AN AIR BRAYTON SOLAR ENGINE Final Report

Hal J Strumpf and Kevin P. Barr 31 Aug. 1981 79 p refs Prepared for JPL (Contracts NAS7-100; JPL-995136) (NASA-CR-168657, NAS 1.26:168657; AIRESEARCH-81-18087) Avail: NTIS HC A05/MF A01 CSCL 10C

The application of latent-heat buffer thermal energy storage to a point-focusing solar receiver equipped with an air Brayton engine was studied. To demonstrate the effect of buffer thermal energy storage on engine operation, a computer program was written which models the recuperator, receiver, and thermal storage device as finite-element thermal masses. Actual operating or predicted performance data are used for all components, including the rotating equipment. Based on insolation input and a specified control scheme, the program predicts the Brayton engine operation, including flows, temperatures, and pressures for the various components, along with the engine output power. An economic parametric study indicates that the economic viability of buffer thermal energy storage is largely a function of the achievable engine life. A R H.

N82-20643*# AiResearch Mfg. Co. Torrance, Calif.
STEAM RANKINE SOLAR RECEIVER, PHASE 2 Final Technical Report

L. E. DeAnda and M Faust 23 Nov. 1981 95 p refs Prepared for JPL (Contracts NAS7-100; JPL-955157) (NASA-CR-168656; NAS 1.26:168656; AIRESEARCH-80-17527) Avail: NTIS HC A05/MF A01 CSCL 10A

A steam rankine solar receiver (SRSR) based on a tubular concept was designed and developed. The SRSR is an insulated, cylindrical coiled tube boiler which is mounted at the focal plane of a fully tracking parabolic solar reflector. The concentrated solar energy received at the focal plane is then transformed to thermal energy through steam generation. The steam is used in

a small Rankine cycle heat engine to drive a generator for the production of electrical energy. The SRSR was designed to have a dual mode capability, performing as a once through boiler with and without reheat. This was achieved by means of two coils which constitute the boiler. The boiler core size of the SRSR is 17.0 inches in diameter and 21.5 inches long. The tube size is 7/16 inch I.D. by 0.070 inch wall for the primary, and 3/4 inch I.D. by 0.125 inch wall for the reheat section. The materials used were corrosion resistant steel (CRES) type 321 and type 347 stainless steel. The core is insulated with 6 inches of cerablanket insulation wrapped around the outer wall. The aperture end and the reflector back plate at the closed end section are made of silicon carbide. The SRSR accepts 85 kwth and has a design life of 10,000 hrs when producing steam at 1400 F and 2550 psig. S L

N82-20646*# Solarex Corp., Rockville, Md
A MODULE EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT (MEPSDU) Quarterly Report, 1 Sep. - 30 Nov. 1981

30 Nov. 1981 25 p refs Sponsored in part by DOE Prepared for JPL

(Contract JPL-955902)

(NASA-CR-168667; DOE/JPL-955902-81/4, NAS

1.26:168667, QR-4) Avail: NTIS HC A02/MF A01 CSCL 10A

The development of a cost effective process sequence that has the potential for the production of flat plate photovoltaic modules which meet the price goal in 1986 of 70 cents or less per Watt peak is described. The major accomplishments include (1) an improved AR coating technique, (2) the use of sand blast back clean-up to reduce clean up costs and to allow much of the Al paste to serve as a back conductor, and (3) the development of wave soldering for use with solar cells. Cells were processed to evaluate different process steps, a cell and minimodule test plan was prepared and data were collected for preliminary Samics cost analysis. A R H

N82-20649*# Springborn Labs, Inc., Enfield, Conn.
INVESTIGATION OF TEST METHODS, MATERIAL PROPERTIES, AND PROCESSES FOR SOLAR CELL ENCAPSULANTS Quarterly Progress Report

P. B. Willis Oct 1981 46 p refs Sponsored in part by DOE (Contract JPL-954527; JPL Proj. 6072.1)

(NASA-CR-168671; DOE/JPL-954527-81/20, JPL-9950-648; NAS 1.26:168671, QPR-21) Avail: NTIS HC A03/MF A01 CSCL 10A

Encapsulant materials and processes for the production of cost-effective, long-life solar cell modules were investigated. The following areas were explored: (1) soil resistant surface treatment, (2) corrosion protecting coatings from mild steel substrates; (3) primers for bonding module interfaces, and (4) RS/4 accelerated aging of candidate encapsulation compounds. B W

N82-20651*# Siltec Corp., Menlo Park, Calif
LSA LARGE AREA SILICON SHEET TASK ENHANCED ID SLICING TECHNOLOGY FOR SILICON INGOTS Final Report

George F. Fiegl Dec 1981 43 p refs Sponsored in part by DOE Prepared for JPL

(Contract JPL-955282)

(NASA-CR-168668, NAS 1.26:168668,

DOE/JPL-955282-81/1) Avail: NTIS HC A03/MF A01 CSCL 10A

A commercially available saw was equipped with a programmable ingot advance/rotation unit and a closed loop cutting edge position control system. Extensive experimentation with ingot rotation revealed that, due to the combination of the anisotropic material character of the monocrystalline silicon and ingot rotation during cutting, severe limitations on productivity were imposed. Cutting edge position control, with low kerf blades reduced the deflection by one order of magnitude thus contributing significantly to the kerf reduction. While prefabricated blade inserts promise great potential for increasing the blade lifetime while decreasing kerf, more fundamental work in the materials area of the bond is required before these blades become an effective production tool. An alternative solution of etched core construction permitted low kerf slicing, but further refinement for greater lifetime is necessary. A.R.H.

N82-20655*# National Aeronautics and Space Administration, Washington, D. C.

DYNAMIC ELECTRICAL RESPONSE OF SOLAR CELLS

Jean-Pierre Catani Jun. 1981 42 p Transl. into ENGLISH from CNES Note Technique no. 85 (France), Oct 1978 p 1-41, 69-87 Translation was announced as N80-11629 Transl by SCITRAN, Santa Barbara, Calif.

(Contract NASw-3198)

(NASA-TM-76686; NAS 1.15:76686) Avail: NTIS HC A03/MF A01 CSCL 10A

The dynamic response of a solar generator is of primary importance as much for the design and development of electrical power conditioning hardware as for the analysis of electromagnetic compatibility. A mathematical model of photo-batteries was developed on the basis of impedance measurements performed under differing conditions of temperature, light intensity, before and after irradiation. This model was compared with that derived from PN junction theory and to static measurements. These dynamic measurements enabled the refinement of an integration method capable of determining, under normal laboratory conditions, the dynamic response of a generator to operational lighting conditions. Author

N82-20662*# Kayex Corp., Rochester, N. Y.
LOW COST CZOCHRALSKI CRYSTAL GROWING TECHNOLOGY. NEAR IMPLEMENTATION OF THE FLAT PLATE PHOTOVOLTAIC COST REDUCTION OF THE LOW COST SOLAR ARRAY PROJECT Final Report, 12 Mar. 1979 - 30 Sep. 1980

E. G. Roberts 30 Sep 1980 190 p refs Sponsored in part by DOE Prepared for JPL

(NASA-CR-168658, NAS 1.26:168658, JPL-9950-632,

DOE/JPL-955270-8076) Avail: NTIS HC A09/MF A01 CSCL 10A

Equipment developed for the manufacture of over 100 kg of silicon ingot from one crucible by recharging from another crucible is described. Attempts were made to eliminate the cost of raising the furnace temperature to 250 C above the melting point of silicon by using an RF coil to melt polycrystalline silicon rod as a means of recharging the crucible. Microprocessor control of the straight growth process was developed and demonstrated for both 4 inch and 6 inch diameter. Both meltdown and melt stabilization processes were achieved using operator prompting through the microprocessor. The use of the RF work coil in poly rod melting as a heat sink in the accelerated growth process was unsuccessful. The total design concept for fabrication and interfacing of the total cold crucible system was completed. A R H

N82-20663*# Burt, Hill, Kosar, Rittleman, and Associates, Butler, Pa. Research and Solar Applications Div

COMMERCIAL/INDUSTRIAL PHOTOVOLTAIC MODULE AND ARRAY REQUIREMENT STUDY. LOW-COST SOLAR ARRAY PROJECT ENGINEERING AREA Final Report

Dec 1981 326 p refs Sponsored in part by DOE Prepared for JPL

(Contract JPL-955698)

(NASA-CR-168664, NAS 1.26:168664, DOE/JPL-955698) Avail: NTIS HC A15/MF A01 CSCL 10B

Design requirements for photovoltaic modules and arrays used in commercial and industrial applications were identified. Building codes and referenced standards were reviewed for their applicability to commercial and industrial photovoltaic array installation. Four general installation types were identified - integral (replaces roofing), direct (mounted on top of roofing), stand-off (mounted away from roofing), and rack (for flat or low slope roofs, or ground mounted). Each of the generic mounting types can be used in vertical wall mounting systems. This implies eight mounting types exist in the commercial/industrial sector. Installation costs were developed for these mounting types as a function of panel/module size. Cost drivers were identified. Studies were performed to identify optimum module shapes and sizes and operating voltage cost drivers. The general conclusion is that there are no perceived major obstacles to the use of photovoltaic modules in commercial/industrial arrays. R J F

N82-20664*# Mobil Tyco Solar Energy Corp., Waltham, Mass.
LARGE AREA SILICON SHEET BY EFG Annual Progress Report, 1 Oct. 1980 - 30 Sep. 1981

30 Sep 1981 71 p refs Prepared for JPL

(Contract JPL-954355)

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(NASA-CR-168680; NAS 1 26 168680, DOE/JPL-954355-81)
Avail. NTIS HC A04/MF A01 CSCL 10A

Progress was made in improving ribbon flatness and reducing stress, and in raising cell performance for 10 cm wide ribbon grown in single cartridge EFG furnaces. Optimization of growth conditions resulted in improved ribbon thickness uniformity at a thickness of 200 micron, grown at 4 cm/minute, and growth at this target speed is routinely achieved over periods of the order of one hour or more. With the improved ribbon flatness, fabrication of large area (50 sq cm) cells is now possible, and 10 to 11% efficiencies were demonstrated on ribbon grown at 3.5 to 4 cm/minute. Factors limiting performance of the existing multiple ribbon furnace were identified, and growth system improvements implemented to help raise throughput rates and the time percentage of simultaneous three-ribbon growth. However, it is evident that major redesign of this furnace would be needed to overcome shortfalls in its ability to achieve the Technical Features Demonstration goals of 1980. It was decided to start construction of a new multiple ribbon furnace and to incorporate the desired improvements into its design. The construction of this furnace is completed. J M S

N82-20671# Air Force Engineering and Services Center, Golden, Colo.

STATE-OF-THE-ART REVIEW OF SOLAR PONDS Final Report

William A Tolbert Apr 1981 16 p refs
(AF Proj. 2054)
(AD-A109038, DOE/SSO-4042/1) Avail. NTIS
HC A02/MF A01 CSCL 13/2

This report provides a brief but concise review of solar pond technologies and their potential for application within the military. The report covers salt gradient solar ponds (SGSP), shallow solar ponds (SSP), saltless convecting solar ponds, gel ponds, viscosity stabilized ponds, and membrane ponds. In addition, several criteria were evaluated with respect to solar ponds. These included reliability, maintainability, efficiency, survivability, environmental impact and economics. Research and development requirements and ongoing activities were also summarized. This report documents one of several ongoing state-of-the-art reviews of solar technologies performed by an Air Force liaison office with the Department of Energy. Author (GRA)

N82-20672# Air Force Engineering and Services Center, Golden, Colo. Research and Technology Liaison Office

STATE-OF-THE-ART REVIEW OF LOW-COST COLLECTOR TECHNOLOGIES Final Report

William A Tolbert Jun 1981 13 p refs
(AF Proj 2054)
(AD-A109039, DOE/SSO-4042/2) Avail. NTIS
HC A02/MF A01 CSCL 13/2

This report provides a brief but concise review of low-cost solar collector technologies and their potential for application within the military. The report covers low-cost, light-weight concepts for flat-plate collectors, parabolic trough collectors, heliostats and parabolic dish collectors. In addition, several criteria were evaluated with respect to low-cost collector technologies. These included reliability, maintainability, survivability, mobility/erectibility, environmental impact and economics. Research and development requirements and ongoing activities were also summarized. This report documents one of several ongoing state-of-the-art reviews of solar technologies performed by an Air Force liaison office with the Department of Energy. Author (GRA)

N82-20674# Texas Univ at Arlington, Dept. of Chemistry.
THE DESIGN OF SEMICONDUCTOR PHOTOELECTRO-CHEMICAL SYSTEMS FOR SOLAR ENERGY CONVERSION

Allen J Bard 21 Dec 1981 34 p refs Submitted for publication
(Contract N00014-78-C-0592, NR Proj. 051-693)
(AD-A109477, TR-20) Avail. NTIS HC A03/MF A01 CSCL 20/12

The principles and applications of semiconductor electrodes in photoelectrochemical (PEC) cells for carrying out useful chemical reactions are described. The factors in the design of efficient and stable systems and semiconductor particulate systems constructed on the basis of PEC cell principles are discussed. Author (GRA)

N82-20684*# Ross (Bernd) Associates, San Diego, Calif.
DEVELOPMENT OF AN ALL-METAL THICK-FILM COST-EFFECTIVE METALLIZATION SYSTEM FOR SOLAR CELLS
Quarterly Report, Nov. 1980 - Apr. 1981

Bernd Ross Sep. 1981 39 p refs
(Contracts NAS7-100, JPL-955688)
(NASA-CR-168502, NAS 1 26:168502;
DOE/JPL-955688-80/10, DE-82-001936; QR-3) Avail. NTIS
HC A03/MF A01 CSCL 10A

Screened electrodes made from fluorocarbon activated copper paste and silver fluoride activated copper paste, tape adhesion and scratch tests were studied. Experiments were conducted with variations in past parameters, firing conditions, including gas ambients, furnace furniture, silicon surface and others. A liquid medium intended to provide transport during the carbon fluoride decomposition, is incorporated in the paste. DOE

N82-21225# Lincoln Lab., Mass Inst of Tech., Lexington
MATERIALS, PROCESSES AND TESTING LABORATORY
RESIDENTIAL TECHNICAL PROGRESS REPORT Progress Report, Mar. - Jun. 1981

S. E Forman and M P Themelis 31 Aug 1981 29 p ref
(Contract DE-AC02-76ET-20279)
(DE82-002816; DOE/ET-20279/151) Avail. NTIS
HC A03/MF A01

Performance measurements are reported for prototype photovoltaic modules in various residential applications in the Northeast, in New Mexico, in Florida and in Hawaii. Current-voltage characteristics were measured and the dependence of power delivered upon cell temperature was measured. Failure analysis of high leakage current modules, visual examination results of modules at the Northeastern and New Mexico sites, and examination of photovoltaic/thermal liquid collectors are presented. T M

N82-21345*# Jet Propulsion Lab., California Inst. of Tech., Pasadena

EVALUATION OF THE EFFECTS OF A FREEZE/THAW ENVIRONMENT ON CELLULAR GLASS

P. Frickland, E Cleland, and T Hasegawa 15 Aug 1981 41 p refs
(Contract DE-AT04-81AL-16228)

(NASA-CR-168719, DOE/JPL-1060-44, NAS 1.26 168719;
DE81-03093) Avail. NTIS HC A03/MF A01 CSCL 11B

Cellular glass technology with respect to solar energy applications was briefly reviewed and current applications and related studies are discussed. Using the evaluation criteria of water vapor permeability and conformability, a protective butyl rubber/silicone conformal coating system was selected for use on Foamglas substrates in a freeze/thaw environment. The selection of a specific freeze/thaw cycle which closely models field conditions is discussed. A sampling plan is described which allows independent evaluation of the effects of conformal coatings, cycle number and location within the environmental chamber. The results of visual examination, measurement of density, modulus of rupture and Young's modulus are reported. Based upon statistical evaluation of the experimental results, it is concluded that no degradation in mechanical properties of either coated or uncoated Foamglas occurred within the duration of the test (53 freeze/thaw cycles). T M

N82-21441# Lincoln Lab., Mass Inst of Tech., Lexington
PROTOTYPE RESIDENTIAL PHOTOVOLTAIC-SYSTEMS
EVALUATION PLANS

M C Russell Oct 1981 33 p refs
(Contract DE-AC02-76ET-20279)
(DE82-004726; DOE/ET-20279/163) Avail. NTIS
HC A03/MF A01

A sequence of tests is identified to assess the reliability and safety of residential photovoltaics systems. In addition, a standard means of characterizing a PV system in terms of its power and energy performance is presented. At present, these tests and characterization procedures are being applied to prototype residential systems under evaluation. DOE

N82-21442# Massachusetts Inst. of Tech., Cambridge
SOLAR PHOTOVOLTAIC RESIDENTIAL PROJECT Monthly
Management Report, 1 Jul. 1981 - 31 Jul. 1981

1981 17 p
(Contract DE-AC02-76ET-20279)

(DE82-000653; DOE/ET-20279/T11) Avail NTIS
HC A02/MF A01

Progress with technology transfer and the performance of photovoltaic power supplies in Northeastern and Southwestern residences are reported Also, systems operation in Florida and Hawaii are discussed briefly Technology development in the field of power conditioning and flywheel storage is described Work on some non-residential field tests is also described Project management data are summarized DOE

N82-21443# Lincoln Lab., Mass Inst of Tech., Lexington
CARLISLE HOUSE: AN ALL-SOLAR-ELECTRIC RESIDENCE

B E Nichols Oct 1981 25 p refs
(Contract DE-AC02-76ET-20279)
(DE82-004376; DOE/ET-20279/143) Avail. NTIS
HC A02/MF A01

The first solar photovoltaic house designed and constructed under the US Department of Energy's Solar Photovoltaic Residential Project was completed The house, which is powered by a 7-kWp photovoltaic system, will be used to assess the occupants' acceptance of and reactions to residential photovoltaic systems and to familiarize utilities, builders, developers, town building officials and others with issues concerning photovoltaic installations The house is located on a two-acre lot in Carlisle, Massachusetts, approximately twenty miles northwest of Boston Built by a local architect/developer team, the house includes energy conservation and passive solar features It utilizes a roof-mounted, flat-plate PV array which operates in a two-way energy exchange mode with the electric utility The energy conservation and passive solar features of this house are described and detailed description of the utility-interactive photovoltaic system is presented, along with initial performance data DOE

N82-21542# Sandia Labs., Livermore, Calif Thermal Sciences Div

RADSOLVER: A COMPUTER PROGRAM FOR CALCULATING SPECTRALLY-DEPENDENT RADIATIVE HEAT TRANSFER IN SOLAR CAVITY RECEIVERS

M Abrams Sep 1981 58 p refs
(Contract DE-AC04-76DP-00789)
(DE82-000833; SAND-81-8248) Avail NTIS
HC A04/MF A01

RADSOLVER is a computer program which calculates the radiation energy transport in cavity type receivers having an arbitrary number of apertures through which collimated beams of solar radiation enter In contrast to the common assumption of gray (or semi-gray) surfaces used in the modeling of radiation transport, RADSOLVER accounts for the wavelength-dependence of emission, absorption and reflection with a band model of the radiative properties. Illustrative examples along with input and output are presented DOE

N82-21715# Uppsala Univ. (Sweden). Inst of Technology,
OPTICAL PROPERTIES OF SOLIDS FOR SOLAR ENERGY CONVERSION Ph.D. Thesis

Bjoern Karlsson 1981 19 p refs Sponsored in part by the Swedish Natural Science Research Council (NFR), the Swedish Council for Building Research (BRF), and the Swedish Board for Technical Development (STU)
(ISSN-0345-0058; ISBN-91-554-1226-2) Avail. NTIS
HC A02/MF A01

The optical properties of transition metal carbides and nitrides were studied by reflectance measurements between 0.2 and 15 micrometers at room temperature and up to 500 C. An interpretation of the pronounced difference between the nitrides and carbides is made from a model in the electronic density of states distribution The model is used to explain shifts in the optical constants when carbon or nitrogen-vacancies are introduced in the nitride. Calculations based on the optical constants suggest the nitrides as a new material for transparent heat-mirrors. The refractive index and band-edge of CuO, Cu sub 2O, Fe sub 2O sub 3, Cr sub 2O sub 3, i-C and a-Si have been measured and discussed within the framework of a new model for evaluating their potential use as the absorbing layer on a tandem-selective surface. A number of oxides on copper and steel were prepared by thermal and chemical methods and investigated for use as selectively absorbing surfaces. Thin films of noble and transition metals have been prepared and optically investigated for use as semi-transparent coatings on domestic windows. Author

N82-21718# Los Alamos Scientific Lab., N. Mex.
A PASSIVE SOLAR RETROFIT STUDY FOR CONCRETE BLOCK BUILDINGS Report, Oct. 1980 - Sep. 1981

William O Wray, Charles R. Miles (NCEL), and Claudia E. Kosiewicz
Jan. 1982 28 p refs
(Contract N68305-81-MP-10003)

(AD-A110189; CEL-CR-82.007) Avail. NTIS
HC A03/MF A01 CSCL 13/1

A passive solar retrofit study has been conducted for the Navy at the Los Alamos National Laboratory. The purpose of the study was to determine the energy savings obtainable in concrete block buildings from several passive solar heating and conservation strategies A procedure involving the use of test cell data and computer simulation was employed to assess the merits of six retrofit options The six strategies selected were chosen on the basis of providing a series of options that will deliver increasing energy savings at the cost of correspondingly increased levels of commitment Author (GRA)

N82-21720# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

SOLAR ENERGY INFORMATION USER STUDY: MILITARY ENGINEERS

T L. Marle and W. W. Belew Sep. 1981 100 p
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-001606; SERI/TR-751-1047) Avail. NTIS
HC A05/MF A01

Data from questionnaires administered to military engineers and architects attending a 2 day solar design workshop are summarized The workshop was designed to inform engineers when and where solar energy could be used more effectively. The study aimed to identify the solar energy information needs and information habits of the professionals, their familiarity with and appraisal of relevant military publications containing solar energy information currently available, and the overall effectiveness of the workshops (including structure and content). To measure the effectiveness of the workshop itself and provide input on producing an effective and comprehensive information dissemination plan for military engineers nationwide, 2 questionnaires were designed and administered to the participants A preworkshop questionnaire assessed the participant's knowledge of solar energy prior to attending the workshop T.M

N82-21721# Argonne National Lab., Ill. Energy and Environmental Systems Div.

ECONOMIC ASSESSMENT OF BATTERY STORAGE IN SOLAR PHOTOVOLTAIC APPLICATIONS First-year Project Summary

R O Mueller, W J. Walsh, B K. Cha, and R F. Giese May 1981 56 p refs
(Contract W-31-109-eng-38)

(DE82-004045; ANL/SPG-20) Avail: NTIS HC A04/MF A01

Savings attributable to batteries were evaluated for three representative US utility service areas The photovoltaic (PV) devices were assumed capable of exporting excess power to the utility grid; and the batteries, sited at the substation, were operated as a form of load-leveling utility storage. A cost-allocation model, SIMSTOR, was employed to determine utility fuel and resulting capital cost savings The effects of installing PV devices were evaluated Results indicated that batteries and PV systems do not directly compete when attached to the electricity supply grid Utility savings were primarily fuel savings, those from the batteries were savings in utility capacity. Batteries with higher discharge rates and larger storage capacities are to be favored It was determined that lead/acid and zinc/chlorine batteries are the leading contenders in the near term M D.K.

N82-21727# Arizona Univ., Tucson Environmental Research Lab

OFF-PEAK POWER USE IN PASSIVE SOLAR HOMES: PERFORMANCE, MONITORING, AND ANALYSIS OF PERIODIC HEATING AND COOLING IN HIGH MASS HOMES

J F. Peck Aug 1981 42 p refs Sponsored by Electric Power Research Inst
(EPRI Proj 1191-7)
(DE82-900874; EPRI-EM-1966) Avail. NTIS
HC A03/MF A01

The thermal performance of two passive solar homes and an identical standard home used as a control are described

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The peak hour electrical demand rates of these homes are compared and off peak refrigeration of homes with large quantities of thermal mass is discussed. A computer model which is being developed to assess the potential of off peak refrigeration is also described
DOE

N82-21729# Princeton Univ., N. J. Energy Group
HEATING/DAYLIGHTING PROTOTYPE DEVELOPMENT, PHASE 1. PASSIVE AND HYBRID SOLAR MANUFACTURED BUILDING PROJECT COVERING RESEARCH AND COMPONENT DESIGN Final Technical Report, 1 Oct. 1978 - 31 Aug. 1981

L. L. Lindsey and Marvin K. Snyder (Butler Manufacturing Co. Research Center) Sep 1981 79 p refs
(Contract DE-FC02-80CS-30367)
(DE82-002097. DOE/CS-30367/6) Avail: NTIS
HC A05/MF A01

The design of passive and hybrid solar space heating and daylighting into prefabricated buildings is described. Systems considered include one sided and two sided roof apertures and a wall mounted air collector system. Several storage concepts were considered, and best results are expected from using the floor slab and perhaps rock beds. A test building design is described. Performance simulation and thermal analysis on the design are described and annual performance estimates and cost estimates are made
DOE

N82-21730# DHR, Inc., Washington, D.C.
MATERIALS-RESEARCH RECOMMENDATIONS TO IMPROVE THE PERFORMANCE AND DURABILITY OF SOLAR HEATING AND COOLING SYSTEMS

Stephen Herzenberg and Richard Silbergliitt 11 Sep. 1981
258 p refs
(Contract DE-AC01-80ER-30008)
(DE82-000738. DOE/ER-30008/T1) Avail: NTIS
HC A12/MF A01

The type of materials research most likely to improve the durability and efficiency of future active and passive solar heating and cooling systems is analyzed. Research needs are compared with ongoing solar materials research, and the extent to which present research efforts are addressing the critical flat plate collector needs is assessed. Areas most in need of additional attention are identified. Research recommendations are made for glazing materials, selective absorbers and heat transfer fluids.
DOE

N82-21731# Lincoln Lab., Mass Inst of Tech., Lexington
SAFETY PROCEDURES FOR THE 100-KW SOLAR PHOTOVOLTAIC SYSTEM AT NATURAL BRIDGES NATIONAL MONUMENT

R F Hopkinson Sep. 1981 47 p refs
(Contract DE-AC02-76ET-20279)
(DE82-002840. DOE/ET-20279/108) Avail: NTIS
HC A03/MF A01

The 100-kWp solar photovoltaic (PV) power system at Natural Bridges National Monument is a unique electrical power-generation system and special safety guidelines were developed to govern its operation. General safety requirements are set forth to safeguard newcomers to the PV system. Procedures to be used in event of emergency, including a recommended shutdown procedure, are included together with specific safety hazards inherent in the array field, battery room, control room and inverter room
DOE

N82-21733# Exxon Research and Engineering Co., Florham Park, N.J.
CONCEPTUAL DESIGN OF A SOLAR COGENERATION FACILITY INDUSTRIAL PROCESS HEAT, CATEGORY A. EXECUTIVE SUMMARY Final Report, 10 Sep. 1980 - 14 Aug. 1981

P. Joy, Martin Brzeczek, Harold Seilestad, Carl Silverman, and George Yenetchi Jul 1981 235 p Prepared in cooperation with Badger Energy, Inc., Martin Marietta, Denver and Pacific Gas and Electric, San Ramon, Calif.
(Contract DE-AC03-80SF-11438)
(DE82-001663. DOE/SF-11438/T1-Vol-1) Avail: NTIS
HC A11/MF A01

The conceptual design of a central receiver solar cogeneration facility at a California oil field is described. The process of selecting the final cogeneration system configuration is described and the

various system level and subsystem level tradeoff studies are presented, including the system configuration study, technology options, and system sizing. The facility is described, and the functional aspects, requirements, operational characteristics, and performance are discussed. Capital and operating costs, safety, environmental, regulatory issues and potential limiting considerations for the design are included. Each subsystem is described in detail including a discussion of the functional requirements, design, operating characteristics, performance estimates and a top level cost estimate. An economic assessment is performed to determine the near-term economic viability of the project and to examine the impact of variations in major economic parameters such as capital and operating and maintenance costs on economic viability. Two measures of economic viability used are levelized energy cost and net present value.
DOE

N82-21734# Lincoln Lab., Mass Inst. of Tech., Lexington
INFORMATION GATHERING, DATA REDUCTION, AND INFORMATION DISSEMINATION FOR RESIDENTIAL EXPERIMENT STATION OPERATIONS

P Raghurman and E. C. Kern, Jr Sep 1981 26 p refs
(Contract DE-AC02-76ET-20279)
(DE82-002157. DOE/ET-20279/141) Avail: NTIS
HC A03/MF A01

The Residential Experiment Stations (RESs) were designed to develop residential photovoltaic systems and to disseminate information to the photovoltaic community, cognizant institutions and, ultimately, the public. The residential data systems are discussed that were designed specifically for the RESs to gather and process the physical data required. The specific reports are covered which will be issued and the contents of each report are listed. A sample format for each report is also presented. The appendices describe the quantities that will be measured at the monitored houses, prototype systems and initial system evaluation experiments. They also include a description of the data processing
DOE

N82-21735# Westinghouse Electric Corp., Pittsburgh, Pa.
Advanced Energy Systems Div
ROBINS AIR FORCE BASE SOLAR COGENERATION FACILITY, VOLUME 1 Final Report

Aug 1981 321 p refs 2 Vol
(Contract DE-AC03-81SF-11494)
(DE82-001922. DOE/SF-11494/T1-Vol-1) Avail: NTIS
HC A14/MF A01

A conceptual design and cost estimate for a demonstration solar facility to generate electricity and deliver process steam to the existing base distribution systems is considered. The solar energy system is a central receiver arrangement. The technical approach to the project and the rationale for selecting the site at Robins Air Force Base are discussed. The evaluation of alternative configurations considered to have potential for improving the facility value is summarized. The solar facility is described, including system level functional requirements, design, operation, performance, cost, safety, environmental, institutional, and regulatory considerations. The design, functional requirements and operating characteristics which influence cost or performance for each subsystem are described. The subsystems are the collector, receiver/tower, master control, electric power generation, and facility steam and feedwater subsystems
DOE

N82-21736# Westinghouse Electric Corp., Pittsburgh, Pa.
Advanced Energy Systems Div
ROBINS AIR FORCE BASE SOLAR COGENERATION FACILITY, VOLUME 2 Final Report

Aug 1981 196 p refs 2 Vol
(Contract DE-AC03-81SF-11494)
(DE82-001866. DOE/SF-11494/T1-App-A-H) Avail: NTIS
HC A09/MF A01

Eight appendices are included. The first is a facility specification which defines the characteristics, and design and environmental requirements for the facility. The facility conceptual design, performance, costs and economic data are provided as well as a description of the existing facility. The second appendix contains the drawings generated in support of the conceptual design. The third presents the MIRVAL computer code used to calculate the incident energy on the solar receiver. The fourth provides details on the predicted performance of the predicted performance of the modified steam turbine and the typical commercial turbine. The fifth contains the annual integration performance model of sizing the facility. The sixth contains steam load data projected

to 1986. A computer model developed to integrate the hour-by-hour, steady-state, performance of the final conceptual cogeneration facility is given in the seventh appendix. Finally, descriptions and vendor data for the balance of the plant equipment grower, master control, electric power generation, and facility steam and feedwater subsystems. DOE

N82-21737# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

CONVINCING THE HOME BUILDER TO BUILD SOLAR HOMES: EVALUATION OF PASSIVE SOLAR WORKSHOP FOR BUILDERS

S. Klein Sep 1981 97 p refs
(Contract DE-AC02-77CH-00178)
(DE82-001978; SERI/TR-722-892) Avail. NTIS
HC A05/MF A01

In 1979-80, a pilot series of workshops for home builders was offered throughout the United States. The primary objectives of the project were to educate the home builder in passive solar design techniques, to promote favorable attitudes toward solar concepts, and to encourage builders to use solar design in residential construction. Builders and designers were targeted because they are the decision makers in the progress of commercializing solar design in new construction. The need is outlined for continued and expanded programs for builders to facilitate usage of solar design in the residential sector, based on information provided in nearly 1100 pre- and post-training forms returned. DOE

N82-21738# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.

SOLAR DESIGN AND INSTALLATION EXPERIENCE: AN OVERVIEW OF RESULTS FROM THE NATIONAL SOLAR DATA NETWORK

H O. Holte and C. J. Kelly, ed Jun 1981 78 p refs
(Contract DE-AC01-79CS-30027)
(DE82-001657; SOLAR/0009-81/37) Avail. NTIS
HC A05/MF A01

Results, conclusions and insights drawn from analysis of the various types of solar energy systems are presented. Some sites have been monitored for over four years. Performance information, derived from accurately measured field data, are presented and may be related to design data for the sites. Information is identified for such factors as the ratio of storage volume to collector area, heating and cooling load and the ratio of collector area to building floor area. DOE

N82-21743# California Univ., Livermore. Lawrence Livermore Lab

ECONOMIC ANALYSIS OF SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS: A METHODOLOGY TO DETERMINE ANNUAL REQUIRED REVENUE AND INTERNAL RATE OF RETURN

W. C. Dickinson and Kenneth C. Brown 11 Aug 1981 48 p refs
(Contract W-7405-eng-48)
(DE82-001628; UCRL-52814-Rev-1) Avail. NTIS
HC A03/MF A01

An economic evaluation of solar industrial process heat systems, is developed to determine the annual required revenue and the internal rate of return. First, a format is provided to estimate the solar system's installed cost, annual operating and maintenance expenses, and net annual solar energy delivered to the industrial process. The annual required revenue and the price of solar is calculated. The economic attractiveness of the potential solar investment can be determined by comparing the price of solar energy with the price of fossil fuel, both expressed in leveled terms. This requires calculation of the internal rate of return on the solar investment or, in certain cases, the growth rate of return. DOE

N82-21745# Sandia Labs., Albuquerque, N. Mex.
ACTIVE AND PASSIVE COOLING FOR CONCENTRATING PHOTOVOLTAIC ARRAYS

M. W. Edernburn and Michael W. Edernburn Oct. 1981 23 p refs
(Contract DE-AC04-76DP-00789)
(DE82-003922; SAND-81-0530) Avail. NTIS
HC A02/MF A01

Optimization, based on minimum energy cost, of active and passive cooling designs for point-focus Fresnel lens photovoltaic

arrays and lines-focus, parabolic-trough photovoltaic arrays is discussed, and the two types of cooling are compared. Passive cooling is more cost-effective for Fresnel lens arrays while the reverse is true for parabolic-trough arrays. DOE

N82-21746# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

EXPLORATORY DEVELOPMENT OF THIN-FILM POLY-CRYSTALLINE PHOTOVOLTAIC DEVICES Semiannual Topical Report, 1 Oct. 1980 - 1 Jun. 1981

Jun 1981 56 p refs Prepared in cooperation with RCA Labs
(Contract DE-AC02-77CH-00178)
(DE82-000092; SERI/PR-0-9100-1) Avail. NTIS
HC A04/MF A01

During this period, heavy emphasis was placed on substrate and epitaxial process and reactor development since these are the major components of this approach to low-cost solar-cell modules. The substrate task seeks to apply the HEM ingot technology to commercial metallurgical grade (MG) silicon to form a substrate suitable for epitaxial growth and solar-cell fabrication. A conceptual study of three epitaxial reactor systems was conducted to provide a sound theoretical and practical basis for continued and future development of reactor systems. Initial cost projections which were conducted based on SAMICS/IPEG methodologies indicate that attainment of the cost-goal of less than 0.50 \$/Wp can be achieved. T.M.

N82-21748# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

PHOTOVOLTAIC RESEARCH AND DEVELOPMENT: MATERIALS RESEARCH Annual Report

Paul Schissel Sep. 1981 18 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-001796; SERI/PR-641-1306) Avail. NTIS
HC A02/MF A01

Program objectives, milestones, planned research topics and equipment acquisition and specifications are listed. On-going research activities are described, including principal in-house activities on thick-film metallization, photodegradation of polymeric materials, and encapsulation by electrostatic lamination of glass mirrors. DOE

N82-21750# Pennsylvania State Univ., University Park. Materials Research Lab

PHOTOVOLTAIC AND STRUCTURAL PROPERTIES OF a-Si:H THIN FILMS Quarterly Technical Report, 1 Jun. - 31 Aug. 1981

R. Messier Nov 1981 21 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contract DE-AC02-77CH-00178)
(DE82-002755; SERI/PR-9227-1-T1; QTR-5) Avail. NTIS
HC A02/MF A01

The physical structure of a vapor-deposited thin film is related to adatom mobility, adatom species, and bombardment effects at the growing film surface. Bombardment effects were found to be the dominant factor. For floating film potentials greater than approximately -20V, Ar⁽⁺⁾-ion bombardment results in a drastic decrease in observable film microstructure. Adatom significant bombardment. The evolution of film physical structure was studied in detail. Hydrogenated a-Si films prepared by rf-sputtering were investigated as a function of film thickness, substrate type, and roughness. The physical structure was shown to evolve with film thickness as a result of the nucleation, growth, and incomplete coalescence of island-like structures which leads to a supernetwork of larger voids. The structural evolution was essentially unaffected by substrate type for this material in which low adatom mobility is the controlling factor. M.D.K.

N82-21751# Pennsylvania State Univ., University Park. Material Research Lab

PHOTOVOLTAIC AND STRUCTURAL PROPERTIES OF a-Si:H THIN FILMS Quarterly Technical Progress Report, 1 Dec. 1980 - 28 Feb. 1981

R. Messier and I. S. T. Song 1981 7 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contract DE-AC02-77CH-00178)
(DE82-002698; SERI/PR-9227-1-T3; QTPR-3) Avail. NTIS
HC A02/MF A01

The substrate floating potential, V_{sub}/s , was measured

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as a function of RF-sputtering conditions using an electrostatic probe. The large negative $V_{\text{sub s/}}$ induced at low $P_{\text{sub Ar/}}$ was responsible for energetic ion-bombardment at the growing film/plasma interface. This bombardment, when below a threshold potential -20V, results in local atomic rearrangement and selective resputtering, leading to minimization of microstructure defects. Results on film characteristics vs. $V_{\text{sub s/}}$, H-implantation in c-Si, and Si-H bonding vs. $P_{\text{sub H2/}}$ and $T_{\text{sub s/}}$ lead to a more complete picture of bombardment and thermal processes in a-Si:H film formation. DOE

N82-21752# Midwest Research Inst., Golden, Colo. Photovoltaics Research Branch

PLAN FOR A PHOTOVOLTAIC APPLIED RESEARCH LABORATORY FOR DEVELOPING COUNTRIES

Steve Hogan, K. Firor, T. Ciszek, J. Olson, and S. Wagner. Oct. 1981. 17 p.

(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-003289. SERI/TR-611-1094) Avail. NTIS
HC A02/MF A01

The planning of a photovoltaic laboratory in a developing country is discussed. With a budget of \$500,000, equipment and materials are purchased for a four-year period. In the fourth year 1000W (peak power) of modules will be produced from blank silicon wafers. DOE

N82-21753# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Labs.

THIN-FILM POLYCRYSTALLINE SILICON SOLAR CELLS

Final Report, 15 Apr. 1980 - 15 Apr. 1981

Amal K. Ghosh, Tom Feng, Daniel J. Eustace, and H. Paul Maruska

Jul 1981. 78 p. refs.
(Contracts DE-AC02-77CH-00178; SERI XJ-0-9077-1)
(DE82-000633. SERI/TR-9077-T3) Avail. NTIS
HC A05/MF A01

The highest efficiencies achieved with single crystals are 14.1% for ITO/n-Si and 13.3% of SnO₂/n-Si, while the corresponding values for polysilicon are 11.2% and 10.1%. For large area single crystal devices the efficiency values are 11.7% and 11.2% for ITO and SnO₂ cells, respectively, while for polysilicon the corresponding values are 9.82% and 8.55%. The lower efficiency for large area devices is mainly due to lower $J_{\text{sub sc}}$ and FF. Results are presented to show the optimum grid spacing required. From stability studies it is shown that there are two distinct mechanisms for degradation, one optical and the other thermal. The optical degradation could be eliminated if the cells could be protected from UV light and the thermal degradation can be prevented if the cells are operated below 100°C. DOE

N82-21755# Science Applications, Inc., McLean, Va. Solar Technology Div.

COMPARISON OF GROUND-COUPLED SOLAR-HEAT-PUMP SYSTEMS TO CONVENTIONAL SYSTEMS FOR RESIDENTIAL HEATING, COOLING AND WATER HEATING

Final Report

M. K. Choi, J. H. Morehouse, and P. J. Hughes. Golden, Colo.

Solar Energy Research Inst. Jul 1981. 82 p. refs.
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-003633; SERI/TR-98288-2) Avail. NTIS
HC A05/MF A01

An analysis is performed of ground-coupled stand-alone and series configured solar-assisted liquid-to-air heat pump systems for residences. The year-round thermal performance of these systems for space heating, space cooling, and water heating is determined by simulation and compared against non-ground-coupled solar heat pump systems as well as conventional heating and cooling systems in three geographic locations: Washington, DC; Fort Worth, Texas, and Madison, Wisconsin. The results indicate that without tax credits a combined solar/ground-coupled heat pump system for space heating and cooling is not cost competitive with conventional systems. Its thermal performance is considerably better than non-ground-coupled solar heat pumps in Fort Worth. Though the ground-coupled stand-alone heat pump provides 51 percent of the heating and cooling load with non-purchased energy in Fort Worth, its thermal performance in Washington and Madison is poor. DOE

N82-21762# AAI Corp., Baltimore, Md.
SOLAR PRODUCTION OF INDUSTRIAL PROCESS HOT

WATER. PHASE 3: OPERATION AND EVALUATION OF THE YORK BUILDING PRODUCTS COMPANY, INCORPORATED. SOLAR FACILITY Final Report, Sep. 1978 - Sep. 1981

J. M. Bollinger, N. Kaplan, and H. A. Wilkening, Jr. Oct. 1981. 94 p. refs.

(Contract DE-AC03-76CS-31217)
(DE82-003000. DOE/CS-31217/T7) Avail. NTIS
HC A05/MF A01

The solar facility utilizes 35 collectors with a total aperture area of 8960 sq ft. The system is designed to deliver a water/ethylene glycol solution at 200 F to a heat exchanger, which, in turn, supplies water at 180 F to a autoclave (underground tank) for the concrete block curing process. A fossil fuel boiler system also supplies the autoclave with processed hot water to supplement the solar system. The system was operational 92.5% of the days during which the data acquisition system was functional. Sufficient solar heating was available to deliver hot water to the heat exchanger on 448 days, or 81.8% of the days on which reliable data was recorded. Total fuel saved during the three year period was 10,284 gallons. Thus, this program successfully demonstrated the technical feasibility of generating industrial process hot water with solar energy. DOE

N82-21765# Messerschmitt-Boelkow-Blohm G m b H, Otterbrunn (West Germany). Unternehmensbereich Raumfahrt

HELIOSTAT FIELD LAYOUT FOR SOLAR THERMAL POWER PLANTS [DIE AUSLEGUNG VON HELIOSTATFELDERN FUER SOLAR THERMISCHE KRAFTWERKE]

Hartung, Kindermann, and W. Mayer. Jun 1980. 15 p. refs.

In GERMAN. ENGLISH summary.

(M82-UR-453/80-OE) Avail. NTIS HC A02/MF A01

The calculation of the optimum distribution of heliostats, serving a solar tower collector for solar thermal power generation, is considered. A theoretical basis for the problem is posed, encompassing physical characteristics of the heliostats, their number, and intensity of the reflected radiation from each unit in function of their layout. Theoretical results lead to numerical procedures (program package FAUST). Various heliostat field configurations (project EURELIOS and GAST) are then discussed and evaluated in light of this model. Author (ESA)

N82-21767# Statens Provningsanstalt, Boraas (Sweden). Lab fuer Fysikalisk Maetteknik

SP-C12-301: THERMAL PERFORMANCES OF SOLAR ENERGY ABSORBERS [SP-C12-301: SOLFAANGARES TERMISKA PRESTANDA]

Hans E. B. Andersson. 5 Nov 1979. 28 p. In SWEDISH.
(SP-MET-1979-2) Avail. NTIS HC A03/MF A01

The testing scheme applies to the case of absorbers where the heat carrier is a liquid passing from a single inlet to a single outlet. The absorbers are intended as part of a roof and must be tested in a standardized construction. Thermal efficiency, losses and the influence of the angle of incidence are discussed. The total solar flux in the plane of the absorber must be at least 600 W/sqm, normally 800 to 1100 W/sqm. A Sun-simulator may also be used for testing. Author (ESA)

N82-21769# Esser (Klaus) G m b H and Co. K G., Duesseldorf (West Germany)

SOLAR COLLECTORS FOR FLAT ROOFS

G. Dohse and G. Reisewitz. Aug 1980. 23 p. Transl into ENGLISH of "Sonnerkollektoren fuer Flachdacher". Rept.

BMFT-FB-T-80-043-E. West Germany. Sponsored Bundeministerium fuer Forschung und Technologie.
(PB82-129834. BMFT-FB-T-80-043-E) Avail. NTIS
HC A02/MF A01 CSCL 13A

The development and construction of solar collectors for flat roofs and the testing of their service life was discussed. The problematic nature of installation techniques, which meet technical requirements and guarantee good operation, as well as optimization of collector parts was discussed. A technically and economically satisfying solution to the problem of linking up the collector was found. GRA

N82-22073# Stanford Univ., Calif. Dept. of Materials Science and Engineering.

PREPARATION AND PROPERTIES OF EVAPORATED CdTe FILMS COMPARED WITH SINGLE CRYSTAL CdTe

Progress Report, 1 May - 31 Jul. 1981

Richard H Bube 1981 20 p
(Contracts DE-AC02-77CH-00178, SERI XW-1-9330-1)
(DE82-000228; SERI/PR-9330-1-T3; PR-3) Avail NTIS
HC A02/MF A01

The hot wall vacuum deposition system is discussed and is is good temperature tracking between the furnace core and the CdTe source itself are indicated. Homojunction cells prepared by HWVE deposition of n-CdTe on p-CdTe substrates show no significant change in dark or light properties after open circuit storage for the next 9 months. CdTe single crystal boules were grown with P, As and Cs impurity. For P impurity it appears that the segregation coefficient is close to unity, that the value of hole density is controlled by the P, and that growth with excess Cd gives slightly higher values of hole density than growth with excess Te. CdTe.As crystals appear similar to CdTe.P crystals.

DOE

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03 HYDROGEN

Includes hydrogen production, storage, and distribution.

A82-19449 **The sulfur thermochemical cycle for hydrogen production.** M. Dokiya (National Chemical Laboratory for Industry, Yatabe, Ibaraki, Japan). *Energy Developments in Japan*, vol. 4, July 1981, p. 31-42. 18 refs. Translation.

Results of research on sulfur-cycle hydrogen production are presented. An H₂S cycle using MoS₂ as a catalyst is mentioned as showing promise for thermochemical water splitting, with an equilibrium reaction yield of 7%. Use of I or Pt as catalysts raised efficiencies to 16 and 12%, respectively, and further studies employing hybrid cycles with CO₂-S and noble metals are reviewed. Thermal decomposition reactions with sulfuric acid are examined, noting a potential 30% thermal efficiency, and sulfur cycle research being undertaken at various industrial laboratories is outlined. It is noted that experiments with sulfuric acid salts for water electrolysis at Los Alamos will probably use solar collectors as a heat source.

M.S.K.

A82-20075 **Photoresponse of n-type semiconductor NiTiO₃.** P. Salvador (Consejo Superior de Investigaciones Científicas, Instituto de Catálisis y Petroleoquímica, Madrid, Spain), C. Gutierrez (Consejo Superior de Investigaciones Científicas, Instituto de Química Física, Madrid, Spain), and J. B. Goodenough (Oxford University, Oxford, England). *Applied Physics Letters*, vol. 40, Jan. 15, 1982, p. 188-190. 8 refs.

The 60-Hz photocurrent of 1,000-ohm cm, Nb-doped n-TiO₃ has been measured by lock-in amplification as a function of wavelength and applied potential. NiTiO₃ is oxidized anodically in the dark producing Ni(2 plus) ions in solution; however, this corrosion is but a fraction of the total charge passed either with visible or UV light, which indicates that photogenerated holes are able to oxidize water. The spectral response is shifted towards the visible region, as compared with TiO₂, and the flatband potential is 0.4 V more negative than that of the H(plus)/H₂ redox couple, which would make possible the use of NiTiO₃ for water photoelectrolysis. However, the quantum efficiency for visible light is much lower than that for UV light, primarily because of low oscillator strength for the visible light Ni(2 plus)-Ti(4 plus) charge transfer excitation in this structure. (Author)

A82-20137 **The prospects for liquid hydrogen fueled aircraft.** G. D. Brewer (Lockheed-California Co., Burbank, CA). *International Journal of Hydrogen Energy*, vol. 7, no. 1, 1982, p. 21-41. 12 refs.

It is pointed out that an alternative fuel for transport aircraft must be either producible or available anywhere in the world. It is contended that this requirement can be met by liquid hydrogen because it can be produced from water using any locally available energy source. It is not dependent on the availability of fossil resources. With conventional production technologies, LH₂ may cost more per unit energy than hydrocarbon alternatives. Because of the weight advantage, however, aircraft using LH₂ will be more efficient and their direct operating costs will be competitive. It is shown that, with advanced technologies, LH₂ can provide cost and energy advantages. A plan to develop LH₂ technology on an international basis is proposed. C.R.

A82-20138 **Comparison of the expenses required for the on-board fuel storage systems of hydrogen powered vehicles.** C. Carpetis (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). *International Journal of Hydrogen Energy*, vol. 7, no. 1, 1982, p. 61-77. 8 refs.

The on-board storage of hydrogen in vehicles requires sophisticated tank systems and appreciable energy expenditure. The energy requirement for the loading of liquid hydrogen in a cryogenic storage tank is substantially higher than the amount needed to charge a corresponding hydride vehicle tank. However, the hydride tank must

provide a considerable part of its hydrogen fuel energy content in order to meet the energy requirements due to its own weight. This amount increases rapidly with increasing design range. Considering the total primary energy flow for both cases, it turns out that a clear break-even point exists. For design ranges higher than about 200 km the liquid hydrogen storage requires less energy expense than the hydride storage tank, the difference being very substantial (more than 100%) in the usual 400-500 km range. Similar results are found in the costs of the on-board storage of hydrogen for different design ranges. A comparison of these results with the storage costs studied earlier for large-scale stationary hydrogen storage facilities indicates that, from the specific capacity point of view, the break-even conditions are very similar in both cases, although due to different reasons. (Author)

A82-21194 **Replacement of fossil fuels by hydrogen.** R. Dahlberg (Telefunken AG, Heilbronn, West Germany). *International Journal of Hydrogen Energy*, vol. 7, no. 2, 1982, p. 121-142. 26 refs.

The replacement of fossil fuels by solar hydrogen plantations is considered. A model is proposed in which ten plantation families, situated in suitable deserted zones of the world after the year 2000, would generate enough electrical energy to produce solar cells and materials for the construction of ten new plantations within a decade. The technological growth process for identical solar plantation units could be completed about 50 years after construction of the first plantation. All ten plantation families would, by using their electrical energy for the electrolysis of water, generate an amount of hydrogen per year which is four to five times the energy of the world's present annual consumption of oil. This concept envisions the global replacement of fossil fuels by hydrogen within a period consistent with the remaining time span of fossil fuel availability. Storage and transportation of hydrogen would be economical, and the energy produced would not present any environmental problems. Advantages with respect to gains in international cooperation, world peace, and world economy are also discussed. J.F.

A82-21196 **Estimation of storage costs for large hydrogen storage facilities.** C. Carpetis (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). *International Journal of Hydrogen Energy*, vol. 7, no. 2, 1982, p. 191-203. 10 refs.

The paper presents an economic evaluation of alternative hydrogen storage methods (pressurized gas, metal hydride and cryogenic storage) for large stationary (utility-scale) applications. The presentation of cost calculation clarifies the importance and influence of a set of relevant parameters depending on the charging-discharging schedule, the relation of the capacity to power level, etc. The results presented define the useful range of application for each storage method, whereas the corresponding cost composition (power related capital costs, capacity-related capital costs, energy costs) is analyzed and discussed. (Author)

A82-21649 **Gas producing process for large quantities of hydrogen (Gaserzeugungsverfahren für grosse Wasserstoffmengen).** K. J. Mundo (Uhde GmbH, Dortmund, West Germany). *Brennstoff-Wärme-Kraft*, vol. 34, Jan. 1982, p. 15-21. 15 refs. In German.

Due to the Federal Republic of Germany's energy economy change-over from oil to other energy carriers, hydrogen will be playing a larger part, and large hydrogen plants will be required for the production of the necessary quantities of liquid hydrocarbons from coal. The development of synthesis gas requirements is estimated for important ranges of application in the next two decades, and the possibilities of satisfying these requirements are discussed in terms of the present state of engineering, assuming that various developments can be successfully concluded. The efficiency of the process for production of larger quantities of hydrogen, and manufacturing costs are also discussed and compared with other forms of energy. D.L.G.

A82-23782 **Photoelectrolysis at Fe₂O₃/TiO₂ heterojunction electrode.** F.-T. Liou, C. Y. Yang (Brookhaven National Laboratory, Upton, NY), and S. N. Levine (New York, State University, Stony Brook, NY). *Electrochemical Society, Journal*, vol. 129, Feb. 1982, p. 342-345. 13 refs. Research sponsored by the U.S. Department of Energy.

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The fabrication of a heterojunction consisting of a thin film of n-type polycrystalline TiO₂ deposited on n-type polycrystalline Fe₂O₃ to form an anode which can photodecompose water in the presence of light is reported. It has been found that under illumination, incident light passes through the TiO₃ film and generates holes in the underlying Fe₂O₃ which, under an appropriate bias, contribute to the electrode reaction of the TiO₂/electrolyte interface. The discontinuity at the conduction bands is estimated to be 0.38 eV and at the valence bands, 0.42 eV, which presents an energy barrier to the migration of holes from the Fe₂O₃. Tests involving CVD TiO₂ films on Fe₂O₃ substrate were performed under 550 C to avoid formation of iron titanates. A photoresponse initiated at 560 nm indicated a hole contribution from the Fe₂O₃ substrate.

M.S.K.

A82-24796 Liquid hydrogen for space flight - The long step from proposal to reality. J. L. Sloop (International Consultants on Energy Systems, Bethesda, MD). *Journal of the Astronautical Sciences*, vol. 29, Oct.-Dec. 1981, p. 373-381. 8 refs.

A series of technological advancements has made it practical to use liquid hydrogen in manned and unmanned space vehicles. These developments and their implications are discussed in detail. They include (1) the liquefaction of gases, their storage and handling; (2) the demonstration that a liquefied gas could be used successfully in rocket flights; (3) the development of lightweight and large rocket structures, and (4) aircraft and rocket experiments with liquid hydrogen. It is concluded that liquid hydrogen will be used not only for space boosters, but for aircraft, cars, trucks, and buses as well. Proposals to generate hydrogen by nuclear and solar energy are also under investigation.

J.F.

A82-25778 Hydrogen production by immobilized cells. I - Light dependent dissimilation of organic substances by *Rhodospseudomonas palustris*. M. Vincenzini, R. Materassi, M. R. Tredici, and G. Florenzano (Firenze, Università, Florence, Italy). *International Journal of Hydrogen Energy*, vol. 7, no. 3, 1982, p. 231-236. 12 refs.

A82-25779 Hydrogen by water electrolysis as basis for small scale ammonia production - A comparison with hydrocarbon based technologies. T. Grundt and K. Christiansen (Norsk Hydro A/S, Oslo, Norway). *International Journal of Hydrogen Energy*, vol. 7, no. 3, 1982, p. 247-257. 5 refs.

The Norsk Hydro electrolyzer technology is described, along with comparisons of ammonia production using different feedstocks and inherent costs and efficiencies. The electrolyzers are bipolar filter press types with electrodes, diaphragm, and gaskets sandwiched together in each cell with an area of 2.1 sq m. A one-cell load is 1700 A/sq m for a total load of 3600 A, and 235 cells are placed in each electrolyzer. An electrolyte composed of 25% KOH is used, and electrolyzer units have initial efficiencies of 98%, falling off at the rate of 1% every 4 yr, due to stray-currents in the lye and gas ducts and some recombination. The production of 1/2 ton of NH₃ is noted to require 1970 cu m of H₂ and 657 cu m of N₂, and the formation process is reviewed. The use of hydrocarbon feedstocks such as natural gas, naphtha, fuel oil, and coal is considered, especially for the gasification of coal, and NH₃ formation is shown to be competitive with reforming and partial oxidation processes. M.S.K.

A82-25780 The Daimler-Benz hydride vehicle project. H. Buchner and R. Povel (Daimler-Benz AG, Stuttgart, West Germany). *International Journal of Hydrogen Energy*, vol. 7, no. 3, 1982, p. 259-266.

Thirty passenger cars with hydrogen and hydrogen/gasoline hybrid operation and TiFe hydride tanks will be tested in Berlin. A central refueling station will deliver pure hydrogen derived out of the town gas network. High and low temperature hydride tanks will be tested in some vans and passenger cars in Stuttgart. An individual refueling station with integrated heat recovery will demonstrate the possibility of using existing energy infrastructures (electricity, gas) for hydrogen production. (Author)

A82-25781 Use of hydrogen in dual-fuel engines. G. Gopai, P. S. Rao, K. V. Gopalakrishnan, and B. S. Murthy (Indian Institute of Technology, Madras, India). *International Journal of*

Hydrogen Energy, vol. 7, no. 3, 1982, p. 267-272.

The dual-fuel method is the easiest and most flexible method for using hydrogen in a diesel engine. In this work, a conventional single cylinder, four-stroke diesel engine has been converted to work on the dual-fuel principle with hydrogen as the inducted fuel. The main objectives of the investigation were to determine the optimum proportions between hydrogen and diesel oil under various engine operating conditions and to study the combustion process in the engine under these conditions. The results show that very satisfactory dual-fuel operation with hydrogen is possible. The thermal efficiencies obtained were comparable with pure diesel operation and up to about half the engine's energy requirement could be derived from hydrogen. The chief problem noticed is that of knocking setting in well before the stoichiometric hydrogen-air ratio. This requires further research for rectification. (Author)

A82-26595 * Hydrogen uses and demands through the year 2025. J. H. Kelley (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), W. J. D. Escher (Escher-Foster Technology Associates, St. Johns, MI), and W. van Deelen (Commission of the European Communities, Brussels, Belgium). *Chemical Engineering Progress*, Jan. 1982, p. 58-61. Research supported by the U.S. Department of Energy and NASA.

The magnitude and markets for applications of hydrogen produced by water-splitting through thermal or electrolytic means are projected up to the year 2025. Uses are divided into energy and nonenergy categories, with U.S. synfuels programs accounting for 65% of the increased demand for hydrogen. Applications for transportation fuel, as a natural gas supplement, in fuel cells, in refinery and synfuels industries, for synthesizing chemicals, and for manufacturing semiconductors are summarized. Electrolytic processes are noted to be more suitable for smaller scale production, where use is on-site or local. An annual growth of 8.4-9.2% is foreseen in the energy sector and 3-3.6% in the nonenergy sector, with a total contribution to the primary energy uses of 12-13% by the year 2025. Hydrogen's negligible environmental impact and the ability to interface hydrogen systems with existing equipment are seen as factors encouraging hydrogen-use growth. M.S.K.

N82-16270# Brookhaven National Lab. Upton, N Y National Center for Analysis of Energy Systems.

SYSTEMS ANALYSIS OF H₂/NATURAL GAS SUPPLEMENTATION AND SEPARATION

M Beller and J D'Acerno 1981 5 p refs Presented at Ann Contractors' Rev. Meeting on Thermal and Chem Storage, Tysons Corner, Va

(Contract DE-AC02-76CH-00016)

(DEB1-030031, BNL-29962, CONF-810940-3) Avail: NTIS HC A02/MF A01

A systems analysis of the concept of supplementing natural gas with hydrogen was conducted in terms of present fuel supplies and prices. An added option was analyzed, this involves separation of the hydrogen from the mixed stream for use as a nonenergy commodity. The study concludes that no insurmountable barriers exist for the supplementation concept, the separation option will depend only upon economic factors. DOE

N82-19196*# Little (Arthur D.), Inc., Cambridge, Mass. **AN ASSESSMENT OF THE CRASH FIRE HAZARD OF LIQUID HYDROGEN FUELED AIRCRAFT** Final Report Feb. 1982 132 p refs

(Contract NAS3-22482)

(NASA-CR-165526; ADL-85161)

Avail NTIS

HC A07/MF A01 CSCL 01C

The crash fire hazards of liquid hydrogen fueled aircraft relative to those of mission equivalent aircraft fueled either with conventional fuel or with liquefied methane were evaluated. The aircraft evaluated were based on Lockheed Corporation design for 400 passenger, Mach 0.85, 5500 n mile aircraft. Four crash scenarios were considered ranging from a minor incident causing some loss of fuel system integrity to a catastrophic crash. Major tasks included a review of hazardous properties of the alternate fuels and of historic crash fire data; a comparative hazard evaluation for each of the three fuels under four crash scenarios; a comprehensive review and analysis and an identification of areas further development work. The conclusion was that the crash fire hazards are not significantly different when compared in general for the three fuels, although some fuels showed minor advantages in one respect or another. R.J.F.

FUELS AND OTHER SOURCES OF ENERGY

Includes fossil fuels, nuclear fuels, geothermal and ocean thermal energy, tidal energy, and wind energy.

A82-19120 Special purpose anemometry for wind power studies. U. Hassan (ERA Technology, Ltd., Leatherhead, Surrey, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 186-193. 12 refs.

Three relatively low-cost anemometric devices suitable for certain applications in wind power studies are described. The Tatter Flag is made of cotton, is 30 x 38 cm in size, and measures winds by the amount of tattering in the flag. A linear correlation with mean wind speed has been shown to exist, with a certainty of 0.87. Obvious disadvantages such as cattle eating the flag are noted. The TALA (Tethered Aerodynamic Lifting Anemometer) kite senses the aerodynamic force on the kite with a tension gage on the tether line. The tension is calibrated in speed, and the height of the kite is determined from the length of the line and the angle of the kite. The TALA kite is used to make rapid assessment of local flowfields. Finally, the ERA GUST anemometer comprises a perforated sphere on a vertical tube fastened at the bottom to a strain gage bridge circuit. An electrical signal proportional to the gust load provides accurate short term gust behavior. M.S.K.

A82-19254 The application of mixture theory models and numerical solution techniques to coal gasification reactors. T. R. Blake (Massachusetts University, Amherst, MA) and E. W. Peterson (Systems, Science and Software, La Jolla, CA). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 574-578. 23 refs.

A82-19255 Coal gasification combined cycle power generation simulation. A. S. Patel (General Electric Co., Schenectady, NY). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 579-581.

A82-19299 A model for industrial production of fuel grade ethanol from sugar beets. A. A. Koutinas, P. Yianoulis, and K. Gravalos (Patras, University, Patras, Greece). *Energy Conversion and Management*, vol. 21, no. 4, 1981, p. 313-318. 6 refs.

A82-19975 Recycling World Congress, 3rd, Basel, Switzerland, September 29-October 1, 1980, Proceedings. Sessions 1-2 /Day 1/, Sessions 3-4 /Day 2/, and Sessions 5-6 /Day 3/. Oxted, Surrey, England, Recycling World Congress, 1980. Sessions 1-2 /Day 1/, 134 p.; Sessions 3-4 /Day 2/, 113 p.; Sessions 5-6 /Day 3/, 117 p. \$108.25, price of three volumes, \$256.50.

The recovery of useful products from refuse was examined in terms of the use of research waste to produce heat, the generation of CH₄ from waste, pyrolysis resource recovery, and fuel production from municipal solid waste. The fabrication of building blocks from cement and asbestos factory wastes was discussed, along with the production of ferro-chromium from slags and the use of secondary lead. Attention was also given to recycling metallic incinerator waste, the pyrolysis of plastic wastes scrap in a fluidized bed, and recycling discarded tires as fuel for a cement plant. Various treatments for the reuse of municipal trash were explored and the recovery of usable chemical wastes was described. Sewage sludge and household wastes were investigated for useful products, compost wastes were chemically analyzed, especially for heavy metals, and methods of recycling plastics in all forms were presented. M.S.K.

A82-20256 Biological sources of energy from the sea. E. J. Philips. *Sea Frontiers*, vol. 28, Jan.-Feb. 1982, p. 36-46.

The use of marine plants and microscopic organisms as possible future energy sources is examined. Parallels are drawn between the

coming depletion of fossil fuel resources and the first energy crisis on earth, when evolving cells began to use up the stores of organic molecules in the ocean, and photosynthesis, in the form of plant biomass, is considered as a possible solution to the present energy crisis. The energy potential of marine biomass, specifically the seaweeds, microscopic algae and photosynthetic bacteria, is then assessed, and experimental attempts at the culturing of such organisms, are noted. Microbial energy technologies, principally the replacement of chemical processes requiring fossil fuels with biological conversion systems and direct biomass conversion into hydrogen and methane fuels, are then examined. Possible applications of techniques involving genetic engineering and cell-free systems to future bioenergy research are indicated, and the impetus to the rapid development of solar energy posed by the problems of pollution and availability of present energy sources is emphasized. A.L.W.

A82-22198 † The use of Doppler spectroscopy to study the characteristics of the polydisperse characteristics of emulsion water and solid microimpurities in aviation fuels (Primenenie metoda Doplerovskoi spektroskopii dlia issledovaniia kharakteristik polidispersnosti emul'sionnoi vody i tverdykh mikroprimesei v aviapli-vakh). A. N. Korolevich, T. V. Oleinik, and A. Ia. Khairullina. *Zhurnal Prikladnoi Spektroskopii*, vol. 35, Dec. 1981, p. 1016-1023. 11 refs. In Russian.

The feasibility of using Doppler spectroscopy to determine drop sizes of emulsion water and particle sizes of solid microimpurities in kerosene flow through a pipe is confirmed. Measured Doppler spectra are used to reconstruct particle size distribution functions for fractions of microparticles beginning with 2 microns. The method makes possible the rapid continuous monitoring of the disperse phase in aviation fuel and may be suitable in the automated analysis of multicomponent disperse media. B.J.

A82-23238 * Deposit formation in liquid fuels. III - The effect of selected nitrogen compounds on diesel fuel. J. H. Worstell, S. R. Daniel, and G. Frauenhoff (Colorado School of Mines, Golden, CO). *Fuel*, vol. 60, June 1981, p. 485-487. 11 refs. Grant No. NSG-3122.

The influence of substituted quinolines, pyrroles, indoles, and pyridines on deposit formation in a diesel fuel is evaluated. Significant increases in deposition rate are found which are dependent upon the basicity of the nitrogen compound within a given compound class. These effects correspond closely with those produced in a Jet A fuel. Removal of highly polar fuel components renders the nitrogen compound influence inoperative. These components are therefore participants in deposit-forming reactions.

(Author)

A82-23817 Exergetic analysis of complex multimaterial processes using nuclear coal gasification as an example (Exergetische Analyse komplexer Mehrstoffprozesse am Beispiel der nuklearen Kohlevergasung). R. Pruschek (Universität Essen-Gesamthochschule, Essen, West Germany) and F. K. Boese (INTERATOM, Internationale Atomreaktorbau GmbH, Bergisch Gladbach, West Germany). *Brennstoff-Wärme-Kraft*, vol. 33, Oct. 1981, p. 404-411. 22 refs. In German. Research supported by the Bundesministerium für Forschung und Technologie.

A comprehensive exergetic analysis is presented for several variants of nuclear coal gasification. The analysis is based on the availability and costs of energy carrier coals and on the rising costs of energy production. In particular, the exergy of chemically reacting materials as well as of mixtures is calculated, and evaluation quotients are computed. Nuclear coal gasification for several gasification possibilities using ligneous and bituminous coals is also examined. J.F.

A82-23819 # Injection and thermal breakthrough in fractured geothermal reservoirs. G. S. Bodvarsson and C. F. Tsang (California, University, Berkeley, CA). *Journal of Geophysical Research*, vol. 87, Feb. 10, 1982, p. 1031-1048. 44 refs. Contract No. W-7405-eng-48.

Reinjection of geothermal wastewater is gradually becoming a preferred means of waste disposal. Fluid movement in most geothermal reservoirs is controlled by fracture. The considered investigation has the objective to study the advancement of the thermal front during injection into a fractured reservoir system. A

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reservoir system consisting of equally spaced horizontal fractures intersecting an injection well is considered. A rather simple mathematical model is developed and solved analytically. Numerical calculations are carried out in order to investigate the importance of the assumptions employed in the analytical study and extend the applicability of the results. The results from the analytical work are given in the form of type curves which can be used to design the locations of the injection wells with reference to the production wells and the injection rate. G.R.

A82-23950 Processes for reducing emissions of particulates and oxides of sulfur and nitrogen for various coal utilization alternatives. R. J. Farrell (Scientific Design Co., Inc., New York, NY) and E. N. Ziegler (New York, Polytechnic Institute, Brooklyn, NY). In: *Advances in environmental science and engineering*. Volume 4. New York, Gordon and Breach Science Publishers, 1981, p. 46-75. 80 refs.

Problems connected with an increased use of coal as substitute for other fuels are partly related to environmental pollution considerations. A review is conducted of the status of both the current options and emerging technologies with respect to removal of the primary pollutants, including particulates, SO₂, and NO_x. It is found that utility installations which control particulates at coal combustion sites typically use electrostatic precipitators. Those which control SO₂ typically use flue-gas desulfurization units. Tighter emission controls will substantially increase the application of filters, regenerative flue gas desulfurization processes and dry-sorption processes for SO₂ removal, and new burner designs and post combustion denitrification for NO_x control. Strong incentives exist for the development of a 'breakthrough' in a number of areas. Fluidized-bed combustion or the combustion of solvent-refined coal will each capture portions of the utility market. The employment of coal-liquefaction processes appears probable. G.R.

A82-24059 Oceans '80; International Forum on Ocean Engineering in the '80s, Seattle, WA, September 8-10, 1980, Conference Record. Forum sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, 566 p. Members, \$35.; non-members, \$46.67.

Engineering applications for the development of ocean and shoreline based technologies are reviewed. Attention was given to the use of instruments such as automatic profiling equipment, surf transducers, and acoustic measuring equipment for ocean phenomena. Various ocean-based resources were investigated, including thermal stratification, wave power, and minerals. Advancements in arctic based ships and ports were discussed, as were topics of navigation and safety, undersea engineering, and characteristics of new submersibles and underwater bases. Techniques for measuring the performance of current measuring devices were examined, along with marine weather systems, methods of oil spill clean-up, and underwater communications systems. Finally, power systems for ships were outlined, and environmental studies of the ocean and methods of applications of Seasat data were explored. M.S.K.

A82-24296 Corrosion of stainless steels in the geothermal environments of the Salton Sea known geothermal resource area. J. P. Carter, S. D. Cramer, and R. K. Conrad (U.S. Bureau of Mines, Avondale, MD). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper*. 15 p. 20 refs.

A82-24297 Geothermal power plant corrosion experience - A global survey. P. F. Ellis, II and D. M. Anliker (Radian Corp., Austin, TX). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper*. 21 p. 30 refs. Research supported by the U.S. Department of Energy. An overview of corrosion experience from a number of operating geothermal power plants around the world is presented. These power plants are located in six countries and utilize vapor or liquid dominated resources. General plant descriptions and process stream chemistries are presented, and each subsystem of the geothermal power system is considered for its unique corrosion problems. The subsystems discussed are wells, two-phase flow

systems, steam transmission systems, turbines, gas extractors, and heat rejection system (condensers, piping, valves, pumps, cooling towers, and concrete structures). Atmospheric corrosion effects on painted structures, electrical components, and power transmission lines are also discussed. Materials and components which have failed as well as those which have been successful are identified. (Author)

A82-24391 Crude sources and refining trends and their impact on future jet fuel properties. N. R. Sefer and C. A. Moses (Southwest Research Institute, San Antonio, TX). *Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 5-8, 1981, Paper 811056*. 17 p. 21 refs. Contract No. N00140-80-C-2269.

Jet fuel properties which would influence future availability or cost of JP-5 supplied to the Navy are determined. Significant fuel properties are identified for jet fuel produced from oil shale and coal to develop an alternate test procedure for qualifying new aviation turbine fuels. The availability of JP-5 could be improved by relaxing the freezing point specification to broaden the selection of suitable crudes or broaden the boiling range from a given crude. JP-5 can be made from shale oil with properties that meet current specification, and coal liquids are high in aromatics, low in hydrogen content, and require moderate to high severity hydrogenation. The kerosene fraction will meet JP-5 specifications after most of the aromatics are hydrogenated. D.L.G.

A82-24584 # The rotating heat pipe - Implementation as a uniform-temperature heat source. R. F. Limoges (Eastman Kodak Research Laboratories, Rochester, NY). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/HT-2*. 6 p. 7 refs. Members, \$2.00; nonmembers, \$4.00.

A wickless rotating heat pipe, if properly controlled, is a uniform heat source. The data presented are based on work done with 12.7 cm diameter x 76 cm long rotating heat pipes operating between 120 and 140 C. The major areas reviewed are: materials of fabrication, working fluids, sealing, temperature control, heaters, and safety. The optimum rotating heat pipe defined by these studies is fabricated of type 304 stainless steel, uses water as the working fluid, is sealed with welded joints, and utilizes a pressure switch and a fast-response quartz lamp for temperature control. Surface-temperature control of + or - 0.15 C and temperature uniformity within 0.8 C are obtained. Results of experiments designed to study the effects of hydrogen in the enclosed volume of the heat pipe are presented. (Author)

A82-24684 Synthetic, coal-derived fuels. G. R. Hill (Utah, University, Salt Lake City, UT). In: *The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980*. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 19-23. 8 refs.

Liquefaction and gasification processes for increasing the usage of coal are reviewed, noting their importance as an interim energy source until fusion and solar technologies are suitable for all energy requirements. Coal is ranked from anthracites to hydrogen-free graphites, with bituminous coals containing the lowest water concentrations relative to resource size and availability. Current processes for converting coal to gas or liquid are outlined, including high and low temperature carbonization, hydrolysis, liquid-phase hydrogenation, and reactions with oxygen or steam to produce syngas. The Fischer-Tropsch process permits the production of methanol, ethanol, methane, and hydrogen to replace gasoline. Finally, gasification processes are examined in terms of fixed bed, entrained flow, fluidized bed, and integrated high Btu gas processes, all currently performed at precommercial levels of operation. M.S.K.

A82-24691 Pacific Gas and Electric Company - Biomass energy activities. M. J. Blanchet, B. M. Jenkins, J. G. Meyer, P. Maciel, and R. F. Goldstein (Pacific Gas and Electric Co., San Francisco, CA). In: *The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980*. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 99-104. 11 refs.

Pacific Gas and Electric activities in utilizing biomass for the production of gas and electricity are reviewed. Research is centering

on quantifying the available resource, identifying viable conversion systems, determining the economics, and defining limiting factors such as balances between competing alternatives and institutional restraints. A feasibility study for a pyrolysis plant for producing syngas from San Francisco solid waste streams is detailed, along with studies of the forest and crop residues within a 50 mi radius of a subjective plant site. Current projects include a landfill gas recovery system for gas injection into the company lines, a biogas digester at a beef feedlot for processing one dry ton of manure/day, and purchases of cogenerated power from industrial concerns burning wood residue, walnut shells, pelleted wood, garbage, grape pomace, and cotton gin trash. Open ocean kelp farms are noted for future study. M.S.K.

A82-24969 Hydrocracking of coal using molten salts as catalysts. S. Kikkawa, M. Nomura, H. Sakashita, M. Nishimura, and M. Miyake (Osaka University, Osaka, Japan). (*Chemical Society of Japan, Journal*, vol. 923, no. 6, 1980.) *Energy Developments in Japan*, vol. 4, Oct. 1981, p. 183-200 52 refs. Translation.

Characteristics of the reactions during coal liquefaction and the hydrocracking of coal and coal-related materials using ZnCl₂-transition metal chloride or ZnCl₂-alkaline metal chloride are discussed. The studies involve development of a molten salt catalyst for hydrocracking heavy residual oils or coals, including hydrocarbons containing many heteroatoms. It was found that ZnCl₂ shows higher activity for hydrocracking of anthracene and phenanthrene, and experiments with Yubari coal using the binary metal catalysts ZnCl₂-MoCl₅ and ZnCl₂-CrCl₃ are described. The use of molten salts in the desulphurization of heavy residual oils is also explored, specifically for the hydrocracking of benzophenone, and the possibility that a coal-like polymer structure containing an oxygen surplus might depolymerize above ternary melts is suggested. M.S.K.

A82-25373 Magmatic gases in well fluids aid the mapping of the flow pattern in a geothermal system. H. Armannsson, G. Gislason, and T. Hauksson (National Energy Authority, Geothermal Div., Reykjavik, Iceland). *Geochimica et Cosmochimica Acta*, vol. 46, Feb. 1982, p. 167-177. 22 refs.

Gas composition and silica concentrations of well fluids are used in conjunction with pressure, temperature and enthalpy data to obtain a model of the drilled part of the Krafla geothermal field (Northeast Iceland). A magma chamber is located at 3-8 km depth under the field. Magmatic gases emanate from the chamber and travel via a channel reaching the surface at the Hveragil eruptive fissure. The composition of the gases is apparently modified on the way, in that sulphur, which presumably is in the form of sulphur dioxide to begin with, is removed, and what remains is in the form of hydrogen sulphide. It is suggested that the major removal mechanism is the deposition of pyrite and pyrrhotite during the passage of the gases through the hydrothermal system. (Author)

A82-25468 Numerical study of wind energy characteristics over heterogeneous terrain - Central Israel case study. M. Segal, R. A. Pielke (Virginia, University, Charlottesville, VA), and Y. Mahrer (Jerusalem, Hebrew University, Jerusalem, Israel). *Boundary-Layer Meteorology*, vol. 22, Mar. 1982, p. 373-392. 35 refs. Research supported by the United States-Israel Binational Science Foundation and NSF.

A numerical mesoscale meteorological model has been applied over the heterogeneous terrain of central Israel in order to study wind energy characteristics of three typical synoptic situations. The supportive nature of this method for observationally oriented wind energy studies has been emphasized. Mesoscale forcing effects on the availability of wind energy and on the exponent, p , in the vertical wind power law are evaluated. (Author)

A82-26015 Relationship of hydrothermal phenomena within the Leinster Granite to crustal fractures delineated from Landsat imagery. P. M. Brück (University College, Cork, Ireland) and P. J. O'Connor (Geological Survey of Ireland, Dublin, Ireland). *Photogrammetria*, vol. 37, Feb. 1982, p. 151-159. 16 refs.

Landsat imagery was combined with existing geologic maps of the Leinster Granite in SE Ireland to develop a model of hydrothermal processes in the area and detect the fracture zones. Observed linears were interpreted as fractures, and satellite imagery allowed the discernment of hydrothermal alteration zones, occurrences of

spodume and red-feldspar pegmatites, and explosion breccias. Pb-Zn mineralization sites displayed a spatial association with a transverse fracture system, with galena and sphalerite the main ores in veins with thicknesses ranging from a few meters to a few cm. Hydrothermal processes which may have led to the formation of the Leinster Granite are detailed, along with a suggestion that fractures occurring late in the cooling granite's history formed channels for circulating ground waters. M.S.K.

A82-26177 # Prospecting for wind energy - A field assessment of physical modelling. D. Neal and D. C. Stevenson (Canterbury, University, Christchurch, New Zealand). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 27-30. 5 refs.

The requirements for the modeling of wind characteristics over irregular terrain are examined, and laboratory measurements are discussed. The area considered in the present study is situated on Banks Peninsula in the South Island of New Zealand. The prevailing winds for this region are from the northeast and southwest. A model was constructed using 9 mm thick expanded polystyrene-bead board. This was cut to the shape of the terrain contours obtained from a photographically enlarged map. The final form of construction included the modeling of surface roughness elements on the model. The laboratory measurements were made in a 1.2 m x 1.2 m cross section boundary layer wind tunnel. Measurements of the velocity and turbulence intensity profiles were made with a field data acquisition system including fast response propeller anemometers. G.R.

A82-26604 * Ore deposits in Africa and their relation to the underlying mantle. H.-S. Liu (NASA, Goddard Space Flight Center, Greenbelt, MD). *Modern Geology*, vol. 8, no. 1, 1981, p. 23-36. 70 refs.

African magmatism is largely related to the tensional stress regimes of the crust which are induced by the hotter upwelling mantle rocks. These mantle rocks may provide emanating forces and thermal energy for the upward movements of primary ore bodies with fluid inclusions in the tensional stress regimes of the crust. In this paper, the Goddard Earth Gravity Model is used to calculate a detailed subcrustal stress system exerted by mantle convection under Africa. The resulting system is found to be correlated with the African metallogenic provinces. Recognition of the full spectrum of ore deposits in Africa that may be associated with the hotter upwelling mantle rocks has provided an independent evidence to support the hypothesis of mantle-derived heat source for ore deposits. (Author)

A82-27399 Future fossil fuels - Their utilization and incorporation in modern energy systems (Künftige fossile Brennstoffe - Ihre Nutzung und Einbettung in moderne Energiesysteme). W. Hafele, H. Barnert, and W. Sassin (International Institute for Applied Systems Analysis, Laxenburg, Austria). *DFVLR-Nachrichten*, Mar. 1982, p. 8-19. 8 refs. In German.

Investigations have been conducted regarding the world energy problem, taking into account the next 50 years. It is pointed out that fossil fuels will have to be made available during the considered period. This will be feasible. However, the acquisition of the needed fuels will have to be more and more based on 'unconventional' sources, and the fuels will become expensive. Attention is given to relations between the size of the world population and the energy problem, aspects of energy and utility, liquid hydrocarbons, fossil fuels and the desirability of a zero emission of pollutants, and local and temporal conditions regarding the utilization of fossil fuels. G.R.

A82-27635 # Seasat satellite investigation of the structure of Western Nebraska and its application to the evaluation of geothermal resources. J. Stix (Los Alamos National Laboratory, Los Alamos, NM). In: International Symposium on Remote Sensing of Environment, 15th, Ann Arbor, MI, May 11-15, 1981, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1981, p. 735-750. 43 refs.

Seasat synthetic aperture radar (SAR) satellite imagery was used to interpret the structural framework and, indirectly, the geothermal potential of an area in Western Nebraska. Lineaments were mapped

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from the imagery and then compared to known structure. It was found that Seasat does record surface manifestations of subtle basement structures, particularly faulting. Furthermore, four areas with geothermal potential were delineated using Seasat and other data. It is stressed that more subsurface geology and geophysical data are needed before a final evaluation of the geothermal potential can be made. Seasat imagery is a useful reconnaissance exploration tool in the interpretation of regional structure within areas of little topographic relief. (Author)

A82-27661 # Thermal IR detection of submarine gas seepages in the western Istra off-shore area /Yugoslavia/. M. Knapp and B. Koscec (Industroprojekt, Zagreb, Yugoslavia). In: International Symposium on Remote Sensing of Environment, 15th, Ann Arbor, MI, May 11-15, 1981, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1981, p. 1039-1046.

A82-27693 # Application of machine processing of visible and thermal data to the study of the geothermal area of Cerro Prieto, Mexico. A. Jinich, J. L. Farah, M. Garza, C. Velarde, R. Méndez, J. Rosenblueth (Universidad Nacional Autónoma de México, Villa Obregón, Mexico), R. Alvarez, G. García, R. Hernández, and A. López (Comisión Federal de Electricidad, Mexico). In: International Symposium on Remote Sensing of Environment, 15th, Ann Arbor, MI, May 11-15, 1981, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1981, p. 1387-1396. 13 refs. Research supported by the United Nations. UN Project MEX-120-8-004-05-X.

A82-27694 # Non-parametric classification of abandoned coal mine features using multioriented and ratio transformed Landsat data. P. W. Mausel, R. C. Howe, and K. Lulla (Indiana State University, Terre Haute, IN). In: International Symposium on Remote Sensing of Environment, 15th, Ann Arbor, MI, May 11-15, 1981, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1981, p. 1397-1409. 7 refs.

A82-28130 † Experience with a variety of studies of earth resources in the Kalmyk ASSR using space imagery (Opyt kompleksnogo izucheniia prirodnykh resursov Kalmytskoi ASSR na osnovе kosmicheskoi informatsii). I. N. El'vartynov and Iu. P. Kienko. (Vsesoiuznaia Konferentsiia po Problemam Issledovaniia Prirodnykh Resursov Zemli i Mirovogo Okeana, Aviatsionno-Kosmicheskimi Sredstvami, Moscow, USSR, Nov. 1980.) *Geodeziia i Aerofotos'emka*, no. 1, 1982, p. 23-26. In Russian.

Various applications of the remote sensing of earth resources in the Kalmyk ASSR are reviewed. These applications include structural mapping, gas and oil exploration, hydrogeology, soil studies, and the mapping of agricultural lands and pastures. B.J.

A82-28391 Temperature effects on the kinetics of the anaerobic digestion of crop residues to methane. E. C. Clausen and A. H. Shah (Tennessee Technological University, Cookeville, TN). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 78-85. 15 refs.

Results of a study to determine the optimum temperature ranges for bacterial digestion of crop residues to methane are presented. Four 7 l plexiglass stirred tank reactors were fed sewage sludge and the temperature was varied from 35 to 60 C in 5 deg intervals to gain kinetic data. Feed concentration was tested in the range of 2-10/wt solids. Gas production was lowest at 45 C, and thermophilic digestion did not proceed until above 55 C. An analysis of the rate kinetics for a 200 metric tons/day of cornstalks methane plant was performed, and included the processing steps. Initial costs were \$2.7 million for the plant, with over 50% of going for the digesters, and \$803,000/yr operating expenses for collection and transport of the residue. Minimum methane costs of \$0.10/1000 l of CH₄ were reached at 40 C. M.S.K.

N82-16205# Tennessee Technological Univ. Cookeville Dept of Chemical Engineering
CONVERSION OF ORNL WASTE PAPER TO SUGAR USING ACID HYDROLYSIS
E. C. Clausen, A. H. Shah, P. R. Saggurti, W. P. Teichert, and M. E. Harrison 1981 34 p refs Presented at the 7th Ann

Meeting of Am. Inst. of Chem. Eng. New Orleans, Nov 1981 (Contract W-7405-eng-26)
(DE82-000462. K/SUB-80-7994/1. CONF-811108-5) Avail
NTIS HC A03/MF A01

The Oak Ridge National Laboratory generates large quantities of waste paper that is presently being landfilled. Three processes were investigated in the laboratory for acid hydrolyzing this waste paper to glucose which may be later fermented to ethanol for fuel. Laboratory yields and operating conditions for a high temperature dilute acid process, a concentrated acid process and a process which utilizes waste acid are presented. DOE

N82-16210# Cities Service Research and Development Co., Tulsa, Okla

FLASH HYDROLYSIS OF WESTERN KENTUCKY NO. 9 BITUMINOUS COAL WITH CATALYST Final Technical Progress Report

31 Mar 1981 254 p refs
(Contract DE-AC22-79ET-14943)
(DE81-029631. DOE/ET-14943/T1) Avail NTIS
HC A12/MF A01

The effects of selected catalysts on liquefaction of caking and noncaking pulverized coals were investigated. With caking coals, the free fall flash hydrolysis reactor operated satisfactorily between temperatures of 1250 to 1550 F and between 900 to 950 F with and without catalyst additions. Noncaking coals could be treated at all ranges of temperatures with or without catalyst additions. Up to two pounds per hour of coal and four pounds per hour of hydrogen were fed into the reactor. Of the catalysts tested, zinc chloride proved most effective, but only at low temperature of about 900 F. At temperatures of 1250 to 1450 F, zinc chloride, as well as other catalysts, proved to be ineffective. At 1400 to 1450 F and 1000 psig with 0.5 seconds solids residence time, about 47 percent of the carbon in caking coals were converted into useful gas and liquid products: 10 percent BTX, 7 percent light oil, 10 percent heavy oil, 27 percent total oil, 12 percent methane, 8 percent ethane, and 20 percent total gas. DOE

N82-16211# Minnick (L. John). Plymouth Meeting, Pa
DEVELOPMENT OF POTENTIAL USES FOR THE RESIDUE FROM FLUIDIZED-BED-COMBUSTION PROCESSES Quarterly Technical Progress Report, Mar. - May 1981

L. John Minnick 1981 30 p
(Contract DE-AC21-77ET-10415)
(DE81-030157. DOE/ET-10415/T4) Avail. NTIS
HC A03/MF A01

Evaluation of the solid wastes from fluidized bed combustion for potential commercial uses is described. Methods by which the material can be safely disposed of should commercial applications be slow in developing were explored. It was shown that spent bed materials from atmospheric fluidized bed (AFB) boilers are potentially useful in a number of commercial applications. AFB residue materials from different sources do contain a substantial component of reactive lime which can, after proper processing, be concentrated and effectively separated from the residue. Spent bed materials also exhibit unusual cementitious properties when used as received or after processing in certain construction related compositions. Evaluation of a number of different sources of AFB residue in the following areas of research was emphasized in the study: (1) characterization of AFB by-product materials, (2) determination of most effective means of beneficiation or separation of materials, (3) laboratory evaluation of the feasibility for use of AFB residue in such applications as a lime substitute, neutralization of acidic trade wastes, flue gas desulfurization, and the stabilization of highly plastic soils, and (4) performance testing of commercial applications involving some cementitious activity. M.D.K.

N82-16213# Washington State Univ., Pullman Dept of Mechanical Engineering

CHARACTERISTICS OF COAL/LIGHT HYDROCARBON SLURRIES IN SPRAY COMBUSTION Semiannual Progress Report, 1 Mar. - 31 Aug. 1981

W. L. Grosshandler, Clayton T. Crowe, and Jacob N. Chung
Sep 1981 23 p refs
(Contract DE-FG22-80PC-30216)
(DE82-000387. DOE/PC-30216/T2) Avail NTIS
HC A02/MF A01

The status of the atomization process, recirculation within the droplet, and the combustion of coal/vaporized fuel in a diffusion burner is discussed. The droplet spray apparatus was

completed and checked out for mixing effectiveness and spray uniformity. Initial runs with pure methanol were completed. Preliminary tests were run with slurries composed of 15% and 30% mixtures of coal in liquid with mean particle sizes of 50 and 150 (Sigma)m. Analysis of the data shows small increases in Sauter mean diameter due to the presence of coal particles. The equations of motion for coal particles translating inside a circulating light hydrocarbon were developed. A computer program has been written to solve for the particle motion numerically. Particle trajectories and general distribution patterns are predicted. The combustion facility was designed and built. Initial testing to assess the stability and flatness of the reaction zone is described. Both a spouted bed and fluidized bed feeder were built to control the mass flow of coal to the burner, and the stability and flow rate of each are being assessed DOE

N82-16228# Virginia Polytechnic Inst and State Univ, Blacksburg
DEVELOPMENT AND APPLICATION OF ANALYTICAL TECHNIQUES TO CHEMISTRY OF DONOR SOLVENT LIQUEFACTION Quarterly Progress Report, Jul. - Sep. 1981

H C Dorn and L T Taylor Oct 1981 29 p refs
 (Contract DE-AC02-89PC-30041)
 (DE82-001076, DOE/PC-30041/T7) Avail. NTIS
 HC A03/MF A01

The quantitation and speciation of organically bound trace metals in coal liquefaction soluble products presents a real challenge. Quantitation methods have been minimal and have involved single element analysis via atomic absorption spectrometry (AAS) or multi-element analysis via inductively coupled plasma atomic emission spectrometry (ICP-AES) both on acid digested aqueous-based matrices. These methods have not proven highly satisfactory because acid digestion introduces, in some cases, a substantial blank value, requires a great amount of time and in the AAS case provides for only single element determinations with mandatory background correction. Elimination of the sample step preparation coupled with use of ICP-AES seems highly attractive for trace multielement quantitative analysis of coal liquefaction products. We have recently established the capability for metal detection in an organic matrix DOE

N82-16263# Oak Ridge National Lab, Tenn Instrumentation and Controls Div

POTENTIAL ECONOMIC BENEFITS FROM PROCESS CONTROL OF COAL PREPARATION PLANTS

N C Bradley, G O Allgood, and J C Moyers Oct 1981 55 p refs
 (Contract W-7405-eng-26)

(DE82-000881, ORNL-5736) Avail: NTIS HC A04/MF A01
 In practically all US coal preparation plants, the machines and instrumentation and control devices are manually operated to clean the run-of-the-mine coal of mud, rock, and other contaminants that are removed from the earth with the desired product. The result is a large loss of a valuable natural resource. Based on 1978 production figures, 10 million tons of discarded coal could have been saved by on-line measurement and control techniques. Measurement sensors for on-line control of coal cleaning process should be developed because there are no commercial, moderate-cost sensors of medium accuracy (5 to 10 percent) available for such applications. An expenditure of approximately \$10 million to develop measurement sensors and process control techniques for coal preparation would be recovered by the conservation of coal DOE

N82-16264# Department of Agriculture and Fisheries, Silverton (South Africa) Div of Agricultural Engineering
SUNFLOWER SEED OIL AS AN EXTENDER FOR DIESEL FUEL IN AGRICULTURAL TRACTORS

J J Bruwer, B vanD Boshoff, F J C Hugo, L M duPlessis, J Fuls, C Hawkins, A N vanderWalt, and A Engelbrecht 1980 8 p refs Presented at the Symp of the South African Inst of Agr Engr, Silverton, South Africa, 11 Jun 1980
 (DE81-903440, CONF-8006187-1) Avail NTIS US Sales Only HC A02/MF A01, DOE Depository Libraries

The use of sunflower seeds as an extender for diesel fuels in agricultural tractors is considered. Production requirements to meet the demand are briefly reviewed. Physical and chemical properties of sunflower seed oil are discussed. Tractor engines using diesel fuel or sunflower seed oil were tested as well as engines using various blends of sunflower seed oil with gasoline, diesel fuel, power kerosene, and illuminating kerosene.

Results were compared. Engine service life and injection equipment performance are discussed DOE

N82-16269# California Univ., Livermore Lawrence Livermore Lab

LLNL GAS-STIMULATION PROGRAM Semiannual Progress Report, Oct. 1980 - Mar. 1981

M E Hanson, G. D Anderson, and R J Shaffer 9 Jun. 1981 52 p refs

(Contract W-7405-eng-48)
 (DE82-000802, UCRL-50036-81-1) Avail. NTIS
 HC A04/MF A01

Preliminary theoretical and experimental analyses of fracture propagation in a nonuniform stress field were performed. Preliminary analyses of fluid flow in apertures were completed. The mechanical properties of some of the core material from Mesaverde sandstones and shales from wells in Wyoming and Colorado were characterized. The feasibility of ultrasonic techniques in measuring in-situ stresses was investigated. Development of a transducer package to test the measurements in a borehole, and techniques to evaluate and interpret measurements are described. The effect of stress on velocity anisotropy was investigated. Geologic studies relating in-situ stresses to geologic structure and examining the effects of pore pressure increases on fracturing in the Green River Basin due to gas generation were performed DOE

N82-16271# Stearns-Roger Corp., Denver, Colo
BI-GAS PILOT PLANT OPERATION Quarterly Technical Progress Report, 1 Oct. - 31 Dec. 1980

1980 139 p
 (Contract DE-AC01-80ET-14705)
 (DE82-000223, DOE/ET-14705/22) Avail NTIS
 HC A07/MF A01

At present, the major development effort is concentrated on gasification. As is typical for developmental projects of this magnitude, a large number of operating difficulties have been experienced and overcome since the first operations in August of 1976. Currently the overcoming of operating difficulties still requires some effort. However, most tests are stable and allow the gathering of process design data in the form of validated heat and material balances. These are applied in model simulations of gasifier operation DOE

N82-16272# Radian Corp., McLean, Va
VERIFICATION OF THE FOREIGN SYN-FUELS INDUSTRIALIZATION EXPERIENCE Final Report

Sep 1981 88 p refs Prepared jointly with Institute of Gas Technology, Chicago and Research Planning Associates, Paris
 (Contract DE-AC01-80RA-50006)
 (DE82-000230, DOE/RA-50006/T1, DCN-81-207-001-08)
 Avail NTIS HC A05/MF A01

A survey of foreign commercial gasifiers is presented. A master list of commercial gasifiers operating in foreign countries was prepared, listing facilities which are currently operating or have been shut down for less than five years. This list represents the set of sources from which gasifier operation information is potentially available. On site visits to two facilities are reported DOE

N82-16273# Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)

PROCEEDINGS OF THE 4TH INTERNATIONAL SYMPOSIUM ON ALCOHOL FUELS TECHNOLOGY, VOLUME 1

1980 483 p refs In PORTUGUESE and ENGLISH Symp held at Sao Paulo, Brazil, 5-8 Oct 1980 2 Vol
 (DE81-903753, CONF-801030-Vol-1) Avail NTIS (US Sales Only) HC A21/MF A01, DOE Depository Libraries

Progress in alcohol and biomass fuels research is reported. Three main areas regarding the alcohol and biomass fuels are covered: production and distribution, utilization, and socio-economical impacts DOE

N82-16274# Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)

PROCEEDINGS OF THE 4TH INTERNATIONAL SYMPOSIUM ON ALCOHOL FUELS TECHNOLOGY, VOLUME 2

1980 433 p refs In PORTUGUESE and ENGLISH Symp held at Sao Paulo, Brazil, 5-8 Oct. 1980 2 Vol
 (DE81-903754, CONF-801030-Vol-2) Avail. NTIS (US Sales Only) HC A19/MF A01, DOE Depository Libraries

An overview of alcohol fuels technology is given. Topics

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covered include: diesel engines, fleet tests, lubrication and emission, socioeconomic aspects, and project summaries. DOE

N82-16275# Los Alamos Scientific Lab., N. Mex
CATALYTIC COAL CONVERSION SUPPORT: USE OF LASER FLASH-PYROLYSIS FOR STRUCTURAL ANALYSIS
Progress Report, 1 Oct. - 31 Dec. 1980

C. K. Rofer-Depoorter, comp. Oct 1981 5 p
(Contract W-7405-eng-36)
(DE82-004221; LA-9033-PR) Avail NTIS HC A02/MF A01

A coal processing apparatus that will allow online sampling of gases generated during coal processing is operational. Improvements were made in the lasers and the GC/MS. Lignin impregnated with ZnCl₂, coal extracted with liquid CO₂, and isolated resinite and fusinite were pyrolyzed. A thermal model of the pyrolysis is being developed. DOE

N82-16277# Sandia Labs, Albuquerque, N. Mex.
REVERSIBILITY OF COAL LIQUEFACTION

M. G. Thomas, T. C. Bickel, and D. E. Trudell 1981 16 p
Refs Presented at the Ann Meeting of the Inst. of Chem Engr., New Orleans, 8 Nov. 1981
(Contract DE-AC04-76DP-00789)
(DE81-027804; SAND-81-0211C; CONF-811108-3) Avail NTIS HC A02/MF A01

Dissolution of coal was shown to be affected by the amount of preasphaltenes formed which is related to the repolymerization of preasphaltenes when solvent quantity and/or quality are limited. Repolymerized preasphaltenes are shown to be reactive suggesting that a process reversibility exists for this first step of the liquefaction sequence and explaining limited solvation for early stage liquefaction. This reversibility is direct evidence that gas formation is a non-essential side reaction that is a consequence of time at temperature, not the interconversion of coal derived materials. Addition of asphaltenes, increases the amount of oil produced. This increase is accompanied by some polymerization of the asphaltenes. Process reversibility is thus observed for both the primary and secondary step of liquefaction. The effect of increases in hydrogen availability by chemical spikes and/or H-donor molecules was shown to partially compensate for the solvent deficiencies observed in the later stages of processing. M.D.K.

N82-16278# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

SMALL-SCALE FUEL-ALCOHOL PLANT, VOLUME 2: DETAILED EQUIPMENT INFORMATION Design Report

Aug. 1981 206 p
(Contract DE-AC07-76ID-01570)
(DE82-001037; DOE/TIC-2001037-Vol-2, ID-10102-Vol-2) Avail. NTIS HC A10/MF A01

Technical information about the equipment used in the Small Scale Fuel Alcohol Plant (SSFAP) is reported. Details are provided in the form of data sheets for off-the-shelf mechanical equipment and instrumentation. A specification is also included for a microprocessor. Complete drawings are included for mechanical hardware specifically designed for this plant. The information is arranged with all instrument and equipment data sheets grouped by the type of equipment. Vendor listings are provided for each type of equipment required. The design in this report represents the design after startup testing and some short periods of operation but before continuous production began. It is expected that a person or firm desiring to build a similar plant would hire a consultant or architect-engineering firm to modify this design to fit the specific application and site. DOE

N82-16281# Gilbert (Glen A.) and Associates, Inc., Oak Ridge, Tenn.

FOREIGN COAL-LIQUEFACTION-TECHNOLOGY SURVEY AND ASSESSMENT

T. D. Pay and S. S. Patel Oct. 1981 341 p refs Prepared for ORNL
(Contract W-7405-eng-26)
(DE82-0009555; ORNL/Sub-79/13837/6) Avail: NTIS HC A15/MF A01

The Foreign Coal Liquefaction Technology survey and Assessment is part of the International Energy Technology Assessment effort. Six countries were chosen. They are Australia, the Federal Republic of Germany (FRG), Japan, New Zealand, South Africa and the United Kingdom. These countries have active coal liquefaction programs, are using or developing technologies that could be used in the US and/or involved with

US coal liquefaction programs. The resources that each has and the policies that have been adopted by their governments are presented. Although each of these countries has numerous programs underway or planned, the amount of information available on each program varies. Brief descriptions of the programs are given in the first chapter, the second chapter deals only with those liquefaction projects and gasifiers associated with direct liquefaction for which an adequate amount of reference material could be found. In the third chapter, critical areas common to all or many liquefaction systems are described. DOE

N82-16282# Utah Univ., Salt Lake City. Dept. of Mining, Metallurgical and Fuels Engineering.

CONCEPTS OF FUNDAMENTAL PROCESSES RELATED TO GASIFICATION OF COAL Quarterly Progress Report, Jan. - Mar. 1981

W. H. Wisler Sep. 1981 3 p
(Contract DE-AM03-77SF-01484)
(DE82-000763; DOE/SF-01484/T2) Avail: NTIS HC A02/MF A01

The primary objective of the research on single stage catalytic coal gasification is to optimize the process variables and catalyst systems to maximize yields. The 200 mesh coal will be slurried in a hydrogen donor solvent, tetralin, in a ratio of 2 parts solvent to 1 part coal by weight, and initially a sulfided Ni-W/SiO₂-Al₂O₃ catalyst will be used. All of the required equipment arrived and the system has undergone pressure testing and some minor redesign. The objective of the project on single stage coal gasification to high Btu gas is to investigate the potential for obtaining high methane yields by direct catalytic hydrogenation of coal in a single stage with a maximum temperature of 5500 C. The work completed so far has included a thermodynamic feasibility study which involved investigating the effect of various parameters, temperature, pressure, and steam percent in hydrogen feed. Fifteen experimental runs have been completed. DOE

N82-16283# Pittsburg Univ., Pa Dept. of Chemical and Petroleum Engineering

EXPERIMENTAL STUDY OF THE MULTIPLE STEADY STATES IN AN ADIABATIC COAL-LIQUEFACTION REACTOR Annual Report, 1 Sep. 1980 - 31 Aug. 1981

Y. T. Shah and P. C. Singh Sep 1981 75 p refs
(Contract DE-FG22-80PC-30243)
(DE82-000770; DOE/PC-30243/T2) Avail NTIS HC A04/MF A01

The purpose of the proposed study is to investigate experimentally the thermal behavior of coal liquefaction reactors. Stability of the steady state is specifically planned to be investigated in the adiabatic continuous stirred tank reactor used in the A-1 unit of the Gulf Research Center. When a reactor has more than one possible temperature for steady state operation, large temperature excursions may result from a small perturbation. An efficient control of temperature is then needed to avoid this type of run away of the reactor. In case of coal liquefaction reactors, below 4500 C no substantial reaction is observed, while above 4650 C there is every possibility of coking of the reactor. The operating range is thus very narrow and it is undesirable to have temperature excursions. A theoretical investigation of these reactors has shown multiple steady states in pilot plant operations. Industrial coal liquefaction reactors operate very close to an adiabatic mode. DOE

N82-16284# Brigham Young Univ., Provo, Utah
INVESTIGATION OF SULFUR-TOLERANT CATALYSTS FOR SELECTIVE SYNTHESIS OF HYDROCARBON LIQUIDS FROM COAL-DERIVED GASES Quarterly Technical Progress Report, 19 Mar. - 18 Jun. 1981

C. H. Bartholomew 15 Jul. 1981 32 p refs
(Contract DE-AC01-79ET-14809)
(DE82-000274; DOE/ET-14809/7-7) Avail: NTIS HC A03/MF A01

During the seventh quarter, preparation of the proposed boride-promoted catalysts was completed. An aqueous solution technique was found to improve the preparation of the supported metal boride catalysts. Characterization of 3 and 15% cobalt catalysts by O₂ titration and H₂ and CO chemisorptions showed dispersions to be near 7.3%. Reduction was optimum after 36 hours at 623 K. Activity/selectivity measurements showed Co/SiO₂ catalysts to be more active by an order of magnitude than corresponding Fe/SiO₂ catalysts in Fischer-Tropsch synthesis. The unsupported cobalt boride was found to be less

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active, though it produced a higher molecular weight product than similar silica-support cobalt catalysts H₂S deactivation equipment construction and calibration has been completed and preliminary tests performed. DOE

N82-16285# Washington Univ., St. Louis, Mo Dept. of Chemical Engineering.

DYNAMIC BEHAVIOR OF MOVING-BED COAL-GASIFICATION REACTORS Annual Report, 1 Sep. 1980 - 31 Aug. 1981

B. Joseph Sep. 1981 82 p refs
(Contract DE-FG22-80PC-30219)
(DE82-000595, DOE/PC-30219/T1) Avail: NTIS
HC A05/MF A01

A rigorous dynamic model of the two moving-bed coal gasifier was developed. The resulting coupled nonlinear partial differential equations were solved numerically using a digital computer. The model was validated through comparison with steady state pilot plant operating data and with results of existing steady state models. A number of transient studies were conducted using the dynamic mode including response to variations in coal feed rate, steam rate and oxygen feed rate. The internal solid and gas temperature profiles as well as the product gas composition were tracked as a function of time. The stability of the gasifier under various types of feedback control strategies were studied. The results are given in the form of response curves to typical input disturbances. DOE

N82-16286# Southwest Research Inst., San Antonio, Tex. Dept. of Engine and Vehicle Research

ALTERNATE FUELS IN MEDIUM-SPEED DIESEL ENGINES: OFF-SPECIFICATION DIESEL FUELS, SIMULATED COAL-DERIVED FUEL AND METHANOL

Q A Baker Jan. 1981 155 p refs
(Contract DOE-EM-78-C-4266)
(PB81-242562; FRA/ORD-80/401; Rept-1) Avail: NTIS
HC A08/MF A01 CSDL 21D

The first year of research activity of a multi-year research, development, and demonstration effort to investigate the use of alternate fuels in medium-speed diesel engines is described. Tests were performed on a laboratory two cylinder medium speed diesel engine in an attempt to define its ability to operate on alternate fuels and to define the performance and emission characteristics of the engine under such operation. GRA

N82-16375# California Univ., Livermore Lawrence Livermore Lab

EFFECTS OF GAS-FLOW PATTERN ON CAVITY SHAPE

John R Creighton 22 Jul 1981 16 p refs Presented at the 7th Ann. Underground Coal Conversion Symp., Fallen Leaf Lake, Calif., 7-11 Sep 1981
(Contract W-7405-eng-48)
(DE82-000347, UCRL-85907, CONF-810923-10) Avail: NTIS
HC A02/MF A01

The effects of different gas flow patterns on the cavity shape in laboratory scale coal block experiments are shown. The burning of pure carbon is modeled. The rate of removal of carbon from the cavity wall is shown to depend on the local rate of oxygen transport to the wall. A numerical model which assumes plug flow in the cavity with a laminar boundary layer gives cavities shaped like an exponential horn, with the largest radius next to the inlet. The downstream shape is in reasonable agreement with experiment. When cavity flow is calculated using the full Navier-Stokes equations the flow near the inlet resembles an expanding jet surrounded by a toroidal vortex. The maximum rate of oxygen transport to the wall occurs where the jet strikes the converging cavity wall some distance downstream. The reduced oxygen transport near the inlet causes the upstream portion of the cavity to be rounded. The downstream portion of the cavity is similar to that with plug flow. DOE

N82-16381# Los Alamos Scientific Lab., N. Mex

COAL-GASIFICATION INSTRUMENTATION PROGRAM (PR 11734) Quarterly Progress Report, 1 Jul. - 30 Sep. 1981

1 Oct 1981 38 p refs
(Contract W-7405-eng-36)
(DE82-001153; DOE/TIC-2001153) Avail: NTIS
HC A03/MF A01

Methods of measuring alkali metals, NO, NH₃ and H₂S in coal gasification products are being studied using laser-induced breakdown spectroscopy, coherent anti-Stokes Raman spectroscopy and infrared spectroscopy. Detection limits under various

conditions and comparison with gas chromatography results are presented. DOE

N82-16454*# Ketron, Inc., Wayne, Pa
UNDERGROUND COAL MINING SECTION DATA Final Report

Charles P Gabrill and Jack T Urie 24 Sep. 1981 151 p refs Prepared for JPL
(NASA-CR-168393; JPL-9950-601) Avail: NTIS
HC A08/MF A01 CSDL 08I

A set of tables which display the allocation of time for ten personnel and eight pieces of underground coal mining equipment to ten function categories is provided. Data from 125 full shift time studies contained in the KETRON database was utilized as the primary source data. The KETRON activity and delay codes were mapped onto JPL equipment, personnel and function categories. Computer processing was then performed to aggregate the shift level data and generate the matrices. Additional, documented time study data were analyzed and used to supplement the KETRON database. The source data including the number of shifts are described. Specific parameters of the mines from which these data were extracted are presented. The result of the data processing including the required JPL matrices is presented. A brief comparison with a time study analysis of continuous mining systems is presented. The procedures used for processing the source data are described. NW.

N82-16462# Department of Energy, Morgantown, W. Va Energy Technology Center.

PRELIMINARY RESOURCE ASSESSMENT OF COALBED METHANE IN THE UNITED STATES

Apr. 1981 30 p refs
(DE82-001356; DOE/METC/SP-186) Avail: NTIS
HC A03/MF A01

Preliminary results of the DOE Methane Recovery from Coalbeds Project reveal that many of the coal regions in the United States have significant volumes of coalbed methane. These results show that 45 cooperative wells drilled to date have helped to update the estimates of methane in the various coal regions. The most promising coal region is in the Green River Basin where preliminary estimates show that the methane potential may be over 23 trillion cubic feet. Another area of considerable interest is in the Arkoma Basin where the methane content of coal samples ranged from 200 to 400 cubic feet per ton (cf/ton) of coal. The methane estimate in this basin is between 16 to 36 trillion cubic feet. The Piceance Creek coal region is an area presently generating considerable interest and industry activity. The methane content of the coal samples extracted from this basin averaged over 100 cf/ton. The Northern Appalachian region also shows considerable promise. DOE

N82-16464# New Mexico State Univ., Las Cruces Dept. of Chemical Engineering.

ENHANCED OIL RECOVERY BY CO₂ FOAM FLOODING Quarterly Report, 1 Jul. - 30 Sep. 1981

S Holbrook, Murty Kuntamukkula, John T Patton, and Ken Spence (Bartlesville Energy Technology Center, Okla.) 30 Sep 1981 6 p
(Contract DE-AS21-78ET-12083)
(DE82-000949, DOE/MC-12083/14) Avail: NTIS
HC A02/MF A01

Progress reports are presented for the following tasks: apparatus design and construction; foam generation and static stability; dynamic foam stability; foam rheology; oil displacement efficiency; mathematical modeling; and final reports. The past quarter was productive with the major effort directed toward bringing the project to a successful completion. All project objectives were met and the results are encouraging with respect to potential commercial applications. DOE

N82-16465# Rensselaer Polytechnic Inst., Troy, N. Y. Office of Contracts and Grants

EFFECTS OF POROSITY TYPE, PORE GEOMETRY, AND DIAGENETIC HISTORY ON TERTIARY RECOVERY OF PETROLEUM FROM CARBONATE RESERVOIRS Final Report, 1 Jul. 1979 - 30 Nov. 1980

G M Friedman, Kenneth Ruzyla, and Anne Reeckmann Sep 1981 228 p refs
(Contract DE-AC21-79MC-11580)
(DE82-000896, DOE/MC-11580/5) Avail: NTIS

04 FUELS AND OTHER SOURCES OF ENERGY

HC A11/MF A01

The mechanisms controlling porosity in Red River formation (Upper Ordovician) carbonate reservoirs, were studied in order to determine what types of pore systems result from a given set of depositional and diagenetic conditions. The Red River Formation of Montana is a major oil-producing reservoir in the area and Cabin Creek Field is a good candidate to undergo tertiary recovery in the future. The stratigraphy, distribution of lithofacies, depositional environments, and diagenesis of the study area are discussed. The various types of porosity present, their origin, how they are distributed throughout the upper Red River reservoirs, and how they relate to depositional environment are discussed. Size and shape of pores and pore throats are in terms of statistical measures from capillary-pressure curves, and by interpretation of scanning-electron micrographs of resin-pore casts. Petrophysical relationships, diagenetic controls on the development and geometry of pore systems, and the role of pore geometry in the determination of carbonate reservoir characteristics are also addressed. DOE

N82-16472# Terra Tek, Inc., Salt Lake City, Utah Drilling Research Lab.

SMALL BUSINESS INNOVATION RESEARCH: OIL RECOVERY ENHANCEMENT BY ACOUSTIC MEANS Final Report

Ahmed S. Abou-Sayed, George J. Dvorak, Sidney J. Green, Arion H. Jones, Richard Lingle, and Joseph B. Walsh Feb 1981 47 p refs

(Grant NSF DAR-79-17712)

(PB81-243842, NSF/IST-81001)

Avail: NTIS

HC A03/MF A01 CSCL 081

The effect of a stress wave pulse on a porous saturated rock was studied. Three different situations were analyzed: The presence of a linear viscoelastic (Newtonian) fluid in the pore space, the presence of a nonlinear (non-Newtonian) fluid in the pore space without a pore filled pressure gradient, i.e., fluid flow; and the presence of a nonlinear (non-Newtonian) fluid in the pore space with a pore fluid pressure gradient, i.e., fluid flow. It was found that there can be no pumping action with a periodic stress wave in a system containing a linear, Newtonian fluid for stress pulses in the low frequency range. Pumping will occur for frequencies above about 1,000 cycles per second for the material and pore spacing considered in the study typical of some rocks. GRA

N82-16501# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho

CASE STUDIES OF LOW-TO-MODERATE TEMPERATURE HYDROTHERMAL ENERGY DEVELOPMENT

Oct. 1981 126 p refs Prepared in cooperation with California Univ., Lawrence Berkeley Lab

(Contract DE-AC07-76ID-01570)

(DE82-000883; IDO-10098) Avail: NTIS HC A07/MF A01

Six development projects that use low to moderate temperature geothermal resources were examined. The projects illustrate many facets of hydrothermal development. The history of this development, its exploratory methods, and its resource definition, are described and address legal, environmental, and institutional constraints. DOE

N82-16517# Foster Wheeler Corp., Livingston, N.J.
INDUSTRIAL STEAM SUPPLY SYSTEM CHARACTERISTICS PROGRAM. PHASE 2: LOW- AND MEDIUM-Btu GAS-FIRED BOILERS WITH ASSOCIATED GASIFICATION PLANTS Final Report

Sep. 1981 292 p refs Prepared for ORNL

(Contract W-7405-eng-26)

(DE82-000535; ORNL/Sub-80/13847/2; FWDC-9-41-8903)

Avail: NTIS HC A13/MF A01

For each system, two coal sources were considered, an Eastern high-sulfur bituminous coal and a Western low-sulfur subbituminous coal. Eight different systems were studied and conceptual cost estimates prepared for each of them. Scaling factors were developed over a range of plant sizes; cost ratios were prepared for multiple unit systems; and cost sensitivities vs degree of sulfur removal were developed for each of the on-site gasification systems. T.M.

N82-16519# Booz-Allen and Hamilton, Inc., Bethesda, Md.
Energy Analysis and Environment Div
ASSESSMENT OF EMERGING ENERGY SOURCES Sum-

mary Report

Sep. 1981 43 p refs

(DE82-900318; EPRI-EA-2023-SY)

Avail: NTIS

HC A03/MF A01

The results of a broad review and analysis of the commercialization potential for eight emerging sources of energy are summarized. Tight gas sands, heavy oil, methane from geopressured aquifers, oil shale, enhanced oil recovery, advanced coal mining technologies, and underground coal gasification are discussed. Each source of energy or technology was evaluated with respect to six factors affecting commercialization: size and characteristics of resource, technical and economic performance; relevant energy market growth rates, logistical considerations, development lead times, and regulatory and institutional factors. The evaluation was based on a review of existing literature, extensive interviews with industry expert, and an overall assessment of the degree to which these factors would constrain commercial development. In addition, estimates were made of supply potential from each emerging energy. DOE

N82-16529# Institute of Gas Technology, Chicago, Ill.
DEVELOPMENT OF HYDROCONVERSION OF BIOMASS TO SYNTHETIC FUELS. PROJECT 61042 TECHNICAL REPORT Technical Progress Report, 16 May - 30 Sep. 1980

Dec 1980 57 p refs

(Contract DE-AC02-80CS-83004)

(DE82-000874; DOE/CS-83004/1)

Avail: NTIS

HC A04/MF A01

The objective of this program is to develop the hydroconversion (in-situ production and addition of hydrogen to carbonaceous species) of biomass (forest and crop residues) to produce substitute natural gas. The program will also include experiments to investigate the production of hydrocarbon liquids from biomass. Progress made during the first reporting period is reported. A list of recent biomass survey and availability literature was compiled; samples of wood materials were obtained for characterization, handling, and bench-scale testing. Standard chemical and physical tests for biomass materials were identified for use in characterizing each material and its char in the program. The initial analysis and testing began with a sample of Douglas fir hog fuel. Bench-scale hydrodevolatilization and char gasification tests were performed. Experiments with maple hardwood chips are in progress. A detailed report describing the process development unit design was submitted. DOE

N82-16539# RMR Associates, Palo Alto, Calif.
COGENERATION POTENTIAL: ENHANCED OIL RECOVERY Final Report

R. M. Rodden and J. L. Boyen Aug. 1981 69 p refs Sponsored by EPRI

(EPRI Proj. 1276-7)

(DE81-904202; EPRI-EM-1996)

Avail: NTIS

HC A04/MF A01

The purpose of this project was to perform preliminary evaluation of the potential in the United States for generating electric power in connection with producing steam for the enhanced recovery of oil. The analysis identified the size and location of the heavy oil resource base and developed estimates of oil recovery potential. Using these data, estimates were made of electric power capacity that could result if cogeneration were used to supply the necessary steam for thermal recovery. Incentives and obstacles to the use of cogeneration for thermally enhanced oil recovery are identified and discussed. The attitudes of the utilities companies and the petroleum producers toward the possible use of cogeneration for thermal oil recovery are also identified and discussed. The report presents preliminary design information on cogeneration systems that would be suitable for thermally enhanced recovery. DOE

N82-16545# Economic Research Service, Washington, D. C.
Natural Resource Economics Div
COAL DEVELOPMENT IN RURAL AMERICA: THE RESOURCES AT RISK

Wallace McMartin, Virgil Whetzel, and Paul R. Myers Aug. 1981 92 p refs

(PB81-243313, RDRR-29) Avail: NTIS HC A05/MF A01 CSCL 10A

The resource base in rural America that will be affected by future mining, transportation, and use of coal is described. These resources are land, water, vegetation, people, and farm or ranch enterprises. Author

N82-16557# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
THERMODYNAMIC DATA FOR FLUE-GAS DESULFURIZATION PROCESSES

Leo Brewer Aug. 1981 56 p refs Presented at the FGD Symp., Morgantown, W. Va., 6-7 Nov 1980
 (Contract W-7405-eng-48)
 (DE81-030545; LBL-11758; CONF-801176-1) Avail NTIS HC A04/MF A01

Thermodynamic and kinetic data for the various materials that might be used in desulfurization processes resulting from coal and oil combustion are presented. Examination of the available thermodynamic data for sulfur compounds indicates serious uncertainties and a complete review is planned to provide the best set of internally consistent values obtainable from the literature and from current experiments. Although the main emphasis will be on information needed for aqueous limestone or lime slurry treatment, the data could also be used for other processes covering a wider temperature range. Thus it is planned to provide the data, when possible, for the range from room temperature to at least 1000K. The present compilation covers most of the materials that might play a role in SO₂ extraction processes and for which data were found. Supplements will be issued as data are obtained for additional substances of interest DOE

N82-16560# Exxon Research and Engineering Co., Linden, N.J. Contract Research Div.

FORMATION OF NO_x AND OTHER PRODUCTS FROM CHEMICALLY BOUND NITROGEN IN COAL COMBUSTION Final Report

David W Blair and J O L Wendt Jun. 1981 298 p refs
 (Contract DE-AC21-77ET-11314)
 (DE81-028536; DOE/ET-11314/T1) Avail NTIS HC A13/MF A01

The purpose of this project was to advance the fundamental understanding of fuel nitrogen conversion in coal combustion towards the ultimate end of providing for the rational design of coal combustors with acceptably low NO_x outputs. In pursuit of this objective the program attacked the problem both experimentally and theoretically. Experimental work concentrated upon the pyrolysis stage of coal combustion. It investigated the loss of mass, nitrogen, and sulfur from the solid phase and the distribution of important chemical species in the pyrolyzate under simulated combustion heating conditions. Experimentally variables included temperature, heating rate, atmospheric reactivity, thermal history (preheating, reheating) and coal type. These experiments were performed upon twenty coals of widely varying types, two chars, and one petroleum coke. The results of the work suggest that the conditions of coal nitrogen conversion can be controlled by adjusting external variables. DOE

N82-16673# Pacific Northwest Lab., Richland, Wash
THE WIND CHARACTERISTICS PROGRAM ELEMENT Annual Report, Oct. 1979 - Sep. 1980

L. L. Wendell, W R Barchet, J R Connell, A H Miller, W. T. Pennell, and D S Renne Sep. 1981 200 p refs
 (Contract DE-AC06-76RL-01830)
 (DE82-004876; PNL-3876) Avail. NTIS HC A09/MF A01

The progress accomplished directly by the Pacific Northwest Laboratory (PNL) and by subcontractors funded directly by DOE or through PNL is reported. To expedite the management of the activities to produce the required information, the WCPE was divided into three program areas: wind energy prospecting, support for design and operations, and site evaluation. Accomplishments in each of these program areas provide a highlight of WCPE activities. DOE

N82-16918# Sandia Labs., Albuquerque, N. Mex
EFFECT OF THERMOMECHANICAL PROPERTIES ON INITIAL CAVITY GROWTH

R E Glass 1981 21 p refs Presented at the 7th Underground Coal Conversion Symp., Fallen Leaf Lake, Calif., 8 Sep. 1981
 (Contract DE-AC04-76DP-00789)
 (DE81-030839; SAND-81-1941C, CONF-810923-9) Avail: NTIS HC A02/MF A01

Recent field and laboratory studies in UCG have indicated that the thermomechanical properties of coals may be the controlling parameters in determining initial cavity growth. To examine this possibility laboratory and modeling efforts are being directed at determining these properties and incorporating them in a cavity growth model. The results of the work emphasize the critical role that anisotropic strengths play in determining the shape of the cavity DOE

N82-17286 North Carolina Univ. at Chapel Hill
CORRELATION AND INTERFEROMETRIC DATA ANALYSIS APPLIED TO GAS CHROMATOGRAPHY FOURIER TRANSFORM INFRARED SPECTROSCOPY Ph.D. Thesis

Richard Claburn Wieboldt 1981 140 p
 Avail: Univ. Microfilms Order No. 8125636

Gas chromatography Fourier transform infrared spectroscopy provides the chemist with the ability to separate and identify, simultaneously, mixture components. Effective analysis of data generated requires algorithms that rapidly identify portions of data which contain useful information and provide assistance in identification. The development of such algorithms and their application to the analysis of shale oil mixtures is reported. The optical design for a gas chromatograph FTIR interface is described along with its limitations. A correlation technique which allows the FTIR to be used as a specific detector for the gas chromatograph is also discussed. The use of fast Fourier transform subroutines is described in detail as part of the method for generating the synthetic interferograms. With this approach, the key absorption features for nine functional groups were determined. Dissert Abstr

N82-17314# Amoco Oil Co., Naperville, Ill. Research and Development Dept

COAL-LIQUEFACTION CATALYST DEVELOPMENT Quarterly Progress Report, 1 Oct. - 30 Dec. 1980

J A Mahoney and J. J Helstrom Mar. 1981 54 p
 (Contract DE-AC22-79ET-14803)
 (DE82-000137; DOE/ET-14803/T6, QPR-5) Avail. NTIS HC A04/MF A01

The materials initially deposited onto the catalyst were determined. A large amount of coke with an H/C ratio of 1.13 was deposited. The deposition of trace metals was also quite severe, and high levels of iron and titanium were found. At the same time there was a substantial corresponding reduction in surface area and pore volume. The sulfur is already at the usual level found in used catalysts, reflecting the condition that the major portion of the sulfur is probably combined with the sulfided cobalt and molybdenum, it would appear that only a minor part of the sulfur is combined with the coke. These results might indicate that, although a considerable amount of coke has been deposited, it is quite permeable in the early part of the experiment and becomes less permeable with time. DOE

N82-17315# Utah Univ., Salt Lake City Dept of Mining and Fuels Engineering

CHEMISTRY AND CATALYSIS OF COAL LIQUEFACTION: CATALYTIC AND THERMAL UPGRADING OF COAL LIQUID AND HYDROGENATION OF CO TO PRODUCE FUELS Quarterly Progress Report, Apr. - Jun. 1981

Wendell H Wiser Aug 1981 56 p refs
 (Contract DE-AC22-79ET-14700)
 (DE82-000762; DOE/ET-14700/7) Avail NTIS HC A04/MF A01

A technique was developed to measure active sites on a sulfided CoMo/Al₂O₃ catalyst by gravimetric measurements of O₂ chemisorbed at -780 C in a dilute air/He stream. It was found that neither polarity nor concentration affected effective diffusivity of solutes in a porous catalyst support, which confirmed earlier results that surface diffusion is not operative in these systems, and that the dominant factor which determines diffusivity appears to be a drag coefficient. Reports of the following task groups with summaries are presented: chemical-catalytic studies, carbon-13 NMR investigation of CDL and coal, catalysis and mechanism of coal liquefaction, fundamental chemistry and mechanism of pyrolysis of bituminous coal, catalytic hydrogenation of CD liquids and related polycyclic aromatic hydrocarbons; denitrogenation and deoxygenation of CD liquids and related N- and O-compounds, and catalytic cracking of hydrogenated CD liquids. DOE

N82-17317# Argonne National Lab., Ill. Chemical Engineering Div

SAMPLING AND ANALYSIS OF HYDROCARBONS IN COMBUSTION GASES Quarterly Report, Jan. - Mar. 1981

I Johnson, D C Fee, and K M. Myles Aug 1981 24 p refs
 (Contract W-31-109-eng-38)
 (DE82-002511; ANL-CEN-FE-81-7) Avail. NTIS HC A02/MF A01

Real-time on-line methods for the chemical analysis of ultratrace levels of polycyclic organic compounds in the flue gases from fluidized-bed coal combustors were evaluated. The technique that currently shows the most promise for on-line monitoring is atmospheric-pressure-ionization triple quadrupole mass spectrometry. DOE

04 FUELS AND OTHER SOURCES OF ENERGY

N82-17339# Notre Dame Univ., Ind. Dept of Metallurgical Engineering and Materials Science
MICROSTRUCTURAL EFFECTS IN ABRASIVE WEAR
Quarterly Progress Report, Dec. 1980 - 1 Jun. 1981
T. H. Kosel, M. C. Rao, H. R. Shetty, M. T. Fernandes, and N. F. Fiore 29 Oct. 1981 71 p refs
(Contract DE-AS02-77ET-10460)
(DE82-003653, DOE/ET-10460/16/17) Avail: NTIS
HC A04/MF A01

This report describes research aimed at establishing quantitative relationships between microstructure and wear resistance of highly alloyed materials, including high-Cr white irons and experimental Co-base and Ni-base powder metallurgy (PM) alloys now used or potentially to be used in coal mining, handling, and gasification. The specific types of wear under study are low-stress abrasion and gouging wear encountered in mining, coal conversion, and transfer applications. During this period, work was concentrated on analysis of results. The many detailed observations obtained in the work on scratch test simulations of abrasive wear mechanisms have been summarized in drafts of three papers. The first, A Study of Abrasive Wear Mechanisms Using Diamond and Alumina Scratch Tests, is included as an appendix to this report and is being submitted for publication. Revision of the other papers is in progress. DOE

N82-17391# Buderus A.G. Wetzlar (West Germany).
PROMOTION OF UTILIZING PRIMARY ENERGY AND REDUCTION OF EMISSION WITH GRATE-EQUIPPED HEAT GENERATORS FIRED COMPLETELY AUTOMATIC WITH SOLID FUELS Final Report, Dec. 1980
Eberhard Nickel and Guenter Hoefeld Bonn Bundesministerium fuer Forschung und Technologie Dec 1981 181 p refs
Sponsored by Bundesministerium fuer Forschung un Technologie
(BMFT-FB-T-81-222, ISSN-0340-7608) Avail: NTIS
HC A09/MF A01

The development of two automatic boiler systems for the combustion of anthracite and crushed coke is described. The systems differ in their output range and in the type of grate used. Both systems allow the substitution of coke or coal for fuel oil. Maintenance facilities and boiler efficiency are considered. J.D.H.

N82-17395# Kimball (L. Robert) and Associates, Ebsenburg, Pa
BRIQUETTING OF FINE COAL USING A SODIUM CHLORIDE BINDER Final Report
E. Y. Crossmore, Jr., R. J. Kimball, and S. M. Kimball Oct 1981 41 p refs
(Contract DE-AC01-79ET-14303)
(DE82-000632, DOE/ET-14303/T1) Avail: NTIS
HC A03/MF A01

The economic and technological feasibility of producing dense, weather resistant briquettes from fine particulate bituminous coal was demonstrated. The binder consists of a sodium chloride dendritic crystalline matrix. The proclivity for liberation of pyritic sulfur and ash from fine coal particles for precombustion Deep Cleaning was investigated, in efforts to comply with clean air standards. Process technology as to coal beneficiation produces fine sized particles and handling the material after treatment is problematic. Reconstitution of this fine particulate was studied. Briquettes were produced which are equivalent to lump natural coal. Their heat value is greater as they contain less moisture and subjective burn tests for the product show a fouling index increase range. DOE

N82-17396# Spectron Development Labs., Inc., Costa Mesa, Calif.
EXPERIMENTAL INVESTIGATION OF SYN FUEL SPRAY CHARACTERISTICS AND COMBUSTION DYNAMICS
Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981
Jul. 1981 80 p refs
(Contract DE-AC22-80PC-30299)
(DE82-000412; DOE/PC-30299/T4; SDL-81-2176-180) Avail:
NTIS HC A05/MF A01

Fundamental information on the characteristics and behavior of both petroleum based oils and synthetic fuels in spray combustion was sought by applying advanced optical diagnostic techniques to study the processes of fuel injection and atomization, droplet ignition, and spray combustion. The program was conducted in three phases: cold flow spray experiments; monodispersed droplet combustion; and spray combustion

experiments. Parametric testing of all candidate injectors with number 2 fuel oil was completed. Efforts on spray characterization study were limited to completion of the final design of the traverse system for the droplet sizing interferometry (DSI). Detailed design of the monodisperse droplet combustion was completed. M.D.K.

N82-17397# American Farmers' Marketing Cooperative, Mayfield, Ky. Ethanol Div.
FEASIBILITY STUDY FOR ALTERNATIVE FUELS PRODUCTION: BIOMASS TECHNOLOGY. VOLUME 2: ADDENDUM, ECONOMIC AND FINANCIAL ANALYSIS
15 Dec 1980 198 p refs
(Contract DE-FG07-80RA-50333)
(DE82-000030; DOE/RA-50333/T1-Vol-2) Avail: NTIS
HC A9/MF A01

The feasibility of constructing and operating a motor-fuel ethanol plant is investigated. Detailed results are presented. The results of site surveys and area surveys are presented. Site preparation plans are outlined. Energy and material balances and equipment requirements are established as a part of the overall procedure to validate costs. Process flow sheets are included. Detailed diagrams of the plant design are also included. The management plan for the operation of the plant is discussed. DOE

N82-17398# Fluor Engineers and Constructors, Inc., Irvine, Calif.
COAL-TO-METHANOL: AN ENGINEERING EVALUATION OF TEXACO GASIFICATION AND ICI METHANOL-SYNTHESIS ROUTE Final Report
P. A. Buckingham, D. D. Cobb, A. A. Leavitt, and W. G. Snyder Aug 1981 126 p refs
(DE81-904235; EPRI-AP-1962) Avail: NTIS
HC A07/MF A01

Results of a technical and economic evaluation of producing methanol from bituminous coal using Texaco coal gasification and ICI methanol synthesis is reported. The scope of work included: development of an overall configuration for a large plant comprising coal preparation, air separation, coal gasification, shift conversion, COS hydrolysis, acid gas removal, methanol synthesis, methanol refining, and all required utility systems and off-site facilities. Design data were received from both Texaco and ICI while a design and cost estimate were received from Lotepro covering the Rectisol acid gas removal unit. The plant processes 14,448 tons per day (dry basis) of Illinois No. 6 bituminous coal and produces 10,927 tons per day of fuel-grade methanol. An overall thermal efficiency of 57.86 percent was calculated on an HHV basis and 52.64 percent based on LHV. Total plant investment at an Illinois plant site was estimated to be \$1159 million dollars in terms of 1979 investment. Using EPRI's economic premises, the first-year product costs were calculated to \$4.74 per million Btu (HHV) which is equivalent to \$30.3 cents per gallon and \$5.37 per million Btu. DOE

N82-17399# Hydrocarbon Research, Inc., Lawrenceville, N. J.
H-COAL PROCESS IMPROVEMENT STUDY: BENCH-UNIT BASELINE RUN WITH PREHEATER/REACTOR
May 1981 57 p
(Contract DE-AC05-77ET-10152)
(DE82-002572; DOE/ET-10152/T2) Avail: NTIS
HC A04/MF A01

The thermal dissolution of coal and its effects on the mechanism of coal liquefaction in an H-Coal system were investigated. The two-state coal liquefaction system consists of a coal slurry preheater and a liquefaction reactor, a catalytic-hydrogenation-reactor. The preheater design and unit modifications are discussed. The objective of the run reported was to obtain baseline data with the preheater integrated in the bench unit system. Operating conditions and results are summarized and compared with those of previous bench runs without a preheater. The effect a preheater has on product yields and product quality was determined. Based on comparison data it is concluded that a preheater tends to increase heavy liquid yields with more residual oil and a higher proportion of heavy distillates in the distillate product. However, more experimental data at comparable operating conditions, with and without a preheater, are needed to confirm this observation. The experimental run closely simulated the conditions of another run which also included a preheater; however, product yields differed by as much as 6 w %. The higher slurry space velocities in the preheater for this run correspond to lower slurry residence times, which resulted in lower yields of lighter fractions than obtained in PDU Run 5. DOE

N82-17400# Cummins Engine Co., Inc., Columbus, Ohio.
SYNFUEL MODIFIED DIESEL Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981
 1981 16 p
 (Contract DE-AC03-79ET-15450)
 (DE82-002298; DOE/ET-15450/T18) Avail: NTIS
 HC A02/MF A01

A two-year program was proposed to test three diesel engines operating on coal-derived liquid fuels and compare the results with standard diesel fuel oil No. 2; namely: (1) prechamber diesel; (2) dual fuel diesel (direct injection); and (3) spark-assisted diesel engines. The three types of diesel engines tested were to be modified in three forms; (1) conventional water-cooled, (2) waterless-uncooled; and (3) adiabatic (uncooled). Only the conventional water-cooled prechamber diesel engine and the spark assisted prechamber diesel engine were studied. Subcontracts were let to test the prechamber diesel engine and the spark-assisted prechamber. The direct injection dual fuel engine test will be delayed until the second year of the contract. No engine modifications for waterless-uncooled and adiabatic uncooled are scheduled for the first year. The selected engine models were installed in the laboratory. Preliminary operation was made. Both subcontractors began to construct a particulate measuring system according to recommendations. DOE

N82-17401# Chevron Research Co., Richmond, Calif.
REFINING AND UPGRADING OF SYNFUELS FROM COAL AND OIL SHALES BY ADVANCED CATALYTIC PROCESSES Interim Report
 R F Sullivan, D J ORear, and H A Frumkin Sep 1981
 319 p refs
 (Contracts DE-AC22-76ET-10532; EF-76-C-01-2315)
 (DE82-001127; DOE/ET-10532/T3, FE-2315-61, IR-5) Avail:
 NTIS HC A14/MF A01

Two coal syncrudes derived from Illinois No. 6 and Wyodak coals were refined in an extensive program which included pilot plant and laboratory studies. These studies demonstrated that advanced, commercial petroleum technology can be used to refine these syncrudes to gasoline, jet, diesel and heating fuels. The coal syncrudes have a low hydrogen content, compared to petroleum, and high concentrations of oxygen and nitrogen impurities. These syncrudes are a blend of two coal distillates boiling between C sub 5 and 680 F. Consequently, they contain no residual and have about 95% boiling in the gasoline or diesel fuel ranges. With these properties, an appropriate way to refine the syncrudes is by hydroprocessing. Hydroprocessing yields a volume of finished products which is almost equivalent to the original volume of syncrude. In addition, the heteroatoms are ultimately removed as sulfur and salable ammonia. The engineering studies provided estimates of the refining costs. DOE

N82-17402# Chevron Research Co., Richmond, Calif.
REFINING AND UPGRADING OF SYNFUELS FROM COAL AND OIL SHALES BY ADVANCED CATALYTIC PROCESSES Quarterly Report, Apr. - Jun. 1981
 R. F. Sullivan and D. J. ORear Sep. 1981 35 p
 (Contracts DE-AC22-76ET-10532, EF-76-C-01-2315)
 (DE81-030849; DOE/ET-10532/T2) Avail: NTIS
 HC A03/MF A01

Samples of solvent refined coal 2 middle and heavy distillates were water-washed and blended for use in a study of the potential biological hazards of synthetic crudes. A pilot plant screening was started on the blended distillate. Syncrude derived from Big Brown Texas lignite was analyzed and hydrotreated in a pilot plant. Early results show that properties and response to hydrotreating of the syncrude are similar to the results found on H-coal and solvent refined coal 2 syncrudes. DOE

N82-17404# Institute of Gas Technology, Chicago, Ill
RAPID-RATE BITUMINOUS COAL GASIFICATION Final Report, Sep. 1978 - Dec. 1980
 D Q. Tran Aug 1981 71 p refs
 (Contract GRI-5011-322-0082)
 (PB82-115478; GRI-79/0104) Avail: NTIS
 HC A04/MF A01 CSCL 21D

A free-fall, laminar-flow reactor capable of studying the devolatilization of caking coals was constructed. The unit can provide kinetic data as a function of several process variables, including temperature, pressure, residence time and reactive gas composition at temperatures to 1600 F and pressures to 1500 psig. The reactor system was used successfully to obtain

devolatilization data for two caking coals, Illinois No. 6 and Pittsburgh No. 8. Limiting (maximum) yields of CO, CO₂, H₂O, and CH₄ were obtained for these two coals, and correlations were developed to predict the yield of these species from the H/C and O/C ratio of the raw coal. Author (GRA)

N82-17450# Westinghouse Electric Corp., East Pittsburgh, Pa.
EVALUATION OF CONTROL AND PROTECTION CIRCUITS Open File Report, 13 Nov. 1979 - 31 Mar. 1981
 E C. Strycula and D. A. Paice Apr. 1981 50 p refs
 (Contract DI-BM-JO-308035)
 (PB82-105065; BM-OFR-126-81) Avail: NTIS
 HC A03/MF A01 CSCL 08I

Solid state equipment offers a number of potential advantages in the coal mining industry. These advantages can only be realized, however, through careful and judicious design of the control and protection circuitry. Problems relating to the interaction of solid state equipment on the electrical system and the special design considerations that apply to solid-state circuitry are examined. Design guidelines are provided for solid-state applications in the areas of (1) equipment operated from a dc trolley wire, (2) drive systems for surface mining equipment, (3) ac motor starters, and (4) electromagnetic interference. GRA

N82-17455# Technische Univ., Aachen (West Germany). Inst of Ferrous Metallurgy
PRELIMINARY INVESTIGATIONS ON THE INJECTION OF A COAL-OIL-SLURRY INTO THE BLAST FURNACE Final Report
 Ulrich Rejek and Friedrich Hermann Franke Bonn Bundesministerium fuer Forschung und Technologie Dec. 1981 83 p refs
 Sponsored by the Bundesministerium fuer Forschung und Technologie
 (BMFT-FB-T-81-221; ISSN-0340-7608) Avail: NTIS
 HC A05/MF A01

The flow and pumping behaviour and sedimentation of coal-oil-slurries as a function of concentration, temperature, coal and oil type, grain size, size distribution, pipe geometry etc were determined. The results are intended to facilitate the planning of an injection plant and to enable an assessment of the economic feasibility of such a plant. The results show that for trouble-free transportation, (without undue increase in viscosity) the maximum coal concentration is 50 percent by weight with lignite coal-oil-slurries and 65 percent by weight with bituminous low volatile coal-oil-slurries at 80 C. A fine grinding of the coals leads to high viscosity in the slurries. The utilization of coarse particles leads to a rapid sedimentation at low velocities. TM.

N82-17507# CLD Group, Inc., Ventura, Calif
FIELD DEMONSTRATION OF THE CONVENTIONAL STEAM DRIVE PROCESS WITH ANCILLARY MATERIALS Annual Report, 1 Oct. 1979 - 30 Sep. 1980
 Ron Bowman Oct 1981 133 p refs
 (Contract DE-FC03-79SF-10761)
 (DE82-003040; DOE/SF-10761/1, AR-1) Avail: NTIS
 HC A07/MF A01

The applicability of foams to achieve mobility control and/or permeability reduction of injected steam in steam drive operations was tested. Foam chemicals were screened for thermal stability and the foam systems in porous media were emplaced. The compatibility of the emplacement techniques and the capacity of the chemical system to achieve a significant measure of mobility control over injected steam was verified. The two major reservoir problems in steam drive operations are addressed: the flow of steam through thief zones or other channels that exist at the outset of initiating operations, and the progressive increase in channelling of steam through the oil depleted, steam swept zone. DOE

N82-17508# Consolidated Controls Corp., El Segundo, Calif.
DESIGN, FABRICATION, AND EVALUATION OF A SPIRAL-FLOW LETDOWN VALVE Final Report
 H. J. Balhouse Sep 1981 68 p refs
 (DE82-900863; EPRI-AP-2044) Avail: NTIS
 HC A04/MF A01

A letdown valve with spiral-flow trim designed for coal liquefaction plant service was designed and tested. Letdown valves in these plants have tended to fail in a very short time due to rapid erosion of the valve trim. In the spiral-flow design, erosion is reduced by keeping velocity at a low, constant level through friction loss in a long spiraling flow path. In a field test at the

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SRC-1 pilot plant, the valve controlled the processes flow for over 34 hours before it became inoperative as a result of plugging due to accumulation of solids in operational areas. It is concluded that in order to realize the potential advantages of the spiral-flow concept, more development effort is needed in the areas of prevention of plugging and the application of erosion-resistant materials and coatings. Directions for future work in these areas, plus application of the concept to a non-cavitating liquid letdown valve and other pressure reduction devices, are discussed. DOE

N82-17552# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

HELIUM PRODUCTION IN NATURAL GAS RESERVOIRS
E. B. Pereira and J. A. S. Adams (Rice Univ., Houston, Tex.)
Aug 1981 14 p refs Submitted for publication
(INPE-2214-PRE/014) Avail: NTIS HC A02/MF A01

About 11,000 published natural gas analyses of helium were used in the estimation of the average global scale accumulation and concentration of radiogenic helium in sediments. Simple lognormal statistics are employed to derive a net accumulation rate between 1000,000 to 670,000 helium atoms per cubic meter of reservoir rock per second. This accumulation rate permits an inference of an average helium concentration of non-reservoir sediments of about 67 ppm. By assuming a simple closed system model, it is shown that deep seated sources of helium are not necessary to explain the present regime of helium in sediments on a global scale, and that the accumulation rate and concentration obtained are in close agreement with existing fundamental geochemical estimates of uranium and thorium in rather average type of sediments. R.J.F.

N82-17553*# Wyle Labs, Inc., Huntsville, Ala Scientific Services and Systems Group.

BASILINE STUDIES ON THE FEASIBILITY OF DETECTING A COAL/SHALE INTERFACE WITH A SELF-POWERED SENSITIZED PICK Final Report

Granville R. Anderson, II 19 Feb. 1981 98 p refs
(Contract DEN8-000011)
(NASA-CR-161960) Avail: NTIS HC A05/MF A01 CSDL 081

The feasibility of utilizing a sensitized pick to discriminate between cutting coal and roof material during the longwall mining process was investigated. A conventional longwall mining pick was instrumented and cutting force magnitudes were determined for a variety of materials, including Illinois #6 coal, shale type materials, and synthetic coal/shale materials. E.A.K.

N82-17554*# Mississippi State Univ., Mississippi State Engineering and Industrial Research Station

THE DESIGN OF A MECHANICAL REFERENCING SYSTEM FOR THE REAR DRUM OF THE LONGWALL SHEARER COAL MINER Final Report

E. William Jones and Thomas Chen-Hsing Yang 4 Jun 1981 78 p refs

(Contract NCA8-00131)
(NASA-CR-161962; MSSU-EIRS-ME-81-4) Avail: NTIS HC A05/MF A01 CSDL 081

The design of two systems which reference the position of a longwall shearer coal miner to the mine roof of the present cut and of the last cut are presented. This system is part of an automation system that will guide the rear cutting drum in such a manner that the total depth of cut remains constant even though the front drum may be following an undulating roof profile. The rear drum referencing mechanism continually monitors the distance from the mine roof to the floor for the present cut. This system provides a signal to control a constant depth of cut. The last cut follower mechanism continually monitors the distance from the mine roof of the prior cut to the cutting drum. This latter system provides a signal to minimize the step height in the roof between cuts. The dynamic response of this hydraulic-pneumatic and mechanical system is analyzed to determine accumulator size and precharge pressure. B.W.

N82-17555*# Missouri Univ., Rolla Rock Mechanics and Explosives Research Center

THE DETECTION OF THE COAL ROOF INTERFACE BY USE OF HIGH PRESSURE WATER Final Report

1981 55 p refs
(Grant NsG-8055)
(NASA-CR-161959) Avail: NTIS HC A04/MF A01 CSDL

081

A device whereby water jets can be used to detect the interface between coal and the overlying roof rock is described. Once this identification is made this distance can be measured using instruments such as the autofocus systems recently developed in the photographic industry. Experiments carried out show that the device can discriminate between coal and rock at coal thicknesses up to 8 inches. An autofocus system was examined which indicates accuracies of better than 0.1 inches. B.W.

N82-17560*# Shaker Research Corp., Ballston Lake, N. Y.
DEVELOPMENT OF SENSITIZED PICK COAL INTERFACE DETECTOR SYSTEM Final Report

R. F. Burchill [1982] 68 p
(Contract NAS8-32538)
(NASA-CR-161961) Avail: NTIS HC A04/MF A01 CSDL 081

One approach for detection of the coal interface is measurement of pick cutting loads and shock through the use of pick strain gage load cells and accelerometers. The cutting drum of a long wall mining machine contains a number of cutting picks. In order to measure pick loads and shocks, one pick was instrumented and telemetry used to transmit the signals from the drum to an instrument-type tape recorder. A data system using FM telemetry was designed to transfer cutting bit load and shock information from the drum of a longwall shearer coal mining machine to a chassis mounted data recorder. The design of components in the test data system were finalized, the required instruments were assembled, the instrument system was evaluated in an above-ground simulation test, and an underground test series to obtain tape recorded sensor data was conducted. T.M.

N82-17564# Sheffield Univ. (England). Dept. of Control Engineering.

THE MODELLING OF SEMIFLEXIBLE CONVEYOR STRUCTURES FOR COAL-FACE STEERING INVESTIGATIONS. PART 1: SPATIALLY DISCRETE MODELS

J. B. Edwards, R. A. Wolfenden (National Coal Board), and A. M. S. R. Yazdi Apr. 1981 35 p refs Submitted for publication 2 Vol
(RR-151-Pt-1) Avail: NTIS HC A03/MF A01

The coal-cutting machine shown is of the ranging-drum shearer type. The machine both cuts the coal from the solid face as it proceeds along the face and simultaneously loads the product onto the scraper-chain conveyor. This operation is aided by the spiral vanes around the rotating drum periphery upon which the cutting picks are mounted. The scraper-chain conveyor also has more than a single function: it not only conveys the cut product to the face-end but, because of the robust construction of its structure, it also provides a comparatively smooth track upon which the power-loader rides. Mathematical models of the steering system and the overall process are presented. Examples of predicted behavior are given. J.M.S.

N82-17565# Sheffield Univ. (England). Dept. of Control Engineering.

THE MODELLING OF SEMIFLEXIBLE CONVEYOR STRUCTURES FOR COAL-FACE STEERING INVESTIGATIONS. PART 2: SPATIALLY CONTINUOUS MODELS

J. B. Edwards Apr 1981 25 p refs Submitted for publication 2 Vol
(RR-152-Vol-2) Avail: NTIS HC A02/MF A01

A linear model of a flexible conveyor used on longwall coal-faces and designed to permit vertical floor undulations to be followed is presented along with a continuous elastic beam model. Predictions of the multipass system stability using the beam model are discussed. J.M.S.

N82-17572# Donohue, Anstey, and Morrill, Boston, Mass.
A PROJECT TO TEST FOR SHALE GAS IN OHIO Final Report

30 Apr. 1981 197 p
(Contract DE-AC21-78MC-08339)
(DE82-000916; DOE/MC-12697/T3) Avail: NTIS HC A08/MF A01

Methods to find deep zones of natural fracture in the search for viable shale gas are discussed. The measurement of seismic velocity in the shale is examined. This speed is expected to be lowered by the presence of fractures, particularly if the fractures contain gas. The seismic reflection method, which times the

echoes from deep rock layers, is used to measure the speed of sound in the shale. The results of the seismic velocity analysis are summarized. Gas was obtained from two naturally fractured zones in the Chagrin shale. The well was stimulated and tested at three separate levels, the Rhinestreet shale, Huron shale, and the Chagrin. DOE

N82-17573# Donohue, Anstey, and Morrill, Boston, Mass
SHALE GAS IN THE SOUTHERN CENTRAL AREA OF NEW YORK STATE: PART 1. HOW TO FIND AND DEVELOP SHALE GAS IN NEW YORK STATE
 Apr. 1981 71 p Sponsored in part by New York Energy Research and Development Authority
 (Contract DE-AC21-79MC-12697)
 (DE82-000913; DOE/MC-12697/T1) Avail. NTIS
 HC A04/MF A01

The economics of shale-gas exploration in New York are discussed. To date three wells have been artificially fractured in the Marcellus shale of New York, and all three appear to be producers. The chances of extracting gas are improved if geological techniques can identify zones of a suitable degree of natural fracturing in the shale. These techniques are aided by detailed structure maps of the shale units. It is concluded that the most likely source of shale gas in south central New York is the Marcellus formation. The following recommendations are made: shale gas wells should be drilled with air; the dry open hole should be logged with gamma-ray, density, temperature and noise logs, the shale should be artificially fractured using a nitrogen stimulation technique DOE

N82-17574# Commercialization Insights, Tampa, Fla
EVALUATION OF ALTERNATIVES IN DOWNHOLE STEAM GENERATION
 Sep. 1981 82 p Sponsored by DOE
 (DE82-001943; DOE/TIC-2001943) Avail: NTIS
 HC A05/MF A01

The development of downhole steam generators for requirements of commercialization, technical, and economic goals were evaluated. It is found that: (1) the high pressure downhole steam generator has potential for commercialization in the production of heavy oil; (2) oil yield is the critical performance parameter; (3) the downhole hydrogen/oxygen has potential for production of resources which are not unproducible or uneconomical; (4) the critical performance provided in nearly 1100 pre and poststraining forms returned by the solar and 201 stream sediment samples. Statistical and areal distributions of uranium and possible uranium related variables are displayed. Pertinent geologic factors in evaluating the potential for uranium mineralization are discussed. The high uranium values occur primarily in pleistocene delta deposits and in glacial outwash and till. Groundwater in this area is geographically associated with high values of calcium, magnesium, manganese, potassium, selenium, strontium, sulfate, and total alkalinity DOE

N82-17575# New Mexico Inst. of Mining and Technology, Socorro. Petroleum Recovery Research Center
DEVELOPMENT OF MOBILITY CONTROL METHODS TO IMPROVE OIL RECOVERY BY CO₂ Quarterly Report, 1 Jul. - 30 Sep. 1981
 J. P. Heller 1981 6 p refs
 (Contract DE-AC21-79MC-10689)
 (DE82-001968, DOE/MC-10689/10, PRR-81-41; QR-8)
 Avail: NTIS HC A02/MF A01

The development of foam-type mobility control agents, core flooding system, and direct thickeners consisting of polymers soluble in CO₂ are discussed. The core flooding test system is operational with all components essentially complete. Foam generation was principally concerned with experiments designed to ascertain the proper operating regions for the generator. The second mobility agent is being developed for the direct thickness of CO₂. A number of polymeric compounds were found which are soluble in CO₂ DOE

N82-17576# Gruy Federal, Inc., Houston, Tex
TARGET RESERVOIRS FOR CO₂ MISCIBLE FLOODING, TASK TWO. SUMMARY OF AVAILABLE RESERVOIR AND GEOLOGICAL DATA. VOLUME 1: PERMIAN BASIN GEOLOGICAL AND RESERVOIR DATA. PART 2: ADAIRSAN ANDRES THROUGH EUNICE Final Report
 L. B. Cobb Oct. 1981 336 p refs

(Contract DE-AC21-79MC-08341)
 (DE82-001348; DOE/MC-08341/31-Vol-1-Pt-2) Avail: NTIS
 HC A15/MF A01

The types of injected fluid, type of injector, fluid status, efficiency of type injector, injection pattern, and operational problems are coded and tabulated for oil and gas reservoirs in New Mexico and Texas. Water analysis records are included. DOE

N82-17595# Institute of Gas Technology, Chicago, Ill.
ANALYSIS OF GEOPRESSURED AQUIFERS Annual Report, Jan. - Dec. 1980
 M. G. Doherty Aug 1981 155 p refs
 (Contract GRI-5011-310-0109)
 (PB82-103862; GRI-80/0072) Avail. NTIS
 HC A08/MF A01 CSCL 081

The Institute of Gas Technology undertook technical and economic analyses of the coproduction of water and gas from watered-out geopressured gas caps, hydrogeopressured aquifers, and low-permeability geopressured aquifers for the Gas Research Institute. Out of over 100,000 wells screened in Louisiana and Texas, 489 were identified as having watered out under a strong water drive, making them possible candidates for watered-out geopressured gas cap wells. GRA

N82-17603*# Gilbert/Commonwealth, Reading, Pa
MAGNETOHYDRODYNAMICS (MHD) ENGINEERING TEST FACILITY (ETF) 200 MW_e POWER PLANT CONCEPTUAL DESIGN ENGINEERING REPORT (CDER) Final Report
 Sep 1981 593 p refs
 (Contracts DEN3-224, DE-AI01-77ET-10769)
 (NASA-CR-165452-Vol-5, DOE/NASA/0224-1-Vol-5) Avail:
 NTIS HC A25/MF A01 CSCL 10B

The reference conceptual design of the magnetohydrodynamic (MHD) Engineering Test Facility (ETF), a prototype 200 MWe coal-fired electric generating plant designed to demonstrate the commercial feasibility of open cycle MHD, is summarized. Main elements of the design, systems, and plant facilities are illustrated. System design descriptions are included for closed cycle cooling water, industrial gas systems, fuel oil, boiler flue gas, coal management, seed management, slag management, plant industrial waste, fire service water, oxidant supply, MHD power train, magnet, heat recovery/seed recovery, inverter, heating, ventilating, and air conditioning, and electrical. NW

N82-17618# Kernforschungsanlage, Juelich (West Germany).
METEOROLOGICAL DATA BASIS
 L. Jarass (ATW, G.M.B.H., Regensburg, West Germany) In its Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr 1981 p 1-16

Avail. NTIS HC A06/MF A01

Wind speed and direction data from 16 observation points in the Federal Republic of Germany are evaluated. Hourly mean figures for wind speed and direction, measured at heights of 10 m to 30 m above ground, for the years 1969 to 1976 at coastal stations and for the years 1969 and 1972 at inland stations, are analyzed. Daily and seasonal time variations and the temporal distribution of wind speed, lulls, and correlation and autocorrelation of wind speeds are considered and charted. Extreme velocities are discussed. A general evaluation of possible sites for wind power generation facilities is presented. J.D.H.

N82-17629# Amax Exploration, Inc., Wheat Ridge, Colo.
TUSCARORA AREA, NEVADA: GEOTHERMAL RESERVOIR ASSESSMENT CASE HISTORY, NORTHERN BASIN AND RANGE Final Report, 1 Oct. 1978 - 9 Sep. 1980
 H. D. Pilkington Aug 1981 45 p refs
 (Contract DE-AC08-79ET-27011)
 (DE82-001328; DOE/ET-27011/1) Avail: NTIS
 HC A03/MF A01

A Geothermal exploration of the Tuscarora prospect consisted of an integrated program of geologic, hydrogeochemical and soil geochemistry studies. Geophysical exploration included: heatflow studies, aeromagnetic, self potential, gravity, dipole-dipole resistivity and magnetotelluric surveys. Exploration drilling includes 32 shallow thermal gradient holes, six intermediate depth temperature gradient wells and one 5454 foot test for discovery well. Shallow low temperature reservoirs were encountered in the Tertiary rocks and in the Paleozoic rocks immediately beneath the Tertiary. DOE

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N82-17630# Gilbert (Glen A.) and Associates, Inc., Reading, Pa.

RESEARCH AND EVALUATION OF BIOMASS RESOURCES/CONVERSION/UTILIZATION SYSTEMS. BIOMASS ALLOCATION MODEL. VOLUME 1: TEST AND APPENDICES A & B

R. P. Stringer, Y. K. Ahn, H. T. Chen, R. W. Helm, E. T. Nelson, and K. J. Shields Aug 1981 222 p refs 2 Vol (Contract DE-AC02-78ET-20611) (DE82-000838; DOE/ET-20611/12-Vol-1; GAI-2204-Vol-1) Avail: NTIS HC A10/MF A01

A biomass allocation model was developed to show the most profitable combination of biomass feedstocks, thermochemical conversion processes, and fuel products to serve the seasonal conditions in a regional market. This optimization model provides a tool for quickly calculating which of a large number of potential biomass missions is the most profitable mission. Other components of the system serve as a convenient storage and retrieval mechanism for biomass marketing and thermochemical conversion processing data. The system can be accessed through the use of a computer terminal, or it could be adapted to a microprocessor. A User's Manual for the system is included. Biomass derived fuels included in the data base are the following: medium Btu gas, low Btu gas, substitute natural gas, ammonia, methanol, electricity, gasoline, and fuel oil. DOE

N82-17631# Gilbert (Glen A.) and Associates, Inc., Reading, Pa.

RESEARCH AND EVALUATION OF BIOMASS RESOURCES/CONVERSION/UTILIZATION SYSTEMS. BIOMASS ALLOCATION MODEL. VOLUME 2: APPENDICES C-E

R. P. Stringer, Y. K. Ahn, H. T. Chen, R. W. Helm, E. T. Nelson, and K. J. Shields Aug. 1981 323 p refs 2 Vol (Contract DE-AC02-78ET-20611) (DE82-000839; DOE/ET-20611/12-Vol-2; GAI-2204-Vol-2) Avail: NTIS HC A14/MF A01

The Biomass Feedstock Allocation Model User's Manual is presented. The results of an economic analysis of biomass thermochemical conversion processes are presented as: a sample computer run for process economics; process cost sensitivity plots (the effect of plant capacity and feedstock cost on product cost); and the results of a computer analysis showing product costs using discounted cash flow and utility financing method. The results of process modeling activities are also included. DOE

N82-17690# Colorado State Univ., Fort Collins. Dept. of Agronomy.

FIELD STUDIES ON USBM AND TOSCO 2 RETORTED OIL SHALES: VEGETATION, MOISTURE, SALINITY, AND RUNOFF. Final Report, 1977 - 1980

M. K. Kilkelly, W. A. Berg, and H. P. Harbert, III Aug. 1981 120 p refs (Grant EPA-R-804719) (PB82-109810; EPA-600/7-81-139) Avail: NTIS HC A06/MF A01 CSCL 13B

The vegetative stabilization of processed oil shales and moisture and soluble salt movement within the soil/shale profile were investigated. Research plots with two types of retorted shales (TOSCO II and USBM) with leaching and soil cover treatments were established at two locations: low-elevation and high elevation. Vegetation was established by intensive management, N and P fertilization, seeding, mulching, and irrigation. After seven growing seasons, a good vegetative cover remains with few differences between treatments, with the exception of the TOSCO retorted shale, south aspect, which consistently supports less perennial vegetative cover than other treatments. With time, a shift from perennial grasses to dominance by shrubs is observed. GRA

N82-17696 Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Geological Survey of Queensland.

GEOLOGICAL EVOLUTION AND ECONOMIC GEOLOGY OF THE BURDEKIN RIVER REGION, QUEENSLAND

K. R. Levingston and W. H. Oldham, ed. 1981 72 p refs (BMR-BULL-208; ISSN-0084-7089; ISBN-0-642-05830-X) Avail: NTIS HC A04

The geological history of the area is presented, from the Precambrian to the Cenozoic ages. The physiography of the land is described, and the economic aspects of the geology are

discussed in relation to metals, fuels (coal and petroleum), and nonmetallic minerals. S.L.

N82-17722# Research Inst. of National Defence, Stockholm (Sweden).

SEISMOLOGY 1980. NUCLEAR TEST BAN VERIFICATION. EARTHQUAKE AND EARTH RESOURCE INVESTIGATION Progress Report, 1980

Brittmarie Tygaard Oct. 1981 69 p refs Sponsored by National Council for Radioactive Waste (FOA-C-20427-T1) Avail: NTIS HC A04/MF A01

Seismological projects are reported, including nuclear explosion monitoring, the development of international data centers, seismic risk estimation for nuclear power plants, oil exploration using seismic methods, and crystalline rock investigation using seismic cross hole measurements. The Swedish seismic network is described. In 1980, China conducted 1 nuclear test, France 11, Britain 3, the US 14, and the USSR 21. Apart from the Chinese test, the explosions were underground and within the 150 kton limit. France is the only country which increased the number of tests compared with previous years. Author (ESA)

N82-17739 Columbia Univ., New York.
ANOMALOUS RADON (222) EMISSION AND ITS ASSOCIATION WITH EARTHQUAKES AND TECTONISM
Ph.D. Thesis

Egill Hauksson 1981 161 p
Avail: Univ. Microfilms Order No. 8125301

During 1978 and 1979 radon content in groundwater from nine geothermal wells in Iceland was monitored to correlate possible precursory changes in radon content with local seismicity. Radon emission from fumaroles at Krafla volcano in north Iceland was monitored to establish a possible relationship between radon emission and ongoing episodic microseismicity, rifting, and volcanism. To shed light on the physical basis of anomalous radon emission as a precursor to earthquakes, world-wide radon data are interpreted in terms of recent results in rock mechanics. Dissert. Abstr.

N82-17763# Pakistan Meteorological Dept., Karachi.
METEOROLOGICAL EVALUATION OF WIND ENERGY POTENTIAL IN THE COASTAL BELT OF PAKISTAN

Muhammad Rahmatullah and Qazi Waliullah In WMO Tech. Conf. on Climate, Asia and Western Pacific 1981 p 127-138 refs
Avail: NTIS MF A01, print copy available at WMO, Geneva SwFr 28

Recent improvements in windmill design and the automatic arrangement for the use of a rotor to turn at a low chosen wind speed requires a reappraisal of wind power potential particularly in the coastal belt of Pakistan. Wind data is analyzed to determine the prevailing wind duration within various ranges of speeds at these stations. S.L.

N82-17782# ESCAP, Bangkok (Thailand)
EFFECT OF CLIMATE ON THE DEVELOPMENT OF NATURAL RESOURCES IN ASIA

B. X. Zhang In WMO Tech Conf on Climate, Asia and Western Pacific 1981 p 439-445

Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 28

Since climate is considered to be a consequence of average values in the basic meteorological elements of temperature, moisture, wind, pressure, and evaporation, these average values are used to develop a general criterion for use in planning and managing the development of natural resources. Emphasis is placed on early recognition that an abnormal climatic cycle may be developing and an accurate weather forecast to pinpoint the location and geographic extent of the disaster. The interrelationships between climate and development are addressed in the following areas: human resources, animal and range resources, agricultural resources, forest resources, fishery resources, water resources, mineral resources, and energy resources. J.M.S.

N82-18406# Dynecology, Inc., Harrison, N.Y.
ADAPTATION OF THE SIMPLE GASIFICATION PROCESS TO THE COCONVERSION OF MUNICIPAL SOLID WASTE AND SEWAGE SLUDGE

J. C. Arbo, D. P. Glaser, M. A. Lipowicz, R. B. Schulz, and J. L.

Spencer Apr. 1981 54 p Sponsored in part by EPA
(PB82-112418; NYSERDA-81-6) Avail: NTIS
HC A04/MF A01 CSCL 21D

The combining of coal with biomass and sewage sludge in varying ratios to form simplex briquettes to be fed into gasifiers was examined. The use of biomass sewage sludge and municipal solid wastes permit the use of Eastern-caking coals in commercial medium Btu gasifiers. The results found that many of the 225 experimental briquette formulations meet required structural integrity prevent the clumping and fusing that have hindered effective gasification of this type of coal; and meet storage criteria. The briquettes developed, if commercially available, could convert an urban disposal problem into an energy resource permitting the use of less expensive and more readily available Eastern coal. GRA

N82-18407# Gilbert (Glen A) and Associates, Inc., Reading, Pa.

COMPARISON OF COAL BASED SYSTEMS: MEDIUM-BTU GAS VERSUS SNG FOR INDUSTRIAL APPLICATIONS Final Report

Michael D. Peterik 1 May 1981 202 p refs
(Contract GRI-5014-310-0195)
(PB82-117383; GRI-80/0056) Avail: NTIS
HC A10/MF A01 CSCL 21D

Production and total system economics of fuel gas from coal for industrial use were analyzed. It was found that low-Btu gas offers industry certain cost advantages over higher heat content fuel gases in specific applications, but that its use will be characterized by small scale on-site systems Intermediate Btu gas (IBG), on the other hand, offers an incentive for gas industry involvement because of potential cost reduction to industry through a regional, centralized, utility owned system. Synthetic natural gas costs, benefiting from economics of scale and plant siting, offer industry the lowest cost alternative for the majority of systems studied. Author (GRA)

N82-18408# National Center for Resource Recovery, Washington, D. C.

DENSIFICATION OF REFUSE-DERIVED FUELS: PREPARATION, PROPERTIES AND SYSTEMS FOR SMALL COMMUNITIES Final Report

Jay Campbell and Marc L. Renard Sep. 1981 163 p refs
(Grant EPA-R-804150)
(PB82-103904; EPA-600/2-81-188) Avail: NTIS
HC A08/MF A01 CSCL 21D

Densified refuse derived fuel (d-RDF) is produced by compacting refuse derived fuel into agglomerated pieces sufficiently cohesive to sustain storage and handling. The use of this d-RDF product as a substitute for coal in spreader stroke boilers is a developing resource recovery alternative. The operation, performance and product characteristics of a waste shredding and densification subsystem for production of d-RDF from air classified light fraction is investigated and a technical and economic evaluation of d-RDF facilities for small communities is presented. GRA

N82-18409# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.

STUDIES RELATED TO THE DEEP EARTH GAS Final Report, Sep. 1979 - Dec. 1980

Thomas Gold, Elizabeth Bilson, and Steven Soter 8 May 1981 40 p refs
(GRI Proj. 5014-363-0205)
(PB82-103821; GRI-80/0066) Avail: NTIS
HC A03/MF A01 CSCL 21D

The origin of terrestrial hydrocarbons, principally methane and petroleum and the importance of the ablogenic methane component in natural gas, which originates at much greater depth than the organic methane, from meteoritic carbonaceous matter accumulated in the mantle at the time of the Earth's formation. Experiments include: (1) inverse cracking designed to study the conditions for methane addition to petroleum hydrocarbons; (2) isotope analysis of methane was samples collected in geopressured wells, tectonically active regions, and seeps of possibly ablogenic origin; and (3) construction and testing of a ground gas pressure monitoring unit to be used for the investigation of the relationship of Earth outgassing and tectonic processes. GRA

N82-18410# California Univ., Berkeley Dept of Mechanical Engineering.

FUNDAMENTAL CONSIDERATIONS FOR PREPARING DENSIFIED REFUSE DERIVED FUEL Final Report

George J. Trezek, George M. Savage, and Daniel B. Jones Sep. 1981 59 p refs
(Grant EPA-R-805414)
(PB82-101668; EPA-600/2-81-180) Avail: NTIS
HC A04/MF A01 CSCL 21D

A series of pilot scale tests were conducted to determine the effects of various parameters on the densification of refuse derived fuel. The experiments included a series of bench scale experiments involving a single die arrangement, as well as larger scale studies in which a commercial pellet mill was used. The bench scale tests (tests in which the pellets were individually formed), were conducted both to provide data needed for an analysis of the basis dynamics of pellet formation and as an aid in the interpretation of results obtained with the pellet mill. The energy required to overcome die friction was studied independently of the energy consumed in material deformation and compression. The specific effects of die length, diameter, and taper were determined. GRA

N82-18412# Environmental Protection Agency, Ann Arbor, Mich. Control Technology Assessment and Characterization Branch.
GASOLINE EQUIVALENT FUEL ECONOMY DETERMINATION FOR ALTERNATE AUTOMOTIVE FUELS

Craig A. Harvey Aug. 1981 41 p refs
(PB82-120072; EPA/AA/CTAB/PA/81-16) Avail: NTIS
HC A03/MF A01 CSCL 21D

Some basis for a decision on the most appropriate methodology for calculating the gasoline equivalent fuel economy of a vehicle that uses fuel other than gasoline is provided. Once this methodology is determined, it will provide vehicle manufacturers with a way to gauge the effects of alternative marketing options on their average fuel economy. GRA

N82-18413# Ohio Dept of Natural Resources, Columbus. Water Planning Unit.

SOUTH POINT GASOHOL PROJECT: A WATER ASSESSMENT STUDY

Carrie J. Groves, David Denig-Chakroff, and Arthur F. Woldorf May 1981 50 p refs
(Contract WR20424491)
(PB82-111485) Avail: NTIS HC A03/MF A01 CSCL 21D

Section 13 of the Federal Non-nuclear Energy Research and Development Act of 1974 provides for water assessment reports to be prepared by the Water Resources Council on commercial applications of energy technologies which may have a significant impact on water resources. A summary of the principal findings of the study are reported: (1) a description of the project, (2) water supply availability (3) an analysis of surface-water and ground-water resources with special attention given to potential water quantity/quality impacts of the project and (4) environmental and socio-economic effects of potential water resources impacts. GRA

N82-18414# West Virginia Univ., Morgantown
AN ECONOMIC ANALYSIS OF COAL SUPPLY IN THE OHIO RIVER BASIN ENERGY STUDY REGION

Walter P. Page Oct 1981 83 p refs
(Grant EPA-R-805585)
(PB82-113341; EPA-600/7-81-162) Avail: NTIS
HC A05/MF A01 CSCL 21D

Using the energy and fuel demand model developed for the Ohio River Basin Energy Study (ORBES) region (all of Kentucky, most of West Virginia, substantial portions of Illinois, Indiana and Ohio and southwestern Pennsylvania), coal production levels were projected. A separate research effort allocated the tonnage to producing districts by mine and coal type. The coal supply work focused on identifying the coal supply districts that have historically served the ORBES region and estimating the resource depletion costs associated with expanded levels of coal production between 1974 and 2000. GRA

N82-18422# Battelle Pacific Northwest Labs., Richland, Wash.
PHYSICAL AND CHEMICAL CHARACTERISTICS OF SYNTHETIC ASPHALT PRODUCED FROM LIQUEFACTION OF SEWAGE SLUDGE Final Report, Sep. 1979 - Apr. 1981

J. M. Donovan, T. R. Batter, R. K. Miller, and R. P. Lottman (Idaho Univ., Moscow) Oct. 1981 67 p refs
(Grant EPA-R-806790)

04 FUELS AND OTHER SOURCES OF ENERGY

(PB82-119082; EPA-600/2-81-242) Avail NTIS
HC A04/MF A01 CSCL 138

Direct thermochemical liquefaction of primary undigested municipal sewage sludge was carried out to produce a low molecular weight steam volatile oil, a high molecular weight synthetic asphalt, and a residual char cake. The latter product is capable of supplying the thermal energy requirements of the conversion process. The steam volatile oil has immediate value as a synthetic fuel oil. The synthetic asphalt may prove to be a useful cement for paving or for fuel or coking stock. The thermochemical liquefaction process should be capable of operating technically and in an environmentally acceptable manner in conjunction with many existing waste water treatment facilities. The overall feasibility of the process depends on the value of the oil and synthetic asphalt products as petroleum replacements, and on the costs associated with disposal of sludge. GRA

N82-18469# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Ice Engineering Research Branch.

ELECTROMAGNETIC SUBSURFACE MEASUREMENTS

Arnold M. Dean, Jr. Oct. 1981 24 p

(Proj CWIS-31350)

(AD-A108192, CRREL-SR-81-23) Avail: NTIS
HC A02/MF A01 CSCL 17/9

In 1974, personnel at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) began using an impulse radar system to profile accumulations of ice forms. The system was modified for effective use as a profiling system in a ground or airborne configuration, in certain high-noise environments. The system can penetrate fresh water and media with a high water content. Frazil and brash ice accumulations with approximately 50% water were profiled to a depth of 25 to 35 ft. As a result of the CRREL modifications, the system has found extensive and varied applications as a low-level remote sensing tool. Applications include profiling ice accumulations (including ice jams), river beds, sheet ice, permafrost, subsurface ice masses, river bank revetments through air-entrained water, snow covers, sea ice, icebergs, and peat bogs. Limited laboratory work has also shown that the impulse radar system may be able to detect oil and gas under sea ice. Selected applications and data are presented. Since it was used mainly for research, the CRREL system needs further development to make it useful to operational units. Additional development of hardware and software is recommended. GRA

N82-18571# National Bureau of Standards, Washington, D.C. National Engineering Lab

MATERIALS FOR INSTRUMENTATION FOR FOSSIL ENERGY TECHNOLOGIES. A REVIEW AND PROGRAM PLAN OF RESEARCH AND DEVELOPMENT NEEDS

H. P. R. Frederikse, P. K. Schenck, G. R. Burns, R. R. Dils, and J. R. Whetstone Sep. 1981 135 p refs

(Contract EA-77-A-01-6010)

(PB82-116229; NBSIR-81-2348) Avail: NTIS
HC A07/MF A01 CSCL 14B

The materials problems related to instrumentation for Fossil Energy Facilities are reviewed. Requirements for measurement of process parameters (flow, temperature, pressure, chemical composition), of construction material properties, and of fuel characteristics are discussed. The main part of the report is a suggested program plan for pertinent materials R&D. Short descriptions of the various Fossil Energy Processes, listing of present research activities, and a set of 6 case studies are presented in an appendix. GRA

N82-18690* United Technologies Corp., South Windsor, Conn. Power Systems Div.

LOW NO SUB_x HEAVY FUEL COMBUSTOR CONCEPT PROGRAM. PHASE 1A: COAL GAS ADDENDUM Final Report, 29 Jun. - Oct. 1981

Thomas Rosfjord and Richard Sederquist Jan. 1982 43 p refs

(Contract DEN3-149; DE-AI01-77ET-13111)

(NASA-CR-165577, DOE/NASA/0149-2, GTR-3932) Avail
NTIS HC A03/MF A01 CSCL 10B

The performance and emissions from a rich-lean combustor fired on simulated coal gas fuels were investigated using a 12.7-cm diameter axially-staged burner originally designed for operation with high heating value liquid fuels. A simple, tubular fuel injector was substituted for the liquid fuel nozzle, no other combustor modifications were made. Four test fuels were studied including

three chemically bound nitrogen-free gas mixtures with higher heating values of 88, 227, and 308 kJ/mol (103, 258 and 349 Btu/scf), and a 227 kJ/mol (258 Btu/scf) heating value doped with ammonia to produce a fuel nitrogen content of 0.5% (wt). Stable, ultra-low nitrogen oxide, smoke-free combustion was attained for the nitrogen-free fuels. Results with the doped fuel indicated that less than 5% conversion of NH₃ to nitrogen oxide levels below Environmental Protection Agency limits could be achieved. In some instances, excessive CO levels were encountered. It is shown that use of a burner design employing a less fuel-rich primary zone than that found optimum for liquid fuels would yield more acceptable CO emissions. A R H.

N82-18712# Vereinigte Elektrizitätswerke Westfalen A.G., Dortmund (West Germany) Hauptbereich Maschinentechnik.
CONSTRUCTION AND OPERATION OF A ONE TON PER HOUR PILOT PLANT FOR THE VEW COAL CONVERSION PROCESS Final Report, Feb. 1981

Juergen Poller Bonn Bundesministerium fuer Forschung und Technology Nov 1981 57 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology

(BMFT-FB-T-81-177, ISSN-0340-7608) Avail NTIS
HC A04/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 12.20

The pilot plant is based on airblown partial gasification in an entrained reactor. Results show that at temperatures of about 1450 C, 55% to 65% of the feed coal, and 70% to 80% of the sulfur can be converted into product gas. The quality of the low BTU gas is sufficient for application in the combined gas-stream turbine process. Extensive knowledge is also gained concerning gas accompanying pollutants and the behavior of different brickwork materials in the reactor environment. The acquired data allows proper dimensioning of a prototype plant. Author (ESA)

N82-18737# Kentucky Univ., Lexington
A BASELINE ASSESSMENT OF COAL INDUSTRY STRUCTURE IN THE OHIO RIVER BASIN ENERGY STUDY REGION

David S. Walls, Dwight B. Billings, Mary P. Payne, and Joe F. Childers, Jr. Apr. 1981 581 p refs Prepared in cooperation with Ohio River Basin Energy Study

(Grant EPA-R-805585)

(PB82-103615, EPA-600/7-81-058) Avail NTIS
HC A25/MF A01 CSCL 10A

Detailed information is provided on coal production and employment by county, the consumption and distribution of coal, the ownership structure of the coal industry, coal land and mineral ownership, operator associations and unions in the coal industry, and projections of coal development. The emphasis is on the six ORBES states (Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia), but information also is provided on the coal industry in the other eastern states and the western states when relevant. GRA

N82-18790# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Applied Research Branch.

SITE INVESTIGATIONS AND SUBMARINE SOIL MECHANICS IN POLAR REGIONS

Edwin J. Chamberlain Oct. 1981 20 p refs Sponsored in part by Geological Survey

(AD-A108269, CRREL-SR-81-24) Avail: NTIS
HC A02/MF A01 CSCL 08/13

Placing oil exploration and production structures offshore in the Alaskan Beaufort Sea will require careful site investigation and evaluation of submarine soil mechanics. Ice-bonded permafrost occurs widely under the Beaufort Sea floor. Its engineering properties are important to the design of offshore structures. Highly overconsolidated clays also occur widely and interfere with access to gravels for constructing artificial islands. Sites should be selected to avoid ice-rich permafrost. Laboratory tests may need to be conducted to determine the potential hazards of thaw consolidation and weakening. GRA

N82-18800# Geological Survey, Reston, Va.
ENVIRONMENTAL GEOLOGIC STUDIES ON THE SOUTH-EASTERN ATLANTIC OUTER CONTINENTAL SHELF, 1977-1978 Final Open File Report

Peter Popenoe, ed. 1981 435 p refs
(Contract DI-AA551-MU8-13)

(PB82-109265; OPEN-FILE-81-582-A, BLM/YN/SR-81/02)
 Avail NTIS HC A19/MF A01 CSCL 08G

The methods, techniques, instruments, and procedures utilized in accomplishing the study are summarized. The objectives were: (1) to determine the sedimentation rates and processes on the upper slope and inner Blake Plateau; (2) to determine the distribution, areal extent, and nature of geological features supportive of biological communities; (3) to monitor the transport of bottom sediments across the (OCS) Outer Continental Shelf; (4) to determine the concentration levels of chosen trace metals and silica; (5) to study the shelf edge and slope near areas of oil and gas interest; and (6) to determine the depth and rate of sediment mixing. Detailed results are given. GRA

N82-18840# Aeronautical Research Inst of Sweden, Stockholm, Structures Dept.

LONG RANGE LASER ANEMOMETRY WITH PARTICULAR REFERENCE TO WIND POWER DEVELOPMENT

L. Danielsson and E. R. Pike (Royal Signals and Radar Estab., Malvern, England) 6 Oct 1981 51 p refs Submitted for publication
 (Contract NE-5061-014)

(FFA-TN-HU-2262-Pt-3) Avail. NTIS HC A04/MF A01

Literature on atmospheric scattering of visible (Ar+) and IR (CO2) laser beams with transit time and Doppler processing was reviewed. A decision flow diagram for geometrical specifications of wind measurements and comparison tables are provided in order to show which system is best for any given task, e.g., wind generator interaction. When range resolution, flexibility, and economic requirements permit, an IR system is recommended. The economic advantages of time multiplexing are pointed out.

Author (ESA)

N82-19319# Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (West Germany)

DEUTERIUM HYDROGEN ISOTOPE RATIOS IN ORGANIC MATTER, MINERAL OILS, AND NATURAL GASES Final Report, Mar. 1981

Martin Schoell Bonn Bundesministerium fuer Forschung und Technologie Nov. 1981 79 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-81-204; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 16,80

The dependence of the D/H isotope ratio in mineral oils and natural gases on the type of oil source rock and its usefulness for oil exploration were investigated. A technique was developed capable of determining D/H ratios in organic matter with an accuracy of + or - 2 pro mille. Results show that the isotope ratio in oils are indeed transferred by the mother rocks. Exchange experiments demonstrate that this ratio is not affected by exchange with water, even on geological time scales. The deuterium concentration in the methane of thermally formed natural gases is shown to be dependent on the maturity of the source organic matter, not on the type of mother rock. Cross correlation between the C14/C13 and the D/H ratios of natural gas methanes leads to a genetic diagram characterizing the origin of these gases. A criterium was also developed for the identification of bacterial natural gases.

Author (ESA)

N82-19332 IEA Coal Research, London (England)

CHEMICAL DESULPHURISATION OF COAL

Geoffrey F Morrison Jun. 1981 72 p refs
 (ICTIS-TR-15; ISBN-92-9029-066-8) Copyright Avail. Issuing Activity

The forms of organic and pyritic sulfur in coal and the chemical reactions these may undergo are assessed. Processes for the chemical cleaning of coal are described and evaluated, including wet oxidation, chlorinolysis, hydrothermal, microwave, and chemical comminution processes. The additional sulfur removed by chemical as compared to physical cleaning processes is insufficient to justify the additional complexity and cost of preparation. More research is required into the modes of occurrence and chemistry of sulfur in coal, particularly of organic sulfur, before the efficiency of the chemical cleaning of coal can be improved.

Author (ESA)

N82-19383# Mathtech, Inc., Princeton, N J
IMPEDIMENTS TO ENERGY AND MATERIALS RECOVERY FACILITIES FOR MUNICIPAL SOLID WASTE Final Report

Ernest H. Manuel, Jr and Fritz W Efav Sep 1981 229 p

refs Prepared in cooperation with Franklin Associates, Prairie Village, Kans.

(Contract EPA-68-03-2761)
 (PB82-102302; EPA-600/2-81-181) Avail: NTIS HC A11/MF A01 CSCL 21D

The impediments to recycling municipal solid waste were studied. The eight facilities selected for indepth analysis represented a cross section of technologies, ownership types, geographical locations, and recovered products. None of the facilities were economical in the context of providing the least cost mode of disposal, and all eight facilities experienced net operating losses. A major impediment encountered by most of the facilities was competition from lower-cost landfills. GRA

N82-19384# Systems Technology Corp., Xenia, Ohio

COAL: dRDF (DENSIFIED REFUSE DERIVED FUEL) DEMONSTRATION TEST IN AN INDUSTRIAL SPREADER STOKER BOILER. USE OF COAL: dRDF BLENDS IN STOKER-FIRED BOILERS, VOLUME 1 Final Report

Ned J Kleinhenz Cincinnati, Ohio EPA Sep 1981 146 p 2 Vol

(Contract EPA-68-03-2426)
 (PB82-100868; EPA-600/2-81-183-Vol-1) Avail. NTIS HC A07/MF A01 CSCL 21D

Boiler performance and environmental feasibility when combusting densified forms of refuse derived fuels (dRDF) blended with coal and fired in a modern industrial spreader stoker-fired boiler are evaluated. The second phase of a two phase evaluation program is discussed. Phase 2 demonstration testing was conducted in a larger industrial spreader stoker boiler. In a period of 402 hours, 1702 tons of dRDF were co-fired with coal. An additional 231 hours of coal baseline testing was completed to provide a basis of comparison for the test results. GRA

N82-19385# Systems Technology Corp., Xenia, Ohio

COAL: dRDF (DENSIFIED REFUSE DERIVED FUEL) DEMONSTRATION TEST IN AN INDUSTRIAL SPREADER STOKER BOILER. USE OF COAL: dRDF BLENDS IN STOKER-FIRED BOILERS, APPENDICES A, B, C AND D, VOLUME 2 Final Report

Ned J Kleinhenz Cincinnati, Ohio EPA Sep 1981 250 p refs 2 Vol

(Contract EPA-68-03-2426)
 (PB82-100876; EPA-600/2-81-184-Vol-2) Avail. NTIS HC A11/MF A01 CSCL 21D

Boiler performance and environmental feasibility when combusting densified forms of refuse derived fuels (dRDF) blended with coal and fired in a modern industrial spreader stoker-fired boiler are evaluated. Phase 2 demonstration testing was conducted in a large industrial spreader stoker boiler. Site selection criteria, test data tables, formulae, and fuel evaluations are presented. GRA

N82-19606 IEA Coal Research, London (England)

HYDROLOGICAL PROBLEMS OF SURFACE MINING

Peter A Wood Sep 1981 102 p refs
 (ICTIS-TR-17; ISBN-92-9209-079-X) Copyright Avail. Issuing Activity

The physical aspects of the relation between hydrology and the surface mining of coal are reviewed. Surface and ground water are considered at the planning, extraction and restoration phases of mining. Aspects covered include the collection and handling of hydrological data, the construction of river diversions, the control of runoff, erosion and sediment; problems of ground water and dewatering, and spoil bank hydrology. Mining hydrology interrelationships must be considered in order to ensure the efficient running of a surface mining operation while adequately protecting the environment.

Author (ESA)

N82-19637*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala.

LONGWALL GUIDANCE AND CONTROL DEVELOPMENT Final Report, 1974 - 1982

31 Jan. 1982 118 p refs
 (Contract ET-75-1-01-9012)

(NASA-TM-82455) Avail: NTIS HC A06/MF A01 CSCL 08I

The longwall guidance and control (G&C) system was evaluated to determine which systems and subsystems lent themselves to automatic control in the mining of coal. The upper coal/shale interface was identified as the reference for a vertical G&C system, with two sensors (the natural background and the

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sensitized pick) being used to locate and track this boundary. In order to insure a relatively smooth recession surface (roof and floor of the excavated seam), a last and present cut measuring instrument (acoustic sensor) was used. Potentiometers were used to measure elevations of the shearer arms. The intergration of these components comprised the vertical control system (pitch control). Yaw and roll control were incorporated into a face alignment system which was designed to keep the coal face normal to its external boundaries. Numerous tests, in the laboratory and in the field, have confirmed the feasibility of automatic horizon control, as well as determining the face alignment. S.L.

N82-19674*# Jet Propulsion Lab., California Inst of Tech., Pasadena

THE GEOTHERMAL PROBABILISTIC COST MODEL WITH AN APPLICATION TO A GEOTHERMAL RESERVOIR AT HEBER, CALIFORNIA

Lowell H. Orren, G. Michael Ziman, and Sue Campbell Jones
15 Dec 1981 70 p refs

(Contracts NAS7-100, DE-AI03-79ET-37116)

(NASA-CR-168641, DOE/ET-37116/1; JPL-Pub-81-117) Avail. NTIS HC A04/MF A01 CSCL 10A

A financial accounting model that incorporates physical and institutional uncertainties was developed for geothermal projects. Among the uncertainties it can handle are well depth, flow rate, fluid temperature, and permit and construction times. The outputs of the model are cumulative probability distributions of financial measures such as capital cost, leveled cost, and profit. These outputs are well suited for use in an investment decision incorporating risk. The model has the powerful feature that conditional probability distribution can be used to account for correlations among any of the input variables. The model has been applied to a geothermal reservoir at Heber, California, for a 45-MW binary electric plant. Under the assumptions made, the reservoir appears to be economically viable. Author

N82-20022*# Jet Propulsion Lab., California Inst of Tech., Pasadena

FUTURE FUELS AND ENGINES FOR RAILROAD LOCOMOTIVES. VOLUME 1: SUMMARY

S. G. Liddle, B. B. Bonzo, G. P. Purohit, and J. A. Stallkamp
1 Nov 1981 41 p

(Contracts NAS7-100, DE-AI01-78CS-55151)

(NASA-CR-168642, JPL-Pub-81-101-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 13F

The potential for reducing the dependence of railroads on petroleum fuel, particularly Diesel No. 2 was investigated. Two approaches are studied: (1) to determine how the use of Diesel No. 2 can be reduced through increased efficiency and conservation, and (2) to use fuels other than Diesel No. 2 both in Diesel and other types of engines. Because synthetic hydrocarbon fuels are particularly suited to medium speed diesel engines, the first commercial application of these fuels may be by the railroad industry. B.W.

N82-20279# Ohio Univ., Athens Dept. of Chemistry
INVESTIGATIONS OF THE CHANGES OF COAL STRUCTURE OCCURRING DURING GASIFICATION Progress Report

P. R. Griffiths 26 Oct 1981 21 p refs

(Contract DE-FG22-80PC-30210)

(DE82-002652, DOE/PC-30210/T2) Avail: NTIS HC A02/MF A01

The feasibility of the application of diffuse reflectance infrared Fourier transform (DRIFT) spectrometry to the study of gas/solid reactions was demonstrated. The high signal to noise ratio (SNR) allows application of Fourier self deconvolution routines to increase the spectra information content. The combination of DRIFT spectrometry and Fourier self deconvolution enables the study of the mechanism of coal reactions and catalytic reactions to provide more information. DOE

N82-20280# Department of Energy, Grand Forks, N. Dak. Energy Technology Center

ANALYSES OF THE NORTHERN GREAT PLAINS PROVINCE LIGNITES AND SUBBITUMINOUS COALS AND THEIR ASH

S. A. Cooley Jul. 1981 139 p refs

(DE81-028366, DOE/GFETC/RI-81/2) Avail: NTIS HC A07/MF A01

A compilation of analyses of North Dakota and Montana low-rank coals (lignites and subbituminous coals) and of their ash extends the data base for these coals. Samples both from exploratory core drilling and from auger-drilling at operating mines were evaluated to obtain a wider distribution of data. Averages and standard deviations were calculated for North Dakota and Montana mines, and correlations were investigated for east-west locations depending on geographic ranges. Highest variability for both coals was in moisture and ash contents, with moisture- and ash-free analyses being relatively uniform for each. Composition of ash exhibited wide variability, especially in sodium and calcium contents. Sulfur contents were quite variable, but the average content was usually low. Within-mine variability was usually similar to that between mines. In the eastern Montana transitional area between lignite and subbituminous coals, special precautions in sampling are required to permit accurate classification from analyses. Despite care in selection of representative cores, core samples were indicated to be less uniform in analyses than auger-drilled samples obtained from the same mine. DOE

N82-20281# SRI International Corp., Menlo Park, Calif
EXPLORATORY STUDY OF COAL-CONVERSION CHEMISTRY Final Report, 20 Sep. 1979 - 19 Mar. 1981

D. S. Ross, D. McMillen, W. Ogier, and Q. Nguyen 12 Aug 1981 95 p refs

(Contract DE-AC22-79ET-14855)

(DE82-001104, DOE/ET-14855-19) Avail: NTIS HC A05/MF A01

The rates at which the strong carbon-carbon and carbon-oxygen central bonds in hydroxydiphenylmethanes and hydroxydiphenyl ethers are broken, under homogeneous conditions, in tetralin at 400°C, were examined by tautomerization to the weakly bonded keto forms followed by homolysis of the central bonds. These homogeneous decomposition mechanisms bear directly on the susceptibility of these linkages to homogeneously and heterogeneously catalyzed cleavage. Iron oxides, particularly Fe₃O₄, are effective and selective catalysts for these same cleavages. Relative catalyst effectiveness suggests that the mechanism of catalysis involves radical cation formation. The conversion of coal to benzene soluble coal products in CO/H₂O systems displays a dependence on the pH of the starting aqueous phase. The increase in conversion is paralleled by an increase in the reaction rate of the water gas shift reaction. Potassium or sodium salts of molybdate, dichromate, and permanganate were effective for coal conversion. The catalytic activity of these salts depends on the starting pH of the aqueous solution adjusted with dilute KOH or HCl solutions. It is indicated that despite the catalytic activity of metal oxyanions, the changes in conversion are large over small pH changes. Plots of conversion versus initial pH are S-shaped curves similar to common titration curves. DOE

N82-20283# Virginia Commonwealth Univ., Richmond, Dept. of Chemistry

SUPPORTED METAL CARBONYLS: NEW CATALYSTS FOR LIQUEFACTION OF COAL

 Semiannual Technical Report

G. A. Melson 1981 6 p ref

(Contract DE-AC22-81PC-41761)

(DE82-002659, DOE/PC-41761/T1) Avail: NTIS HC A02/MF A01

Supported metal catalysts prepared from carbonyls and both simple and complex oxides (zeolites) were prepared by a newly developed procedure. Results of characterization by a variety of spectroscopic techniques are presented. DOE

N82-20284# Lummus Co., Bloomfield, N. J.
INTEGRATED TWO-STAGE LIQUEFACTION PARAMETRIC STUDY Quarterly Technical Progress Report, 1 Oct. - 31 Dec. 1980

H. D. Schindler, J. M. Chen, and J. D. Potts (Cities Service Research and Development Co., Tulsa, Okla.) Aug. 1981 66 p

(Contract DE-AC22-79ET-14804)

(DE81-028756, DOE/ET-14804/T2) Avail: NTIS HC A04/MF A01

A research study on Catalytic Expanded Bed Hydroprocessing of coal extracts and the operation of an integrated Two-Stage Liquefaction process development unit was made. Equilibration of the recycle paste solvent was achieved. Three short contact time runs were made with equilibrium solvent. Conversions ranged from 88 to 95 percent at hydrogen consumptions of

0.41 to 2.40 percent of moisture, ash-free coal. Considerable hydrogen was transferred from the solvent to the coal. The recycle solvent contained 23 to 48 percent H₂. The LC-Finin bottoms constituted about 70 percent of the recycle solvent. The deasher recovered 71 to 80.5 percent of the extract from the SCT unit. Ash concentrations of less than 0.10 percent in the recovered extract were achieved. Nitrogen concentrations in the distillate products were below 0.2 percent. Both the catalyst activity and the product quality were the highest obtained thus far in the hydrocracking of coal extracts. An overall yield structure was calculated, based on the results of this period. The distillate (C5-8500F) yield was 3.29 barrels per ton of moisture, ash-free coal at a hydrogen consumption of 4.78 percent based on MAF coal. DOE

N82-20285 California Univ., San Diego
STUDIES IN SHOCK-TUBE SPECTROSCOPY, CHEMICAL REACTION RATES AND MECHANISMS, UTILIZATION OF LOW-BTU GASES, AND GEOTHERMAL ENERGY. 1: SHOCK-TUBE SPECTROSCOPY. 2: SHOCK-TUBE STUDIES OF CHEMICAL REACTION RATES AND MECHANISMS. 3: UTILIZATION OF LOW-BTU GASES. 4: VOLCANOES AS A SOURCE OF GEOTHERMAL ENERGY Ph.D. Thesis

Jules Michael Kline 1981 180 p
 Avail. Univ. Microfilms Order No. 8125440

Correlation-absorption measurements of the (0,0) band of the NO photon system at 2250 Å and emission measurements of the neutrino sub 3 fundamental of N₂O at 4.52 microns are described. Use of a revised Voigt parameter for the NO photon bands, it is shown, leads to an increased value of f_{sub 00}. Measurement of an off peak spectral absorption coefficient for an isolated spectral line using a laser light source is described. The observed temperature and pressure dependence of the spectral absorption coefficient of CH₂O at the HeXe laser line is accounted for. Thermal decomposition of N₂O behind reflected shock waves for 1685 < or = T, deg K < or = 2560 are studied. CH₂O pyrolysis and oxidation by N₂O behind reflected shock waves for 1200 < or = T, deg K < or = 2200 are studied. Measurements of induction times and post induction conversion rates for H₂-containing low Btu gas mixtures are described. Burning rates, heat-release rates, induction times, specific burning times and specific reduced burning volumes are determined for mixtures typical of in situ shale oil retorting. The potential use of volcanoes as a source of geothermal energy is described. Dissert. Abstr.

N82-20327# Committee on Science and Technology (U. S. House)

SYNTHETIC FUELS DEVELOPMENT

Washington GPO 1981 118 p. Hearing before the Subcomm. on Energy Development and Applications and the Subcomm. on Investigations and Oversight of the Comm. on Sci. and Technol., 97th Congr. 1st Sess., No. 33, 27 Jul 1981 (GPO-85-050) Avail. Subcomm. on Energy Development and Applications

Recent developments in synthetic fuels technology are discussed, particularly in the areas of coal gasification, coal liquefaction, shale oil extraction, and alcohol fuel development. Government-industry cooperation is discussed. The problems of synfuel development are evaluated in the context of the U.S. dependence on imported oils. Synfuel production costs are examined. R J F

N82-20332# SRI International Corp., Menlo Park, Calif.
FEASIBILITY STUDY ON NEW PROCESSES FOR FUEL FROM BIOMASS Summary Report, 1 Jun. 1979 - 31 Jan. 1981

D. Z. Rogers, Donald J. Wilhelm, and David S. Ross Jan 1981 94 p refs. Prepared for Pacific Northwest Lab (Contract DE-AC03-79ET-23023; SRI Proj. PYU-8616) (DE82-002834, DOE/ET-23023/T4) Avail. NTIS HC A05/MF A01

The technical and economic feasibility of producing liquid fuels from biomass by two types of proposed processes, peroxidic conversion and catalyzed direct liquefaction in a carbon monoxide/steam system was studied. The work was divided into three tasks: peroxidic conversion, novel acid/base systems, and economic evaluations. The plant capacity and design and economic bases were chosen to facilitate comparison with the LBL and PERC process concepts previously evaluated for DOE by SRI. This evaluation was cast in the same light as SRI's recent evaluation for DOE of the Albany liquefaction program. The product still appears to be a crude, complex, viscous, and troublesome

material that could not be marketed, even as a low-grade fuel, because it is too costly and not an economical chemical feedstock. Catalytic direct biomass liquefaction still appears to offer little potential for commercialization. Economically feasible direct biomass liquefaction will require significant breakthrough in catalyst technology. Implications for research aimed at improving the liquefaction data base and the understanding of possible liquefaction processes are also discussed. GRA

N82-20333# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.

METHANE UTILIZATION FROM COALBEDS FOR POWER GENERATION AT BETHLEHEM MINES CORPORATION MARIANNA MINE NO. 58 Final Report

May 1981 215 p refs (Contract DE-AC21-77ET-13133) (DE81-029791; AESD-TME-3065) Avail. NTIS HC A02/MF A01

During one process of mining coal, methane is removed from the coal seam before the coal is mined. This methane is collected underground, piped to the surface, and exhausted to the atmosphere as a waste by-product of the mining process. An electrical power generation system was assembled to demonstrate utilization of this energy source. An 800 kW gas turbine generator with attendant compression and electrical equipment converted 200,000 standard cubic feet per day of methane to about 250 kWh. This electrical power was utilized by a mine surface load consisting of a 100 hp air compressor and a 300 hp mine ventilation fan. Power generated represented about 25% of the total energy used in all the mine ventilation systems or about 5% of the total underground mine electrical requirements. The main conclusions of the work performed is that low Btu gob gas in the range of 100 to 400 Btu/ft³ can be combusted successfully in a diffusion flame system. The efficiencies that can be achieved are high and in general stability is adequate. Both the efficiency and stability range achieved were sufficient to indicate that a gas turbine could be operated with such fuels over a normal operating cycle. One problem that was noticed during earlier investigations is that because of the low energy content of the fuel, heat losses in the combustor can significantly affect performance, particularly stability. In general such combustion systems should be maintained as near adiabatic as possible and should operate with as high a wall temperature as is possible. Further research and development will be required of any scaled combustion system before it could be considered a suitable candidate for engine installation. S L

N82-20334# West Virginia Univ., Morgantown Dept. of Chemical Engineering

ROLE OF C-CO₂ IN GASIFICATION OF COAL AND CHAR Quarterly Report, 1 Jan. - 31 Mar. 1981

J. T. Sears and C. Y. Wen 1981 16 p refs (Contract DE-AC21-78ET-11338) (DE81-027358, DOE/ET-11338/T1) Avail. NTIS HC A02/MF A01

The high-temperature TGA has been operated with steam and CO₂ for lignite and bituminous chars. Problems with temperature calibration require verification of results before further analysis. Work on attrition of coal in a pressurized, sand fluid-bed was completed. Conditions were 5-45 cm/sec at 1 to 7 atm total pressure. The rate obtained increases with fluidizing velocity and pressure. The rate constants are negligible at velocities below approx = 30 cm/sec for particles 60 to 175 (SIGMA) in diameter. Results appear to be dependent on change in hydrodynamics with pressure. A hot-bed fluidization system was commissioned and operated. Entrainment/elutriation data for coal particles was obtained in the range 5 to 90 cm/sec at 800 to 9000C for a 12.7 cm sand bed. DOE

N82-20335# Battelle Columbus Labs., Ohio.
SYNTHETIC-FUEL AROMATICITY AND STAGED COMBUSTION Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1981

Arthur Levy, James R. Longanbach, and Lisa K. Chan 31 Oct 1981 24 p (Contract DE-AC22-89PC-30302) (DE82-002453, DOE/PC-30302/4) Avail. NTIS HC A02/MF A01

Synthetic liquid fuels, syngases or coal-derived liquids were characterized from a combustion-environmental point of view. Two critical problems, NO_x formation and soot formation,

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were studied Pyrolysis of SCRII cuts in helium resulted in increasing aromatization as the temperature was increased. This occurred with substantial losses of hydrogen, although the amount of aromatic hydrogen per molecule increased. The slight decrease in carbon content and loss of hydrogen were balanced by a relative increase in heteroatom content, presumably oxygen. This resulted in large concentrations of unsubstituted aromatics in the stable liquid products. These were presumed to be soot precursors in staged combustion. Nonbasic nitrogen, primarily pyroles, were found to increase during pyrolysis, while basic nitrogen, primarily pyridine analogs, decreased. Thus, nonbasic nitrogen compounds could be the principal precursors of NO/sub x/ during staged combustion of synthetic coal derived fuels. When substoichiometric amounts of oxygen were added to the system, aromaticity increased. M D K

N82-20336# Dravo Corp., Pittsburgh, Pa.
FEASIBILITY STUDY FOR THE PRODUCTION OF LOW/MEDIUM-Btu GAS FROM COAL FOR TRI-CITY REGIONAL PORT DISTRICT GRANITE CITY, ILLINOIS
Feb 1981 313 p
(Contract DE-FG01-80RA-50137)
(DE82-002881, DOE/RA-50137/1) Avail. NTIS
HC A14/MF A01

The technical specifications for, and the economic feasibility of a wide variety of coal gasification facilities to meet the needs of an industrial park are described. The gasification facility is aimed at making the industrial sites energy independent. Three cases were studied, and the results of each are presented. The cost of gas for each case was determined both at the facility, and as delivered. The projected fuel cost for coal gas in the minimum capacity plant is considerably less than the cost for fuel oil. DOE

N82-20474# Air Products and Chemicals, Inc., Allentown, Pa.
GAS/SLURRY FLOW IN COAL LIQUEFACTION PROCESSES (FLUID DYNAMICS IN 3-PHASE FLOW COLUMNS) Quarterly Technical Progress Report, 1 Oct. - 31 Dec. 1980
David H S Ying, R Sivasubramanian, and Edwin N Givens
Feb 1981 41 p refs
(Contract DE-AC22-79ET-14801)
(DE82-002562, DOE/ET-14801/15) Avail. NTIS
HC A03/MF A01

The need for additional data on behavior of three phase systems in large vessels was addressed. Parameters are investigated at conditions that relate directly to the projected demonstration plant operating conditions. Air/water/sand three phase flow system in both a 5 inch diameter and a 12 inch diameter column is used in this cold flow simulation program. The type of distributor used does not seem to affect the solids distribution profiles. The amount of solids retained in the column increases linearly with decreasing slurry velocity while changes in linear gas velocity does not affect the solids distribution profiles for the conditions studied. It is indicated that withdrawing solids from the bottom of the column results in a decreased amount of solids in the column and the solids concentration profile changes accordingly. It is shown that large particles were preferentially removed by virtue of their faster settling rate. The effects of settled particles and particle/particle interaction on solids accumulation were investigated. It is indicated that the presence of large particles does not influence the accumulation or distribution of fine particles. The column enclosure was completed and tested to identify the organic liquid/liquid which is to be used in the 12 inch diameter column. DOE

N82-20492# Argonne National Lab., Ill Components Technology Div.
DEVELOPMENT AND TESTING OF HIGH-TEMPERATURE ACOUSTIC DOPPLER FLOWMETER
H B Karplus, A C Raptis, and D R Canfield (Pittsburgh and Midway Coal Mining Co.) Sep. 1981 35 p refs
(Contract W-31-109-eng-38)
(DE82-003013, ANL/FE-81-64) Avail. NTIS
HC A03/MF A01

The development and testing of an acoustic Doppler flowmeter are discussed. The characteristics of this flowmeter are (1) standoffs to isolate the transducers from the hot pipes, and (2) an electronics system with servo-controlled adjustable filters that can process a Doppler-shift signal spectrum generated by laminar flow conditions. Flowmeters are adapted to high-

temperature and high-viscosity laminar flow streams found in coal liquefaction plants. DOE

N82-20632# Management Engineers, Inc., Reston, Va.
ROOM AND PILLAR RETREAT MINING: A MANUAL FOR THE COAL INDUSTRY
Peter W Kauffman, Steven A. Hawkins, and Robert R Thompson
Aug 1981 240 p refs
(PB82-120601, BM-IC-8849) Avail. NTIS HC A11/MF A01
CSSL 081

This Bureau of Mines publication is designed primarily to provide mine engineers and production-level mine managers with the following (1) information to assist them in making the decision to retreat mine and in selecting the best retreat mining technique for specific mining conditions, (2) information on mine planning that will enable them to design mine layouts for safe and efficient retreat mining (3) information that will enable them to develop a section foreman's handbook. The manual progressively increases in level of detail. GRA

N82-20680# EMCON Associates, San Jose, Calif
STATE OF THE ART OF LANDFILL GAS RECOVERY
John Pacey, David Armstron, Costa Halvadakis, Gail Karpinski, and Marya Donch Jul 1981 117 p refs Prepared for Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE82-003261, ANL/CNSV-TM-85) Avail. NTIS
HC A06/MF A01

Optimization of methane recovery from landfills involves management of the physical and reclaimed factors associated with extraction of the gas. The technology of gas-recovery enhancement is rapidly evolving and is linked closely with numerous site-specific variables. The state-of-the-art study describes the most common recovery-system techniques and methodologies, and operates some promising alternative methods that can affect future recovery designs and mathematical models. Gas extraction characteristics are summarized for eight on-line and pending systems. DOE

N82-20695# Acurex Corp., Mountain View, Calif Energy and Environmental Div.
ADVANCED PULVERIZED-COAL COMBUSTOR FOR CONTROL OF NO SUB x EMISSIONS Quarterly Report, 1 Jul. - 30 Sep. 1981
R L Pam, S T Suttman, and J T Kelly 30 Oct 1981
13 p refs
(Contract DE-AC22-80PC-30296)
(DE82-002653, DOE/PC-30296/4; QR-4) Avail. NTIS
HC A02/MF A01

The program uses an idealized one-dimensional combustor, incorporating fuel staging. The development of a comprehensive computer model which allows NO mechanisms and rates to be extracted from the experimental data, is reported. A coal devolatilization model was developed and integrated into the PROF code. Combustor curing and facility build up was completed. T.M

N82-20696# Brookhaven National Lab., Upton, N Y.
CALCIUM SILICATE CEMENTS FOR DESULFURIZATION OF COMBUSTION GASES Semiannual Progress Report, 1 Oct. 1980 - 31 Mar. 1981
H J. Yoo, P J McGauley, M Steinberg, G. Farber, F. B Kainz, and J Pruzansky Jun 1981 46 p refs
(Contract DE-AC02-76CH-00016)
(DE82-003245, BNL-51430) Avail. NTIS HC A03/MF A01

Commercial calcium silicate bearing Portland Cement Type II (PC II) was identified as a promising regenerative sorbent for the removal of sulfur in the fluidized-bed combustion (FBC) of coal. The PC II is agglomerated in a drum pelletizer by low energy, low cost agglomeration techniques and cured to form pellets in the size range suitable for operating FBC units. The degree of regeneration is almost complete (above 95%) during cyclic use except for the first cycle. The rate of sulfation increases with the sulfation temperature. The rate of regeneration also increases with the regeneration temperature. A small 40 mm I.D. bench scale fluid bed reactor was used to determine the sulfur removal efficiency of the PC II pellet as well as the concentration of the regenerated SO₂, using propane gas as a fuel and a reducing agent. The concentration of regenerated SO₂ increases with the feed rate of reducing gas and it reaches as high as 24%. Bench scale testing of PC II sorbent in a coal

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fired 6 in fluidized bed combustor indicates acceptable performance. An improved process and engineering design utilizing the PC III pellets in a coal fired power plant indicates improved economy in comparison with once through limestone desulfurization
DOE

N82-20697# TRW, Inc., Redondo Beach, Calif
EVALUATION OF CONTINUOUS OXYDESULFURIZATION PROCESSES Final Technical Report, Sep. 1979 - Jul. 1981
J. F. Jones and D. M. Wever Jul. 1981 106 p
(Contract DE-AC01-79ET-14292)
(DE82-002127; DOE/ET-14292/T1) Avail. NTIS
HC A06/MF A01

Three processes for the oxydesulfurization of coal were evaluated in continuous processing equipment designed, built, and/or adapted for the purpose. The three processes differed primarily in the chemical additives (none, sodium carbonate, or ammonia), fed to the 20% to 40% coal/water slurries, and in the oxygen content of the feed gas stream. Temperature, pressure, residence time, flow rates, slurry concentration and stirrer speed were the other primary independent variables. The amount of organic sulfur removed, total sulfur removed and the Btu recovery were the primary dependent variables.
DOE

N82-20698# Ames Lab., Iowa
ADVANCED RESEARCH AND TECHNOLOGY DIRECT UTILIZATION: RECOVERY OF MINERALS FROM COAL FLY ASH. FOSSIL ENERGY PROGRAM Technical Progress Report, 1 Apr. - 30 Jun. 1981
G. Burnet, J. W. Dunker, and M. J. Murtha Sep. 1981 41 p
refs
(Contract W-7405-eng-82)
(DE82-003133, IS-4777) Avail. NTIS HC A03/MF A01

The purpose of this research is to develop methods to process fly ash for (1) the separation and use of an iron rich fraction, (2) the recovery of metals (primarily Al, Fe, and Ti); and (3) the use of the process residues. During this report period, research on the HiChlor process for the high temperature chlorination of fly ash included investigation of prechlorinations using Cl₂CO gas mixtures to selectively remove iron and titanium, and the physical characterization of fly ash pellets. Gas diffusion coefficients, surface areas, and pore size distributions were measured for both gamma-alumina and fly ash pellets. Experiments on the high temperature sintering of limestone-fly ash mixtures include alumina extractions from sinters prepared using waste materials. High alumina recoveries were obtained for sinters prepared using cement kiln dust as the lime source, and with small amounts of coal refuse added as a mineralizer. Sinter feed mixtures prepared from fly ash, kiln dust, and soda ash were also tested. X-ray diffraction measurements were used to identify the soluble and insoluble compounds found in the clinkers produced. Research has been initiated on methods to agglomerate fly ash mixtures for processing. Agglomerators rather than finely divided powder mixtures will be more easily handled, transported and processed. Feed mixtures for both the lime sinter and the HiChlor processes are being studied. A balling disc unit is being used to form agglomerate spheroids. A theoretical analysis of the magnetic separation of fly ash has been completed.
GRA

N82-20779 Technische Hochschule, Hanover (West Germany)
Inst. fuer Meteorologie und Klimatologie
WIND MEASUREMENTS FROM 50 M HIGH TOWERS IN THE NORTHERN GERMAN COASTAL REGION [WINDMESSUNGEN AN 50 M HOHEN TUERMEN IM NORD-DEUTSCHEN KUESTENGEBIET]
G. Tetzlaff, R. Beyer, and H. Laude In Deutscher Wetterdienst Soc. Meteorol. Palatina, 1780-1795 1980 p. 174-176 refs
In GERMAN, ENGLISH summary

Avail. Issuing Activity

Wind profiles based on measurements with a network of six 46 m high towers in northern Germany are described. Wind measurement is only satisfactory if the relevant parameters, such as roughness length and stability are fully known as a function of wind direction and wind speed. Only then the error of extrapolated wind speed values is acceptable for application in wind energy.
E.A.K.

N82-21111# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics
A PROCEDURE FOR DETERMINING THE RESOURCE

UTILIZATION POTENTIAL OF COAL ASH M.S. Thesis
James F. Karasek Sep. 1981 140 p refs
(AD-A109877; AFIT-LSSR-58-81) Avail. NTIS
HC A06/MF A01 CSDL 21/2

A combination of the increased utilization of coal as an energy source and more stringent environmental regulations is creating problems for the disposal of the ash by-product from the combustion of coal. Utilization of the coal ash as an alternate resource has proven to be a partial solution to the problem. The U.S. Air Force coal conversion program will increase coal consumption and the production of coal ash; this has a potential to create a disposal problem for coal-burning bases. The purpose of this thesis was to develop a procedure to aid an engineer in determining the resource utilization potential of the coal ash at the base. The quality and quantity of the ash are the two main factors that affect the resource utilization potential of the ash. These two factors are a function of the nature of the feed coal, and the production, collection, handling, and storage systems utilized at the base. The procedure does not address the determination of the market potential of the ash, but rather its potential to be utilized as an alternate resource. The procedure provides a sequence of steps to follow in determining the resource utilization potential of a coal ash.
Author (GRA)

N82-21279# Otisca Industries Ltd., Syracuse, N.Y.
HEAVY-LIQUID BENEFICIATION OF FINE COAL Quarterly Report, 1 Apr. - 30 Jun. 1981
D. V. Keller, Jr. and Frederick J. Simmons Jul. 1981 37 p
refs
(Contract DE-AC22-80PC-30139)
(DE81-030965, DOE/PC-30139/T2, QR-3) Avail. NTIS
HC A03/MF A01

This reporting period was devoted to the development of the rheological data for the coal/Freon-113 particle size, density, and percent solids matrix. Preliminary rheological data have also been obtained for the coal-water-magnetite slurry system. The evaluation of this system will continue into the Fourth Quarter. Sufficient rheological data were obtained so that the design criteria for the bench scale cyclone test facility was developed. The design effect for bench scale cyclone test facility was completed and a preliminary design proposal submitted to DOE on July 21, 1981.
DOE

N82-21280# Solar Turbines International, San Diego, Calif
MECHANISMS OF FOULING, SLAGGING, AND CORROSION BY PULVERIZED-COAL COMBUSTION Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1981
L. L. Hsu, A. R. Stetson, and A. G. Metcalfe Oct. 1981 40 p
ref
(Contract DE-AC22-81PC-40272)
(DE82-001661, DOE/PC-40272/T2, SR-81-R-4930-08, QTPR-2) Avail. NTIS HC A03/MF A01

The objective of this program is to conduct a detailed and comprehensive study of the mechanisms of fouling, slagging, and corrosion in pulverized coal combustion by employing well controlled model systems which simulate the coal combustion environment. In the second quarter, work focused on completing construction of the test rig. Meanwhile, the combustor and fuel nozzle were redesigned to allow for introduction of particulates and salt solution through the fuel nozzle. Fabrication of the modified combustor and fuel nozzle is complete. The completed test system will allow particles and salt droplets to flow through the combustion zone prior to impingement on the specimen tubes. Construction of specimen retort for furnace testing is complete. Plans for the next quarter are to install and calibrate the combustor rig.
DOE

N82-21281# Virginia Commonwealth Univ., Richmond Dept. of Chemistry
NEW CATALYSTS FOR THE INDIRECT LIQUEFACTION OF COAL Annual Technical Report, 1 Aug. 1980 - 31 Jul. 1981
G. A. Melson 1981 10 p
(Contract DE-FG22-80PC-30228)
(DE82-000892, DOE/PC-30228/T2) Avail. NTIS
HC A02/MF A01

The synthesis, characterization and evaluation of catalytic activity for synthesis gas conversion of some supported metal catalysts were achieved during the period of grant support. These catalysts are significantly different from those obtained by

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conventional synthetic procedure and results in different product distributions when used for synthesis gas conversion DOE

N82-21282# Energy and Environmental Research Corp., Santa Ana, Calif

SOOT FORMATION IN SYNTHETIC-FUEL DROPLETS
Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1981
G England, J Kramlich, Y Kwan, and R. Payne 30 Nov 1981
32 p refs

(Contract DE-AC22-80PC-30298)
(DE82-004257, DOE/PC-30298/T4, QTPR-4) Avail NTIS
HC A03/MF A01

The droplet effects on particulates, smoke, and NO sub x emissions using the variable spray momentum injector under normal excess air and staged combustion conditions was investigated. A total of four fuels were tested, including an SRC-II blend with middle and heavy distillate. Test results indicated that within the range of droplet sizes and injection velocities investigated, particulate emissions are not strongly dependent upon droplet parameters. The greatest effect was observed for relatively large droplets (500 microns) in regions of low slip velocity. The flame studies research was concentrated upon the completion of the droplet experiments. Microexplosions of individual droplets, oil-coke cenosphere formation for residual fuel oil, and violet secondary atomization of droplets blended from heptane and heavy synthetic fuel oil were observed. At fuel rich conditions, droplet soot was correlated with carbon/hydrogen ratio for a number of fuels. The coupling between the thermal and chemical processes within the soot formation region, the morphology of the soot, and visualization of individual droplet combustion were also studied. DOE

N82-21283# Weber State Coll., Ogden, Utah Dept of Chemistry.

ROLE OF THE HYDROGEN DONOR SOLVENT IN COAL HYDROLIQUEFACTION
Progress Report, 1 Dec. 1980 - 28 Feb. 1982

R R Beishline 15 Oct. 1981 15 p refs
(Contract DE-AC02-79ER-10510)
(DE82-002716, DOE/ER-10510/T3) Avail: NTIS
HC A02/MF A01

A free radical mechanism has been written for the thermolysis of the donor solvent intermediate 1,2-dihydronaphthalene (1,2-DHN). The initiation step ($E/sub a/$ about 38 kcal/mole) is a disproportionation between two molecules of 1,2-DHN to produce hydronaphthyl and tetaryl radicals. These radicals attack 1,2-DHN to produce dimers, or form naphthalene, tetralin and H, principally by disproportionation. The previously unknown structures of the dimers have been determined and are consistent with the proposed mechanism. The mechanism is also consistent with the experimentally measured kinetics, i.e., disappearance of 1,2-DHN by concurrent first and second order reactions. The observed first and second order rate constants are complex composites of the rate constants for the individual steps in the mechanism. Semiquantitative measurements show that molecular hydrogen is about 10% of the reaction product at 4500 C. When polycyclic aromatic hydrocarbons (PAH) are heated with 1,2-DHN, the amount of hydrogen evolved is approximately inversely proportional to the resonance energy of the PAH, i.e., the H addition, abstraction ratio increases with increasing stability of the potential hydroaromatic radical. A quantitative procedure for measuring hydrogen is being developed for future use in determining relative rates of H addition vs abstraction. DOE

N82-21296# Carltech Associates, Columbia, Md
TECHNICAL FEASIBILITY OF USE OF EASTERN GEOTHERMAL ENERGY IN VACUUM DISTILLATION OF ETHANOL FUEL EXTENSION OF DATA

J. Carl Uhrmacher Sep. 1981 19 p refs
(Contract EX-78-A-38-1008)
(PB82-127077, JHU/APL/OM-81-123) Avail: NTIS
HC A02/MF A01 CSCL 07A

The feasibility of vacuum distillation of ethanol fuel with modest temperature geothermal resources is discussed. The flow rates of geothermal water at 155 F are documented as a function of beer-still bottoms pressure. Emphasis is on pressures that are less than 150 mmHg. T.M

N82-21416# Materials Research Labs., Melbourne (Australia).
HYDROCRACKING OF THE OILS OF BOTRYOCOCCUS BRAUNII TO TRANSPORT FUELS

L. W. Hillen, G. Pollard, L. V. Wake, and N. White Jul. 1980
23 p refs

(MRL-R-783; AR-002-170) Avail NTIS HC A02/MF A01
Hydrocarbon oils of the alga *Botryococcus braunii*, extracted from a natural 'bloom' of the plant, were hydrocracked to produce a distillate comprising 67% a petrol fraction, 15% an aviation turbine fuel fraction, 15% a diesel fuel fraction, and 3% residual oil. The distillate was examined by a number of standard petroleum industry test methods. This preliminary investigation indicates that the oils of *B. braunii* are suitable as a feedstock material for hydrocracking to transport fuels. Author

N82-21424# Air Force Engineering and Services Center, Tyndall AFB, Fla Engineering and Services Lab.

THE EFFECT OF FUEL COMPOSITION ON GROUND FALL FROM AIRCRAFT FUEL JETTISONING
Final Report, Mar. 1980 - Feb. 1981

Harvey J. Clewell, III Mar. 1981 35 p refs
(AF Proj. 1900)
(AD-A110305, AFESC/ESL-TR-81-13) Avail: NTIS
HC A03/MF A01 CSCL 01/3

A computer model which simulates the evaporation and free-fall of fuel droplets in the atmosphere was used to determine the effect of fuel composition on the nature and extent of ground contamination by fuel discharged from an aircraft in flight. Three fuel compositions were used: (1) JP-4, the standard Air Force jet fuel; (2) Jet A (JP-8), the standard U.S. commercial jet fuel; and (3) Number 2 Diesel Fuel, representing the upper limit for future, broadened-specification fuels from alternative sources. The results of this study indicate that the amount of liquid fuel reaching the ground from the jettisoning of commercial jet fuels is much greater than for JP-4. Moreover, future broadened specification fuels may produce even greater ground contamination when jettisoned. GRA

N82-21426# Southwest Research Inst., San Antonio, Tex Army Fuels and Lubricants Research Lab

EVALUATION OF THE EFFECTS OF ALCOHOL FUELS ON SPARK IGNITION ENGINE WEAR
Final Report, Sep. 1979 - Sep. 1981

H. W. Marbach, Jr., E. C. Owens, T. W. Ryan, III, E. A. Frame, and D. W. Naegeli Dec 1981 115 p refs
(Contracts DAAK70-79-C-0175; DE-AI01-79CS-50030)
(AD-A110021, AFLRL-150) Avail: NTIS HC A06/MF A01
CSCL 21/7

An investigation of the effects of alcohol fuels on spark ignition engine wear and deposition was jointly sponsored by the U.S. Department of Energy and the U.S. Army Mobility Equipment Research and Development Command. Tests were conducted using neat methanol, anhydrous ethanol, and alcohol blends as fuel in a 2.3 liter engine using a modified ASTM Sequence V-D test procedure. This dynamometer testing indicates that alcohol fuels reduce the buildup of engine deposits. Also, it was found that neat methanol greatly increases engine wear rates at operating temperatures below 75 C, while anhydrous ethanol and alcohol-gasoline blends do not increase wear rates over that of unleaded gasoline. Tests were then conducted to evaluate the effects of methanol fuel on ten fully formulated lubricants and one lubricant with twelve additive composition changes. A 20 hour steady-state test was developed which shows that engine wear is inversely related to engine oil temperature when using methanol as fuel. The study shows that one lubricant appears to best control methanol-related engine wear, but still not to acceptable levels. GRA

N82-21427# Reinke (Ralph G.), Wausau, Wis
DISTILLING ALCOHOL WITH WASTE AUTOMOBILE HEAT
Progress Report

Ralph G. Reinke 26 Apr 1981 19 p
(Contract DE-FG02-81AF-92017)
(DE82-000143; DOE/AF-92017/T1) Avail: NTIS
HC A02/MF A01

A device that will utilize the waste heat of an automobile for the production of alcohol fuel and provide a means for an individual without the land or resource of an agricultural facility to have the capability of producing alcohol is discussed. The method involves piping the radiator cooling fluid through a heat exchanger constructed to serve as a distillation unit. The technical description, financial report, administration report, and problems and remedies are presented. DOE

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N82-21429# Nuclear Assurance Corp., Atlanta, Ga.
FEASIBILITY STUDY OF THE COMMERCIAL PRODUCTION OF ETHANOL FROM WOOD. VOLUME 2: APPENDICES 1-6 Final Report

Jun. 1981 706 p refs 2 Vol.
(Contract DE-FG07-80RA-50322)
(DE82-002410, DOE/RA-50322/T1-Vol-2) Avail: NTIS HC A99/MF A01

The development of a 25 million gallon per year ethanol plant which uses cull timber wood as feedstock is discussed. The individual reports from each subcontractor involved in the investigation are given. Included is feasibility study for fuel grade ethanol plant and reports on wood residues, biomass, and other wood fuel data. A market analysis, hydrolysis of biomass, and an alternate site evaluation and community impact assessment are included. DOE

N82-21430# North Central Consultants Ltd., Jamestown, N Dak
FEASIBILITY STUDY FOR ALTERNATE FUEL PRODUCTION FROM BIOMASS RESOURCES

Jun 1981 260 p Prepared in cooperation with Katzen (Raphael) and Associates and Touche, Ross and Co., prepared for Dawn Enterprises, Inc.
(Contract DE-FG07-80RA-50361)
(DE82-002616, DOE/RA-50361/T1) Avail: NTIS HC A12/MF A01

A 50 mm anhydrous alcohol plant is described. The plant uses barley grown in the region as the raw material to produce a motor fuel grade alcohol through a fermentation and distillation process. North Dakota lignite coal is used as the primary energy sources to produce alcohol from the barley. The site is located on an active branch of the Burlington Northern Railroad, providing efficient and economical access to North Dakota's vast lignite coal fields in western North Dakota and to the established grain and grain by-product markets of Duluth and Minneapolis. The site is also adjacent to paved secondary highways, providing access to state and interstate highway systems. The plant site is adjacent to the City of Walhalla and will be annexed to the city limits and served by community facilities. Electrical energy to operate plant equipment is partially produced by co-generation within the plant but the total electrical energy cannot be produced internally. A technical review of the plant is provided. The process, plant layout, and major equipment procurement and costs are described. A complete economic analysis is provided using the data derived from the technical evaluation and cost estimates. Siting and the environmental and socio-economic considerations are covered. A review of the proposed management and personnel structure is included. DOE

N82-21432# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho

SMALL-SCALE FUEL-ALCOHOL PLANT. VOLUME 1: DESIGN REPORT

Aug. 1981 227 p
(Contract DE-AC07-76ID-01570)
(DE82-001038, DOE/TIC-2001038-Vol-1) Avail: NTIS HC A11/MF A01

A small-scale fuel alcohol plant designed and constructed for the DOE by EG and G Idaho, Inc., an operating contractor at the Idaho National Engineering Laboratory, is described. The plant is reasonably complete, having the capability for feedstock preparation, cooking, saccharification, fermentation, distillation, by-product dewatering, and process steam generation. An interesting feature is an instrumentation and control system designed to allow the plant to run 24 hours per day with only four hours of operator attention. The production designed capacity of the plant is 26.4 gallons of 190-proof ethanol per hour. Most of the processes and equipment used in the plant represent conventional ethanol production technology. Two slight deviations are the control system, which is common in larger plants, and the continuous cooker, which was adapted from the food industry. A device for dewatering the by-product is included, but a by-product drying system was not, because systems evaluated were too expensive for a plant of this size. DOE

N82-21435# Bethlehem Steel Co., Pa
COAL-GASIFICATION STUDY FOR BETHLEHEM STEEL CORPORATION'S SPARROWS POINT FACILITY

Aug 1981 29 p
(Contract DE-FG01-79RA-20218)

(DE82-002570; DOE/RA-20218/1) Avail: NTIS HC A03/MF A01

Although processes for producing environmentally acceptable gas from coal are available commercially, the lack of commercial operating experience in the United States requires that the pioneer users principally rely on engineering and economic analysis. The uncertainty of costs, operating reliability and retrofit impacts as well as many other factors are all considerations which must be weighed seriously when considering the use of low/or medium-Btu coal gas as an alternative fuel option. Financial analysis of the coal gasification project for Sparrows Point was done. The payback period ranged from 6.9 to 15.7 years for air-blown gasification. Oxygen-blown gasification was not at all attractive. It showed a 20.7 year payback at the most favorable end of the range. Two factors affect whether a steel plant will install coal gasification - availability of purchased fuels and economics. There is little incentive to make large capital expenditures when plentiful quantities of purchased fuels are available. Based on economics, coal gasification cannot be justified. DOE

N82-21436# American Association of Community and Junior Colleges, Washington, D.C. Energy Communications Center
ALCOHOL FUELS PRODUCTION, MANPOWER, AND EDUCATION: WHERE DO TWO-YEAR COLLEGES FIT

1981 37 p refs
(Contract DE-FG05-79IR-10295)
(DE82-001929, DOE/IR-10295/T1) Avail: NTIS HC A03/MF A01

Representatives from 2-year colleges met with officials from national organizations to discuss the role of community colleges in the training of personnel and the development of curriculum to enhance the growing alcohol fuels industry. Major conclusions include: (1) Energy issues are too important for colleges to ignore in their program offerings, each college should determine what energy focuses and what program forms make most sense for its local area, (2) Community-size alcohol plants have the potential of leading the way toward local economic development and self sufficiency, (3) Production and manpower projections vary widely from one source to another. Even if the most optimistic production levels are reached, the evidence shows that there will be only a modest need for narrowly-trained alcohol fuels technicians. The most reasonable approach for colleges is to train energy generalists through curricula that focus on basic competencies in science, math, management, and communications. DOE

N82-21437# Pittsburg and Midway Coal Mining Co., Shawnee Mission, Kans

RESEARCH ON SOLVENT-REFINED COAL Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981

Oct 1981 139 p refs
(Contract DE-AC22-81PC-40005)
(DE82-002530, DOE/PC-40005/5) Avail: NTIS HC A07/MF A01

Research progress on Solvent Refined Coal is reported. Alexander Mine coal was evaluated as a feedstock for major liquefaction facilities and had a yield structure similar to other reactive Pittsburgh seam coals at standard SRC II conditions. Two lots of coal from the Ireland Mine (Pittsburgh seam) were found to be of nearly the same composition and produced essentially the same yields. Two experiments in which coal-derived nonvolatile organic matter was processed without fresh coal feed indicated constant rates of conversion of SRC to oil and gas. Insoluble organic matter remained unconverted. The naphtha and middle distillate products from the deep conversion contained less sulfur but more nitrogen than those from conventional SRC II processing. Encouraging results were obtained when a very small amount of iron oxide dispersed on alumina was added to Kaiparowits coal which cannot be proposed at normal SRC II conditions without added catalyst. Subbituminous coals from the McKinley and Edna Mines were processed successfully with added pyrite but would not run when the added catalyst was removed. DOE

N82-21439# Environmental Protection Agency, Ann Arbor, Mich.
Control Technology Assessment and Characterization Branch. A REVIEW OF THE COMPATIBILITY OF METHANOL/GASOLINE BLENDS WITH MOTOR VEHICLE FUEL SYSTEMS

Robert J Garbe May 1981 18 p refs
(PB82-117904; EPA-AA-CTAB/PA/81-12) Avail: NTIS HC A02/MF A01 CSCL 21D

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The compatibility effects of methanol/gasoline blends on vehicle systems were as part of a larger effort by EPA to evaluate the request for a waiver of the Section 211(F) fuel additive regulations submitted by Anafuel Unlimited on February 20, 1981. This waiver was requested by Anafuel for Petrocoal, an oxygenated, unleaded gasoline blend containing up to 12% methanol, up to 6% C-4 alcohols (not identified) and up to 0.033 g/gal but not less than 0.023 g/gal of a proprietary compound claimed by Anafuel to be a corrosion inhibitor. GRA

N82-21591# Curtiss-Wright Corp., Wood-Ridge, N.J. Power Systems Div.

HIGH-TEMPERATURE-TURBINE TECHNOLOGY PROGRAM. PHASE 2: TECHNOLOGY TEST AND SUPPORT STUDIES. REFERENCE TURBINE SUBSYSTEM DESIGN: PHASE 2 REPORT

Jun. 1981 92 p refs
(Contract DE-AC01-76ET-10348)
(DE81-030059; CW-WR-76-020 74A, FE-2291-74A) Avail: NTIS HC A05/MF A01

The design and operation of a gas turbine and combustor for a combined cycle power plant to be run on coal derived fuels and with turbine inlet temperatures of 2600 to 3000 F are described. The turbine subsystem design, i.e., blades, vanes, shaft, bearings, etc. are emphasized. Materials selection information and heat transfer analyses are included. DOE

N82-21693# Equity Oil Co., Salt Lake City, Utah.
BX IN-SITU OIL-SHALE PROJECT Quarterly Technical Progress Report, 1 Jun. - 31 Aug. 1981
Paul M. Dougan 20 Sep. 1981 144 p refs
(Contract DE-FC20-78LC-10747)
(DE82-002134; DOE/LC-10747/T4) Avail: NTIS HC A07/MF A01

The superheated steam injection at the BX In Situ Oil Shale Project is reported. Injection was continuous except for a period when the injection was suspended during the drilling of core hole BX-37. During the quarter, 99,760 barrels of water as superheated steam were injected into project injection wells at an average well head temperature of 7520 F and an average wellhead pressure of 1312 PSIG. During the same period, 135,469 barrels of fluid were produced from the Project production wells for a produced to injected fluid ratio of 1.36 to 1.0. Net oil production during the quarter was 38 barrels. DOE

N82-21694# New Mexico Inst. of Mining and Technology, Socorro Petroleum Recovery Research Center.
MEASUREMENT AND CORRELATION OF CONDITIONS FOR ENTRAPMENT AND MOBILIZATION OF RESIDUAL OIL Final Report
N R Morrow Sep. 1981 115 p refs
(Contract DE-AS01-78ET-12077)
(DE82-001940; EMD-2-68-3302) Avail: NTIS HC A06/MF A01

Six major tasks are discussed: capillary number relationships for rock samples, residual oil saturations near the wellbore; residual oil structure; effect of gravity on residual saturation; magnitude of residual oil saturation; and effects of wettability on capillary number relationships. Detailed progress reports are presented for each task. Measurements of relationships between the ratio of viscous to capillary forces and the reduction in normal waterflood residual oil for a variety of rock types indicate the relative ease with which residual oil can be immiscibly displaced by a tertiary process. In reducing the amount of trapped oil to 50% of normal residual oil saturation, recovery of continuous oil is significantly easier than mobilization of trapped oil. The relative permeabilities of the water phase at reduced residual oil saturations are found to be independent of the displacement mechanism of oil movement by which the reduced residual saturations were achieved. T.M.

N82-21761# Arizona Solar Energy Commission, Phoenix.
EVALUATION OF GEOTHERMAL ENERGY IN ARIZONA Quarterly Topical Progress Report, 1 Apr. - 30 Jun. 1981
D. H. White 1981 43 p Prepared in cooperation with Arizona State Univ., Tempe and Arizona Univ., Tucson
(Contract DE-FC03-80RA-50076)
(DE82-000127; DOE/RA-50076/T5) Avail: NTIS HC A03/MF A01

The identification and delineation of geothermal prospects, the comparison of conventional energy use patterns with geothermal sources, the preparation of area development plans and the compilation of detailed economic and energy data for each area are discussed. Current emphasis is on commercialization. DOE

N82-21773# Office of Technology Assessment, Washington, D C
TECHNOLOGY AND SOVIET ENERGY AVAILABILITY
Nov 1981 415 p
(PB82-133455; LC-81-600166) Avail: NTIS HC A18/MF A01 CSCL 10A

This study addresses in detail the significance of American petroleum equipment and technology to the USSR and the resulting options for U.S. policy. It examines the problems and opportunities that confront the USSR in its five primary energy industries: oil, gas, coal, nuclear, and electric power. It discusses plausible prospects for these industries in the next ten years, identifies the equipment and technology most important to the USSR. In these areas, it evaluates the extent to which the United States is the sole or preferred supplier of such items and analyzes the implications for both the entire Soviet bloc and the Western alliance of either providing or withholding Western equipment and technology. GRA

N82-21780# General Electric Co., Schenectady, N. Y. Energy Systems Programs Dept.
ELECTROCYCLONE DEVELOPMENT PROGRAM Quarterly Technical Report, May - Jul. 1981
1981 26 p
(Contract DE-AC21-80ET-17091)
(DE81-030004; DOE/ET-17091/T3, FE-7091-14) Avail: NTIS HC A03/MF A01

An electrostatically augmented cyclone high efficiency, high throughout gas cleanup device for pressurized fluidized bed application is discussed. The use of large electrocyclones, with individual lockhoppers and inlet/outlet ducts, will avoid the plugging and flow imbalance problems. The electrocyclone development program addresses three critical development areas: (1) performance scaleup; (2) performance at high temperature and pressure; and (3) corona charging. The performance at high temperature and pressure will be demonstrated by actual PFB tests on an 18 in. model geometrically identical to the earlier cold flow model. Preferred electrode geometries and the effects of alkali metal salt vapor on corona current under controlled conditions are determined. The electrocyclone PFB test will confirm the design approach and corona charger performance. DOE

N82-21810# Utah Univ., Salt Lake City Dept. of Geology and Geophysics
FAULT AND JOINT GEOMETRY AT RAFT RIVER GEOTHERMAL AREA, IDAHO
L R Guth, R L Bruhn, and S L Beck Jul 1981 23 p refs
(Contract DE-AC07-79ID-12079)
(DE82-003942; DOE/ID-12079-41) Avail: NTIS HC A02/MF A01

Raft River geothermal reservoir is formed by fractures in sedimentary strata of the Miocene and Pliocene salt lake formation. The fracturing is most intense at the base of the salt lake formation, along a decollement that dips eastward at less than 50 on top of metamorphosed Precambrian and lower Paleozoic rocks. Core taken from less than 200 m above the decollement contains two sets of normal faults. The major set of faults dips between 50 and 70. These faults occur as conjugate pairs that are bisected by vertical extension fractures. The second set of faults dips 100 to 200 and may parallel part of the basal decollement or reflect the presence of listric normal faults in the upper plate. Surface joints form two suborthogonal sets that dip vertically. East-northeast-striking joints are most frequent on the limbs of the Jim Sage anticline, a large fold that is associated with the geothermal field. DOE

N82-21847# National Maritime Inst., Teddington (England). Wind Engineering Services.
REQUIREMENTS FOR THE PROVISION OF OFFSHORE WIND DATA RELATING TO WIND ENERGY CONVERSION SYSTEMS
R I. Harris Feb. 1980 30 p refs

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(NMI-R-75) Avail NTIS HC A03/MF A01

The requirements for environmental data relating to offshore wind energy conversion systems in the United Kingdom to provide a basis for analysis of wind climate and wind structure in offshore wind energy systems are discussed. A review of available data, a measurement program to study offshore wind structure, and an analysis of the sensitivity of the system to wind parameters are proposed. A detailed measurement program at potential sites, a study of the changes and rates of change of wind structure from land to sea, and a feasibility study of an alternative and potentially cheap operational wind energy prediction method are also included. Author (ESA)

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ENERGY CONVERSION

Includes photovoltaic, thermoelectric, geothermal, ocean thermal, and wind energy conversion. Also includes nuclear reactors and magnetohydrodynamic generators.

A82-18840 † **Forms of energy and their transformation (Vidy energii i ikh transformatsii).** L. I. Sedov. (*Vsesoiuznyi S'ezd po Teoreticheskoi i Prikladnoi Mekhanike, Alma-Ata, Kazakh SSR, May 27, 1981.*) *Prikladnaia Matematika i Mekhanika*, vol. 45, Nov.-Dec. 1981, p. 963-984. 32 refs. In Russian.

An examination is presented of initial basic relationships (e.g., force laws and scalar energy laws) for pure mechanical phenomena or for small individualized volumes of matter and fields in physical processes of a general form with internal and external interactions accompanied by transformations of different forms of energy. Attention is given to the meaning of various model representations, particularly space-time models, concepts of general reference systems, global or local tetrad coordinate systems, and universal and particular physical characteristic concepts possessing the properties of covariance. The general theory of admissible postulates, for use in initial thermodynamic principles, is developed. B.J.

A82-18900 **International Conference on Thermoelectric Energy Conversion, 3rd, University of Texas, Arlington, TX, March 12-14, 1980, Proceedings.** Conference sponsored by the Institute of Electrical and Electronics Engineers and University of Texas. Edited by K. R. Rao. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 225 p. Members, \$22.50; nonmembers, \$30.

Papers were presented on thermoelectric generators and materials, including the use of selenides, SiGe alloys, and performance prediction. Further attention was devoted to other thermoelectric devices and novel applications, with mention made of thermal and finite element analysis, high efficiency conversion, element fabrication, thermoelectric condensers for adsorption refrigeration and spacecraft heat rejection using thermoelectric materials. Thermoelectric heat pumps were examined, with consideration given to figures-of-merit for BiSb alloys, designs for maximum cool-down speed, and solid state cooling of spaceborne IR focal planes. Finally, international programs were reviewed, and involved the preparation of thermoelectric thin films, the optimization of an isotopic microgenerator design, and the optimization of eutectic thermoelectric elements. M.S.K.

A82-19052 # **Simulation and operations of large wind machines.** O. Wasynczuk (Purdue University, West Lafayette, IN). In: Annual Allerton Conference on Communication, Control, and Computing, 18th, Monticello, IL, October 8-10, 1980, Proceedings. Urbana, IL, University of Illinois, 1980, p. 187-195. 10 refs. Contract No. DE-AS02-77ET-29100.

The operating characteristics of a class of large, multi-megawatt wind turbine generators is examined. Design features relevant to the dynamic and transient behavior of this particular class of wind turbine generators are described. Results from hybrid computer simulation studies are included to illustrate the dynamic behavior of this class of wind turbine generators operating in a turbulent wind environment and also the transient behavior following electrical disturbances. (Author)

A82-19054 # **Integration problems with large wind energy conversion systems.** R. J. Thomas and J. S. Thorp (Cornell University, Ithaca, NY). In: Annual Allerton Conference on Communication, Control, and Computing, 18th, Monticello, IL, October 8-10, 1980, Proceedings. Urbana, IL, University of Illinois, 1980, p. 206-213.

This paper is concerned with the problems associated with integrating clusters of large wind-turbine generators into a utility grid system. The use of a series-connected AC/DC/AC interface, specifically designed for intermittent sources of energy such as wind-turbine generators, is suggested as a means for circumventing the economic and technical problems associated with present thought in

protection and interconnection schemes. Penetration levels as a function of worst-case stability limits, dynamic siting issues, and cluster-control problems are also addressed. (Author)

A82-19103 **Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings.** Workshop sponsored by the British Wind Energy Association. London, Multi-Science Publishing Co., Ltd., 1980. 234 p.

After presenting status reports on the U.S. and British wind energy development programs, consideration is given to a vertical axis variable geometry wind turbine, an extended multiple stream-tube theory for vertical axis wind turbines, blade shapes for horizontal axis wind turbines, a comparison of studies of wind energy conversion system economics for utility applications, and wind energy systems with battery storage and diesel back-up for isolated communities. Also covered are the storage of wind energy as a liquid fuel, the offshore siting of wind turbine generators in U.K. waters, the predictability of wind turbine output, wind data requirements for wind turbine generator design, and wake structure analysis. O.C.

A82-19104 **The Rutherford six meter variable-geometry vertical axis wind turbine.** G. Stacey and P. J. Musgrove (Reading, University, Reading, Berks., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 21-29. 9 refs. Science Research Council Grant No. GR/A/7483/8.

The paper describes the six-meter, vertical axis variable-geometry wind turbine originally destined for the Cambridge Autarkic House Project but now remaining at the Rutherford Laboratory as a research machine. Predicted performance using both single- and multi-streamtube models is shown, complete with an analysis of the losses between rotor and generator output, for both the two-blade and three-blade configurations. Initial field measurements for the two-blade version are reported. Measured performance is compared both with predicted performance curves and with results from similar machines. Finally, a brief description of future work is given. (Author)

A82-19105 **Double output induction generator scheme for wind energy conversion.** H. R. Bolton, W. C. Lam, and L. L. Freris (Imperial College of Science and Technology, London, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 30-40. 15 refs. Research supported by the Science Research Council.

Methods for increasing the operating speed ranges for grid-connected, three phase induction generators in windpowered turbines are presented. The recovery of 'slip energy', which occurs when the wind turbine encounters winds above the rated speed, is shown to be achievable by the use of an external resistor circuit. The excess power normally shunted into the coils of the field is used to produce heat in a water storage tank or water heater, with possible applications in homes, greenhouses, and industry. A numerical model is formulated which takes into account supersynchronous generating operation, the presence of a hot water resistor bank, and the treatment of heat dissipation. Finally, safety considerations during outage and tariff rates for privately-owned windpowered generators feeding into the grid are discussed, noting favorable rates for utility buying will encourage the use of wind turbines and help replace the burning of fuel. M.S.K.

A82-19106 **A review of medium-scale wind turbine generators.** B. Buss and W. E. Hardy (ERA Technology, Ltd., Leatherhead, Surrey, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 41-50.

A82-19107 **Performance measurements on the six meter diameter horizontal axis windmill.** P. D. Dunn, T. Eisa, A. Ibbetson (Reading, University, Reading, Berks., England), and M. Ewens (Intermediate Technology Development Group, London, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 57-64.

05 ENERGY CONVERSION

A82-19108 An extended multiple streamtube theory for vertical axis wind turbines. S. Read and D. J. Sharpe (Kingston Polytechnic, Kingston-on-Thames, Surrey, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 65-72. 7 refs.

A82-19109 Calculation of the flow patterns and performance of wind turbines using streamline curvature methods. D. J. Milborrow and J. F. Ainslie (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 73-83. 16 refs.

Streamline curvature techniques have been used to make predictions of the flow patterns in the vicinity of wind turbines and also of the variations of static pressure within the flowfield. These studies have been carried out 1) to enable measuring techniques to be improved, 2) to obtain a better insight into the behaviour of rotors at high loadings, where the existing performance theories predict reversed flow in the wake of the machine, 3) to obtain more information on the processes involved in the generation of decay of the rotor wakes, for correlation with studies related to the performance of arrays of wind turbines. The flow patterns and performance data generated have been correlated with data from other studies. It is shown that, when used in conjunction with existing aerodynamic prediction methods, streamline curvature techniques improve the accuracy of performance estimates. (Author)

A82-19110 Blade shapes for horizontal axis wind turbines. M. B. Anderson (Cambridge University, Cambridge, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 84-95. 6 refs. Research supported by the Science Research Council.

A method is presented for determining the optimum blade shape for a turbine operating at a constant rotational speed. Weibull functions are used to determine a weighting distribution in the optimisation procedure. A comparison is made between near-optimum and optimum blade shapes for turbines operating at both constant tip speed ratio and constant rotational speed. (Author)

A82-19111 Wind tunnel tests on the 1/30th scale model of the 60m wind turbine generator. M. Buckley (British Aerospace Public, Ltd., Co., Mechanical Equipment and Systems Div., Hatfield, Herts., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 96-108.

To provide confirmation of aerodynamic data used in the design of the full-scale machine, a one-thirtieth scale model was designed and constructed for a test program in a low speed wind tunnel. Measurements were obtained of rotor forces using strain gauges on the blade roots and drive shaft, as well as overall forces on the wind tunnel balance. The design of the machine, the instrumentation system employed and the data reduction procedures are presented in this paper. (Author)

A82-19113 A comparison of studies of WECS economics for utility applications. R. H. Taylor and A. P. Rockingham (Central Electricity Generating Board, Planning Dept., London, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 118-126. 14 refs.

Several studies world-wide have now been completed which analyse the economic value of wind energy conversion systems (WECS) when incorporated in utility grids. This paper reviews the models which have been used and compares the main conclusions. Results of general applicability suggest that for most utilities, the largest part of the value results from fuel saving, but that capacity credit may be significant in some cases. It has been found that the value of WECS decreases with penetration and it is now generally agreed that any storage included in the system should not be dedicated to wind power but used for the benefit of the entire system. The reasons for the sometimes large quantitative differences in capacity credit and differences in total value as a function of penetration between studies are not apparent, and it is concluded

that studies must be carried out for individual utilities employing appropriate wind characteristics, yearly and daily load curves and mixes of plant. (Author)

A82-19114 The expected cost of electricity generated by the U.S. Mod 2 windmill. R. Lowe (Open University, Milton Keynes, Bucks., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 127-133.

A82-19115 Wind energy systems with battery storage and diesel back-up for isolated communities. G. Slack, B. Sexon, R. Collins, P. Dunn, N. Lipman, and P. Musgrove (Reading, University, Reading, Berks., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. (A82-19103 07-44) London, Multi-Science Publishing Co., Ltd., 1980, p. 134-142.

A82-19117 Wind power integration studies - An overview of the Reading University programme. N. H. Lipman (Reading, University, Reading, Berks.; Science Research Council, Rutherford and Appleton Laboratories, Didcot, Oxon, England), E. Bossanyi, P. D. Dunn, P. J. Musgrove, G. E. Whittle (Reading, University, Reading, Berks., England), and C. Maclean (Science Research Council, Rutherford and Appleton Laboratories, Didcot, Oxon, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 151-162.

Preliminary results of studies of the operational characteristics and performance of windpowered turbine clusters are reported. The chance that short gusts above the cut-off speed may cause shut-downs lasting 10-20 min is considered as a control system problem, and it is found that steadier output can be expected from clusters rather than single machines. Wake effects are mentioned, and ongoing studies of simultaneous winds at nine separate sites are indicated. The prediction of wind energy shortfalls is discussed, noting that steadier power can be expected from diverse clusters rather than single site clusters. The interface of spinning reserve to make up the shortfalls when the wind dies down is modeled, and it is shown that wind turbines are capable of producing 30% of the annual electrical demand. The fuel cost for spinning reserve is calculated to be less than having a peaking plant. M.S.K.

A82-19121 The predictability of wind turbine output. E. A. Bossanyi, G. E. Whittle, P. D. Dunn, N. H. Lipman, P. J. Musgrove (Reading, University, Reading, Berks., England), and C. Maclean (Science Research Council, Rutherford and Appleton Laboratories, Didcot, Oxon, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 194-201. 5 refs.

A method of bins was used with hourly mean wind speeds to predict the output of wind turbines. Rated capacity was regarded as unity and power surpluses or deficits were calculated over 40 bins to establish error probabilities in the predictions of wind speed persistence six hours in advance. Higher rated wind speeds were found to increase the probability for correct predictions of output, while factors such as variable pitch and speed also contributed an influence. The persistence method was favorably compared with 6, 12, and 18 hr wind forecasts by a meteorological office. A final test was made employing 6 hr predictions for three widely spaced sites on the same coast, and the error probability was found to decrease with increasing numbers of sites. Further predictive tests with more than three sites at even greater spacing are indicated. M.S.K.

A82-19122 Wind data requirements for wind turbine generator design. U. Hassan (ERA Technology, Ltd., Leatherhead, Surrey, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 202-210. 9 refs.

The statistical methods of wind modeling for the design of tall masts, buildings, towers, and bridges are shown to be effective for the analysis of wind loads on wind turbine generators (WTG). The wind velocity profile and turbulence is defined as the instantaneous deviations from the short term mean wind speed, and is capable of reducing the fatigue life of the rotors and degrading the quality of power output. The simplified definition of turbulence is noted to be

deficient in its ability to predict the effects of sequential gusts on the rotors, or to show the changes in torque encountered by the rotor swept area. A relationship between the force spectrum and the velocity spectrum is analytically defined to obtain a response spectrum. Finally, the differences in wind speeds in the vertical wind profile are quantified. M.S.K.

A82-19123 Wake structure analysis. B. R. Clayton and P. Filby (University College, London, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 211-220. 19 refs. Research supported by the Science Research Council.

Two related aerodynamic problems, namely the wake interaction effect and the scale effect, need examination in order to predict the full-scale performances of wind turbines in isolation and in arrays. Wake interaction arises from the desire to minimize the surface area occupied by an array. The aerodynamic conditions for each turbine are therefore influenced by the presence of other turbines in the array. Scale effects result from the practical difficulties of satisfying dynamic similarity between full-scale and model flow conditions. Existing data related to these problems are analyzed, and a program including the construction of an experimental rig is described in order to fill the present gaps in knowledge so that full-scale predictions may become more reliable. (Author)

A82-19124 Initial test results on the 5m horizontal axis wind turbine at Swansea. R. G. Herapath and M. G. Woollard (Swansea, University College, Swansea, Wales). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 223-228.

A82-19241 Real-time simulation of MHD/steam power plants by digital parallel processors. R. M. Johnson and D. A. Rudberg (Montana State University, Bozeman, MT). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 274-277. 6 refs.

Attention is given to a large FORTRAN coded program which simulates the dynamic response of the MHD/steam plant on either a SEL 32/55 or VAX 11/780 computer. The code realizes a detailed first-principle model of the plant. Quite recently, in addition to the VAX 11/780, an AD-10 has been installed for usage as a real-time simulation facility. The parallel processor AD-10 is capable of simulating the MHD/steam plant at several times real-time rates. This is desirable in order to develop rapidly a large data base of varied plant operating conditions. The combined-cycle MHD/steam plant model is discussed, taking into account a number of disadvantages. The disadvantages can be overcome with the aid of an array processor used as an adjunct to the unit processor. The conversion of some computations for real-time simulation is considered. G.R.

A82-19242 Digital simulation of an MHD power consolidation/D.C. to A.C. inverter system. K. Crisafulli, R. Johnson, and K. Marcotte (Montana State University, Bozeman, MT). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 308-311.

A82-19297 Performance characteristics of open-cycle linearly-diverging diagonal type single- and multiple-load generators. M. Yoshida and J. Umoto (Kyoto University, Kyoto, Japan) *Energy Conversion and Management*, vol. 21, no. 4, 1981, p. 289-297. 12 refs.

A quasi-two-dimensional theory for evaluating the performance of a diagonal type MHD generator is presented. An equivalent circuit theory is used to describe the distributions of electric quantities in the channel, and the distribution of gas-dynamical quantities in the core flow region are obtained by means of modified one-dimensional MHD flow equations. The electrical quantities in that region are expressed as averages of the previously derived two-dimensional electrical quantities perpendicular to the gas flow, while the electrical quantities in the boundary layer flow are calculated by using the momentum integral equation and the 1/7 power profiles for the gas

temperature and velocity under the assumption of turbulent flow. The theory is applied to a diagonal type generator with a thermal output of 2 GW and the results are compared to those from quasi-one-dimensional calculations. M.S.K.

A82-19794 # Three-dimensional flow development in MHD generators at part load. E. D. Doss and R. K. Ahluwalia (Argonne National Laboratory, Argonne, IL). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0324*. 13 p. 9 refs. Contract No. W-31-109-eng-38

The three-dimensional behavior of flow in MHD generators at design and off-design loading points is investigated. Faraday as well as diagonally-connected channels with insulating or conducting sidewalls are considered. A simple argument is presented to show qualitatively the role of MHD body forces in generating axial vorticity and hence secondary flows in the cross stream. For Faraday channels with strong MHD interaction, the generated vorticity is shown to direct the secondary flow from the cathode to the anode wall along the centerline. For diagonally-connected channels near short-circuit, the generated vorticity is shown to direct the secondary flow from the anode to the cathode wall along the centerline, and vice-versa for near open-circuit conditions. Computational results for large generators are presented and the effect of channel loading on the flow characteristics are discussed. (Author)

A82-19795 # Preliminary investigation of the effect of electrical nonuniformities on frame current distribution of coal-fired MHD generator. M. Ishikawa, Y. C. L. Wu, and M. H. Scott (Tennessee, University, Tullahoma, TN). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0326*. 11 p. 11 refs. Contract No. DE-AC02-79ET-10815.

The effect of electrical nonuniformities on frame currents in a diagonal conducting wall generator is examined by comparing three-dimensional calculations with experimental data. It is found that variations of frame current are much stronger at the cathode side than at the anode side; large local changes may occur in the frame currents that have little correlation with the overall performance. Frame currents flowing counter to the normal flow were predicted by the three-dimensional calculations and observed experimentally. This behavior is attributed to leakage through polarized slugs. For three-electrode frame configurations, calculations show current conservation and predict the tendency as well as the magnitude of frame currents observed experimentally. V.L.

A82-19800 # Recent results on measurement of plasma conductivity using Faraday rotation of submillimeter waves. P. J. Kuzmenko and S. A. Self (Stanford University, Stanford, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0376*. 8 p. 12 refs. NSF-supported research.

This paper examines the application of Faraday rotation to the measurement of electron concentration in combustion MHD plasmas. Details on the design of a working system are given including the selection of operating wavelength. A theoretical comparison between the Faraday rotation technique and two path interferometry shows Faraday rotation in its simplest form to be somewhat less sensitive to changes in electron concentration. This deficit can be balanced against greater immunity to vibration and thermal drift. Improved techniques of measuring the rotation angle promise greater sensitivity. A preliminary experiment has verified the technique. (Author)

A82-20140 Possibilities and limitations of wind energy utilisation. J. Feustel (M.A.N. - Neve Technologie, Munich, West Germany). *International Journal of Ambient Energy*, vol. 2, Oct. 1981, p. 197-205. 10 refs.

The existing wind resource, the most favorable locations, applications, and designs of windpowered generators are reviewed, along with descriptions of current and historic wind turbines and lines of research. Coastal regions, plains, hill summits, and mountains with funneling regions are noted to have the highest annual wind averages, with energy densities exceeding the annual solar insolation at average wind speeds of 5-7.9 m/sec. Applications for utility-grade power production, for irrigation, for mechanical heat production,

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and for pumped storage in water towers or reservoirs are mentioned, as well as electrical power production in remote areas and for hydrogen production by electrolysis. Power coefficients are discussed, with attention given to the German Growian 3 MW machine. It is shown that the least economically sound wind turbines, the machines with outputs below 100 kW, can vie with diesel plant economics in a good wind regime if the wind turbine operates for 15 yr. M.S.K.

A82-20170 Fusion - From science to engineering. J. Kenton. *EPRI Journal*, vol. 6, Dec. 1981, p. 63, 64, 66-68, 70. 8 refs.

The principles and state of advancement in fusion energy devices are explored, along with the transition from theoretical problems to engineering difficulties. Tokamaks are noted to be the closest to actual break-even, the point where the energy extracted from the reactor is equal to the energy necessary to initiate the process, although linear, mirror fusion machines also show promise. Attention is also given to poloidal diverter systems and the ELMO bumpy torus, which has demonstrated continuous operation for the first time. The prospects for a U.S. fusion engineering facility are uncertain in the light of current budget cuts, with most funding being concentrated on military applications. Laser inertial fusion devices are reviewed, as well as particle and ion accelerators for fuel pellet implosions. Finally, the most complex engineering problem is asserted to be the development of the reactor blanket system. M.S.K.

A82-20175 Power systems. G. Kaplan. *IEEE Spectrum*, vol. 19, Jan. 1982, p. 65-68.

Significant events in current, prototype, and experimental utility power generating systems in 1981 are reviewed. The acceleration of licensing and the renewal of plans for reprocessing of fuel for nuclear power plants are discussed, including the rise of French reactor-produced electricity to over 40% of the country's electrical output. A 4.5 MW fuel cell neared completion in New York City, while three 2.5 MW NASA-designed windpowered generators began producing power in the state of Washington. Static bar compensators, nonflammable-liquid cooled power transformers, and ZnO surge arrestors were used by utilities for the first time, and the integration of a coal gasifier-combined cycle power plant approached the planning phase. An MHD generator was run for 1000 hours and produced 50-60 kWe, while a 20 MVA superconducting generator was readied for testing. M.S.K.

A82-20283 The rebirth of MHD. M. Edelhart and A. Greenfield. *Technology*, vol. 2, Jan.-Feb. 1982, p. 79-83.

A low-temperature MHD system employing liquid metal and a low-boiling point organic vapor as its working fluids is described, and considered from the standpoints of: (1) development status; (2) thermal energy sources, with emphasis on low-temperature solar collectors and industrial process waste heat; (3) economic advantage, by comparison to Rankine-cycle and photovoltaic solar systems; and (4) operational efficiency. Figures for the net cost of power produced by the three solar systems compared, when the further conversion of MHD exhaust heat is considered, are \$0.57/kWh for the photovoltaic, \$0.116/kWh for the Rankine cycle, and \$0.054/kWh for the low-temperature MHD. A further contrast is drawn with the typically 2500 C-working gas MHD systems being developed in the U.S. and U.S.S.R. O.C.

A82-20292 * # Effect of vacuum exhaust pressure on the performance of MHD ducts at high B-field. J. M. Smith, J. L. Morgan, and S.-Y. Wang (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0396*. 10 p.

The effect of area ratio variation on the performance of a supersonic Hall MHD duct showed that for a given combustion pressure there exists an area ratio below which the power generating region of the duct is shock free and the power output increases linearly with the square of the magnetic field. For area ratios greater than this, a shock forms in the power generating region which moves upstream with increasing magnetic field strength resulting in a less rapid rise in the power output. The shock can be moved downstream by either increasing the combustion pressure or decreasing the exhaust pressure. The influence of these effects upon duct performance is presented in this paper. (Author)

A82-20739 * # High temperature durable catalyst development. G. C. Snow and H. Tong (Acurex Corp., Mountain View, CA). *Workshop on Catalytic Combustion, 5th, San Antonio, TX, Sept. 15, 16, 1981, Paper*. 38 p. 14 refs. Research supported by the Acurex Corp.; U.S. Environmental Protection Agency Contract No. 68-02-3122; Contract No. DEN3-83.

A program has been carried out to develop a catalytic reactor capable of operation in environments representative of those anticipated for advanced automotive gas turbine engines. A reactor consisting of a graded cell honeycomb support with a combination of noble metal and metal oxide catalyst coatings was built and successfully operated for 1000 hr. At an air preheat temperature of 740 K and a propane/air ratio of 0.028 by mass, the adiabatic flame temperature was held at about 1700 K. The graded cell monolithic reaction measured 5 cm in diameter by 10.2 cm in length and was operated at a reference velocity of 14.0 m/s at 1 atm. Measured NOx levels remained below 5 ppm, while unburned hydrocarbon concentrations registered near zero and carbon monoxide levels were nominally below 20 ppm. V.L.

A82-20743 * # Power system design optimization using Lagrange multiplier techniques. Y. Yu (Xerox Corp., El Segundo, CA) and F. C. Lee (Virginia Polytechnic Institute and State University, Blacksburg, VA). *Power Conversion International Conference, Munich, West Germany, Sept. 14, 1981, Paper*. 18 p. 8 refs. Contract No. NAS3-21051.

An optimization technique using the Lagrange Multiplier Method is proposed to facilitate design of switching power converter systems. The essence of the optimization is to identify the optimal battery voltage level and switching frequency along with the detailed converter design so that the total system weight including the battery and the packaged converter is minimized, and concurrently all specified power circuit performances are satisfied. (Author)

A82-20744 * # A PWM transistor inverter for an ac electric vehicle drive. J. M. Slicker (Eaton Engineering and Research Center, Southfield, MI). *Institute of Electrical and Electronics Engineers, Annual Meeting, Philadelphia, PA, Oct. 5-9, 1981, Paper*. 8 p. 8 refs. Research supported by the U.S. Department of Energy; Contract No. DEN3-125.

A prototype system consisting of closely integrated motor, inverter, and transaxle has been built in order to demonstrate the feasibility of a three-phase ac transistorized inverter for electric vehicle applications. The microprocessor-controlled inverter employs monolithic power transistors to drive an oil-cooled, three-phase induction traction motor at a peak output power of 30 kW from a 144 V battery pack. Transistor safe switching requirements are discussed, and a circuit is presented for recovering trapped snubber inductor energy at transistor turn-off. V.L.

A82-20747 * # Comparative analysis of CCMHD power plants. F. N. Alyea, C. H. Marston, V. B. Mantri (General Electric Co., Energy Systems Programs Dept., Philadelphia, PA), B. G. Geisendorfer (Babcock and Wilcox Co., Fossil Power Generation Div., Barberton, OH), and H. Doss (Bechtel National, Inc., San Francisco, CA). *Symposium on the Engineering Aspects of MHD, 19th, Tullahoma, TN, June 15-17, 1981, Paper*. 8 p. Contract No. DEN3-135; No. DE-AC01-78ET-10818.

A study of Closed Cycle MHD (CCMHD) power generation systems has been conducted which emphasizes both advances in component conceptual design and overall system performance. New design data are presented for the high temperature, regenerative argon heaters (HTRH) and the heat recovery/seed recovery (HRSR) subsystem. Contamination of the argon by flue gas adsorbed in the HTRH is examined and a model for estimation of contamination effects in operating systems is developed. System performance and cost data have been developed for the standard CCMHD/steam cycle as powered by both direct fired cyclone combustors and selected coal gasifiers. In addition, a new CCMHD thermodynamic cycle has been identified. (Author)

A82-20750 * # MHD channel performance for potential early commercial MHD power plants. D. W. Swallow (Avco-Everett Research Laboratory, Inc., Everett, MA). *Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, Aug. 9-14, 1981,*

Paper, 7 p. 15 refs. Contract No. DEN3-51.

The commercial viability of full and part load early commercial MHD power plants is examined. The load conditions comprise a mass flow of 472 kg/sec in the channel, Rosebud coal, 34% by volume oxygen in the oxidizer preheated to 922 K, and a one percent by mass seeding with K. The full load condition is discussed in terms of a combined cycle plant with optimized electrical output by the MHD channel. Various electrical load parameters, pressure ratios, and magnetic field profiles are considered for a baseload MHD generator, with a finding that a decelerating flow rate yields slightly higher electrical output than a constant flow rate. Nominal and part load conditions are explored, with a reduced gas mass flow rate and an enriched oxygen content. An enthalpy extraction of 24.6% and an isentropic efficiency of 74.2% is predicted for nominal operation of a 526 MWe MHD generator, with higher efficiencies for part load operation. M.S.K.

A82-21148 **Interfacing wind energy conversion equipment with utility systems.** R. C. Meier and S. L. Macklis (General Electric Co., Advanced Energy Programs Dept., Philadelphia, PA). *Energy (UK)*, vol. 7, Jan. 1982, p. 15-29.

Methods and problems of interfacing the output of wind energy conversion systems (WECS) with the utility grid are examined. Local gusts were determined to be the main cause of loss of output stability, with the concomitant possibility of going off-line until resynchronization is effected. The problem is less common than loss-of-load due to low- or no-wind conditions, and synchronous generators were found to avoid unacceptable voltage dips from moderate disturbances. A lumped parameter study was performed for the behavior of a wind turbine cluster, and stability of the WECS output was acceptable as long as the connection reactance between the WECS and the utility was less than 0.4/unit. WECS application in a variety of networks were modeled and no unendurable power fluctuations were seen to threaten the utility lines, provided proper control mechanisms were interposed on-line with the systems using mostly already existing utility circuit protection technology. M.S.K.

A82-21650 **Heating by wind (Heizen mit Wind).** F. Auer (Battelle-Institut, Frankfurt am Main, West Germany). *Brennstoff-Wärme-Kraft*, vol. 34, Jan. 1982, p. 39-42. In German.

The economical design of a wind power plant combined with a heat accumulator is discussed. A gliding-museum to be built on the Wasserkuppe in the Rhön mountain is used as an example to investigate which wind power plant and storage alternative can be considered based on meteorological basic data and the heat demand required. A system optimization regarding technical and economical points is used to study the wind power plant and to indicate the best accumulator. The maximum storage time established by an economic optimization is one to two days. In this regard no difference is made between sun energy and wind energy, and the storage size can span the day/night cycle. D.L.G.

A82-22896 # **Lineup of the IM-series aircraft-derivative gas turbines.** K. Takeo (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). *IHI Engineering Review*, vol. 14, Oct. 1981, p. 36-42. 5 refs.

The development of the IM-series of aircraft derivative gas turbines is reviewed. The discussion begins with the IM1500 GL engine, having an output at turbine coupling of 11,100 kW and a thermal efficiency of 26.8%, first used as an industrial gas generator in 1968. Principal characteristics of the IM2000 and IM2500 are then discussed: the output and thermal efficiency of these two models are given as 12,800 kW and 33.5% and 19,300 kW and 35.1%, respectively. Fundamental specifications of the power turbines are described, and the flowpath design is presented. The construction and mechanical design of the engines are described, and results of creep-rupture, high temperature fatigue, and vibratory stress tests are given. Finally, the IM5000 power turbine, with an output of 38,000 kW and an efficiency of 38.4% is described. It is also shown how heat in the high-temperature exhaust gases from the turbines can be used in waste heat recovery systems to improve the total plant efficiency. J.F.

A82-23063 **A review of the impact of the environment on aerogenerator materials.** A. R. Mortimer (Science Research Council,

Rutherford and Appleton Laboratories, Didcot, Oxon, England). *Wind Engineering*, vol. 5, no. 4, 1981, p. 207-218. 37 refs.

Factors which contribute to the unreliability of windpowered generators are examined, with specific regard to the availability of materials, durability, cost, ease of production, and ease of repair. The effects of wind loading and methods for testing salt air contaminants are discussed, along with the effect of moisture, of salt air on lubricants, of microbiological attack, of UV radiation, rain erosion, and icing. The probability of bird strikes is statistically defined, and consideration is given to electrostatic charging, lightning strikes, temperature changes, the corrosion of rubber by ozone, the effects of guano, and wet dry pollution. The visual, EM, and acoustic effects of wind turbines are explored, and production processes which may affect the integrity of the structure are outlined. Finally, failure mechanisms due to salt-air environments are detailed. M.S.K.

A82-23210 **An approximate theory of a rapidly rotating windmill.** O. Hellman (Turku, University, Turku, Finland). *Journal de Mécanique Appliquée*, vol. 5, no. 4, 1981, p. 429-451. 13 refs.

An approximate theory is presented for the calculation of an optimal windmill rotor based on propeller theory taking into account the effects of blade drag. An expression for the power coefficient of a wind machine is derived from considerations of the relation between the velocity field behind an ideal windmill and the energy produced by it, and the optimal velocity field behind a windmill rotor is analyzed. The problem of configuring windmill rotor blades to reproduce as closely as possible the optimal velocity distribution is then considered in terms of the Prandtl approximation of circulation around the rotor blades, and a procedure for rotor calculation is presented. The calculation of windmill rotor blade optimal parameters is illustrated for the case of the Göttingen 625 wing section. A.L.W.

A82-23652 # **The economics of utilizing wind power in apple cold-storage systems.** J. M. A. Tanchoco, R. A. Wysk, and W. E. Norris (Virginia Polytechnic Institute and State University, Blacksburg, VA). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 104, Feb. 1982, p. 23-27. 7 refs. Research supported by the U.S. Department of Agriculture.

A computer model for the economics of a wind turbine powered apple cold storage facility is described, based on the performance of a pilot installation. The facility consisted of an 8 kW windmill, storage batteries, a rectifier to convert the windmill ac power to dc for storage, a dc vapor compression refrigeration system, a 1000 bu apple storage building, and an ice-tank thermal storage system. The performance of the pilot plant was monitored for 2 yr, and the model was devised to include the variations of power and wind, the demand for power, and the quantity of auxiliary power required. Important features of an after-tax analysis of the wind turbine economics are outlined, with attention given to the annual cost equivalence for systems with and without a windmill and with consideration for tax write-offs. It was found that the windpowered system was not economical for a 1000 bu facility, but may be applicable in commercial sized operations. M.S.K.

A82-23653 # **OTEC gas desorption studies.** F. C. Chen and A. Golshani (Oak Ridge National Laboratory, Oak Ridge, TN). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 104, Feb. 1982, p. 35-40. 10 refs. Contract No. W-7405-eng-26.

Experiments on deaeration in packed columns and barometric intake systems, and with hydraulic air compression for open-cycle OTEC systems are reported. A gas desorption test loop consisting of water storage tanks, a vacuum system, a liquid recirculating system, an air supply, a column test section, and two barometric leg test sections was used to perform the tests. The aerated water was directed through columns filled with either ceramic Raschig rings or plastic pall rings, and the system vacuum pressure, which drives the deaeration process, was found to be dependent on water velocity and intake pipe height. The addition of a barometric intake pipe increased the deaeration effect 10%, and further tests were run with lengths of PVC pipe as potential means for noncondensibles disposal through hydraulic air compression. Using the kinetic energy from the effluent flow to condense steam in the noncondensable stream improved the system efficiency. M.S.K.

A82-23680 **Sudden loss of rotor blade from wind power**

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turbine - Calculation of maximax response spectra. B. Akesson and S. Sandstrom (Chalmers Tekniska Hogskola, Goteborg, Sweden). *Journal of Sound and Vibration*, vol. 80, Jan. 8, 1982, p. 81-96. 7 refs.

The maximum response of a linear one-degree-of-freedom system to a transient phase-shifted truncated sinusoidal load is studied. The system represents the nacelle, tower and foundation of a horizontal axis wind power turbine. The load is the horizontal component of the unbalanced centrifugal force from the remaining blade of the turbine rotor when one blade has suddenly broken off (close to the hub). The most dangerous angle of the running rotor at the instant of blade loss is found with respect to different combinations of viscous damping and load duration. Maximax response spectra (envelope spectra) are plotted. A detailed numerical example is given. (Author)

A82-23824 The application of dynamic cold neutron fluoroscopy for the visualisation of fuel and oil system operating characteristics in gas turbine development. P. A. E. Stewart (Rolls-Royce, Ltd., Advanced Projects Dept., Bristol, England). *Aeronautical Journal*, vol. 86, Jan. 1982, p. 23-28. 10 refs.

A82-24015 # Analysis of power takeoff in diagonal conducting wall channels. S. Kuo and E. Levi (New York, Polytechnic Institute, Farmingdale, NY). *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 96-103. 7 refs. Contract No. ET-78-C-01-3084.

An analysis of diagonal-conducting-wall MHD channels leads to design principles for the power takeoff and good quantitative agreement with experimental data. The effect of power takeoff schemes on the output power level is investigated analytically. It is found that it is possible to design the electrical circuit of the channel with passive elements in the takeoff region, and, achieve a fairly even load current distribution under changing load conditions without loss of power output. (Author)

A82-24016 # Performance assessment and cost effectiveness of wind energy conversion systems. G. Miller, M. Hoffert, and D. Corren (New York University, New York, NY). *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 104-108. 7 refs. Research supported by the Solar Energy Research Institute and New York State Energy Research and Development Administration.

Performance and cost characteristics of wind energy conversion systems (WECS) are assessed. Both technological and cost-effectiveness considerations are discussed for these systems with emphasis on developing appropriate economic measures for the application of electric power generation. A cost-effectiveness analysis is developed for target costs per unit frontal area for such systems showing the influence of annual mean windspeed, tower height, atmospheric boundary layer stability, capital-cost financing rates, and the cost escalation rate of the fossil fuel displaced. The latter two parameters are particularly sensitive ones in assessing both lifetime cost-effectiveness and payback time. Although allowable costs vary by several orders of magnitude, initial target costs for cost-effectiveness seem to be of the order of \$50 to \$400/sq m of frontal area. (Author)

A82-24018 # Arc mode molten seed electrodes for MHD power generation. S. Korenaga, H. Imai, and T. Masuda (Ministry of International Trade and Industry, Electrotechnical Laboratory, Ibaraki, Japan). *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 119-124. 19 refs.

Experiments have been conducted in an electric furnace at atmospheric pressure with the object of investigating the seed arcing characteristics and electrical conductivities of seed materials, and ceramic consumption rates by seed arcing. Many important facts have been clarified from these experiments, namely that the arcing behaviors of molten seeds resemble closely those of mercury in a mercury rectifier, the cathode voltage drop of K₂CO₃ seed is close to that obtained for the copper electrode in an MHD channel, the molten seed has an electrical conductivity comparable to those of advanced ceramic electrodes, and so on. These results show that so-called 'arc mode molten seed electrodes' are highly promising for practical application. The arc mode molten seed cathodes for commercial MHD generating channels are discussed. (Author)

A82-24020 # Optimization of fuel composition in open-

cycle magnetohydrodynamic power generation. C. F. Harris (Dayton, University, Dayton, OH) and A. S. Myerson (Georgia Institute of Technology, Atlanta, GA). *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 155-157. 8 refs. Contract No. F33615-77-C-2004. AF Task 19.

To design an MHD generator in such a way as to reduce its size and weight, the fuel composition corresponding to the maximum power density must be determined. A technique making this determination possible is described. It involves a calculation of the power density resulting from the combustion of a given inlet fuel composition as a function of temperature and pressure for several electrode configurations at a magnetic field strength of 2-6 T. The chemical composition of the combustion products at the specified temperature and pressure are calculated with a computer program. These composition data are then used in calculating the electrical conductivity and Hall parameter at the specified conditions. Gas velocities are calculated at the entrance to the electrode channel employing the energy conservation equation for compressible flow, assuming no friction or heat losses. C.R.

A82-24021 # Theory and performance of a Wells turbine. S. Raghunathan (Belfast, Queen's University, Belfast, Northern Ireland), C. P. Tan, and N. A. J. Wells. *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 157-160. 5 refs.

A simple theoretical approach to the design of the Wells turbine is described, with the theoretical prediction then compared with experimental data. In the test, the flow is measured using a calibrated orifice plate mounted at the end of the test section at a distance of 0.7 m from the rotor. The pressure tapings are located at a distance of 0.2 m upstream and downstream of the rotor. Low differential pressure transducers are used. The power output is obtained by measuring both the torque and rotational speed, with the torque being measured by an optical rotary transducer. The turbine is loaded using a dc commutator machine which also serves as a motor to run the turbine up to a required speed. It is observed within the range of experimental data that differences exist between the oscillating flow and steady flow results. It is concluded that the Wells self-rectifying air turbine is a feasible device for converting energy from oscillating wave energy devices. C.R.

A82-24239 Molten carbonate fuel cell improvements. K. F. Blurton and L. G. Marianowski (Institute of Gas Technology, Chicago, IL). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980.

London, Academic Press, 1981, p. 211-225, Discussion, p. 225, 226. 6 refs. Research supported by the U.S. Department of Energy and Electric Power Research Institute.

It is noted that a molten carbonate fuel cell integrated with a coal gasification power plant is one of the most promising coal-using technologies because of its high efficiency, acceptable cost, and environmental acceptability. For the molten carbonate system to achieve these goals, however, continued development is required which must take into account the operating conditions of the application. The progress made in improving cell performance and life is surveyed, evaluating the effect of contaminants on cell performance and the design of multicell stacks and identifying alternative electrolyte compositions. Also discussed is the status of research on other major areas. C.R.

A82-24249 Al-air cells - Potential small electric generators for field use. T. Valand, O. Mollstad, and G. Nilsson (Forsvarets Forskningsinstitut, Kjeller, Norway). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 523-533; Discussion, p. 533, 534. 11 refs.

The Al-air system is a very attractive system for use as an electric generator in the field. Besides the high energy density of the 'fuel' (theoretically 21 kW h per l Al), it is easy and safe to handle. Since it reacts in an electrochemical cell, it also easily adjusts to variations in load. In order to test the ability of the system, a 40 W mechanically rechargeable Al-air cell has been constructed. The reaction products, which in a short time will clog up the cell, are continuously removed from the electrolyte. The cell has a total efficiency of approximately 40% and has a current efficiency of

100% with respect to AI. Unfortunately, some serious problems have to be solved before the cell can be put into use. The properties of the cell, the problems, and possible solutions are discussed. (Author)

A82-24382 Evolution and development of high voltage /270 volt/ dc aircraft electric systems in the United States. J. D. Segrest (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA) and W. W. Cloud (Lockheed-California Co., Burbank, CA). In: Aircraft electrical power systems; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 5-8, 1981. Warrendale, PA, Society of Automotive Engineers, Inc., 1981, p. 51-63. 10 refs.

The system concept of high voltage dc power systems for aircraft applications is reviewed, with regard to the state-of-the-art in the hardware available. The history of dc system use is outlined, noting the continually increasing demand of higher voltage levels. Mention is also made of the inherent unsatisfactory lifetime levels of current constant speed 400 Hz power devices with respect to future aircraft. Cycloconverter and DC-Link power generating systems are subject to complex designs and display a poor power factor, wave form distortion, and EM incompatibility. Brushless dc motors are available for engine mounting, and provide 270 V dc, which offers high reliability, high efficiency, light weight, power continuity, fuel economy, and personnel safety. Existing systems and advanced systems are outlined, with operational performance and requirements, including the need to develop solid-state load controllers for over 50 amps power load. M.S.K.

A82-24564 # Frequency response analysis of ocean wave energy converter. M. Masubuchi (Osaka University, Osaka, Japan) and R. Kawatani. *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/DSC-10*. 9 p. 13 refs. Members, \$2.00; nonmembers, \$4.00.

The energy conversion efficiency and dynamic behavior of a wave energy converter which absorbs power while oscillating on an incident sinusoidal wave train are analyzed. The device consists of two, differently-configured floating bodies connected by a rigid link, and its basic equations are obtained by assuming two-dimensional motions and considering the interaction between the two bodies and hydrodynamic and damping forces. Numerical solutions are obtained through the use of the Lewis form as the configuration of the floating bodies. Assuming that energy absorption is proportional to the square of the relative velocity between the oscillating body and the connecting link, it is shown that nearly 100% of incident wave energy is converted into mechanical energy over a wide frequency band. O. C.

A82-24692 Fuel cell power plants for utility applications. L. G. Eklund and L. M. Handley (United Technologies Corp., Hartford, CT). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 143-147. Contracts No. EX-76-C-01-2102, No. EC-77-C-03-1471.

The status of three fuel cell programs as prototypes for commercial fuel cell power plants for utility applications are discussed. The systems use either natural gas or distillate fuels, and are compatible with gaseous or liquid coal products. Two of the systems use phosphoric acid fuel cells as a basic building block in a proof of principle for supplying electricity and other energy requirements for buildings and industrial processes. The plants are on site, and deliver either a few kW to hundreds of kW, or a multimegawatt output for utility applications. A 40 kW unit is described which operates automatically, performs its own heat recovery, recovers water for its own use, and runs a simulated 16-unit apartment building. A 4.8 MW system located in New York city features a power conditioner to alter the dc output to three phase ac for the power grid. Finally, research on utility-size molten carbonate fuel cells offering 40-50% efficiency in converting coal to grid-quality power are described. M.S.K.

A82-24693 Phosphoric acid fuel cell plants for dispersed electric power generation. A. R. Jones (Westinghouse Electric Corp., Advanced Energy Systems Div., Pittsburgh, PA). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980.

New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 148-153. 8 refs.

The operational characteristics of a phosphoric acid fuel cell are detailed, and features of a commercial prototype fuel cell are described. The fuel cell power plant comprises a fuel processor, fuel cells, and a power conditioner. Hydrogen is extracted from the fuel source, which can be coal, biomass, or wasted natural gas. Reformers are required to reduce CO impurities in the H₂ gas fed to the fuel cells. It is projected that fuel cell units are commercially competitive with combustion turbines with current production technology, and can be sited close to the load because of benign environmental effects. The necessity of reliable central control of dispersed fuel cell plants is stressed as means of maintaining efficiency of use. A distributed gas cooling approach to remove rejected heat has been developed for military 1.5 kW fuel cells, and sufficient output to offset parasitic power losses in commercial plants are reviewed. M.S.K.

A82-24694 Engineering development of molten carbonate fuel cell power plants. L. J. Degan (General Electric Co., Schenectady, NY). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 154-159. Research supported by the Electric Power Research Institute and New York State Energy Research and Development Authority.

Initial system goals and modifications in the development of molten carbonate fuel cells are described. The cells are now in the technology readiness stage, with current work applied to fabricating fuel cells and stacks. Initial design goals in 1978 comprised fuel cells suitable for utilities using coal as fuel, and in smaller sizes where waste heat could be utilized for other purposes. Alterations in plans call for a wider choice of fuels, 100-1000 MW sizing for utilities, base load performance, instantaneous change of load, and both ac and dc generation for industrial applications. Sensitivity studies are concentrating on fuel cell pressure levels, excess air ratios, current densities, the anode recirculation ratio, and the steam cycle efficiency, and results of a stimulation of a combined cycle use are reported. Cost sensitivity trials have indicated a necessity to maintain a current density of at least 161.5 mA/sq cm, and sulfur-rich fuels can be used. M.S.K.

A82-24695 * An assessment of alternative fuel cell designs for residential and commercial cogeneration. R. A. Wakefield (Mathtech, Inc., Washington, DC). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 160-165. Research sponsored by the U.S. Department of Energy; Contract No. DEN3-89.

A comparative assessment of three fuel cell systems for application in different buildings and geographic locations is presented. The study was performed at the NASA Lewis Center and comprised the fuel cell design, performance in different conditions, and the economic parameters. Applications in multifamily housing, stores and hospitals were considered, with a load of 10kW-1 MW. Designs were traced through system sizing, simulation/evaluation, and reliability analysis, and a computer simulation based on a fourth-order representation of a generalized system was performed. The cells were all phosphoric acid type cells, and were found to be incompatible with gas/electric systems and more favorable economically than the gas/electric systems in hospital uses. The methodology used provided an optimized energy-use pattern and minimized back-up system turn-on. M.S.K.

A82-24968 High temperature solid electrolyte fuel cell. H. Sato (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan). (*Sun Shine Journal*, vol. 2, no. 1, 1981, p. 26-37.) *Energy Developments in Japan*, vol. 4, Oct. 1981, p. 111-128. Translation.

The components, operating mechanisms, and material for the fabrication of high temperature solid electrolyte fuel cells are described, along with features of a working prototype. The solid electrolyte fuel cell operates at temperatures from 800-1000 C, allowing some impurities in the fuel, and necessitating larger sized units for economic operation. Stabilized zirconia is employed as an

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electrolyte with high ionic conductivity, and the movement of oxygen ions in relation to the lattice points is discussed. Porous electrodes composed of zirconia or nickel alloys are chosen as anodes. A tubular shaped structure for the prototype allows three layers of fuel electrode, electrolyte, and an air electrode on the outer surface of a porous substrate tube of Al, and fabrication steps of the cell are provided. An air electrode is used as the cathode, and an output of 12 W is achieved with a flat output characteristic curve, indicating a potential long life. M.S.K.

A82-25160 New connections for new technologies. N. Lihach, *EPRI Journal*, vol. 7, Jan.-Feb. 1982, p. 6-11, 13.

Problems and techniques and equipment for utilities to incorporate the electric output from small cogenerators, e.g. wind turbines, solar cells, and fuel cells, into grid quality power are examined. It is noted that currently available power conditioning systems are suitable only for multihundred MW power systems, and have no successful counterparts in the intermediate range. Applications of newly designed power conditioning units in fuel cells and battery installations, using state-of-the-art solid state circuitry, are reviewed. Specific mention is made of harmonics problems, including methods of phase-shaping, wave-shaping, and filtering specific harmonics. Procedures for eliminating electromagnetic impulses at the source are outlined, and the necessity for developing durable power conditioning systems, resistant to a variety of environmental hazards, are stressed, along with the requirements that remote power generation equipment reliably shut down when the utility grid cuts off power to that section due to damage. M.S.K.

A82-25523 High-efficiency millimetre-wave InP TEOs made by liquid phase epitaxy. K. H. Yen and J. J. Berenz (TRW Defense and Space Systems Group, Redondo Beach, CA). *Electronics Letters*, vol. 18, Feb. 18, 1982, p. 171, 172.

High-efficiency InP TEO devices have been fabricated by depositing gold-germanium contacts directly on thinned epitaxial layers using DC magnetron sputtering. The best RF performance has been obtained at 34 GHz for devices with an active layer length of 4.4 microns. The highest efficiency measured was 7.6% with 417 mW of power output at 34 GHz, the highest power output was 519 mW with 5.8% efficiency. V.L.

A82-25788 † Hydraulic models of flow in an MHD generator channel, based on the equations of a two-dimensional boundary layer (O gidravlicheskih modeliakh techeniia v kanale MGD-generatora, osnovannykh na uravneniakh ploskogo pogranichnogo sloia). V. A. Bitiurin, V. A. Zhelnin, G. A. Liubimov, and S. A. Medin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1982, p. 67-75. 10 refs. In Russian.

Flow in an MHD generator channel with a rectangular cross section is examined. It is assumed that the boundary layers on the walls of the channel are sufficiently thin, and that an inviscid core flow is present. It is shown that a hydraulic description of such a flow can be based on the two-dimensional turbulent boundary layer equations, which take into account the transverse inhomogeneities in the flow. Various aspects of the development of such hydraulic models are considered. B.J.

A82-25997 Wind tunnel tests on slow-running vertical-axis wind-rotors. S. Sivasegaram (Peradeniya, University, Peradeniya, Sri Lanka). *Indian Academy of Sciences, Proceedings (Engineering Sciences)*, vol. 4, Sept. 1981, p. 395-404. 17 refs.

This paper summarizes the results of investigations on the Savonius-type, slow-running, vertical-axis wind-rotors as well as on rotor designs on different subclasses under comparable design and test conditions. It is seen that the performance of the conventional Savonius rotor could be considerably improved upon and the best results are achieved by using two-bladed rotors with a more sophisticated sectional profile than in the conventional design. Rotors with several blades, although capable of considerably higher performance than the Savonius rotor, do not appear to be as good as those with two blades and improved sectional geometry. (Author)

A82-26178 # Power generation from the East Australian current by use of arrays of submerged Darrieus vertical axis turbines. K. D. Thomson (Defence Research Centre, Salisbury, Australia). In:

Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 35-38. 9 refs.

A82-26216 # Diffuser-augmented wind turbine analysis. C. A. J. Fletcher (Sydney, University, Sydney, Australia). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 435-438. 9 refs. Research supported by the National Energy, Research, Development, and Demonstration Council.

The performance of diffuser-augmented wind turbines has been established by matching the forces acting on a blade element to overall momentum and energy balances. This permits the radial variation, wake rotation and Reynolds number effects on the turbine blades to be taken into account. Good agreement with experimental data is obtained for both turbines and turbine-simulating screens. Optimising the pitch setting to take account of the total drag as well as the power output indicates that a substantial drag reduction with only a small loss of power output is possible; this is relevant to jet-stream electricity generation. (Author)

A82-26614 Design and performance of a small shrouded Cretan windwheel. P. D. Fleming and S. D. Probert (Cranfield Institute of Technology, Cranfield, Beds., England). *Applied Energy*, vol. 10, Feb. 1982, p. 121-139. 22 refs. Research supported by the Science and Engineering Research Council.

Test data for the performance of a shrouded Cretan-type sail mill are reported. The mill was chosen because of simplicity and low-cost considerations, for applications in developing countries. The mill had 9 sails, a 0.64 m diam cycle wheel as a rotor, and was tested in rim-attached and sail-with-pole configurations. Winds shape the sails into airfoil shapes, and the addition of the shroud to augment the wind flow boosted the power coefficient to close to the Betz limit. The sail-with-pole form, comprising a loosely sheeted sail with the leading edge wrapped around the spoke and fastened to itself was found to be a practical configuration for driving a peristaltic pump. Maximum power was obtained with a higher rotor speed than the rotor speed for maximum torque. Prospective uses for the shrouded sail mill are given as irrigation and land drainage, and for boosting the thermo-syphon in a domestic solar heating circuit. M.S.K.

A82-26769 † Increasing the dielectric strength of inter-electrode inserts in an MHD generator channel by air injection (Pro pidvishchennia elektrichnoi mitsnosti mizhelektrodnoi vstavki kanalu MGD-generatora vduvom povitria). E. T. Bazeev, N. I. Mazur, A. A. Miroshnichenko, and G. M. Schogolev (Akademiia Nauk Ukrain'skoi RSR, Institut Tekhnichnoi Teplofiziki i Institut Elektroinamiki, Kiev, Ukrainian SSR). *Akademiia Nauk Ukrain'skoi RSR, Dopovid, Seriia A - Fiziko-Matematichni ta Tekhnichni Nauki*, Feb. 1982, p. 71-73. 7 refs. In Ukrainian.

Interelectrode insulating inserts have been tested in the plasma dynamic channel of an MHD generator with and without air injection. It is found that the dielectric strength of inserts thermally protected by air injection is higher than that of inserts without air injection, with only a slight resistance drop (no more than 1% for commercial MHD channels). V.L.

A82-28024 EURELIOS, the world's first thermo-mechanical helioelectric power plant. J. Gretz (European Economic Community, Helioelectric Power Plant EURELIOS, Adrano, Italy). *Endeavour*, vol. 6, no. 1, 1982, p. 34-39. 8 refs.

Characteristics of the power source, design, costs and operating mechanisms and performance of the EURELIOS central receiver solar electric power plant are described. Noting that the solar input at the earth's surface is about 1 kW/sq m, 6200 sq m of float glass mirrors mounted on 182 heliostats were fabricated to focus the incoming radiation onto a receiver aperture atop a 55 m high tower. The curved mirrors permit the focus of 80% of the energy input to be deposited on a 2.2 m diam aperture which is equipped with heat exchangers imbedded in pyrex and darkened and finned to maximize absorption. Feedwater is superheated in the receiver and is transferred to a buffer tank of hot water at 19 bar and molten salt at 410 C, and then on to turbines for actual power production. The grid

serves as back-up power system. Total costs are calculated at \$1600/kWe. M.S.K.

A82-28313 Precision casting for gas turbine engines. C. W. Foster (Rolls-Royce, Ltd., London, England). *Aircraft Engineering*, vol. 54, Feb. 1982, p. 11-14.

The paper describes the gas turbine casting process in detail. High-temperature creep resistance is the property whose desirability most advances casting and materials technology. Vacuum melting and casting, directionally solidified (DS) casting, equi-axed and single-crystal casting are major developments in the progress of this technology. The vacuum process was used in the RB211-524 engine, while the DS process was employed in more advanced engines of the RB series. Rolls-Royce has built a new demonstration furnace whose melting unit, furnace chamber, withdrawal chamber, vacuum system, casting cycle, and control system are described. The future will bring increasing use of automation, production of more cast-to-size features, single-crystal castings application and process developments that will produce complex internal cooling configurations that are impossible today. C.D.

A82-28537 # Harnessing wind power. J. Fagenbaum. *Mechanical Engineering*, vol. 104, Apr. 1982, p. 64-73. 18 refs.

The design goals, test results, operating mechanisms, and ultimate limits of large wind energy conversion systems (WECS) are explored. NASA is currently managing and monitoring the performance of the Mod O, Mod OA, Mod 1, and Mod 2 wind turbines, which produce from 100 kW-2.5 MWe for grid interconnection. The Mod 2 machines have a 300 ft diam rotor, begin producing at 14 mph and achieve the rated output at 20 mph. Testing has shown the necessity of incorporating partial span pitch control, a flexible shaft, yaw control, microprocessor monitored wind condition sensors, and a soft-shell tower to lower vibration hazards with WECS. Large WECS have proved to be relatively nonpolluting, although some television and radio interference is present. Institutional issues for the protection of land, of aircraft flight paths, and for utility interconnect are outlined, and large WECS development programs in Denmark, Sweden, Spain, and Germany are described. M.S.K.

N82-16478*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

VARIABLE GAIN FOR A WIND TURBINE PITCH CONTROL Final Report

Robert C Seidel and Arthur G Birchenough Dec 1981 14 p refs

(Contract DE-AI01-76ET-20320)
(NASA-TM-82751: DOE/NASA/20320-34, E-1067) Avail
NTIS HC A02/MF A01 CSCL 10A

The gain variation is made in the software logic of the pitch angle controller. The gain level is changed depending upon the level of power error. The control uses low gain for low pitch activity the majority of the time. If the power exceeds ten percent offset above rated, the gain is increased to a higher gain to more effectively limit power. A variable gain control functioned well in tests on the Mod-0 wind turbine. T.M.

N82-16481*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

SUMMARY AND EVALUATION OF THE CONCEPTUAL DESIGN STUDY OF A POTENTIAL EARLY COMMERCIAL MHD POWER PLANT (CSPEC) Final Report

P. J. Staiger and P. F. Penko Jan. 1982 22 p refs

(Contract DE-AI01-77ET-10769)
(NASA-TM-82734: DOE/NASA/10769-21, E-1046) Avail
NTIS HC A02/MF A01 CSCL 10B

The conceptual design study of a potential early commercial

MHD power plant (CSPEC) is described and the results are summarized. Each of two contractors did a conceptual design of an approximately 1000 MWe open-cycle MHD/steam plant with oxygen enriched combustion air preheated to an intermediate temperature in a metallic heat exchanger. The contractors were close in their overall plant efficiency estimates but differed in their capital cost and cost of electricity estimates, primarily because of differences in balance-of-plant material, contingency, and operating and maintenance cost estimates. One contractor concluded that its MHD plant design compared favorably in cost of electricity with conventional coal-fired steam plants. The other contractor is making such a comparison as part of a follow-on study. Each contractor did a preliminary investigation of part-load performance and plant availability. The results of NASA studies investigating the effect of plant size and oxidizer preheat temperature on the performance of CSPEC-type MHD plants are also described. The efficiency of a 1000 MWe plant is about three points higher than of a 200 MWe plant. Preheating to 1600 F gives an efficiency about one and one-half points higher than preheating to 800 F for all plant sizes. For each plant size and preheat temperature there is an oxidizer enrichment level and MHD generator length that gives the highest plant efficiency. B.W.

N82-16483*# Engelhard Industries, Inc., Edison, N.J. Industries Div.

DEVELOP AND TEST FUEL CELL POWERED ON-SITE INTEGRATED TOTAL ENERGY SYSTEMS. PHASE 3: FULL-SCALE POWER PLANT DEVELOPMENT Quarterly Report, May - Jul. 1981

25 Aug. 1981 35 p refs

(Contracts DEN3-241; DE-AI01-80ET-17088)

(NASA-CR-165455: DOE/NASA/0241-2; QR-2) Avail: NTIS
HC A03/MF A01 CSCL 10B

A schematic and physical layout is given for the 5kW integrated system and the development status of individual components is described. The results of using a one dimensional mathematical model of the 5kW reformer are presented. Plans for a single-tube reformer test unit for the acquisition of temperature profile data are described. Tentative specifications for a 50kW dc-to-ac inverter are listed. Performance data are given on two 3-cell stacks incorporating semiautomatic acid replenishment systems and improved electrocatalysts. A qualification test on methanol/steam reforming catalyst T2107RS is reported, including a portion in which the catalyst was deliberately poisoned with 800 ppm ethanol in the feed. Author

N82-16485*# Ford Motor Co., Dearborn, Mich.

ADVANCED GAS TURBINE (AGT) POWERTRAIN SYSTEM INITIAL DEVELOPMENT REPORT Progress Report, 20 May - 24 Sep. 1979

Aug. 1980 150 p Prepared in cooperation with AirResearch Mfg. Co. Phoenix, Ariz

(Contract DEN3-37)

(NASA-CR-165130: DOE/NASA/0037-80/2.

DDA-ADR-10086) Avail. NTIS HC A07/MF A01 CSCL 10B

The powertrain consists of a single shaft regenerated gas turbine engine utilizing ceramic hot section components, coupled to a slit differential gearbox with an available variable stator torque converter and an available Ford integral overdrive four-speed automatic transmission. Predicted fuel economy using gasoline fuel over the combined federal driving cycle (CFDC) is 15.3 km/l, which represents a 59% improvement over the spark-ignition-powered baseline vehicle. Using DF2 fuel, CFDC mileage estimates are 17.43 km/l. Zero to 96.6 km/hr acceleration time is 11.9 seconds with a four-second acceleration distance of 210 m. The ceramic radial turbine rotor is discussed along with the control system for the powertrain. T.M.

N82-16495*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.

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THE NASA LEWIS LARGE WIND TURBINE PROGRAM

R L Thomas and D. H Baldwin 1981 24 p refs Presented at the 5th Biennial Wind Energy Conf and Workshop, Washington, D.C. 5-7 Oct. 1981

(Contract DE-AI01-79ET-20305)

(NASA-TM-82761; DOE/NASA/20305-7, E-1082) Avail NTIS HC A01/MF A01 CSCL 10B

The program is directed toward development of the technology for safe, reliable, environmentally acceptable large wind turbines that have the potential to generate a significant amount of electricity at costs competitive with conventional electric generation systems. In addition, these large wind turbines must be fully compatible with electric utility operations and interface requirements. Advances are made by gaining a better understanding of the system design drivers, improvements in the analytical design tools, verification of design methods with operating field data, and the incorporation of new technology and innovative designs. An overview of the program activities is presented and includes results from the first and second generation field machines (Mod-OA, -1, and -2), the design phase of the third generation wind turbine (Mod-5) and the advanced technology projects. Also included is the status of the Department of Interior WTS-4 machine. T.M

N82-16522# Power Technologies, Inc., Schenectady, N Y DYNAMICS OF SINGLE- AND MULTI-UNIT WIND-ENERGY CONVERSION PLANTS SUPPLYING ELECTRIC UTILITY SYSTEMS

E. N Hinrichsen and P. J Nolan Aug 1981 141 p refs

(Contract DE-AC01-78ET-20466)

(DE82-000666, DOE/ET-20466/78/1) Avail NTIS HC A07/MF A01

The development of large wind turbine generators (WTGs) and their integration into electric power systems is accelerating. Since wind is neither as steady nor as dense a form of energy as steam or water, wind turbine generators differ greatly in construction and operation from steam and hydro turbine generators. The dynamic behavior of WTGs connected to utility power systems, was examined. DOE

N82-16525# Mathematical Sciences Northwest, Inc., Bellevue, Wash

ENERGY EXCHANGER PERFORMANCE AND POWER CYCLE EVALUATION, EXPERIMENTS AND ANALYSIS Final Report, 23 May 1978 - 31 Dec. 1980

W J Thayer, III, Robert T. Taussig, John F. Zumdieck, Thinius S Vaidyanathan, and Walter H. Christiansen Apr 1981 161 p refs

(Contract DE-AC06-78ER-01084)

(DE82-001069, DOE/ER-01084/T1) Avail NTIS HC A08/MF A01

The energy exchanger, or pressure exchanger, is a rotating, axial flow machine which utilizes unsteady gasdynamic processes to directly transfer work between two gas streams. A program which has provided technology required for the development of efficient energy exchangers for power operation applications is described. The program contains three major elements: testing of a laboratory scale device, development of an energy exchanger flow model, and analysis of potential applications in advanced power generation cycles. The test energy exchanger was developed and tested over a range of operating conditions. This device transferred approximately 100 kW of mechanical power between two gas streams by simultaneously expanding one stream and compressing the other through pressure ratios of approximately 2.5. The efficiency of this transfer process was as high as 74%. DOE

N82-16547# FDO Technische Adviseurs B.V. (Netherlands) EXCHANGE OF NATIONAL EXPERIENCE IN THE FIELD OF NEW ENERGY SOURCES: IN PARTICULAR, SOLAR, WIND, AND GEOTHERMAL ENERGY: THE 25 m EXPERIMENTAL HORIZONTAL AXIS WIND TURBINE (25 m HAT)

G. B Geerdink Oct. 1980 19 p Presented at the Sem. on Technol. Related to New Energy Sources, Juelich, West Germany, 8-12 Dec. 1980; sponsored by the Senior Advisers to ECE Governments on Science and Technology. Sponsored by the Government of the Netherlands. Prepared for the United Nations Economic Commission for Europe

(PB81-239568; UN-ECE-SC-TECH-SEM-7-R-6) Avail NTIS HC A02/MF A01 CSCL 10B

The design of the wind generator, its rotor's capabilities, electricity generated, safety, various loadings, and instrumentation

are discussed. Overall dimensions and weight of components, the characteristics of the electrical system, of the yard mechanism and others are given in detail, including photos, drawings and graphs. GRA

N82-16900# Argonne National Lab., Ill.

MHD HEAT AND SEED RECOVERY TECHNOLOGY PROJECT Quarterly Report, Oct. - Dec. 1980

Michael Petrick and Terry R. Johnson Jul 1981 45 p refs

(Contract W-31-109-eng-38)

(DE82-001608; ANL/MHD-81-1; QR-12) Avail: NTIS

HC A03/MF A01

Experimental investigations are being conducted or planned in the following of critical problem areas: (1) corrosion and erosion of refractories and metal alloys; (2) NO/sub x/ behavior in the radiant boiler and secondary combustor; (3) radiant boiler design to meet the multiple requirements of steam generation, NO/sub x/ decomposition, and seed-slag separation; (4) effects of solid or liquid seed deposits on heat transfer and gas flow in the steam and air heaters; (5) formation, growth, and deposition of seed-slag particles, and (6) character of the combustion gas effluents. DOE

N82-16901# Argonne National Lab., Ill. Engineering Div.

TECHNICAL SUPPORT FOR OPEN-CYCLE MHD PROGRAM Progress Report, Jan. - Mar. 1980

G F Berry, ed. Jul. 1981 110 p refs

(Contract W-31-109-eng-38)

(DE82-001955; ANL/MHD-80-6) Avail: NTIS HC A06/MF A01

The development of analytical tools needed for investigating the performance of the major components in the combined cycle MHD/steam power system is described. The analytical effort is centered on the primary components of the system that are unique to MHD and, also, on the integration of these analytical models into a model for the entire power producing system. The present project activities include modeling of the secondary combustor, generator, radiant boiler, and formation and decomposition of NO. The results of preliminary off design studies and of system optimization studies are presented, and analysis of the U-25B generator performance, which was done in support of the proposed test plan, is included. Refinements and improvements in the MHD systems code and executive program are considered. DOE

N82-16937*# AiResearch Mfg Co., Phoenix, Ariz

ADVANCED GAS TURBINE (AGT) POWERTRAIN SYSTEM DEVELOPMENT FOR AUTOMOTIVE APPLICATIONS Progress Report, Oct. 1979 - Jun. 1980

Nov. 1980 431 p refs

(Contract DEN3-167)

(NASA-CR-165175, DOE/NASA/0167-80/1;

AiResearch-31-3725; PR-1) Avail: NTIS HC A19/MF A01 CSCL 13F

Progress in the development of a gas turbine engine to improve fuel economy, reduce gaseous emissions and particulate levels, and compatible with a variety of alternate fuels is reported. The powertrain is designated AGT101 and consists of a regenerated single shaft gas turbine engine, a split differential gearbox and a Ford Automatic Overdrive production transmission. The powertrain is controlled by an electronic digital microprocessor and associated actuators, instrumentation, and sensors. Standard automotive accessories are driven by engine power provided by an accessory pad on the gearbox. Component/subsystem development progress is reported in the following areas: compressor, turbine, combustion system, regenerator, gearbox/transmission, structures, ceramic components, foil gas bearing, bearings and seals, rotor dynamics, and controls and accessories. J.M.S.

N82-17180# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France)

INFLUENCE OF CORRELATIONS AND COMPUTATIONAL METHODS ON THE PREDICTION OF OVERALL EFFICIENCY

In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 29-31 refs

Avail: NTIS HC A15/MF A01

The process of designing a gas turbine or a steam turbine begins with an evaluation of the influence of component design parameters on the overall cost. For both the steam turbine and

the gas turbine, energy costs are rapidly increasing and component efficiency is therefore a primary design objective. For the aircraft gas turbine, the weight of the component influences the fuel consumption and is therefore also an important energy cost consideration. Turbine efficiency predictions, together with information which influence the weight and cost, were obtained from flow field calculations which define the thermodynamic properties and velocity triangles throughout the turbine. These computational methods may be full span through flow calculations which predict the fluid properties from the hub to the tip between each blade row or they may be mean line calculations. In either case they are dependent upon loss and deviation models for their effectiveness in the efficiency optimization stage of the design process. The loss and deviation correlations which are in common use by steam turbine and gas turbine manufacturers are frequently developed internally and are maintained as proprietary information. The overall efficiency predictions which are discussed are therefore limited to results obtained using the correlations built into the methods which are described. T M

N82-17203# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

HELICOPTER PROPULSION SYSTEMS

Sep. 1981 277 p refs Partly in ENGLISH, partly in FRENCH Meeting held in Toulouse, 11-14 May 1981 (AGARD-CP-302, ISBN-92-835-0299-X) Avail: NTIS HC A13/MF A01

Component technology for turboshaft engines and transmissions, inlet protection systems, engine-airframe dynamic compatibility, and future requirements are described. For individual titles, see N82-17204 through N82-17225.

N82-17204# Textron Bell Helicopter, Fort Worth, Tex

HELICOPTER PROPULSION SYSTEMS: PAST, PRESENT AND FUTURE

Robert R. Lynn and Gordon E. Holbrook In AGARD Helicopter Propulsion Systems Sep 1981 12 p refs

Avail: NTIS HC A13/MF A01

Helicopter propulsion systems are reviewed, and it is noted that helicopter development is paced to a major extent by the power plant. Power available, reliability, fuel consumption, power-to-weight ratio, and life cycle costs are key parameters. The application of emerging technologies such as microelectronics, ceramics and other new materials and approaches, and the continuing refinement of the aerodynamics and dynamics of gas turbine power plants are discussed and noted to result in a significant benefit to the helicopter and its operator. Important airframe-propulsion system interface requirements are given, and the need is discussed for new innovative certification procedures that provide for emergency operation with acceptable economics. Finally, future propulsion system capabilities are projected and their dramatic benefit for the helicopter noted. Author

N82-17208# Rolls-Royce Ltd., Leavesden (England).

MECHANICAL ADVANCES IN THE DESIGN OF SMALL TURBOSHAFT ENGINES

J. Dornay and K. J. Hart In AGARD Helicopter Propulsion Systems Sep. 1981 12 p

Avail: NTIS HC A13/MF A01

Mechanical components have a significant influence on the efficiency of a small gas turbine engine. Some of the performance losses associated with the design of the power transmission and internal air system are defined and discussed. Improvements in engine efficiency must be considered in conjunction with cost, reliability and size or weight. Many of the problems considered are applicable to gas turbines in general but become acute in small engines due to the adverse effects of scale on many components design parameters. To meet the increasing demand for more efficient powerplants the mechanical research engineer must improve the analysis of mechanical component behavior to produce optimized engine designs. Author

N82-17211# Avco Lycoming Div., Stratford, Conn Preliminary Design and Advanced Programs

AERODYNAMIC COMPONENTS FOR SMALL TURBOSHAFT ENGINES

J. W. Schrader and W. F. Schneider In AGARD Helicopter Propulsion Systems Sep. 1981 15 p

Avail: NTIS HC A13/MF A01

Future developments of advanced helicopter engines are projected from an aerothermodynamic viewpoint. Cycles for engines aiming at lower specific fuel consumption, improved power lapse rates, and implementation of contingency ratings are discussed. These cycles include nonregenerative and regenerative cycles. Design trends are presented for the major engine aerodynamic components. Author

N82-17459# Open Univ., Milton (England) Energy Research Group.

EVALUATION OF THE DESIGN, CONSTRUCTION AND OPERATION OF A GAS FUELED ENGINE DRIVEN HEAT PUMP

C. A. Phillips Jan 1981 76 p refs (ERG-034) Avail: NTIS HC A05/MF A01

The design, construction, testing, and evaluation of a gas fueled engine driven heat pump are considered. The heat pump, using air as its source of heat is driven by a 360 cc single cylinder marine engine converted to run on natural gas. The unit was built, installed in a laboratory, and underwent intensive performance testing. The heat pump works well and justifies the design assumptions made, having allowed for a poor performance from the particular engine used. At 6 C (ambient) an output of 14 kW with an overall efficiency or C.O.P. (total heat output/gas input) of 1.1 was achieved. Results compare favorably with a seasonal efficiency of a gas boiler of around 0.65 to 0.70. J.M.S

N82-17536# Messerschmitt-Boelkow-Blohm G m b H, Otto-brunn (West Germany) Unternehmensbereich Drehfluegler und Verkehr

STRESS ANALYSIS AND TEST PHILOSOPHY FOR WIND ENERGY CONVERTER BLADES

H. Bansemir and K. Pfeifer 1980 28 p Presented at 4th Meeting of Experts on Rotor Blade Technol with Special Respect to Fatigue Design Probl., Stockholm, 21-22 Apr 1980 (NBB-UD-300-80-0) Avail: NTIS HC A03/MF A01

Projected wind energy converter blades for a 5MW plant are described and analyzed. The calculation of laminate cross-section properties as well as the overall behavior of the blade is considered. Special attention is given to the bolted area and to the compression stresses in the blade, because it is mainly loaded by bending moments. Tests performed in order to obtain basic data of the materials used in the design are discussed. Special components such as the bolted area are tested by static and dynamic loads. Finally the strains in the entire blade under load and the eigenfrequencies are measured. A.R.H.

N82-17606*# Mathematical Sciences Northwest, Inc., Bellevue, Wash

OVERVIEW STUDY OF SPACE POWER TECHNOLOGIES FOR THE ADVANCED ENERGETICS PROGRAM

R. Taussig, S. Gross, A. Milner, M. Neugebauer, W. Phillips, J. Powell, E. Schmidt, M. Wolf, and G. Woodcock Oct 1981 341 p refs (Contract NAS3-22477)

(NASA-CR-165269, MSNW-1169) Avail: NTIS HC A15/MF A01 CSCL 10B

Space power technologies are reviewed to determine the state-of-the-art and to identify advanced or novel concepts which promise large increases in performance. The potential for increased performance is judged relative to benchmarks based on technologies which have been flight tested. Space power technology concepts selected for their potentially high performance are prioritized in a list of R & D topical recommendations for the NASA program on Advanced Energetics. The technology categories studied are solar collection, nuclear power sources, energy conversion, energy storage, power transmission, and power processing. The emphasis is on electric power generation in space for satellite on board electric power, for electric propulsion, or for beamed power to spacecraft. Generic mission categories such as low Earth orbit missions and geosynchronous orbit missions are used to distinguish general requirements placed on the performance of power conversion technology. Each space power technology is judged on its own merits without reference to specific missions or power systems. Recommendations include 31 space power concepts which span the entire collection of technology categories studied and represent the critical technologies needed for higher power, lighter weight, more efficient power conversion in space. Author

N82-17615*# Stonehart Associates, Inc., Madison, Conn

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PREPARATION AND EVALUATION OF ADVANCED ELECTROCATALYSTS FOR PHOSPHORIC ACID FUEL CELLS Quarterly Report, Oct. - Dec. 1981

Paul Stonehart, John Baris, John Hochmuth, and Peter Pagliaro Dec. 1981 44 p
(Contract DEN3-176, Contract DE-AI03-80ET-17088)
(NASA-CR-165594, DOE/NASA/0176-81/5, QR-8) Avail:
NTIS HC A03/MF A01 CSCL 10A

Two cooperative phenomena are required the development of highly efficient porous electrocatalysts (1) is an increase in the electrocatalytic activity of the catalyst particle, and (2) is the availability of that electrocatalyst particle for the electromechanical reaction. The two processes interact with each other so that improvements in the electrochemical activity must be coupled with improvements in the availability of the electrocatalyst for reaction. Cost effective and highly reactive electrocatalysts were developed. The utilization of the electrocatalyst particles in the porous electrode structures was analyzed. It is shown that a large percentage of the electrocatalyst in anode structures is not utilized. This low utilization translates directly into a noble metal cost penalty for the fuel cell. E.A.K.

N82-17617# Kernforschungsanlage, Juelich (West Germany) IMPLEMENTING AGREEMENT FOR A PROGRAM OF RESEARCH AND DEVELOPMENT ON WIND ENERGY CONVERSION SYSTEMS

Apr 1981 109 p refs Partly in ENGLISH and GERMAN Presented at 1981 Meeting of Experts of Annex 3 and 3a on Integration of Wind Power into Natl Elec Supply Systems, Regensburg, West Germany, 29-30 Jan. 1981 Sponsored by Bundesministerium fuer Forschung und Technol. and Regensburg Univ., West Germany
(Juel-Spez-108, ISSN-0343-7639) Avail: NTIS HC A06/MF A01

The technical and economic feasibility of wind power electric generation in Germany and the Netherlands is discussed. Problems of power output fluctuations are considered. For individual titles, see N82-17618 through N82-17625.

N82-17621# Regensburg Univ. (West Germany) Forschungsprojekt Windenergie. ASSESSMENT OF THE POTENTIAL OF LWECs IN THE NETHERLANDS

W. Dub *In* Kernforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 41-62 refs

Avail: NTIS HC A06/MF A01

The potential of large wind energy conversion systems (LWECs) in the Netherlands is assessed. Hourly data on mean wind speeds and wind directions from 5 stations are analyzed and extrapolated up to a height of 100 m and monthly and annual mean wind speeds. The wind power conversion efficiency of wind turbines and the monthly and annual energy production of WECS 1 are calculated. The daily wind energy production of a compound system of 3 MW wind turbines and the daily percentages of the 1980 national electric power needs they would meet are determined using 1975 wind data. The number of 3 MW and 0.8 MW wind turbines required to produce 9.97 TWh per year is determined. J.D.H.

N82-17622# Regensburg Univ. (West Germany) Forschungsprojekt Windenergie.

POWER FLUCTUATIONS: TECHNICAL AND STATISTICAL ASPECTS

H. Pape *In* Kernforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 63-70 refs

Avail: NTIS HC A06/MF A01

Electric power output fluctuations from wind turbines occurring within minutes are considered. Means of regulating the fluctuations are discussed. A statistical proof that an increasing number of wind turbines tends to generate a more regular power output than each individual wind turbine is presented. J.D.H.

N82-17623# Regensburg Univ. (West Germany) Forschungsprojekt Windenergie.

FORECASTING WIND POWER OUTPUT

W. Dub *In* Kernforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion

Systems Apr 1981 p 71-80 refs

Avail: NTIS HC A06/MF A01

Long term forecasts of electric energy output from wind power are presented. Periods of 2-6 hours, 6-12 hours, 12-24 hours, and 24-48 hours are considered. The prediction of wind speed is discussed. It is determined that, having a good estimator of the mean wind speed $V_{sub T}$ for a planning period T , the mean wind power output will be underestimated, so long as the wind speed used is the range of cut-in and rated speeds. J.D.H.

N82-17624# Regensburg Univ (West Germany). Forschungsprojekt Windenergie.

ASSURED LOAD CARRYING CAPABILITY AND CAPACITY CREDIT

H. Pape *In* Kernforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr 1981 p 81-95 refs

Avail: NTIS HC A06/MF A01

The determination of assured load carrying capability and the capacity credit for use in planning windpowered electric generation facilities is considered. Calculation of the available capacity of thermal power plants is described and compared with calculation of available capacity for wind turbines, taking into account outages caused by the unavailability of the primary energy, wind. The assured load carrying capability of power plants is defined. An operational definition of the capacity credit of wind turbines as related to a fixed time t ϵ T is presented and extended to the period T . J.D.H.

N82-17625# Gesamthochschule, Kassel (West Germany) Fachbereich Elektrotechnik.

POSSIBILITIES FOR AVOIDING STRONG VARIATIONS OF THE ELECTRICAL OUTPUT POWER OF WIND ENERGY SYSTEMS [MOEGLICHKEITEN ZUR VERMEIDUNG VON STARKEN SCHWANKUNGEN DER ELEKTRISCHEN ABGABELEISTUNG VON WINDENERGIEANLAGEN]

G. Cramer *In* Kernforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 96-99 refs

Avail: NTIS HC A06/MF A01

The conversion of the kinetic energy of wind into electric power through wind powered converters by the primary energy of atmospheric circulation speed is discussed. It is suggested that wind powered generators which work with the supply network should avoid overloading the installation from wind performance caused by a fast change of the blade pitch. There are possibilities to achieve numerical comparison of the temporary storage performance of kinetic energy by application of rotating masses with flywheels, which allow for rotation speed variations. Through the feed of direct or alternate current in the rotor cycle form asynchronous machines with slip rings or through the influence of the slip performance a speed of variable duty on the network is accomplished. E.A.K.

N82-17637# Stuttgart Univ (West Germany) Inst. fuer Statik und Dynamic.

STATIC AND DYNAMIC INVESTIGATIONS OF DIFFERENT TOWERS FOR WIND TURBINES Final Report

J. H. Argyris and K. A. Braun 1980 125 p refs Transl. into ENGLISH of "Statische und dyn. untersuch. verschiedener tuerme fuer windturbinen" Rept ISD-261 Stuttgart Univ., Stuttgart, 1979 122p Original report in GERMAN previously announced as N81-12628 Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-274; ISD-261; ISSN-0170-6071) Avail: NTIS HC A06/MF A01

The kinematics of a cantilevered, a conventional guyed, and a compliant (elastic column held by a rigid framework) tower were studied. The static layout of the towers is established, using the reactions due to different gusts which a two-bladed rotor (120 m diameter) imposes on a rigid support as external loads. The rotor blades are assumed to be inelastic. Each one has a flapping hinge and a flap-pitch coupling. Dynamic responses were calculated by the finite element method. The guyed tower is superior to the cantilevered one. A 10.4 deg inclination angle seems best for the compliant tower, but more dynamic and

stability analyses are needed before undertaking further tower geometry optimization
Author (ESA)

N82-17638# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

ROTOR MODEL FOR THE VERIFICATION OF COMPUTATIONAL METHODS Final Report

J. H. Argyris, W. Aicher, F. Karl, W. Kuemmerle, and M. Mueller 1980 66 p refs Sponsored in cooperation with International Energy Agency (Contract BMFT-ET-4086-A) (ISD-275; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

A windmill rotor model with 7.3 m rotor diameter was constructed in order to test a data acquisition/transmission system and computational models. Data, e.g., strains, angles, linear movements, accelerations, are measured at the rotor, digitized, and transmitted optoelectronically. Measurements of rotor blade dynamic response to cyclic gravity loading are compared with theoretical values. Deviation between measurements and calculations is 11%.
Author (ESA)

N82-17639# Stuttgart Univ. (West Germany) Inst. fuer Statik und Dynamik.

STATIC INVESTIGATIONS OF ROTOR BLADES UNDER DEADWEIGHT AND DURING STATIONARY OPERATION Final Report

J. H. Argyris, K. A. Braun, and B. Kirchgassner 1980 62 p refs Transl into ENGLISH of "Statische untersuch. von rotorblatetern unter eigengewicht und im stationaeren betrieb" Rept ISD-243 Stuttgart Univ., Stuttgart, 1979 57 p Original report in GERMAN previously announced as N82-17639 Sponsored in cooperation with International Energy Agency (Contract BMFT-ET-4086-A) (ISD-269; ISD-243, ISSN-0170-6071) Avail: NTIS HC A04/MF A01

Several rotorblades of a horizontal axis windmill are studied both nonoperating under deadweight, and under quasi-stationary loading with constant forces at rated operation, the blades of which have flap and lead-lag freedom as well as flap-pitch coupling. With a suitable mass distribution it is possible to reduce the blade bending moments in the flap direction drastically. The use of aircraft construction materials is considered. Carbon fiber reinforced plastic is the most suitable. Most of the blade models are investigated without lag hinge. The coning angle of rated operation assumed for the layout is reduced considerably for the blade models with lead-lag freedom in order to obtain sufficient centrifugal stiffness in the lag direction.
Author (ESA)

N82-17640# Stuttgart Univ. (West Germany) Inst fuer Statik und Dynamik

STABILITY AND RESPONSE TO GRAVITY OF THE FLAP LAG MOTION FOR A RIGID ROTOR BLADE WITH FLAP-PITCH COUPLING Final Report

J. H. Argyris and B. Kirchgassner 1980 59 p refs Transl. into ENGLISH of "Stabilitaet und schwerkraftresponse der schlag-schwenkbewegung eines starren rotorblattes mit blattwinkelruecksteuerung" Rept ISD-244 Stuttgart Univ., Stuttgart, 1979 80 p Original report in GERMAN announced as N80-30949 Sponsored in cooperation with International Energy Agency (Contract BMFT-ET-4086-A) (ISD-270; ISD-244; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

The coupled flap lag motion of a single, rigid rotor blade of a wind energy converter with flap and lag hinges and a coupling of the angle of attack with the flap motion is investigated. The equations of motion are developed under the assumption of linearized quasi-stationary aerodynamic forces. Static and dynamic stability of the coupled flap and lag motion are investigated. The equations are integrated for different cases under cyclic gravitational forces in order to estimate the importance of nonlinear terms and of the error resulting from the linearization of the conservative system. The nonlinear terms can be neglected, as can the effects of cyclic stiffness resulting from gravitational force. Results for nonlinearities arising from aerodynamic forces are inconclusive.
Author (ESA)

N82-17641# Stuttgart Univ. (West Germany) Inst fuer Statik und Dynamik

DYNAMIC ANALYSIS OF A ROTOR BLADE WITH FLAP AND LAG FREEDOM AND FLAP-PITCH COUPLING Final Report

J. H. Argyris, K. A. Braun, and B. Kirchgassner 1980 103 p

refs Transl. into ENGLISH of "Dyn. anal. eines rotorblattes mit schlagfreiheit, schwenkfreiheit u. blattwinkelruecksteuerung" Rept. ISD-258 Stuttgart Univ., Stuttgart, 1979 95 p Original report in GERMAN previously announced as N80-30950 Sponsored in cooperation with International Energy Agency (Contract BMFT-ET-4086-A)

(ISD-271; ISD-258; ISSN-0170-6071) Avail: NTIS HC A06/MF A01

For a windmill rotor blade, a linearized system of differential equations of motion is developed, using a finite element idealization of linearized quasi-stationary aerodynamic forces. Constant rotational speed and a rigidly supported hub are assumed. For two rotor blade models, which differ only in their stiffness in lag direction, the complex eigenfrequencies are calculated. The dynamic response of the rotor blades is computed for cyclic gravity loads at rated operation, for a gust, and, in one case, for the tower wake. From the deformation of the structure the stresses at selected points along the blade are calculated. Torque and rotor thrust are determined for one model. Additional stiffness improves stability and lead-lag angles. The coning angle is excellently stabilized by the flap-pitch coupling.
Author (ESA)

N82-17642# Stuttgart Univ. (West Germany) Inst. fuer Statik und Dynamik.

STATIC AND DYNAMIC INVESTIGATIONS FOR THE MODEL OF A WIND ROTOR Final Report

J. H. Argyris, K. A. Braun, B. Kirchgassner, and R. Walther 1980 71 p refs Transl into ENGLISH of "Statische und dyn. untersuch. und einem windrotormodell" Rept ISD-259 Stuttgart Univ., Stuttgart, Jun. 1979 69 p Original report in GERMAN previously announced as N81-12626 Sponsored in cooperation with International Energy Agency (Contract BMFT-ET-4086-A) (ISD-272; ISD-259, ISSN-0170-6071) Avail: NTIS HC A04/MF A01

A wind rotor was constructed in order to test a data acquisition/transfer system which collects experimental data from the operating model and displays it on a screen. The comparison between the experimental data and the model results is used to check the applied computation methods. The static and dynamic analyses of the rotor model are considered. An 11% difference between experimental and model results is shown. A response problem with variable stiffness in time which arose during the dynamic analysis is solved by setting the structural stiffness constant over small time intervals, diagonalizing the time interval considered and integrating. After integration the solutions of the generalized degrees of freedom are transformed back into the physical system, using the time interval eigenvectors.
Author (ESA)

N82-17643# Stuttgart Univ. (West Germany). Inst fuer Statik und Dynamik.

LOADING CYCLES AND MATERIAL DATA FOR THE LAYOUT OF A WIND TURBINE OF SPECIAL HUB CONCEPT Final Report

J. H. Argyris and K. A. Braun 1980 38 p refs Transl. into ENGLISH of "Lastwechselzahlen und materialwerte fuer die auslegung einer windturbinen spezieller nabenkonstruktion" Rept ISD-260 Stuttgart Univ., Stuttgart, Jun. 1979 38 p Original report in GERMAN previously announced as N81-12627 Sponsored in cooperation with International Energy Agency (Contract BMFT-ET-4086-A) (ISD-273; ISD-260; ISSN-0170-6071) Avail: NTIS HC A03/MF A01

The number of loading cycles of a rotor blade was estimated in order to assess allowable blade stress. Fatigue strengths and allowable stresses are calculated for aeronautic construction materials. Using wind data, the number of starts and stops was estimated. With a guess for the number of revolutions necessary to reach stationary operation from standstill, the number of loading cycles was determined, using the blade aerodynamics. The number of operational hours gives the number of loading cycles for rated operation. Rotation speeds of 1.67 and 2 rad/sec are considered. For 1.67, the number of loading cycles during stationary operation = 2.06×10^8 to the 8th power, during starts and cut offs = 357,000. For 2 rad/sec, results are 2.47×10^8 to the 8th power and 463,000. Stress values, expressed in installed power/sqmm, are: aluminum alloy = 98, stainless steel = 294, glass fiber reinforced plastic = 98; and carbon fiber reinforced plastic = 147.
Author (ESA)

N82-17646# World Meteorological Organization, Geneva

05 ENERGY CONVERSION

(Switzerland).

METEOROLOGICAL ASPECTS OF THE UTILIZATION OF WIND AS AN ENERGY SOURCE

1981 201 p refs

(WMO-575; ISBN-92-63-10575-8; WMO-TN-175) Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 40

The application of meteorological data and knowledge to the planning and operation of wind energy conversion systems (WECS) is discussed. The development of WECS and WMO activities related to energy matters, with special regard to wind energy, is reviewed. Atmospheric circulation systems of various scales, atmospheric turbulence, and the boundary layer are considered, including numerical models. Wind energy technology, i.e., the different types of wind machines (both small and large conversion systems) together with their usual possibilities of application, and the environmental impact of WECS, which should be kept in mind in the planning stage in order to reduce it to a minimum, are treated. As to wind energy meteorology, the requirements for, and the availability of, meteorological data for use in the exploratory, planning and operational phases of WECS are determined. The economic aspects of deciding on the establishment of wind energy systems are also indicated. A world map, illustrating the global distribution of potential wind energy is included. Author (ESA)

N82-18123# Tokyo Univ. (Japan).

AN EXTENSION OF THE LOCAL MOMENTUM THEORY TO THE ROTORS OPERATING IN TWISTED FLOW FIELD

Akira Azuma, Ken-ichi Nasu, and Takatoshi Hayashi /n DGLR Seventh European Rotorcraft and Powered Lift Aircraft Forum 1981 19 p refs

Avail: NTIS HC A99/MF A01

The local momentum theory was developed to calculate the dynamic airloading of a helicopter rotor, where the velocity perpendicular to the plane of rotation was assumed to be negligibly low in comparison with the rotating velocity. In the case of propellers or windmills, however, this assumption is no longer adequate, and the flow field seen in the rotor-fixed-coordinate system is noticeably twisted along the span. In order to permit calculation of the induced velocity distribution as well as the airloading of the blade in such a twisted flow field, we have carried out an extension of the local momentum theory. Since our method of calculation is based on the instantaneous circulation distribution rather than the instantaneous momentum balance, it may be called the Local Circulation Method. The present method is also applicable to propellers and windmills in yawed flow.

Author

N82-18127# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastik.

MODAL CHARACTERISTICS OF ROTOR BLADES: FINITE ELEMENT APPROACH AND MEASUREMENT BY GROUND VIBRATION TEST

D. Ludwig /n DGLR Seventh European Rotorcraft and Powered Lift Aircraft Forum 1981 23 p refs

Avail: NTIS HC A99/MF A01

The mass and stiffness matrices for a rotating blade are established by the finite element method. The formulation is based on the Lagrange function for combined flapwise bending, chordwise bending, and torsion of twisted nonuniform rotor blades. The element matrices are created by the non-numeric computer program REDUCE. An ordering scheme was introduced to demonstrate which terms may be simplified or neglected. As examples, eigen analyses, with the finite element computer program, are performed for a homogeneous beam and for the nonrotating blade of a wind energy converter. The results of the calculations for the beam are compared with the analytical solutions. The rotor blade of the wind energy converter was tested in a ground vibration test. A short description of the ground vibration test technique and performance is given. N.W.

N82-18128# Hochschule der Bundeswehr, Munich. (West Germany). Inst. fuer Luftfahrttechnik und Leichtbau

DYNAMIC AND AEROELASTIC CHARACTERISTICS OF COMPLETE WINDTURBINE SYSTEMS

E. W. Steinhardt /n DGLR Seventh European Rotorcraft and Powered Lift Aircraft Forum 1981 16 p refs

Avail: NTIS HC A99/MF A01

For the investigation of the dynamic and aeroelastic characteristics of large horizontal axis windturbines, a hybrid model consisting of rigid bodies and flexible continuous structures was developed. Degrees of freedom include tower bending and torsion, pitch and yaw of the nacelle as well as rotation, inplane and out-of-plane bending of the blades. Aerodynamic forces are introduced with special regard to motion-induced effects and on gusts. A set of partial integro-differential equations was established via the principle of virtual work. The application of Galerkin's extended method gives a system of linear periodic differential equations. The numerical results confirm strong rotor-tower-coupling and illustrate the typical features of periodic systems. Instantaneous aerodynamic terms are found to be of minor importance and hingeless rotors will be damped better than teetering rotors, but tower and blade reactions to gravity and gusts are higher. Author

N82-18693*# Structural Composites Industries, Inc., Azusa, Calif

DESIGN, EVALUATION, AND FABRICATION OF LOW-COST COMPOSITE BLADES FOR INTERMEDIATE-SIZE WIND TURBINES Final Report

Oscar Weingart Sep 1981 210 p refs

(Contracts DEN3-100: DE-A101-79ET-20320)

(NASA-CR-165342; DOE/NASA/0100-1; SCI-81520) Avail: NTIS HC A10/MF A01 CSCL 10A

Low cost approaches for production of 60 ft long glass fiber/resin composite rotor blades for the MOD-OA wind turbine were identified and evaluated. The most cost-effective configuration was selected for detailed design. Subelement and subscale specimens were fabricated for testing to confirm physical and mechanical properties of the composite blade materials, to develop and evaluate blade fabrication techniques and processes, and to confirm the structural adequacy of the root end joint. Full-scale blade tooling was constructed and a partial blade for tool and process tryout was built. Then two full scale blades were fabricated and delivered to NASA-LeRC for installation on a MOD-OA wind turbine at Clayton, New Mexico for operational testing. Each blade was 60 ft. long with 4.5 ft. chord at root end and 2575 lbs weight including metal hub adapter. The selected blade configuration was a three cell design constructed using a resin impregnated glass fiber tape winding process that allows rapid wrapping of primarily axially oriented fibers onto a tapered mandrel, with tapered wall thickness. The ring winder/transverse filament tape process combination was used for the first time on this program to produce entire rotor blade structures. This approach permitted the complete blade to be wound on stationary mandrels, an improvement which alleviated some of the tooling and process problems encountered on previous composite blade programs. Author

N82-18694*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.

ASSESSMENT OF STEAM-INJECTED GAS TURBINE SYSTEMS AND THEIR POTENTIAL APPLICATION

Robert J Stochl Feb 1982 21 p refs

(NASA-TM-82735; E-1047) Avail: NTIS HC A02/MF A01 CSCL 10B

Results were arrived at by utilizing and expanding on information presented in the literature. The results were analyzed and compared with those for simple gas turbine and combined cycles for both utility power generation and industrial cogeneration applications. The efficiency and specific power of simple gas turbine cycles can be increased as much as 30 and 50 percent, respectively, by the injection of steam into the combustor. Steam-injected gas turbines appear to be economically competitive with both simple gas turbine and combined cycles for small, clean-fuel-fired utility power generation and industrial cogeneration applications. For large powerplants with integrated coal gasifiers, the economic advantages appear to be marginal. T.M.

N82-18704# Ecole Polytechnique, Montreal (Quebec). Center de Developpement Technologique

CALCULATION OF THERMODYNAMIC EQUILIBRIA IN THE CARBONATE FUEL CELL, VOLUME 1. TASK 1: BINARY TERNARY AND QUATERNARY PHASE DIAGRAMS CONTAINING Li(+), Na(+), K(+), CO3(=), SO3(=) AND OH(-) Final Report

A. D. Pelton, C W Bale, P. L. Lin, M. L. Saboungi, and M. Blander 31 Aug. 1981 182 p refs Prepared in cooperation with Argonne National Lab. 2 Vol

(Contract DE-AC02-79ET-15416)
(DE82-000690, DOE/ET-15416/2-Vol-1) Avail: NTIS
HC A09/MF A01

All available phase diagram and thermodynamic data on the eighteen binary systems containing Li(), Na(), K(), SO₄(2+), and OH(+) have been collected and critically assessed. A set of self consistent thermodynamic parameters describing the free energies of all known compounds, solid solutions, and liquid solutions in the binary systems has been formulated. The phase diagrams have been calculated, and estimated error limits of all diagrams are given. Fourteen ternary phase diagrams containing Li(), Na(), K(), SO₄(2+), CO₃(2+) and OH(+) have been calculated from the assessed data for their binary subsystems with the aid of the Conformal Ionic Solution Theory. Comparison with experimental data is made where experimental diagrams are available and small ternary parameters are added where necessary. All calculated ternary phase diagrams are presented as polythermal projections of liquidus surfaces, and estimated error limits are given for each system. DOE

N82-18705# Ecole Polytechnique, Montreal (Quebec) Centre de Development Technologique
CALCULATION OF THERMODYNAMIC EQUILIBRIA IN THE CARBONATE FUEL CELL, VOLUME 2. TASK 2: EQUILIBRIA BETWEEN THE CARBONATE ELECTROLYTE AND THE C-H-O-S GAS PHASE. TASK 3: VAPOUR PRESSURES AND THE VOLITISATION OF THE ALKALI SPECIES Final Report

C W Bale, A. D. Pelton, J. Melancon, M. L. Saboungi, and M. Blander 31 Aug 1981 72 p refs Prepared in cooperation with Argonne National Lab 2 Vol.
(Contract DE-AC02-79ET-15416)
(DE82-000689; DOE/ET-15416/2-Vol-2) Avail: NTIS
HC A04/MF A01

A complete thermodynamic analysis has been performed upon eleven selected fuel feeds obtained after various pretreatment processes. The equilibrium partial pressures of some 34 gaseous species have been computed for each of the fuels at the anode inlet and outlet (75% hydrogen utilization). The complex gaseous equilibria of the fuels have been graphically represented with the aid of Gibbs ternary C-H-O composition triangles. The influence of temperature and pressure upon carbon deposition in the anode compartment has been determined and graphically presented. The effect of water addition upon carbon formation and upon free hydrogen production has been evaluated. The influence of sulfur impurities upon the gaseous equilibria in both electrode compartments and upon the chemical stability of the Ni/NiO electrodes has been assessed. DOE

N82-18706# Westinghouse Research and Development Center, Pittsburgh, Pa
HIGH-TEMPERATURE, SOLID-OXIDE-ELECTROLYTE FUEL-CELL POWER-GENERATING SYSTEM Quarterly Report, 1 Dec. 1980 - 28 Feb. 1981
22 Mar 1981 60 p refs
(Contract DE-AC02-80ET-1709)
(DE82-002095, DOE/ET-17089/T2) Avail: NTIS
HC A04/MF A01

Porous support tube work was directed at reducing the firing temperature, where electrically heated furnaces that enable better zone temperature control can be utilized. Work on the air electrode for the FEA cell design concentrated on modifying the lanthanum manganite, to enhance its conductivity while matching its thermal expansion to that of the other fuel cell components. The thermal expansion and electrical resistivity of LaO₅CaO₅MnO₃ were determined. An initial FBA cell was fabricated. Although its performance was below that of the cells in the series cell stack arrangement, it did prove that fabrication of all fuel cell components (including the interconnection) can be accomplished in this cell design. Analytical measurements on an actual HTSOE cell stack resulted in the use of the differential resistance ((RADIAL)V/(RADICAL)) to isolate voltage losses under operating conditions, envisaged for the HTSOE fuel cell generator. DOE

N82-18719# Aeronautical Research Inst of Sweden, Stockholm
A TWO DIMENSIONAL STUDY OF THE MAXIMUM POWER THAT CAN BE OBTAINED FROM A WIND TURBINE IN A WIND SHEAR LAYER
Bo C. A. Johansson Apr 1981 59 p refs
(FFA-134; ISSN-0081-5640) Avail: NTIS HC A04/MF A01;
Aeronautical Research Inst. of Sweden, Stockholm Kr 70

Betz's stream tube theory for the maximum power that can be obtained from a wind turbine in a uniform flow is extended to two dimensions. The undisturbed velocity field (allowed to vary arbitrarily vertically) and the location of the wind turbine are given. The maximum power is calculated by calculus of variations. For common wind velocity profiles, the maximum power is only slightly larger than the power, which is obtained by a constant relative wind speed retardation equal to Betz's retardation, while for a linear velocity profile there is a considerable difference. Author (ESA)

N82-18720# Aeronautical Research Inst of Sweden, Stockholm Structures Dept.
MEASUREMENTS OF WAKE INTERACTION EFFECTS ON THE POWER OUTPUT FROM SMALL WIND TURBINE MODELS

Per-Henrik Alfredsson and Jan-Aake Dahlberg 4 Jul 1981 62 p refs
(Contracts NE-5061-013; NE-5061-014)
(FFA-TN-HU-2189-Pt-5; ISSN-0081-5640) Avail: NTIS
HC A04/MF A01

Power interference between two and three wind turbine models in a wind tunnel at four different ambient turbulence conditions was measured in order to assess turbine drag effects. Maximum power coefficient is 0.35 with a corresponding thrust coefficient of 0.85 at a tip speed ratio of 4. Flow visualization with small spacing between the turbines (2 x D) and power interaction measurements show that the presence of a downstream turbine affects the upstream turbine wake. By traversing a turbine across the wake of an upstream turbine, a chart of constant power lines (iso power lines) was established for the four ambient flow conditions. The power measurements in the wake can be used to estimate the overall efficiency of a limited array of wind turbines. Author (ESA)

N82-18721# Aeronautical Research Inst. of Sweden, Stockholm Structures Dept.
ICING PROBLEMS FOR WIND TURBINES. SUMMARY OF STUDIES PERFORMED DURING WINTER SEASON 1980/81

Anders Gustafsson, Tord Kvick, and Staffan Meijer (Swedish Meteorological and Hydrological Inst) 6 Oct. 1981 30 p refs Prepared in cooperation with Sydkraft AB
(Contract NE-5061-014)
(FFA-TN-HU-2262-Pt-4) Avail: NTIS HC A03/MF A01

The significance of an ice detector signal which shuts down a wind energy conversion system, not equipped with deicers, was studied. Correlations between the detector signal, meteorological parameters and ice buildup on the blades were investigated. Theoretical and field study data were used. Visual checks followed icing signals but little ice was observed since icing mostly occurred at night. The data are inadequate to enable conclusions to be drawn. Time lag between signals and visual observation must be shortened. Data must be collected when icing is expected, even if there is no signal. Author (ESA)

N82-19487 Iowa Univ., Oakdale.
RADIATIVE HEAT TRANSFER IN TURBULENT MHD CHANNEL FLOW Ph.D. Thesis
Farborz Alipour-Haghighi 1981 148 p
Avail: Univ. Microfilms Order No. 8128371

Radiative heat transfer in a MHD channel has been studied for fully developed turbulent flow of an electrically conducting fluid. A uniform magnetic field is imposed transverse to the flow direction between the electrically insulated parallel plates. Thermal entry region is analyzed for constant wall temperature including viscous dissipation and Joulean heating. A van Dreist mixing length model with Mei and Squire correction factor is used for eddy diffusivity of momentum and a modified Cebeci model is used for eddy conductivity. An exponential wide band model is employed in evaluation of radiative heat flux for a real gas. The tegro-differential equation for thermal energy transport is solved by a finite difference iterative method. It is shown that radiative heat transfer is a major mechanism of heat transfer in the channel and accelerates the thermal development and results in reduced gas temperature profiles. Dissert Abstr.

N82-19550*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
EXPERIENCE WITH MODIFIED AEROSPACE RELIABILITY AND QUALITY ASSURANCE METHOD FOR WIND TURBINES

05 ENERGY CONVERSION

William E. Klein 1982 11 p refs Proposed for Presentation at 9th Ann. Engr Conf. on Reliability, Hershey, Penn., 16-18 Jun. 1982 Revised
(Contract DE-AI01-76ET-20320)
(NASA-TM-82803; DOE/NASA/20320-38; E-1142) Avail: NTIS HC A02/MF A01 CSCL 14D

The SR&QA approach assures that the machine is not hazardous to the public or operating personnel, can operate unattended on a utility grid, demonstrates reliability operation, and helps establish the quality assurance and maintainability requirements for future wind turbine projects. The approach consisted of modified failure modes and effects analysis (FMEA) during the design phase, minimal hardware inspection during parts fabrication, and three simple documents to control activities during machine construction and operation. Five years experience shows that this low cost approach works well enough that it should be considered by others for similar projects. T.M.

N82-19666 Department of Energy, London (England). Severn Barrage Committee.

TIDAL POWER FROM THE SEVERN ESTUARY, VOLUME 1

1981 125 p refs Original contains color illustrations 2 Vol. (EP-46-Vol-1, ISBN-0-11-410916-8) Copyright. Avail: Issuing Activity; HMSO £9.80 + postage, PHI

Environmental, energy, and economic factors associated with building a tidal power barrage in the Bristol channel were studied. An ebb generation scheme is recommended since it minimizes the unit cost of electricity generation and has less effect on ports than flood or two way generation. The economic justification for a barrage depends on factors which are not known when the decision on whether to build is taken, e.g., the extent of nuclear generation, or the price of coal in the first third of the next century. Further study of the environmental consequences of the barrage is required. An inner barrage is recommended since the larger output of an outer barrage does not outweigh engineering, environmental and economic disadvantages. Author (ESA)

N82-19667 Department of Energy, London (England). Severn Barrage Committee

TIDAL POWER FROM THE SEVERN ESTUARY, VOLUME 2: ANALYSIS, STUDIES, REPORTS AND EVALUATIONS

1981 470 p refs 2 Vol. (EP-46-Vol-2; ISBN-0-11-410919-2) Copyright. Avail: Issuing Activity; HMSO £19.50 + postage, PHI

Environmental, energy, and economic factors associated with building a barrage in the Bristol channel were studied. Data collection and analysis are described. Sites, configurations, and costs are considered. Turbine caissons, sluice caissons, and hydroelectric plant are treated. Embankments, navigation and locks are discussed. Environmental, social, industrial, and economic impact are evaluated. An inner barrage, ebb generation scheme is recommended. Author (ESA)

N82-19670*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PHOSPHORIC ACID FUEL CELL TECHNOLOGY STATUS

Stephen N. Simons, Robert B. King, and Paul R. Prokopius 1981 20 p refs Presented at Fuel Cells: Technol. Status and Appl., Chicago 16-18 Nov. 1981; sponsored by Institute of Gas Technology
(Contract DE-AI01-80ET-17088)

(NASA-TM-82791; DOE/NASA/17088-3) Avail: NTIS HC A02/MF A01 CSCL 10A

A review of the current phosphoric acid fuel cell system technology development efforts is presented both for multimewatt systems for electric utility applications and for multikilowatt systems for on-site integrated energy system applications. Improving fuel cell performance, reducing cost, and increasing durability are the technology drivers at this time. Electrodes, matrices, intercell cooling, bipolar/separator plates, electrolyte management, and fuel selection are discussed. B.W.

N82-19672*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio

PERFORMANCE AND OPERATIONAL ECONOMICS ESTIMATES FOR A COAL GASIFICATION COMBINED-CYCLE COGENERATION POWERPLANT

Joseph J. Nainiger, Raymond K. Burns, and Annie J. Easley Mar 1982 32 p refs

(NASA-TM-82729; E-1032) Avail: NTIS HC A03/MF A01 CSCL 10B

A performance and operational economics analysis is presented for an integrated-gasifier, combined-cycle (IGCC) system to meet the steam and baseload electrical requirements. The effect of time variations in steam and electrical requirements is included. The amount and timing of electricity purchases from sales to the electric utility are determined. The resulting expenses for purchased electricity and revenues from electricity sales are estimated by using an assumed utility rate structure model. Cogeneration results for a range of potential IGCC cogeneration system sizes are compared with the fuel consumption and costs of natural gas and electricity to meet requirements without cogeneration. The results indicate that an IGCC cogeneration system could save about 10 percent of the total fuel energy presently required to supply steam and electrical requirements without cogeneration. Also for the assumed future fuel and electricity prices, an annual operating cost savings of 21 percent to 26 percent could be achieved with such a cogeneration system. An analysis of the effects of electricity price, fuel price, and system availability indicates that the IGCC cogeneration system has a good potential for economical operation over a wide range in these assumptions. R.J.F.

N82-19681# Advanced Engineering Lab., Salisbury (Australia). Defence Research Centre.

FEASIBILITY STUDY ON A LOW POWER VERTICAL AXIS WIND-POWERED GENERATOR

W. R. Crook, T. Puust, M. L. Robinson, and L. J. Vencel Sep. 1980 102 p refs

(AEL-0039-TR; AR-001-672) Avail: NTIS HC A06/MF A01

Investigations carried out to establish a design concept for a 1 kW wind-powered generator suitable for use as an alternative power source in isolated locations is described. Design criteria include high power to weight ratio, simplicity of assembly, and potential for fixed, mobile or portable applications. A suitable configuration using a Darrieus straight blade rotor with a microprocessor based control system is proposed. Information on the power output to be expected in different wind environments is provided. Author

N82-19691# Friedrichsfeld G.m.b.H., Mannheim (West Germany). Steinzeug- und Kunststoffwerke

PRODUCTION TECHNOLOGY OF AN OXYGEN ION CONDUCTIVE CERAMIC FOR HIGH TEMPERATURE FUEL CELLS AND HIGH TEMPERATURE WATER ELECTROLYSIS Final Report

Guenther Heimke, Helmut Mayer, and Arno Reckziegel Bonn Bundesministerium fuer Forschung und Technologie Oct 1981 104 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-T-81-180, ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 21.85

The cheap mass production of stabilized zirconia ceramic bodies with thin walls, suitable for high temperature fuel cell or water electrolysis applications is discussed. Chemical and thermal corrosion effects were laboratory tested. Such bodies sintered from YZ03-YbZ03 and YZ03 doped zirconia with high density, good electrical conductivity, small grain size, and 5 mm wall thickness can be produced by conventional methods at temperatures > 1700 C. Extremely fine grained structure ceramics of almost theoretical density can be produced at 1600 C using coprecipitated powders. These powders are, however, too expensive for mass production. Author (ESA)

N82-19695# Aeronautical Research Inst. of Sweden, Stockholm, Structures Dept.

A PITCH CONTROL SYSTEM FOR LARGE SCALE WIND TURBINES

Brad S. Liebst 12 Jan 1981 146 p. refs Sponsored in cooperation with Aeronautical Research Foundation Prepared in cooperation with MIT
(Contract NE-5061-014)

(FFA-TN-HU-2262-Pt-6) Avail: NTIS HC A07/MF A01

A pitching blade segment control system, to alleviate problems associated with wind shear, tower shadow, and gravity, like shortened lifetime and noise generation was designed. The classical linear quadratic Gaussian optimal regulator approach is used in the control formulation. An aerodynamic analysis, incorporating wind shear and tower shadow, is performed. An equivalent hinge model describes the turbine structural dynamics

Pitch, flap and lag blade degrees of freedom and shaft torsion and generator dynamics are included. It is shown that the system reduces vibration and noise, provides a cleaner power signal, improves gust response, and increases annual energy output.

Author (ESA)

N82-19792# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
TURBULENCE STATISTICS FOR DESIGN OF WIND TURBINE GENERATORS

J. C. Kaimal, J. E. Gaynor, and D. E. Wolfe Dec. 1980 109 p refs Sponsored in part by DOE (PB82-112939; NOAA-81082702; Rept-3) Avail: NTIS HC A06/MF A01 CSCL 04B

Characteristics of moments and probability distributions for two high-wind episodes are examined in depth. The two episodes represent entirely different stability conditions. Statistics for the GUST 0 and GUST 1 models for different heights and bandpass filters are the main focus. Author (GRA)

N82-20193# Sandia Labs, Albuquerque, N. Mex Dept of Engineering Science and Mechanics.

METHODS FOR ANALYSIS OF WIND RIPPLE IN WIND TURBINES

R. E. Akins Apr 1981 59 p refs (Contract DE-AC04-76-DP-00789) (SAND-81-7006) Avail: NTIS HC A04/MF A01

Efficient and economical utilization of wind power requires the ability to measure and ultimately predict the effects fluctuations in the incident wind have on a wind turbine. In order to begin to quantitatively assess these effects, experimental techniques were developed to allow analysis of full-scale performance of wind turbines with particular emphasis on the effects caused by turbulence in the incident wind. R.J.F.

N82-20402*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md
THE 1981 GODDARD SPACE FLIGHT CENTER BATTERY WORKSHOP

Gerald Halpert, ed Mar 1982 544 p Workshop held in Greenbelt, Md., 17-19 Nov 1981 (NASA-CP-2217; NAS 155 2217) Avail: NTIS HC A23/MF A01 CSCL 10C

Results of testing, analysis, and development of lithium, nickel-cadmium, and nickel-hydrogen batteries are reported. Focus is on the improvement of power systems in the areas of high capacity, high energy density, and long cycle and storage life. Applications of these batteries as spacecraft power supplies are discussed. Those spacecraft include deepspace probes, spacecraft in geostationary orbit, and large space systems in low-Earth orbit. For individual titles, see N82-20403 through N82-20446.

N82-20644*# Hydrothermal Power Co Ltd, Mission Viejo, Calif
DESIGN, FABRICATION, DELIVERY, OPERATION AND MAINTENANCE OF A GEOTHERMAL POWER CONVERSION SYSTEM Final Report

Dec. 1980 139 p refs Prepared for JPL (Contract JPL-954404) (NASA-CR-168653; NAS 126.168653) Avail: NTIS HC A07/MF A01 CSCL 10B

The design, fabrication, delivery, operation and maintenance of an Hydrothermal Power Company 1250 KVA geothermal power conversion system using a helical screw expander as the prime mover is described. Hydrostatic and acceptance testing are discussed. R.J.F.

N82-20667*# FWG Associates, Inc., Tullahoma, Tenn.
THEORETICAL DESIGN STUDY OF THE MSFC WIND-WHEEL TURBINE Final Report

Walter Frost and Philip A Kessel Mar. 1982 44 p refs (Contract NAS8-34387) (NASA-CR-3532; NAS 126:3532) Avail: NTIS HC A03/MF A01 CSCL 10A

A wind wheel turbine (WWT) is studied. Evaluation of the probable performance, possible practical applications, and economic viability as compared to other conventional wind energy systems is discussed. The WWT apparatus is essentially a bladed wheel which is directly exposed to the wind on the upper half and exposed to wind through multiple ducting on the lower half. The multiple ducts consist of a forward duct (front concentrator) and two side ducts (side concentrators). The forced rotation of the wheel is then converted to power through

appropriate subsystems. Test results on two simple models, a paper model and a stainless steel model, are reported. Measured values of power coefficients over wind speeds ranging from 4 to 16 m/s are given. An analytical model of a four bladed wheel is also developed. Overall design features of the wind turbine are evaluated and discussed. Turbine sizing is specified for a 5 and 25 kW machine. Suggested improvements to the original design to increase performance and performance predictions for an improved WWT design are given. S.L.

N82-20678# Hydrologic Engineering Center, Davis, Calif.
POTENTIAL FOR INCREASING THE OUTPUT OF EXISTING HYDROELECTRIC PLANTS

Darryl W Davis and John J Buckley Jun 1981 26 p refs Presented at the Waterpower 81st Intern Conf. on Hydropower, Washington, D.C., 22-24 Jun. 1981 (AD-A109772; HEC-TP-78) Avail: NTIS HC A03/MF A01 CSCL 10/2

The potential for increasing power output both through physical improvements in generating equipment and by changes in the manner that existing projects are operated were investigated and estimates of power increase prepared. The investigation was nationwide in scope, including Hawaii, Alaska, and Puerto Rico. All existing hydroelectric plants, regardless of ownership, were investigated for improvement in power output. The potential is identified by the type of improvement and is reported as aggregate regional values and national summaries. GRA

N82-20685# California Univ., Livermore. Lawrence Livermore Lab.

ASSESSMENT OF THE SUITABILITY OF AGRICULTURAL WASTE WATER FOR GEOTHERMAL POWER PLANT COOLING IN THE IMPERIAL VALLEY. 1: WATER QUALITY

W F Morris Sep. 1981 36 p refs (Contract W-7405-eng-48) (DE82-001869; UCID-19205) Avail: NTIS HC A03/MF A01

Evaluation of the quality of agricultural waste water is the first step in assessing the suitability of agricultural waste water for geothermal power plant cooling. Samples of agricultural waste water from the New and Alamo rivers located in the Imperial Valley of California were analyzed. Determinations of standard water quality parameters, solids content, and inorganic compositions of the solids were made. The results are compared with data on samples of irrigation water and steam condensate also obtained from sites in the Imperial Valley. The data were evaluated in relation to cooling tower operation, waste generation, and waste disposal. DOE

N82-20688# Midwest Research Inst., Golden, Colo.
ELECTRIC UTILITY VALUE ANALYSIS METHODOLOGY FOR WIND ENERGY CONVERSION SYSTEMS

L R Bush, C Keith Cretcher, and Ted H. Davey Sep 1981 31 p refs (Contract DE-AC02-77CH-00178) (DE82-003573; SERI/TR-98336-1) Avail: NTIS HC A03/MF A01

The methodology summarized in this report was developed in support of a study of the value of augmenting conventional electric energy generation with wind energy conversion systems (WECS). A major objective of the value analysis study is the creation of an analytical methodology to assess WECS installed in a utility's generation system. The pertinent measures of value include both the displacement of conventional fuels measured in volumetric and economic terms, and the potential for capacity credit, realized either through the sale of capacity or deferral of new installations. Recognizing the strong site dependence of wind energy conversion, a second major objective of the value analysis study is the application of the methodology to several candidate utilities. These results will illustrate the practicability of the methodology and identify any deficiencies, allow a comparison of relative WECS value among the sites studied, and develop background information pertinent to possible selection decisions for WECS siting and level of penetration. The specific purpose of this report is to outline the methodology developed in support of the value analysis study. DOE

N82-21030*# Bionetics Corp., Hampton, Va.
SOUND MEASUREMENTS AND OBSERVATIONS OF THE MOD-OA WIND TURBINE GENERATOR

Kevin P. Shepherd and Harvey H. Hubbard (College of William and Mary, Newport News, Va) Feb. 1982 20 p refs

05 ENERGY CONVERSION

(Contract NAS1-14970; Grant NAG1-166)
(NASA-CR-165856; NAS 126:165856) Avail: NTIS
HC A02/MF A01 CSCL 20A

Sound measurements are reported for a wind velocity of about 5 m/s and a power output of about 70 kW. Both broadband and narrowband data were obtained for a range of angles and azimuth angles from the machine. Both discrete frequency and broadband components were identified. Loading harmonics at multiples of the blade passage frequency and electrical generator harmonics at multiples of the shaft speed dominated the spectrum below 100 Hz. The 10,000 Hz peak is believed to be of mechanical origin in the nacelle and the other arises from blade aerodynamic sources. Aural detection distances of about 525 m upwind and 850 downwind were observed. T.M.

N82-21063 British Library Lending Div., Boston Spa (England).
FORECASTING THE TECHNICAL AND ECONOMIC CHARACTERISTICS OF HIGH POWER THERMONUCLEAR TOKAMAK REACTORS

A. N. Karkhov and B. P. Maksimenko 24 Jun. 1981 22 p
refs Transl. into ENGLISH from Atomnaya Tikh. za Rubeshom
(USSR), no 3, 1980 p 19-28
(BLL-CTO-1921-(9091.9F)) Avail: British Library Lending Div.,
Boston Spa, Engl.

Methods for making parametric investigations of Tokamak power reactors by predicting their technical and economic parameters to determine the direction in which the concept will develop are examined. High temperature plasma physics, the engineering and technical development of Tokamak reactor concepts, mathematical models of individual systems and subsystems, and computational programs developed for the parametric investigations are examined. R.J.F.

N82-21193*# National Aeronautics and Space Administration,
Lewis Research Center, Cleveland, Ohio

COLD-AIR PERFORMANCE OF A 15.41-CM-TIP-DIAMETER AXIAL-FLOW POWER TURBINE WITH VARIABLE-AREA STATOR DESIGNED FOR A 75-KW AUTOMOTIVE GAS TURBINE ENGINE Final Report

Kerry L. McLallin, Milton G. Kofskey, and Robert Y. Wong Feb 1982 33 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-82644; E-899; NAS 115:82644;
DOE/NASA/51040-30) Avail: NTIS HC A03/MF A01 CSCL
21E

An experimental evaluation of the aerodynamic performance of the axial flow, variable area stator power turbine stage for the Department of Energy upgraded automotive gas turbine engine was conducted in cold air. The interstage transition duct, the variable area stator, the rotor, and the exit diffuser were included in the evaluation of the turbine stage. The measured total blading efficiency was 0.096 less than the design value of 0.85. Large radial gradients in flow conditions were found at the exit of the interstage duct that adversely affected power turbine performance. Although power turbine efficiency was less than design, the turbine operating line corresponding to the steady state road load power curve was within 0.02 of the maximum available stage efficiency at any given speed. Author

N82-21194*# National Aeronautics and Space Administration,
Lewis Research Center, Cleveland, Ohio

PRELIMINARY RESULTS ON PERFORMANCE TESTING OF A TURBOCHARGED ROTARY COMBUSTION ENGINE

P. R. Meng, W. J. Rice, H. J. Schock, and D. P. Pringle 1982 24 p refs Presented at the 1982 Soc of Automotive Engrs. Intern Congr and Exposition, Detroit, 22-26 Feb. 1982
(NASA-TM-82772; E-1097; NAS 115:82772) Avail: NTIS
HC A02/MF A01 CSCL 21E

The performance of a turbocharged rotary engine at power levels above 75 kW (100 hp) was studied. A twin rotor turbocharged Mazda engine was tested at speeds of 3000 to 6000 rpm and boost pressures to 7 psi. The NASA developed combustion diagnostic instrumentation was used to quantify indicated and pumping mean effect pressures, peak pressure, and face to face variability on a cycle by cycle basis. Results of this testing showed that a 5900 rpm a 36 percent increase in power was obtained by operating the engine in the turbocharged configuration. When operating with lean carburetor jets at 105 hp (78.3 kW) and 4000 rpm, a brake specific fuel consumption of 0.45 lbm/lb-hr was measured. B.W.

N82-21196*# Pratt and Whitney Aircraft Group, East Hartford,

Conn Commercial Products Div
ENERGY EFFICIENT ENGINE SHROUDLESS, HOLLOW FAN BLADE TECHNOLOGY REPORT

C. J. Michael Dec 1981 91 p refs
(Contract NAS3-20646)
(NASA-CR-165586; NAS 1.26 165586; PWA-5594-199) Avail:
NTIS HC A05/MF A01 CSCL 21E

The Shroudless, Hollow Fan Blade Technology program was structured to support the design, fabrication, and subsequent evaluation of advanced hollow and shroudless blades for the Energy Efficient Engine fan component. Rockwell International was initially selected to produce hollow airfoil specimens employing the superplastic forming/diffusion bonding (SPF/DB) fabrication technique. Rockwell demonstrated that a titanium hollow structure could be fabricated utilizing SPF/DB manufacturing methods. However, some problems such as sharp internal cavity radii and unsatisfactory secondary bonding of the edge and root details prevented production of the required quantity of fatigue test specimens. Subsequently, TRW was selected to (1) produce hollow airfoil test specimens utilizing a laminate-core/hot isostatic press/diffusion bond approach, and (2) manufacture full-size hollow prototype fan blades utilizing the technology that evolved from the specimen fabrication effort. TRW established elements of blade design and defined laminate-core/hot isostatic press/diffusion bonding fabrication techniques to produce test specimens. This fabrication technology was utilized to produce full size hollow fan blades in which the HIP'ed parts were cambered/twisted/isothermally forged, finish machined, and delivered to Pratt & Whitney Aircraft and NASA for further evaluation. Author

N82-21710*# National Aeronautics and Space Administration,
Lewis Research Center, Cleveland, Ohio

MICROPROCESSOR CONTROL SYSTEM FOR 200-KILOWATT MOD-OA WIND TURBINES Final Report

Ted W. Nyland and Arthur G. Birchenough Jan 1982 26 p refs
(Contract DE-AI01-76ET-20370)
(NASA-TM-82711; E-10006; NAS 115 82711;
DOE/NASA/20370-22) Avail: NTIS HC A03/MF A01 CSCL
10A

The microprocessor system and program used to control the operation of the 200-kW Mod-OA wind turbines is described. The system is programmed to begin startup and shutdown sequences automatically and to control yaw motion. Rotor speed and power output are controlled with integral and proportional control of the blade pitch angle. Included in the report are a description of the hardware and a discussion of the software programming technique. A listing of the PL/M software program is given. Author

N82-21712*# National Aeronautics and Space Administration,
Lewis Research Center, Cleveland, Ohio

EXPERIMENTAL PERFORMANCE OF THE REGENERATOR FOR THE CHRYSLER UPGRADED AUTOMOTIVE GAS TURBINE ENGINE Final Report

Jerry M. Winter and Ralph C. Nussle Feb 1982 62 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-82671; E-953; DOE/NASA/51040-32; NAS
1.15:82671) Avail: NTIS HC A04/MF A01 CSCL 10B

Automobile gas turbine engine regenerator performance was studied in a regenerator test facility that provided a satisfactory simulation of the actual engine operating environment but with independent control of airflow and gas flow. Velocity and temperature distributions were measured immediately downstream of both the core high-pressure-side outlet and the core low-pressure-side outlet. For the original engine housing, the regenerator temperature effectiveness was 1 to 2 percent higher than the design value, and the heat transfer effectiveness was 2 to 4 percent lower than the design value over the range of test conditions simulating 50 to 100 percent of gas generator speed. Recalculating the design values to account for seal leakage decreased the design heat transfer effectiveness to values consistent with those measured herein. A baffle installed in the engine housing high-pressure-side inlet provided more uniform velocities out of the regenerator but did not improve the effectiveness. A housing designed to provide more uniform axial flow to the regenerator was also tested. Although temperature uniformity was improved, the effectiveness values were not improved. Neither did 50-percent flow blockage (90 degree segment) applied to the high-pressure-side inlet change the effectiveness significantly. Author

N82-21713*# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.

CELL MODULE AND FUEL CONDITIONER DEVELOPMENT

Quarterly Report, Oct. - Dec. 1981

J. M. Feret Jan. 1982 51 p

(Contract DEN3-161; Contract DE-AI01-80ET-17088)

(NASA-CR-165620; DOE/NASA/O1611-9A, NAS 1.26 16562,

QR-9) Avail NTIS HC A04/MF A01 CSCL 10A

The efforts performed to develop a phosphoric acid fuel cell (PAFC) stack design having a 10 kW power rating for operation at higher than atmospheric pressure based on the existing Mark II design configuration are described. The work involves: (1) Performance of pertinent functional analysis, trade studies and thermodynamic cycle analysis for requirements definition and system operating parameter selection purposes, (2) characterization of fuel cell materials and components, and performance testing and evaluation of the repeating electrode components, (3) establishment of the state-of-the-art manufacturing technology for all fuel cell components at Westinghouse and the fabrication of short stacks of various sites, and (4) development of a 10 kW PAFC stack design for higher pressure operation utilizing the top down systems engineering approach Author

N82-21719# Naval Civil Engineering Lab., Port Hueneme, Calif
WIND POWER UTILIZATION GUIDE Progress Report, Jul. 1975 - Sep. 1980

D Pal Sep 1981 218 p refs

(AD-A110337, CEL-TN-1613) Avail NTIS HC A10/MF A01 CSCL 04/2

This report presents general information covering site wind potential and characteristics, specific design, system design, and siting requirements for utilization of wind energy conversion systems (WECS) at Navy installations. The objective of this report is also to provide a method for performing economic analysis to plan and justify a WECS in a particular Navy application. The information presented here is sufficient to enable an engineer to prepare a system's design to conduct a feasibility study for a given application of WECS. Most Navy applications of wind power will involve generation of electricity using small wind turbine generators (less than 60 kW size), with or without storage, located at remote Navy sites. Larger (over 100 kW size) WECS will, generally, be integrated with a base grid located on remote overseas or CONUS bases. This report, however, deals only with guidance for applying small WECS at Navy installations. The subject matter is divided into five parts dealing respectively with wind behavior and its determination with wind-driven turbines, power conditioning requirements, siting requirements, and the economics of wind power under different conditions. Three examples are given to demonstrate use of these sections in developing the required feasibility or design information for a given application. Author (GRA)

N82-21722# Argonne National Lab., Ill. Chemical Engineering Div.

ADVANCED FUEL-CELL DEVELOPMENT Progress Report, Jul. - Sep. 1980

R. D. Pierce, R. M. Arons, J. T. Dusek, A. V. Fraioli, G. H. Kucera, R. B. Poepfel, J. W. Sim, J. L. Smith, and R. S. Tam. Jul 1981 37 p refs

(Contract W-31-109-eng-38)

(DE82-003007, ANL-81-16) Avail NTIS HC A03/MF A01

Efforts were directed toward investigating alternative concepts for components of molten carbonate fuel cell stacks, and improving our understanding of component behavior. The principal focus is on the development of sintered beta-LiAlO₂ for electrolyte support and sintered Li sub x Ni sub 1-x O for cathodes. In the electrolyte development effort, both alpha- and beta-LiAlO₂ were synthesized as starting material for sintered electrolyte supports, and tape casting was studied for preparing green bodies for sintering. A sintering procedure was developed which produces flat NiO cathodes with good conductivity and pore structure T M

N82-21723# Westinghouse Electric Corp., Pittsburgh, Pa
EVALUATION OF GASIFICATION AND GAS-CLEANUP PROCESSES FOR USE IN MOLTEN-CARBONATE FUEL-CELL POWER PLANTS Quarterly Technical Progress Report

Gary Jablonski (Davy-McKee), M. A. Alvin, R. A. Wenglarz, and P. Patel 16 Jul. 1981 24 p refs

(Contract DE-AC21-81MC-16220)

(DE82-003207, DOE/MC-16220/T1; QTPR-1) Avail. NTIS HC A02/MF A01

A draft of the gasifier listing, a low temperature gas cleanup system listing and data acquisition for the hot gas cleaning systems listing were completed. Iron oxide, dolomite, zinc oxide, molten carbonate and other such systems were included in that listing. The molten carbonate fuel cell (MCFC) contaminant data available in the open literature are reported. Particulate and chemical species for assessing the effect of contaminants on MCFC operating characteristics are thermodynamically evaluated. Data and process insights, indispensable to the evaluation of suitable coal gas supply systems for molten carbonate fuel cell power plants are provided DOE

N82-21732# United Technologies Corp., South Windsor, Conn Power Systems Div.

DEVELOPMENT OF MOLTEN-CARBONATE FUEL-CELL POWER-PLANT TECHNOLOGY Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1980

Feb 1981 65 p

(Contracts DE-AC02-79ET-15440; DE-AC01-79ET-15440)

(DE82-002108, DOE/ET-15440/4, QTPR-4, FCR-2765) Avail NTIS HC A04/MF A01

The design of a prototype molten carbonate fuel cell stack which meets the requirements of 1990's competitive coal fired electrical utility central station or industrial cogeneration power plants was developed. The four task areas are: (1) systems studies to define the reference power plant design, (2) cell and stack design, development and verification, (3) preparation for fabrication and testing of the full scale prototype stack, and, (4) development of the capability to operate stacks on coal derived gas DOE

N82-21756*# Jet Propulsion Lab., California Inst of Tech., Pasadena

GEOHERMAL PROBABILISTIC COST STUDY

L. H. Orren, G. Michael Ziman, Sue Campbell Jones, Tom K Lee (California Univ., San Diego), Roger Noll (California Univ., San Diego), Louis Wilde (California Inst. of Tech., Pasadena), and Venkatraman Sadanand (California Inst of Tech., Pasadena) Aug. 1981 196 p refs Sponsored in part by NASA

(Contract DE-AI03-79ET-37116)

(NASA-CR-168757, NAS 1.26 168757, DE82-003230;

DOE/ET-37116/T4) Avail. NTIS HC A09/MF A01 CSCL 10B

A tool is presented to quantify the risks of geothermal projects, the Geothermal Probabilistic Cost Model (GPCM). The GPCM model was used to evaluate a geothermal reservoir for a binary-cycle electric plant at Heber, California. Three institutional aspects of the geothermal risk which can shift the risk among different agents was analyzed. The leasing of geothermal land, contracting between the producer and the user of the geothermal heat, and insurance against faulty performance were examined DOE

N82-21759# San Diego Gas and Electric Co., Calif

HEBER GEOHERMAL BINARY DEMONSTRATION PROJECT Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981

G. D. VanDeMark Sep. 1981 32 p Sponsored in part by Electric Power Research Inst., Imperial Irrigation District, Calif Dept of Water Resources, and Southern Calif Edison Co

(Contract DE-FC03-80RA-50239)

(DE82-002462, DOE/RA-50239/T1) Avail. NTIS HC A03/MF A01

Work completed on the nominal 65 Megawatt (Mwe gross) Heber geothermal binary demonstration project, located at Heber, California, is documented. Topics covered include progress made in the areas of wells, fluid production and injection systems, power plant design and construction, power plant demonstration, and data acquisition and dissemination DOE

06 ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

Includes transport of fuels by pipelines, tubes, etc., microwave power transmission, and superconducting power transmission.

A82-20640 * Microwave power - An energy transmission alternative for the year 2000. E. Nalos and R. Sperber (Boeing Aerospace Co., Kent, WA). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 48.1.1-48.1.5. 9 refs. Research supported by the U.S. Department of Energy; Contract No. NAS9-15636.

Recent technological advances related to the feasibility of efficient RF-dc rectification make it likely that by the year 2000 the transmission of power through space will have become a practical reality. Proposals have been made to power helicopters, aircraft, balloons, and rockets remotely. Other proposals consider the transfer of power from point to point on earth via relay through space or a transmission of power from large power sources in space. Attention has also been given to possibilities regarding the transmission of power between various points in the solar system. An outline is provided of the microwave power transmission system envisaged for the solar power satellite, taking into account the transmitting antenna, the receiver on earth, aspects of beam formation and control, transmitter options, the receiving antenna design, and cost and efficiency considerations. G.R.

A82-21975 Equilibrium two-phase heat pipe flows with variable flowrate. L. A. Vulis, I. G. Goriachko, and G. V. Zhizhin. (Krizisy teploobmena i okolokriticheskaia oblast', p. 112-117.) *Heat Transfer - Soviet Research*, vol. 12, Nov.-Dec. 1980, p. 120-126. Translation.

The problem of steady pipe flow of vapor in thermodynamic equilibrium with liquid droplets is analyzed as a part of a study of possible operating modes in a heat pipe. The analysis accounts for phase transitions within the flow core, with phase properties (e.g., velocity and temperature) averaged over the channel cross section. It is assumed that the supplied (or removed) heat is expended completely on phase transitions at the channel walls and that the mean phase velocities are equal, i.e., there is no slip. A set of equations are obtained which allow the calculation of flow parameters in any channel section. V.L.

A82-23944 High power pulsed oscillators. F. A. Myers (Plessey Research /Caswell/, Ltd., Allen Clark Research Centre, Towcester, Northants., England). In: Microwave solid state devices and applications. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1980, p. 187-195. 9 refs.

Available pulsed sources are briefly reviewed including the TRAPATT device, the high-efficiency IMPATT, the Si avalanche device, the Si bipolar transistor, and the Gunn device. Pulsed Gunn oscillators are then discussed with reference to their operational parameters, advantages, and problems encountered. Design guidelines for a Gunn oscillator are presented. V.L.

N82-17448# Westinghouse Research and Development Center, Pittsburgh, Pa
MATERIALS RESEARCH FOR HYDROGEN-COOLED SUPERCONDUCTING POWER TRANSMISSION LINES
Quarterly Report, 1 Apr. - 30 Jun. 1981

A. M. Sletten, A. I. Braginski, M. Rosado, J. R. Gavaler, J. Gregg, J. Schreurs, R. H. Hammond, J. R. Kwo, M. Perez, J. Talvacchio et al 1981 42 p refs Prepared in cooperation with Stanford Univ., Calif.

(Contract DE-AC02-89ET-29354)
(DE82-002171; DOE/ET-29354/T1; QR-7) Avail. NTIS HC A03/MF A01

Dielectric breakdown and loss measurements in liquid hydrogen and liquid hydrogen impregnated synthetic dielectrics

are investigated at temperatures between 14 and 200K and at hydrostatic pressures up to five atmospheres. The effects of dissolved impurities/additives in the liquid are determined, and the self field and low field superconducting properties of high critical temperature materials at temperatures between approximately 14 and 200K are characterized. The construction of the dielectric test apparatus continued and the system of small electrodes was completed. Difficulties were encountered in the construction of the LH2 vessels and the junction box, which have retarded their completion. DOE

N82-18075# New England River Basins Commission, Boston, Mass.

PROCEDURES FOR PREPARING REGIONAL TRANSPORTATION MANAGEMENT PLANS

Michael J. Goetz Aug. 1981 177 p refs

(Contract D1-AA851-IOA-51)

(PB82-106162) Avail. NTIS HC A09/MF A01 CSCL 13B

A set of procedures is presented to provide planners with a working framework for preparing regional transportation management plans. These plans are designed to insure the safe and timely transportation of oil and gas produced offshore to onshore processing and distribution systems. A case study application to the Georges Bank region of the North Atlantic outer continental shelf is included. GRA

N82-18578*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va

SPACE LASER POWER TRANSMISSION SYSTEM STUDIES

M. D. Williams, ed. and E. J. Conway, ed Feb 1982 210 p refs Symp. held in Hampton, Va., 14-15 Oct. 1981

(NASA-CP-2214; L-15030) Avail. NTIS HC A10/MF A01 CSCL 20E

Power transmission by laser technique is addressed. Space to Earth and space to space configurations are considered. For individual titles, see N82-18579 through N82-18586.

N82-18579*# Ball Aerospace Systems Div., Boulder, Colo.
PRELIMINARY STUDY ON THE USE OF LASERS FOR THE TRANSMISSION OF POWER

In NASA Langley Research Center Space Laser Power Transmission System Studies Feb 1982 p 15-32

Avail. NTIS HC A10/MF A01 CSCL 20E

The use of lasers in space is outlined. Possibilities and ideas are presented. The economic payoff of lasers in space in supplying energy for the Earth is considered. Possible operational advantages and economies for the user of space to space energy transmission are addressed. The development of large space power stations to beam energy to Earth is discussed. Applications on Earth and comparisons with microwave systems are emphasized. N.W.

N82-18580*# Schafer (W. J.) Associates, Inc., Arlington, Va.
A STUDY TO SURVEY NASA LASER APPLICATIONS AND IDENTIFY SUITABLE LASERS FOR SPECIFIC NASA NEEDS

In NASA Langley Research Center Space Laser Transmission System Studies Feb. 1982 p 33-44 refs

Avail. NTIS HC A10/MF A01 CSCL 20E

All potential applications of high power lasers which might, in particular, use the JPL copper-halide laser under development were considered for study. A wide range of applications were identified with strong emphasis on remote sensing applications. Power beaming and laser propulsion were also identified as major areas of interest to NASA. N.W.

N82-18583*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va

UTILITY AND TECHNOLOGY FOR A SPACE CENTRAL POWER STATION

Paul F. Holloway and L. Bernard Garrett In its Space Laser Power Transmission System Studies Feb 1982 p 85-122 refs Presented at the Second AIAA Conf on Large Space Platforms, Feb 1981

Avail. NTIS HC A10/MF A01 CSCL 20E

The technological and economical impacts of a large central power station in Earth orbit on the performance and cost of future spacecraft and their orbital-transfer systems are examined.

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It is shown that beaming power to remote users cannot be cost-effective if the central power station uses the same power generation system that would be readily available for provision of on-board power. Laser transmitters/receivers to make central power stations feasible are considered. The cost-effectiveness of meeting Earth-orbiting spacecraft electrical demands from a central power station was analyzed, indicating that this application cannot justify the investment required for the central station. Key technology needs which must be met to enable a viable central power station in the future are identified. N.W.

N82-18585*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

LASER POWER CONVERSION SYSTEM ANALYSIS

In NASA. Langley Research Center Space Laser Power Transmission System Studies Feb. 1982 p 145-158 refs

Avail: NTIS HC A10/MF A01 CSCL 20E

Orbit to orbit and orbit to ground laser power conversion systems and power transfer are discussed. A system overview is presented. Pilot program parameters are considered. SLPS assumptions are listed, a laser SPS overview is presented, specifications are listed, and SLPS coats are considered. N.W.

N82-18586*# Mathematical Sciences Northwest, Inc., Bellevue, Wash.

SPACE LASER POWER TRANSMISSION

In NASA. Langley Research Center Space Laser Power Transmission System Studies Feb 1982 p 165-174 refs

Avail: NTIS HC A10/MF A01 CSCL 20E

Proposed laser transmission applications are reviewed. Technologies for laser power transmissions are assessed. Feasible laser mission systems are set out. Components by wavelength are summarized. Feasible space to space laser power transmission systems are summarized. Space laser transmitter masses for 1 MW and 100 KW output power are summarized. N.W.

N82-18710# Technische Hochschule, Aachen (West Germany). Lehrauftrag Leistungsreaktoren.

RAILWAY TRANSPORT OF LOW TEMPERATURE HEAT FROM LARGE POWER STATIONS BY MEANS OF ALTERNATIVE HEAT CARRIERS AND WATER Final Report

Gerardus Luchtman and Theo Bracke Bonn Bundesministerium fuer Forschung und Technology Nov 1981 165 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology (BMFT-FB-T-81-145; ISSN-0340-7608) Avail. NTIS HC A08/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 32.60

The feasibility of railway transport of liquid and solid heat carriers in tank cars so as to replace pipeline transport of small to medium large heat loads was investigated. The typical characteristics of railway transport were analyzed and all essential technical and economical variables were integrated in a transport model. Over 1000 complex chemical compounds were evaluated for their suitability as heat carriers. Of these, three ammonia compounds are considered as promising. Considering, however, that complicated and expensive facilities are needed for heat transfer to and from ammonia, water is identified as the better choice. Results, based on 1975 transport prices, show that railway heat transport becomes competitive for heat loads above 50 to 100 MW and transport distances over 20 km. Author (ESA)

N82-18723# Institute for Telecommunication Sciences, Boulder, Colo.

ELECTROMAGNETIC COMPATIBILITY ANALYSIS FOR A SATELLITE POWER SYSTEM RECEIVING SITE IN THE MOJAVE DESERT

E. L. Morrison, W B Grant, and E J. Lutton Jun 1981 86 p refs Sponsored in part by DOE (PB82-100710; NTIA/Rept-81-76) Avail: NTIS HC A05/MF A01 CSCL 10B

The Satellite Power System (SPS) as a source of baseline electrical power was evaluated. The SPS program develops an initial understanding of the technical feasibility, the economic practicality, and the social and environmental acceptability of the SPS concept. Electromagnetic compatibility (EMC) of an SPS with existing

and planned electromagnetic and electronic systems is illustrated. A methodology is developed for rectenna site EMC analysis and impact evaluation. GRA

ENERGY STORAGE

Includes flywheels, heat storage, underground air storage, compressed air, storage batteries, and electric hybrid vehicles.

A82-19116 Storing wind energy as a liquid fuel. D. Miller (Haverford College, Haverford, PA). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 143-150. 12 refs.

A system which stores wind energy has been designed. Formic acid is synthesized in an electrolytic reactor using inexpensive catalysts. The vertical axis wind turbine has high solidity and fixed, straight blades. Its low aspect ratio contributes to a power coefficient of 0.43. Power is transmitted hydraulically, and the generator is a modified Faraday disk. The turbine operates at maximum power over the full range of wind speeds, because the area of the reactor electrodes is varied. Costs for equipment are presented, as well as a strategy for using wind energy stored as a liquid fuel. (Author)

A82-20749 * # Synthetic battery cycling. L. H. Thaller (NASA, Lewis Research Center, Cleveland, OH). *Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, Aug. 9-14, 1981, Paper*. 11 p.

The trend in energy storage is toward systems with high-voltage and high-power outputs. These conditions accentuate the cumulative effects of small differences in characteristics from cell to cell in any large multicell battery. These considerations are of particular concern with a number of emerging electrochemical concepts where convenient overcharge reactions do not exist. The use of interactive computer graphics is suggested as an aid in battery system development. Mathematical representations of simplistic but fully representative functions of many electrochemical concepts of current practical interest will permit battery-level charge and discharge phenomena to be analyzed in a qualitative manner prior to the assembly and testing of actual hardware. This technique will be a useful addition to the variety of tools available to the battery system designer as he bridges the gap between interesting single-cell life test data and reliable energy storage subsystems. (Author)

A82-23206 Energy storage: A vital element in mankind's quest for survival and progress. Edited by J. Silverman (Maryland, University, College Park, MD). Oxford, Pergamon Press, 1980. 595 p. \$100.

Among the topics on the development status of energy storage technologies covered are (1) metal-air batteries, electric vehicle electrochemical energy storage, fuel cells and lithium/metal sulfide batteries; (2) aquifer thermal energy storage, metal hydride thermal energy storage, and thermochemical hydrogen production; (3) artificial photochemical solar energy storage, semiconductor-liquid junction solar cells, and photoredox processes; and (4) compressed air and flywheel mechanical energy storage. Consideration is also given to the modelling and assessment of the energy storage alternatives covered, in automotive and electric utility contexts. O.C.

A82-23777 Thermodynamic studies of Li-Ge alloys - Application to negative electrodes for molten salt batteries. M. R. Saint John, A. J. Furgala, and A. F. Sammells (Institute of Gas Technology, Chicago, IL). *Electrochemical Society, Journal*, vol. 129, Feb. 1982, p. 246-250. 33 refs.

A82-23778 * Inexpensive cross-linked polymeric separators made from water-soluble polymers. L.-C. Hsu and D. W. Sheibley (NASA, Lewis Research Center, Cleveland, OH). *Electrochemical Society, Journal*, vol. 129, Feb. 1982, p. 251-254.

Polvinyl alcohol (PVA), cross-linked chemically with aldehyde reagents, produces membranes which demonstrate oxidation resistance, dimensional stability, low ionic resistivity (less than 0.8 Ohms sq cm), low zincate diffusivity (less than 1×10^{-10} the -7th mols/sq cm per min), and low zinc dendrite penetration rate (greater than 350 min) which make them suitable for use as alkaline battery separators. They are intrinsically low in cost, and environmental health and safety problems associated with commercial production

appear minimal. Preparation, property measurements, and cell test results in Ni/Zn and Ag/Zn cells are described and discussed.

(Author)

A82-24236 Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. Symposium sponsored by the Joint Services Electrical Power Sources Committee. Edited by J. Thompson (Royal Aircraft Establishment, Farnborough, Hants., England). London, Academic Press, 1981. 641 p. \$128.

Topics discussed include improved lithium thionyl chloride cells using a new electrolyte, the reaction products of Li-SOCl₂ cells, and glass-to-metal seal corrosion in lithium-sulfur dioxide cells. Papers are presented on the characteristics and applications of Li-MnO₂ cells, on developments in solid state batteries, on the use of crown ethers in electrochemical cells, and on molten carbonate fuel cell improvements. Attention is also given to redox storage systems for solar applications, to the thermal management of batteries, to a review of recent developments in thermal batteries, and to the characteristics of large calcium-thionyl chloride cells. C.R.

A82-24240 * Redox storage systems for solar applications. N. H. Hagedorn and L. H. Thaller (NASA, Lewis Research Center, Cleveland, OH). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 227-242; Discussion, p. 242, 243. 5 refs.

It is noted that the worldwide development of solar photovoltaic and wind turbine systems to meet a range of terrestrial electrical energy requirements has underscored the need for inexpensive and reliable electrical energy storage. The NASA Redox Energy Storage System, based on soluble aqueous iron and chromium chloride redox couples, has exhibited many system-related features which for the most part are unique to this storage system. The technology advances required in the two elements (electrodes and membranes), which are the key to its technological feasibility, have been attained and system development has begun. The design, construction, and testing of a 1-kW system integrated with a solar photovoltaic array is underway to provide early demonstration of the attractive system-related features of the NASA Redox Storage System. Also demonstrated will be its versatility and compatibility with a terrestrial solar photovoltaic electric power system. C.R.

A82-24241 Thermal management of batteries. H. F. Gibbard and C.-C. Chen (Gould Laboratories, Rolling Meadows, IL). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 263-284. 15 refs. U.S. Department of Energy Contracts No. 31-109-38-4200; No. 31-109-38-5006.

Control of the internal temperature during high rate discharge or charge can be a major design problem for large, high energy density battery systems. A systematic approach to the thermal management of such systems is described for different load profiles based on: thermodynamic calculations of internal heat generation; calorimetric measurements of heat flux; analytical and finite difference calculations of the internal temperature distribution; appropriate system designs for heat removal and temperature control. Examples are presented of thermal studies on large lead-acid batteries for electrical utility load levelling and nickel-zinc and lithium-iron sulphide batteries for electric vehicle propulsion. (Author)

A82-24242 A review of recent developments in thermal batteries. A. Attewell (Royal Aircraft Establishment, Farnborough, Hants., England) and A. J. Clark (Mine Safety Appliances Co., Ltd., Glasgow, Scotland). In: Power sources 8: Research and development in non-mechanical electrical power sources. Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 285-302; Discussion, p. 302, 303. 25 refs.

It is noted that 'thermal battery' is a term applied to a class of reserve-type molten salt electrolyte primary cell systems that are inert until brought into use by the ignition of a charge of

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pyrotechnic. Thereafter, the battery remains active for as long as one hour or for only a few seconds, depending on its size, thermal insulation, and electrochemical system and on the ambient temperature and the rate at which power is withdrawn. It is noted that systems using calcium or magnesium as anodes, though inefficient, have been brought to an advanced design and are widely used in weapons systems. The introduction of lithium as an anode material has improved efficiencies and widened performance limits. C.R.

A82-24243 A nickel oxide-iron battery developed for traction purposes - Advantages and limitations. B. Andersson, L. Ojefors (Swedish National Development Co., Akersberga, Sweden), and R. Hudson (Eagle-Picher Industries, Inc., Joplin, MO). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 379-387; Discussion, p. 387, 388. 5 refs. U.S. Department of Energy Contract No. 31-109-38-4292.

The nickel oxide-iron battery described here has successfully proved to be a good candidate for EV battery applications. Based on iron electrode technology and experience of nickel oxide electrodes development work started in May 1978. During the first stage individual cell components were studied, separator systems evaluated and a preliminary cell designed. During the second stage the main work was carried out with 300 A h cells which made it possible to study the important parameters under realistic conditions. The battery design is based on these cell tests. Full scale batteries will be built and tested in electric vehicles during 1980-81. (Author)

A82-24244 A comparison of a low pressure and a high pressure Ni-H₂ cell. T. L. Markin, R. Bennett, N. J. Bridger, and R. M. Dell (Atomic Energy Research Establishment, Harwell, Oxon, England). In: Power sources 8: Research and development in non-mechanical electrical power sources, Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 445-456. Discussion, p. 456, 457.

A low-pressure Ni-H₂ cell employing LaNi₅ hydrogen storage negative electrodes is described. The charge and discharge characteristics of a low-pressure Ni-H₂-10-A h cell are compared with those of a high-pressure Ni-H₂ 10-A h cell employing Pt-H₂ negative electrodes. The characteristics of the low-pressure cell are found to be better than those of the high-pressure Ni-H₂ cell at temperatures between 50 C and -20 C but inferior at -40 C. The maximum power at OCV/2 for one minute is found to be better for the low-pressure cell than for the high-pressure Ni-H₂ cell at 20 C, but the two are similar at low temperatures. For both cells, self-discharge rates are similar, becoming rapid at 50 C. C.R.

A82-24245 Recent improvements in aircraft Ni-Cd cells. R. Bonnatere, J. Leonardi, and P. Oliva (Société des Accumulateurs Fixes et de Traction, Bordeaux, France). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 459-468; Discussion, p. 469.

It is noted that the reliability, power performance, and durability of the alkaline Ni-Cd batteries used in such advanced technical fields as aeronautics and high-speed trains are becoming increasingly important. A new aircraft battery generation created to respond to such requirements is described. Increased reliability and durability result from the development and use of a new graft copolymer membrane, the properties of which are discussed. The use of the new membrane and the optimization of the electromechanical parameters of the cell design have significantly improved the power characteristics of Ni-Cd aircraft batteries. In particular, eliminating the 'potential well' phenomenon in low-temperature, high-rate discharges has led to substantial power gains for low-temperature aircraft starts. C.R.

A82-24246 Development of a sealed Ni-Cd cell capable of operating in unprecedented high temperature environments. M. Oshitani, M. Yamane, and S. Hattori (Yuasa Battery Co., Ltd., Osaka, Japan). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980.

London, Academic Press, 1981, p. 471-487; Discussion, p. 485, 488.

A sealed Ni-Cd cell suitable for use at high temperatures has been developed. Addition of Cd(OH)₂ and/or Co(OH)₂ in the positive electrode improved charge acceptance at high temperatures, but Co(OH)₂ lowered the discharge voltage. Addition of both together gave the best results. Alkali cations, especially Li(+), in the electrolyte improved the charge acceptance. However, a drastic capacity loss occurred in the negative electrode with LiOH solution due to accumulation of Li(+) in the positive electrode. Mixture with other solutions is inevitable. Even at high temperature gamma-Cd(OH)₂ was formed when Na(+) was present, while beta-Cd(OH)₂ was formed in the other cases. (Author)

A82-24248 A sealed rechargeable metal-oxygen battery for traction purposes. M. Bursell (Kungl. Tekniska Hogskolan, Stockholm, Sweden). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 513-521. Research supported by the Styrelsen for Teknisk Utveckling.

A prototype of a sealed, rechargeable iron-oxygen battery that is based on a new oxygen electrode design is described, noting that the electrode design has made it possible to considerably simplify construction. It is pointed out that the oxygen electrode can be described as a self-breathing oxygen pocket electrode. It reaches 2 cm above the electrolyte in the battery and is fed with oxygen at the top of the battery by virtue of the pressure difference between the top of the electrode and the bottom. C.R.

A82-24292 Molten nitrate salt technology development. R. W. Carling (Sandia National Laboratory, Livermore, CA). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper. 7 p. 5 refs.*

This paper presents an overview of the experimental programs underway in support of the Thermal Energy Storage for Solar Thermal Applications (TESSTA) program. The experimental programs are concentrating on molten nitrate salts which have been proposed as heat transfer and energy storage medium. The salt composition of greatest interest is drawsalt, nominally a 50-50 molar mixture of NaNO₃ and KNO₃ with a melting point of 220 C. Several technical uncertainties have been identified that must be resolved before nitrate based solar plants can be commercialized. Research programs at Sandia National Laboratories, universities, and industrial suppliers have been implemented to resolve these technical uncertainties. The experimental programs involve corrosion, decomposition, physical properties, and environmental cracking. Summaries of each project and how they impact central receiver applications such as the repowering/industrial retrofit and cogeneration program are presented. (Author)

A82-25365 † Materials for flywheel energy storage systems (Materialy dlia inertsionnykh nakopitelei energii). I. A. Glebov, E. G. Kasharskii, N. N. Kustov, F. G. Rutberg, A. M. Shkatova, and G. M. Khutoretskii. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport, Jan.-Feb. 1982, p. 32-37. 14 refs. In Russian.*

The paper examines the choice of materials for flywheels to be used as storage units in electrical machinery systems. Particular consideration is given to two extremal problems of flywheel design assurance of maximum specific energy content (i.e., energy content for unit weight), and assurance of maximum total energy capacity. As an example, attention is given to the fabrication of forged flywheels from the 25KhNZMFA and 35KhNZMFA steels. B.J.

A82-25506 Storage of low temperature heat by thermochemical reactions (Le stockage de la chaleur à basse température par réactions thermochimiques). R. Sizmman, D. Jung, and N. Khelifa (München, Universität, Munich, West Germany). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique, 2nd Semester, 1981, p. 42-51. 15 refs. In French.*

Storage of low temperature solar generated heat by means of thermochemical reactions is reviewed as a method for compensating for diurnal and climatological variations in the solar input. The method is modeled as a separation of two exothermically joined chemicals by the addition of 30-150 C heat. The chemicals can then

be reexposed to one another to release the stored thermal energy on demand. Reactions which result in a liquid and a vapor phase are noted to have the highest thermodynamic efficiency. The hydration of Na₂S necessitates the use of a closed loop system, while a silica gel, which can store up to 400 kWh, ideally, and 200 kWh/cu m in practice, is made from environmentally neutral materials. Details of the silica gel/water vapor storage system are explored, showing an adsorption capacity which makes the material suitable for industrial applications. M.S.K.

A82-26336 Melt-freeze-cycle life-testing of Glauber's salt in a rolling cylinder heat store. C. S. Herrick (General Electric Co., Schenectady, NY). *Solar Energy*, vol. 28, no. 2, 1982, p. 99-104. 9 refs. Research supported by the U.S. Department of Energy.

N82-16427# TRW, Inc., McLean, Va.
ALTERNATIVES TO CERAMIC BRICKS AND CERAMIC-BRICK SYSTEMS

J. Michael MacDonald 1981 10 p refs Presented at the Thermal and Chem. Storage Ann. Rev Meeting, Washington, D.C. 14-16 Sep 1981 (Contract W-7405-eng-26) (DE81-032029; CONF-810940-4) Avail: NTIS HC A02/MF A01

Alternative materials for use as thermal energy storage media in electric storage furnaces were evaluated and selected. Selections were based on low cost, availability, durability, and energy storage density. The materials selected were taconite pellets, river gravel, crushed stone, and crushed (air cooled) blast furnace slag. Essential material properties and energy storage densities were established. A conceptual design for an electric storage furnace using these low cost materials was developed. The performance of this conceptual furnace was characterized by an analytical model and a computer code for the model developed. Performance and design comparisons between present day furnaces and the prototype furnace were made. A significant cost advantage for the proposed furnace over existing electric storage furnaces cannot be established. DOE

N82-16521# Exxon Research and Engineering Co., Linden, NJ
Advanced Energy Systems Labs.
DESIGN AND COST ANALYSIS OF A 20-kWh BIPOLAR ZINC-BROMINE BATTERY

Harry Einstein, Richard V Bellows, Patrick Grimes, Edward Kantner, Paul Malachuk, and Kenneth Newby 1981 4 p refs Presented at 6th Elec Vehicle Council Symp., Baltimore, 21 Oct 1981 (Contract DE-AC04-76DP-00789) (DE81-030117; SAND-81-7147C; CONF-811010-4) Avail: NTIS HC A02/MF A01

Exxon's approach to the system uses conductive carbon plastic electrodes in a bipolar configuration, separable bromine complexes, and selective membranes in a circulating electrolyte design. The battery design consists of two kWh battery stacks placed back-to-back with a common center electrolyte feed block. Each of the two battery stacks consists of 78 cells for a system voltage of 120 volt output. Active electrode area per electrode is 12 sq dm cell-to-cell spacing is 0.25 cm. The two-stack module is assembled over a tray serving as a cover for the plastic electrolyte reservoir. Unit cells are comprised of alternating bipolar electrodes and separator assemblies. The projected battery factor price is discussed, along with the manufacturing, materials, and labor costs. T.M.

N82-16526# Technical Univ of Denmark, Copenhagen. Thermal Insulation Lab.
HEAT STORAGE WITH AN INCONGRUENTLY MELTING SALT HYDRATE AS STORAGE MEDIUM BASED ON THE EXTRA WATER PRINCIPLE

Simon Furbo Dec 1980 17 p refs (DE82-901186; DTH-LV-MEDD-108; Rept-8) Avail: NTIS (US Sales Only) HC A02/MF A01; DOE Depository Libraries

The extra water principle, a heat of fusion storage method, is described. The extra water principle uses an inorganic, incongruently melting salt hydrate as a reliable and stable storage medium in an inexpensive way. Different heat storages using the extra water principle are described. The advantages of using a heat fusion storage unit based on Na₂S₂O₃·5H₂O and the extra water principle instead of a traditional hot water tank in small solar heating systems for domestic hot water supply are shown. In small solar heating systems the heat fusion storage

supplies all the wanted hot water in the summer during longer periods than an ordinary hot water storage. It is concluded that the heat of fusion storage is favorable in domestic hot water supply systems with an auxiliary energy source which during the summer have a large energy consumption compared with the energy demands for the hot water supply. DOE

N82-16536# Oak Ridge Y-12 Plant, Tenn. Nuclear Div.
ROTOR TESTING IN FY 1981

R. S. Steele, Jr. and E. F. Babelay, Jr. 13 Jul 1981 8 p refs Presented at the Mech., Magnetic and Underground Energy Storage Ann. Contractors' Rev., Washington, D.C. 24-26 Aug 1981

(Contract W-7405-eng-26) (DE81-028340; Y/DX-338; CONF-810833-4) Avail: NTIS HC A02/MF A01

Flywheel spin tests conducted for the mechanical energy storage technology project are summarized. Two types of tests are discussed. (1) an ultimate speed test, which includes ultimate speed evaluations for a tapered, quasi isotropic, graphite composite flywheel, a constant thickness disk with an SMC core and circumferentially wound graphite restraining ring, and a constant thickness disk with an S-glass alpha-ply layup core and circumferentially wound graphite ring. (2) a cyclic fatigue test. A matching flywheel was used as the first test unit. Test results and general observations and conclusions are presented. DOE

N82-16945# California Univ., Livermore. Lawrence Livermore Lab
COMPARISON OF ENERGY-STORAGE DEVICES FOR USE IN FUTURE AUTOMOBILES

L. G. Connell 20 Jun 1981 11 p refs Presented at Winter Ann Meeting of the ASME Technol and Soc Div., Washington, D.C., 15-20 Nov 1981 Submitted for publication (Contract W-7405-eng-48) (DE81-026530; UCRL-85654; CONF-811101-6) Avail: NTIS HC A02/MF A01

Energy storage devices and their associated propulsion systems which are likely to be capable of providing credible alternatives to current type automotive propulsion systems between now and the year 2000 were studied. It was found that a complete spectrum of automotive performance levels can be achieved by energy storage automobiles during this time period. These range from automobiles with general purpose performance equivalent to internal combustion engine performance to performance suitable for vehicles with specific missions. DOE

N82-17607*# United Technologies Corp., South Windsor, Conn. Power Systems Div.
ELECTROCHEMICAL ENERGY STORAGE FOR AN ORBITING SPACE STATION

R. E. Martin Dec 1981 61 p refs (Contract NAS3-21293) (NASA-CR-165436; FCR-3142) Avail: NTIS HC A04/MF A01 CSCL 10C

The system weight of a multi hundred kilowatt fuel cell electrolysis cell energy storage system based upon alkaline electrochemical cell technology for use in a future orbiting space station in low Earth orbit (LEO) was studied. Preliminary system conceptual design, fuel cell module performance characteristics, subsystem and system weights, and overall system efficiency are identified. The impact of fuel cell module operating temperature and efficiency upon energy storage system weight is investigated. The weight of an advanced technology system featuring high strength filament wound reactant tanks and a fuel cell module employing lightweight graphite electrolyte reservoir plates is defined. E.A.K.

N82-17635# Gould, Inc., Rolling Meadows, Ill.
DEVELOPMENT OF ZINC-BROMINE BATTERIES FOR UTILITY ENERGY STORAGE Monthly Progress Report, Aug. 1981

R. A. Putt 1981 31 p (Contract DE-AC02-78ET-29345) (DE82-002114; DOE/ET-29345/T5) Avail: NTIS HC A03/MF A01

Progress is reported on the following tasks related to the development of zinc-bromide batteries: component development and acceptance, hardware design and construction, and testing. Electrode test cell efficiency data and contract management summary reports are presented in tabular form. M.D.K.

07 ENERGY STORAGE

N82-17648# Applied Physics Lab, Johns Hopkins Univ., Laurel, Md

DESIGN AND SYSTEM LEVEL PERFORMANCE OF A BATTERY CHARGE REGULATOR FOR SOLAR PHOTOVOLTAIC POWERED AIDS TO NAVIGATION

Walter E. Allen Aug 1981 52 p Sponsored in part by Coast Guard

(PB82-106824; JHU/APL/CP-083) Avail: NTIS HC A04/MF A01 CSCL 10C

The design characteristics of the battery charge regulator in photovoltaic solar powered aids to navigation are reported and are specifically designed to match the electrical characteristics of the solar array and batteries to be used. The regulator, a series high/low rate type using a FET switch, is examined. GRA

N82-18067*# Jet Propulsion Lab., California Inst of Tech., Pasadena.

UPGRADED DEMONSTRATION VEHICLE TASK REPORT

J. Bryant, K. Hardy, R. Livingston, and J. Sandberg 15 Oct. 1981 158 p refs
(Contracts NAS7-100, DE-AI01-78CS-54209)
(NASA-CR-168424; JPL-Pub-81-98; DOE/CS-54209/5) Avail: NTIS HC A08/MF A01 CSCL 13F

Vehicle/battery performance capabilities and interface problems that occurred when upgraded developmental batteries were integrated with upgraded versions of commercially available electric vehicles were investigated. Developmental batteries used included nickel zinc batteries, a nickel iron battery, and an improved lead acid battery. Testing of the electric vehicles and upgraded batteries was performed in the complete vehicle system environment to characterize performance and identify problems unique to the vehicle/battery system. Constant speed tests and driving schedule range tests were performed on a chassis dynamometer. The results from these tests of the upgraded batteries and vehicles were compared to performance capabilities for the same vehicles equipped with standard batteries. S.L.

N82-19678*# Naval Weapons Support Center, Crane, Ind. Weapons Quality Engineering Center.

RESULTS OF CONTINUOUS SYNCHRONOUS ORBIT TESTING OF SEALED NICKEL-CADMIUM CELLS

J. D. Harkness 1 Jun. 1981 472 p refs
(NASA Order S-53742-AG)
(NASA-CR-168564, WQEC/C-81-120A) Avail: NTIS HC A20/MF A01 CSCL 10C

Test results from continuous synchronous orbit testing of sealed nickel cadmium cells are presented. The synchronous orbit regime simulates a space satellite maintaining a position over a fixed point on earth as the earth rotates on its axis and revolves about the sun. Characteristics of each lot of cells, test conditions, and charge control methods are described. E.A.K.

N82-19689# General Electric Co., Philadelphia, Pa. Energy Systems Programs Dept.

DESIGN AND FABRICATION OF CONTAINMENT RINGS FOR USE IN TESTS OF SIX PROTOTYPE FLYWHEEL ROTORS

Anthony P. Coppa Feb. 1981 106 p refs
(DE81-030357, UCRL-15370) Avail: NTIS HC A06/MF A01

The design of containment rings for use in the prototype flywheel rotor test was examined. Rotor dynamics and failure characteristics were measured. Six designs for prototypes for containment rings are identified. The all metallic and kevlar overwrapped metallic linear containment designs are compared. E.A.K.

N82-19698# Science Research Council, Chilton (England). THE TECHNIQUES, MAGNITUDES AND OPPORTUNITIES FOR DEVELOPMENT OF ENERGY STORAGE (UK)

F. M. Russell 1981 13 p
(PB82-120858; RL-80-087) Copyright. Avail: NTIS HC A02/MF A01 CSCL 10C

The development of energy storage techniques is discussed. Opportunities for development of existing and new forms of energy storage are examined. The increase in energy transformation with increasing industrialization, the need for efficient energy storage and recovery also grows. The large scale transformation of chemical energy stored in fossil fuels emphasizes the need for energy conversion. Techniques of energy storage, applications, and possible research and development areas are also discussed. GRA

N82-20406*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

RECENT TEST RESULTS ON LITHIUM BCX CELLS

B. J. Bragg In NASA Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 55-75

Avail: NTIS HC A23/MF A01 CSCL 10C

Texts included short circuit analysis, voltage reversal, high temperature exposure, parallel loading sharing, capacity tests, shock and vibration tests, and assembly tests. Both the AA and D cell configurations were tested. Certification of the cells is discussed and applications are highlighted. T.M.

N82-20407*# Central Intelligence Agency, Gaithersburg, Md. CASE-POSITIVE VERSUS CASE-NEGATIVE DESIGNS FOR LOW-RATE LITHIUM THIONYL CHLORIDE CELLS

Tyler X. Mahy In NASA Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 77-90

Avail: NTIS HC A23/MF A01 CSCL 10C

Case polarity design choices are discussed. Two examples of case-negative designs are presented. One battery is thionyl chloride limited and the other is lithium limited. The case-positive design is thionyl chloride limited. It is found that the case-positive/case-negative design consideration does not seem to have much bearing on storage. However, during low rate discharge, the case-negative cells show a steadily decreasing capacity as you go to lower and lower rates. T.M.

N82-20414*# Naval Surface Weapons Center, White Oak, Md. NAVY POSITION ON LITHIUM SAFETY

Frank Bis In NASA Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 157-163

Avail: NTIS HC A23/MF A01 CSCL 10C

The Navy's position on safety of lithium batteries is discussed. Testing includes short circuit with all fuses bypassed, forced discharge at the fuse value, and a modified incineration test. L.F.M.

N82-20415*# Jet Propulsion Lab., California Inst of Tech., Pasadena.

DESTRUCT/NON-DESTRUCT EVALUATION OF CYCLED NiCd CELLS

Salvador DiStefano In NASA Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 165-176

Avail: NTIS HC A23/MF A01 CSCL 10C

AC impedance techniques are discussed for a non-destruct analysis of nickel cadmium batteries. A technique for determining battery cycle life is the ultimate goal. L.F.M.

N82-20416*# Villanova Univ., Pa. Dept. of Chemistry. ELECTROCHEMICAL MODELS FOR THE DISCHARGE CHARACTERISTICS OF THE NiCd CELL

Michael S. Spritzer In NASA Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 177-188

Avail: NTIS HC A23/MF A01 CSCL 10C

Models are developed and discussed as a technique for evaluating the discharge characteristics of the nickel cadmium battery. Results are compared with available experimental data. L.F.M.

N82-20417*# Rockwell International Corp., Seal Beach, Calif. NiCd BATTERY FAILURE ANALYSIS

Karl A. Sense In NASA Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 189-200

Avail: NTIS HC A23/MF A01 CSCL 10C

The failure of a nickel cadmium battery undergoing tests is discussed. Reasons for the complete destruction of the battery while undergoing preparation for thermal vacuum testing are given. L.F.M.

N82-20427*# Martin Marietta Aerospace, Pasadena, Calif. RCA SATCOM IN-ORBIT EXPERIENCE: AN UPDATE

David Stewart In NASA Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 317-326

Avail: NTIS HC A23/MF A01 CSCL 10C

The SATCOM in-orbit battery performance was evaluated. The capacitance and constant current charge rates for each of the three batteries were monitored. A typical eclipse discharge profile was generated and attendant reconditioning/recharge conditions were considered. Battery temperatures, pressures, and average battery voltages are presented in tabular form. In-orbit data from monitoring the end of discharge voltage during eclipses, a key performance parameter, are also given. M.D.K.

N82-20428*# Martin Marietta Aerospace, Pasadena, Calif.
UPDATE: VIKING LANDER NiCd BATTERIES, YEAR SIX
 A. O. Britting, Jr. In NASA Goddard Space Flight Center
 The 1981 GSFC Battery Workshop Mar 1982 p 327-339

Avail. NTIS HC A23/MF A01 CSCL 10C

The performance of NiCd batteries on the Viking Mars landers is discussed. During evaluation, three of the four batteries were maintained in the discharged state. Battery charge regimes and close-together, deep-discharge, reconditioning cycles to retard degradation of batteries are discussed. The effect of elevated temperatures during Martian summer on battery performance were also considered. Tabulated data for average battery capacity as a function of time are given. A design uplink to allow more frequent, greater depth of discharge reconditioning cycles was proposed. M D K

N82-20429*# Rockwell International Corp., Downey, Calif.
GPS ON-ORBIT BATTERY PERFORMANCE
 John L. Kasten In NASA Goddard Space Flight Center
 The 1981 GSFC Battery Workshop Mar 1982 p 341-352

Avail. NTIS HC A23/MF A01 CSCL 10C

Three batteries designed for the GPS system were evaluated. The batteries were wired together, and during the eclipse period were discharged through parallel diodes into a boost converter which then boosted the battery voltage up to the totally regulated bus voltage. Each battery, with a system life of approximately five years, had its own charger. During testing the battery was maintained or used on trickle charge. Data are presented for the battery capacity during the reconditioning. Raw data for each eclipse period and calculations for the average discharge voltage for each battery are given. Thermal cycling for one of the batteries and reconditioning cycles and regimes for all of the batteries are discussed. A reconditioning discharge curve is also given. The problem of temperature cycling in one of the batteries was resolved by redesigning the battery radiator system. M D K

N82-20431*# Bell Telephone Labs., Inc., Murray Hill, N. J.
EFFECTS OF THE MODE OF STORAGE ON THE CAPACITY FADING OF THE SINTERED NICKEL ELECTRODES
 B. Vyes and M. P. Bernhardt In NASA Goddard Space Flight Center
 The 1981 GSFC Battery Workshop Mar 1982 p 367-386

Avail. NTIS HC A23/MF A01 CSCL 10C

A systematic investigation of the effect of temperature and two conditions of storage, shortened and open circuit, on the capacity fading of sintered nickel electrodes in NiCd batteries was conducted. All testing was done on sintered electrodes in flooded cells. Cycling tests to measure the capacity were performed at room temperature. The capacity out to one volt, a capacity useful for satellite applications. Test results indicated that: the shortened electrode showed a higher rate of loss than the open circuit electrodes; there was an increase in both modes with an increase in temperature; there was a loss of capacity with time of storage, a general degradation was observed as a function of time; shortened electrodes showed a higher end of charge than the open circuit ones; and at room temperature there was a lower loss in the open circuit electrode than in the shortened one. M D K

N82-20436*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
COMPARISONS OF DIFFERENT PLATE TREATMENT AND DESIGNS: AN UPDATE
 David Baer In its The 1981 GSFC Battery Workshop Mar 1982 p 435-442

Avail. NTIS HC A23/MF A01 CSCL 10C

Nine groups of cells were studied. The first group was the control. The basic design was cadmium in the positive plate, and no negative treatment. The plate loading level was the IUE. The separator was pellon. The test regime for the remaining cells was a 90 minute cycle with 40% depth of discharge and

a temperature of 20 C. The charge rate was 9.6 amps to a voltage limit. The discharge rate was 9.6 amps. N.W.

N82-20437*# Bowie State Coll., Md.
COMPARISONS OF DIFFERENT PLATE TREATMENTS AND DESIGNS: ANALYSIS

Vasanth Kungahelli In NASA Goddard Space Flight Center
 The 1981 GSFC Battery Workshop Mar 1982 p 443-458

Avail. NTIS HC A23/MF A01 CSCL 10C

The design and process changes on cell performance and life were studied. The merits of each design were analyzed physically, chemically, and electrochemically. A teardown analysis of each cell was carried out. On opening the cell it was found that the cell pack was moist with the electrolyte, the extent varying from one cell to another. The cell components, the positives, the negatives, and the separators, could be separated easily for cell pack of an uncycled cell. The separators from the uncycled cell were clean and white. In the case of cycled cells the separators were stuck to the surface of the negative plates. During the removal of these separators from the negative plates invariably a thin layer of the separator material was strongly adhering to the surface of the negative plates and could not be removed as easily as in the case of the uncycled cells. The separators had dark patches due to cadmium migration. N.W.

N82-20438*# Bell Telephone Labs., Inc., Murray Hill, N. J.
CHARGEABILITY OF NICKEL ELECTRODES STUDIED BY OPTICAL MICROSCOPY

C. K. Dyer In NASA Goddard Space Flight Center
 The 1981 GSFC Battery Workshop Mar 1982 p 459-470

Avail. NTIS HC A23/MF A01 CSCL 10C

Some of the operational characteristics of some nickel hydrogen cells are explained. Some strange capacity excursions with cycling were seen. N.W.

N82-20440*# Communications Satellite Corp., Clarksburg, Md.
COMSAT LABS LIFE TEST DATA FOR NiH2 CELLS

Joseph Stockel In NASA Goddard Space Flight Center
 The 1981 GSFC Battery Workshop Mar 1982 p 481-485

Avail. NTIS HC A23/MF A01 CSCL 10C

Data concerning a ten cell nickel hydrogen battery are presented. The plates are electrochemically impregnated using slurry plaque. N.W.

N82-20441*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio
LIFE TEST OF 50 AH NiH2 BATTERY

Don H. Warnoc In NASA Goddard Space Flight Center
 The 1981 GSFC Battery Workshop Mar 1982 p 487-499

Avail. NTIS HC A23/MF A01 CSCL 01C

Life cycle testing on a battery is reported. The cells were built in 1975, put into battery in 1976, and flown in 1977 in low Earth orbit. N.W.

N82-20442*# TRW, Inc., Redondo Beach, Calif.
CYCLING CHARACTERISTICS ON NiH2 CELLS IN STANDARD AND DAILY ENERGY BALANCE LEO ORBITS

Paul Ritterman In NASA Goddard Space Flight Center
 The 1981 GSFC Battery Workshop Mar 1982 p 501-512

Avail. NTIS HC A23/MF A01 CSCL 01C

A plot of end-of-charge and end-of-discharge voltage versus the number of cycles completed, and end-of-charge and end-of-discharge pressure versus cycles completed are presented. N.W.

N82-20443*# Hughes Aircraft Co., Los Angeles, Calif.
SOME PROPERTIES OF NiH2 CELLS
 Howard H. Rogers In NASA Goddard Space Flight Center
 The 1981 GSFC Battery Workshop Mar 1982 p 513-524

Avail. NTIS HC A23/MF A01 CSCL 10C

Different tests on a flight type cell are discussed. The temperature was measured at the cell flange. The cell was charged to rollover at .75 C rate at 40 degrees C for the first temperature. At that point a voltage reading was taken. Charging was done for an arbitrary ten seconds at 75 C, 30 C, 20 C, 10 C and zero C to obtain momentarily stable voltages. N.W.

07 ENERGY STORAGE

N82-20676# Hydrologic Engineering Center, Davis, Calif.
USE OF NON-SEQUENTIAL TECHNIQUES IN THE ANALYSIS OF POWER POTENTIAL AT STORAGE PROJECTS
Gary M Franc Jun 1981 19 p refs Presented at the Waterpower 81st Conf, Washington, D.C., Jun 1981 (AD-A109788, HEC-TP-80) Avail: NTIS HC A02/MF A01 CSCL 10/2

An electronic computer procedure is described that uses an estimate of power storage available at a dam site to make estimates of average annual energy and dependable capacity using a non-sequential methodology. Comparisons of this method against the more traditional sequential routing analysis are performed. Author (GRA)

N82-20687# United Technologies Research Center, East Hartford, Conn.
TECHNICAL AND ECONOMIC ASSESSMENT OF FLUIDIZED-BED-AUGMENTED COMPRESSED AIR ENERGY-STORAGE SYSTEM. VOLUME 3: PRECONCEPTUAL DESIGN

A. J. Giramonti, R. D. Lessard, D. Merrick (Coal Processing Consultants Ltd.), and M. J. Hobson (Acres American Inc.) Sep. 1981 251 p refs Prepared for Pacific Northwest Lab. (Contract DE-AC06-77RL-01830) (DE82-001945; PNL-3686-Vol-3) Avail: NTIS HC A12/MF A01

A technical and economic assessment of fluidized bed combustion augmented compressed effort are presented in three volumes. Volume III - Preconceptual Design contains the system analysis which led to the identification of a preferred component configuration for a fluidized bed combustion augmented compressed air energy storage system, the results of the effort which transformed the preferred configuration into preconceptual power plant design, and an introductory evaluation of the performance of the power plant system during part-load operation and while load following. DOE

N82-21725# Rocketdyne, Canoga Park, Calif Flywheel Systems.
RPE-10 COMPOSITE FLYWHEEL TESTING Final Report
B. R. Ginsburg Livermore, Calif California Univ Lawrence Livermore Lab 15 Jun. 1981 47 p refs (Contract W-7405-eng-48) (DE82-001694; UCRL-15379) Avail: NTIS HC A03/MF A01

The final report on the technical effort to test an RPE-10 composite flywheel is described. The RPE-10 composite flywheel was designed and fabricated for vehicle use under a Sandia Laboratories contract. The flywheel (Unit No. 2) was tested to a speed of 21,600 rpm, at which time the overwrap separated from the flywheel, terminating the test. The primary cause of failure was attributed to overheating in the test cell, causing a deterioration in material properties of the epoxy bond. The RPE-10 composite flywheel Unit No. 1 was successfully tested without failure to 24,120 rpm at Oak Ridge's Y-12 Laboratory. At this speed, the rotor stored over 2.0 kilowatt hours of kinetic energy. DOE

N82-21763# United Engineers and Constructors, Inc., Philadelphia, Pa
PRELIMINARY ENGINEERING DESIGN AND COST OF ADVANCED COMPRESSED-AIR STORAGE (ACAS) A-5 HYBRID Final Report

E. J. Sosnowicz, J. Blackman (Brown Boveri Corp., North Brunswick, N.J.), A. S. Woodhull, and P. Zaugg Aug 1981 272 p refs (EPRI Proj 1699-1) (DE82-900339; EPRI-EM-1998) Avail: NTIS HC A12/MF A01

The advanced compressed air energy (ACAS) plant investigated operates on a partial adiabatic, partial fuel fired cycle. Only a limited advancement in state-of-the-art technology is projected for this hybrid arrangement. The A-5 hybrid systems stores the heat of compression from the low pressure and intermediate pressure compressors in a thermal energy store (TES). The heat collected in the TES is available for preheating the air from the storage cavern prior to its entering the low pressure turbine combustor. This reduces the amount of fuel consumed during power generation. The fuel heat rate for the hybrid cycle is 2660 Btu/kWh as compared to approximately 4000 Btu/kWh for a conventional CAES plant. A virtual stand-off between the hybrid plant and a conventional CAES plant at 235 mills/kWh in 1990 dollars is shown

With a lower cost and increased fuel cost projections, the hybrid system operating cost is less than that for a conventional CAES plant. TM

N82-21766# Stuttgart Univ (West Germany) Abt Energiewandlung und Waermetechnik.
HEAT STORAGE BY MEANS OF THERMAL DISSOCIATION REACTIONS. STORAGE SYSTEMS AND MATERIALS. [WAERMESPEICHERUNG DURCH THERMISCHE DISSOCIATIONSREAKTIONEN - SPEICHERSYSTEME UND SPEICHERMATERIALEN]

A Nonnenmacher May 1980 50 p refs In GERMAN; ENGLISH summary (IKE-5-213; ISSN-0173-6892) Avail: NTIS HC A03/MF A01

The reversible chemical reactions used for heat storage are classified, according to the phase of the dissociation products and storage techniques, pertaining to the respective phases. The physical principles of heat storage, the relevant thermal dissociation reactions and adsorption cycles are reviewed and the most important working media for the different reaction groups are summarized. The interaction with the storage materials is investigated and reactions of gases and fluids with solids and liquids are emphasized. Storage by adsorption media is also envisaged. Author (ESA)

N82-21772# Science Research Council, Chilton (England)
ENERGY STORAGE: A SHORT LIST OF INTERESTED PARTIES, 1981 AND THE STORAGE OF ENERGY; A WALL CHART

F. M. Russell 1981 29 p refs (PB82-132069, RL-81-067) Copyright Avail: NTIS HC A03/MF A01 CSCL 10C

The storage of energy is an important feature of all industrialized activity and is increasing in importance rapidly as attempts are made to conserve energy and to use energy more efficiently in both industrial and domestic applications. In April 1981 an International Conference on Energy Storage was co-sponsored by SERC, BHRA and ETSU. As part of the SERC contribution to that conference an analysis was made of the activities and interests of the conference participants relevant to energy storage. This short list of parties interested in energy storage was made available to conference delegates but it is believed that a wider distribution of this information may be of use to others who may be either currently active or contemplating initiating work in this area. GRA

08
GENERAL

A82-20876 Space in the 1980's and beyond; Proceedings of the Seventeenth European Space Symposium, London, England, June 4-6, 1980. Symposium sponsored by the Association Aéronautique et Astronautique de France, Deutsche Gesellschaft für Luft- und Raumfahrt, American Astronautical Society, et al. Edited by P. M. Bainum (Howard University, Washington, DC). San Diego, CA, American Astronautical Society (Science and Technology Series. Volume 53); Univelt, Inc., 1981. 302 p. \$40.

Topics discussed include a long-term space program for Europe, space communications, space transportation, applications, and technology, and lunar and planetary exploration. Papers are presented on manufacturing in space, on the contributions of space reflector technology to food production, local weather manipulation, and energy supply, and on a technological approach towards future large solar arrays. Attention is also given to low-pressure greenhouses and plants for a manned research station on Mars, to the extraction of Martian resources for a manned research station, and to the development of future lunar exploration. C.R.

A82-28112 AIP 50th anniversary: Physics vade mecum. Edited by H. L. Anderson (Los Alamos National Laboratory, Los Alamos, NM). New York, American Institute of Physics, 1981. 335 p.

This compendium is intended to be of use to the wide spectrum of physicists associated with the AIP through its member societies. Twenty-two subjects broadly representative of physics as a whole are discussed. Each subeditor was charged to compile within 10 pages the most useful information, formulas, numerical data, definitions, and references most physicists would like to have at hand. The General Section is a compilation of the fundamental constants, the SI units and prefixes, conversion factors, magnitudes, basic mathematical and physics formulas, formulas useful in practical physics applications, and a list of physics data centers. The particular fields considered are: acoustics, astronomy and astrophysics, atomic collision properties, atomic spectroscopy, biological physics, cryogenics, crystallography, elementary particles, energy demand, energy supply, fluid dynamics, high polymer physics, medical physics, molecular spectroscopy and structure, nuclear physics, optics, plasma physics, rheology, solid state physics, surface physics, and thermophysics. B.J.

N82-16301# GAI Consultants, Inc., Monroeville, Pa
INVESTIGATION OF THE USE OF COAL REFUSE-FLY ASH COMPOSITIONS AS HIGHWAY BASE COURSE MATERIAL
Final Report, Oct. 1977 - Sep. 1980
Paul V. McQuade, W. J. Head, and Robert B. Anderson Jun. 1981 68 p Prepared in cooperation with West Virginia Univ., Morgantown
(Contract DOT-FH-11-9324)
(PB82-101940; FHWA/RD-80/129; Rept-77-522) Avail. NTIS HC A04/MF A01 CSCL 13C

The utilization of coal refuse-fly ash compositions as highway base course material is surveyed. The results of a laboratory testing program into the physical and engineering properties of mixtures of these waste products are presented. A comparison of serviceability index and physical damage parameters based on the VESYS Predictive Design Procedure between crushed stone and coal refuse-fly ash compositions are presented. These findings indicate that substituting stabilized coal refuse-fly ash blends in place of conventional base course material is technically and economically feasible. Procedures for developing design mixes and conducting field tests of coal refuse-fly ash base course material are described. Author

N82-20138# Office of Naval Research, London (England)
EUROPEAN SCIENTIFIC NOTES, VOLUME 35, NUMBER 11
Monthly Publication Report, 30 Nov. 1981
Francis A. Richards, ed. and Don J. Peters, ed. 30 Nov. 1981 37 p
(AD-A109387, ESN-35-11) Avail: NTIS HC A03/MF A01 CSCL 05/1

A collection of articles on recent developments in European scientific research is presented. The following topics are discussed: Artificial and Human Intelligence; Organizational Change in Merchant Shipping; Unit of Blood Pressure. Protecting the Millimeter of Mercury; Third International Symposium on Inorganic Ring Systems; NATO Advanced Research Institute on Surface Modification and Alloying of Materials by Direct Energy Processing, and FRAM Ice Floe Stations. E.A.K

N82-20315# National Inst for Transport and Road Research, Pretoria (South Africa).

THE DEVELOPMENT OF PVC-MODIFIED TARS FOR USE IN SURFACE TREATMENTS

I. L. Jamieson 1981 75 p refs
(CSIR-RR-393; CSIR-B-14) Avail: NTIS HC A04/MF A01

An account of this research in improving the durability of tar is presented. It includes the formulation of tars; the manufacture of tars and modified tars, the storage and handling of tars, the performance of PVC modified tars in surface treatments, road experiments and normal contract work. The development of improved tar binders which could be used as alternatives to petroleum bitumen, with considerable cost advantage to road authorities was considered. Practical points which have emerged from this research are included. Author

N82-22099# Committee on Information Hang-Ups, Washington, D.C. Energy Systems Group.

DIRECTORY OF ENERGY AND ENVIRONMENT LIBRARIES AND INFORMATION CENTERS IN THE METROPOLITAN WASHINGTON D.C. AREA

Ellen L. Berman 1981 162 p
(PB82-123993) Avail: NTIS HC A08/MF A01 CSCL 05B

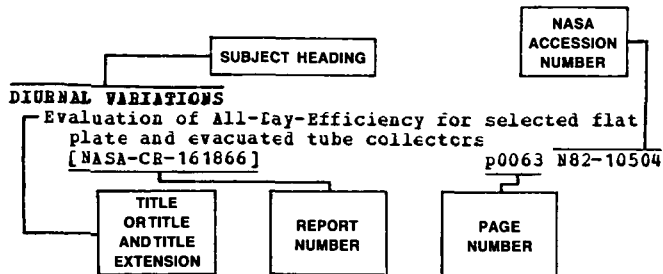
Information on the resources, services, and policies of each library and information center is provided. The directory is arranged alphabetically by name of parent organization. Indexes to key staff members, subject coverage, types of material, and online search services are included. Terms in the subject index conform to the subject list in the questionnaire (Appendix A). The index to Types of Material draws its terms from a list in the RESOURCES section of the questionnaire. GRA

SUBJECT INDEX

ENERGY/A Continuing Bibliography (Issue 34)

JULY 1982

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title, and title extension if used, provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any subject heading the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A

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Heat storage by means of thermal dissociation reactions. Storage systems and materials [IKE-5-213] p0294 N82-21766

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Safety procedures for the 100-kW solar photovoltaic system at Natural Bridges National Monument [DE82-002840] p0234 N82-21731

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A project to test for shale gas in Ohio [DE82-000916] p0252 N82-17572

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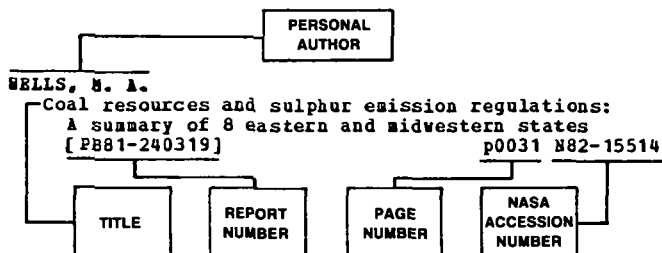
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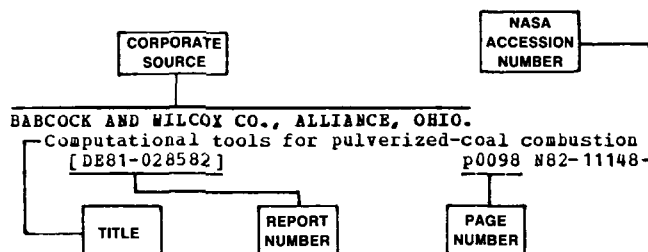
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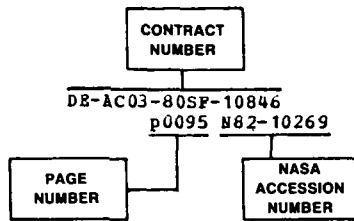
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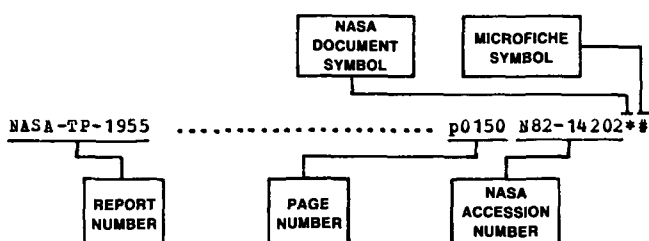
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