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ACCESSION NUMBER RANGES

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

IAA (A-10000 Series)	A81-10001 – A81-19672
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NASA SP-7043(29)

ENERGY

A Continuing Bibliography

With Indexes

Issue 29

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced from January 1 through March 31, 1981 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(29)) lists 1360 reports, journal articles, and other documents announced between January 1, 1981 and March 31, 1981 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974 and succeeding issues are published quarterly.

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

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The 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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All publications abstracted in this bibliography are available to the public through the sources as indicated in the *STAR Entries* and *IAA Entries* sections. It is suggested that the bibliography user contact his own library or other local libraries prior to ordering any publication inasmuch as many of the documents have been widely distributed by the issuing agencies, especially NASA. A listing of public collections of NASA documents is included on the inside back cover.

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N81-11450*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Materials Engineering.
IDENTIFICATION AND ANALYSIS OF FACTORS AFFECTING THERMAL SHOCK RESISTANCE OF CERAMIC MATERIALS IN SOLAR RECEIVERS Final Report
D. P. H. Hasselman, J. P. Singh, and K. Satyamurthy 15 Jul. 1980 150 p refs
(Contracts NAS7-100; JPL-955629)
(NASA-CR-163727; JPL-9950430) Avail: NTIS HC A07/MF A01 CSCL 10A

An analysis was conducted of the possible modes of thermal stress failure of brittle ceramics for potential use in point-focussing solar receivers. The pertinent materials properties which control thermal stress resistance were identified for conditions of steady-state and transient heat flow, convective and radiative heat transfer, thermal buckling and thermal fatigue as well as catastrophic crack propagation. Selection rules for materials with optimum thermal stress resistance for a particular thermal environment were identified. Recommendations for materials for particular components were made. The general requirements for a thermal shock testing program quantitatively meaningful for point-focussing solar receivers were outlined. Recommendations for follow-on theoretical analyses were made. Author

TYPICAL CITATION AND ABSTRACT FROM *IAA*

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A81-18714 * # **Sodium heat pipe use in solar Stirling power conversion systems.** W. F. Zimmerman (General Electric Co., Advanced Energy Dept., Cincinnati, Ohio), S. M. Divakaruni (General Electric Co., Advanced Reactor Systems Dept., Sunnyvale, Calif.), and Y. S. Won (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-13.* 5 p. 6 refs. Members, $1.50; nonmembers, $3.00. Contract No. JPL-955018.

Sodium heat pipes were selected for use as a thermal transport method in a focus-mounted, distributed concentrator solar Stirling power conversion system intended to produce 15-20 kWe per unit. Heat pipes were used both to receive thermal power in the solar receiver and to transmit it to a secondary heat pipe containing both latent heat salt (for up to 1.25 hours of thermal storage) and the heat exchanger of the Stirling engine. Experimental tests were performed on five solar receiver heat pipes with various internal wicking configurations. The performance of the heat pipes at various power levels and operating attitudes was investigated at temperatures near 1550 F; the unidirectional heat transfer in these heat pipes was demonstrated in normal operating attitudes and particularly in the inverted position required during overnight stowage of the concentrator. (Author)

A Listing of Energy Bibliographies Contained In This Publication:

ENERGY

A Continuing Bibliography (Issue 29)

APRIL 1981

01
ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

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

A81-10586 # The ecology of a marine petroleum seep. *Energy and Technology Review,* Sept. 1980, p. 6-9.

Shallow, natural petroleum seeps in the Santa Barbara Channel were used to study the complex effects of oil on the marine environment since 1975. The comparison between the same kinds of organisms, subsisting at seep and oil-free sites, show that the population densities are higher in the vicinity of oil seeps. The results indicate that microorganisms that oxidize sulfur and degrade hydrocarbons in the crude oil are used as food by benthic organisms, and that some fish have adapted to the crude petroleum in the seep. Although the analysis of the seep environment shows that it does not appear to be toxic, the tests demonstrate that starfish accumulate high concentrations of n-alkanes in their digestive glands and reproductive tissues, a phenomenon not well understood and which needs more studies. S.S.

A81-10587 # The effect of underground coal gasification on groundwater. *Energy and Technology Review,* Sept. 1980, p. 10-14. 6 refs.

Ground water contamination as a result of underground coal gasification has been studied over a 15-month period at an experimental site in Wyoming by means of gas chromatography and mass spectrometry. The experiments have shown that except for the earliest measurement (two weeks after gasification), the principal groundwater contaminants are water-soluble, low-molecular-weight aromatic hydrocarbons. A conceptual model of contaminant-transport processes is suggested and the work is currently in progress on acidic and basic organic contaminants. S.S.

A81-10588 # Coal fly-ash studies. *Energy and Technology Review,* Sept. 1980, p. 15-19. 5 refs.

The composition and properties of coal fly-ash particles (particularly those smaller than 8 microns) passed through conventional precipitators, are studied to find ways of minimizing health hazards. The actual outputs of utility-scale power plants that use different forms of pollution control have been evaluated, and it is demonstrated that an electrostatic precipitator (ESP) and a hot-side ESP are more effective in controlling emissions of several potentially toxic trace substances than high-energy Venturi wet scrubber systems. The behavior of coal-combustion pollutants after release into the atmosphere has been investigated by picking and sorting aerosol particles tens of kilometers from the source with cascade impactors mounted on aircraft. The measurements suggest that the levels of mutagens and cancer-causing materials on fly-ash particles from modern plants may be much lower than predicted in earlier studies. S.S.

A81-10793 Atmospheric sulphur - Natural and man-made sources. C. F. Cullis and M. M. Hirschler (City University, London, England). *Atmospheric Environment,* vol. 14, no. 11, 1980, p. 1263-1278. 110 refs.

A review is presented of the sulfur compound emissions processes. The principal natural source of the atmospheric sulfur is biogenic activity; the combustion of coal and petroleum produces 90% of the total human sulfur emission, with smelting of Cu ores providing another large source. Human activities generated a total of 104 Tg S/a in 1976 which represent over 40% of all atmospheric S emissions; this trend indicates that population sources of these emissions will exceed natural causes before the end of this century. A.T.

A81-11322 # Methods of fuel conservation in civil aviation. I (Metody oszczedzania paliwa w lotnictwie komunikacyjnym. I). M. Kawczynski. *Technika Lotnicza i Astronautyczna,* vol. 35, Aug.-Sept. 1980, p. 36-38. In Polish.

Several methods for saving fuel in civil aviation are described. These methods include modifications in aircraft design, operational methods, and aircraft balancing during flight. B.J.

A81-11352 Exploring energy frontiers. A. Favale (Grumman Aerospace Corp., Bethpage, N.Y.). *Grumman Aerospace Horizons,* vol. 16, no. 1, 1980, p. 16-24.

Energy options are discussed along with economic and environmental considerations. Conservation is considered the best near term solution that could reduce oil consumption within 5 to 10 years by several million barrels per day (MBD). Increasing car mileage from 17 mpg to 30 would save almost 3 MBD. Technology for harnessing solar energy is discussed including solar collectors for domestic systems and in space. Wastes can be processed into steam for generating electricity and organic matter can be converted into liquid fuels for automobiles. Plans to develop wind power generators and projects for fusion reactor research are presented. Vast deposits of coal and oil bearing shale offer a huge energy potential in the U.S., although there are high costs for development and environmental problems. R.C.

A81-11443 Wind energy - A systems analysis evaluation of the technical and economic potential for production of electrical current in the Federal Republic of Germany (Windenergie - Eine systemanalytische Bewertung des technischen und wirtschaftlichen Potentials für die Stromerzeugung der Bundesrepublik Deutschland). L. Jarass, L. Hoffmann (Regensburg, Universität, Regensburg, West

Germany), A. Jarras (Forschungsgesellschaft für Alternative Technologien und Wirtschaftsanalysen mbH, Regensburg, West Germany), and G. Obermair (Regensburg, Universität, Regensburg, West Germany). Research supported by the Bundesministerium für Forschung und Technologie; Contract No. BMFT-ET-4085-A. Berlin, Springer-Verlag, 1980. 272 p. 51 refs. In German. $52.

The technical and economic possibilities of the conversion of wind energy into electrical energy in the region of 300 MW is examined. A simulations model SWING (Simulation of Wind Energy Integration in the National Power Grid) is developed based on conventional systems for current conservation and wind energy production designs. Wind patterns in the Federal Republic of Germany are investigated along with optimal sizes of storage systems. Fuel savings are considered along with reductions in power plant performance. R.C.

A81-11605 **The relevance of the Flex-Hub Prop-Fan for fuel-efficient airliners.** K. W. Sambell. In: International Council of the Aeronautical Sciences, Congress, 12th, Munich, West Germany, October 12-17, 1980, Proceedings. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 53-62. 11 refs.

The Flex-Hub Prop-Fan, a variant of the rigid-hub prop-fan, is predicted to have improved performance and control characteristics for twin-engine M 0.8 airliners. In the one-engine inoperative case at take-off, the Flex-Hub Prop-Fan will have a more even thrust distribution in its tip-path plane and will develop higher propulsive efficiency and greater propulsive lift. A preliminary analysis, with a fixed engine core-size, compares payload capability of three aircraft: powered by fan-jets, rigid-hub prop-fans, and flex-hub prop-fans. The respective design gross weights were 300,000 lbs., 320,000 lbs., and 342,000 lbs. At a range of 2,000 n.m., the passengers carried were 232, 255 and 280. The fuel economy (seat-statute miles per U.S. gallon) was 68.7, 76.5 and 79.5. Other unique characteristics of the Flex-Hub Prop-Fan are discussed, including cross-wind control, blade de-icing, and wing trailing-vortex interaction. (Author)

A81-11676 **ECS integration for fuel efficient/low life cycle cost design.** V. K. Rajpaul (Boeing Military Airplane Co., Seattle, Wash.). In: International Council of the Aeronautical Sciences, Congress, 12th, Munich, West Germany, October 12-17, 1980, Proceedings. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 856-861.

Current technology environmental control systems (ECS) in aircraft suffer from deficiencies in two major respects: (1) the fuel penalty for engine bleed air extraction and ram air drag is high, and (2) lack of adequate system temperature and moisture controls result in excessively high avionic equipment failure rates, thereby adversely affecting life cycle costs. Studies conducted in development of energy efficient, low life cycle cost ECS are discussed with a tactical mission aircraft used for illustrating problems, new concepts and payoffs. Concepts which significantly reduce fuel consumption, thrust and drag penalties to an aircraft are related to reliability of interfacing systems, in particular the avionics. Relationship to life cycle cost of ECS/avionic systems is discussed. (Author)

A81-11758 **Hydrogen and the environment.** J. R. Bartlit (California, University, Los Alamos, N. Mex.). In: Hydrogen: Its technology and implications. Volume 5 - Implications of hydrogen energy. Boca Raton, Fla., CRC Press, Inc., 1979, p. 51-66. 29 refs.

A review of the environmental effects of hydrogen is presented. The regulatory framework, including emission vs ambient standards, and limitations on H in environmental rules are discussed; mobile pollution sources in ground and air transportation, the effects of SST on the ozone layer, and land uses are described. Stationary sources of pollution such as H plants, fuel cells, and home hydrogen appliances are considered. Finally, the environmental effects of oil reduction, electric power transmission lines, and thermal pollution from energy parks are analyzed, along with CO2 buildup and water pollution. A.T.

A81-11795 **Toward an energy efficient community (Auf dem Weg zu einer energieeffizienten Gesellschaft).** M. Horn. *Energiewirtschaftliche Tagesfragen*, vol. 30, Oct. 1980, p. 745-748. 11 refs. In German.

The current oil policy of the OPEC countries means that a substantial oil shortage may be expected in the future. Conservative estimates indicate an oil shortage of 65 billion tons in the year 2000. The results of numerous new studies show that (from the technological point of view) the savings potential is high enough to achieve an absolute decrease in total energy consumption by the year 2000, provided better use is made of secondary energy sources in the form of electric power, gas, and solar heat. V.P.

A81-12087 **Computer modeling studies of the impact of vehicle exhaust emission controls on photochemical air pollution formation in the United Kingdom.** R. G. Derwent (Atomic Energy Research Establishment, Environmental and Medical Sciences Div., Harwell, Oxon, England) and O. Hov. *Environmental Science and Technology*, vol. 14, Nov. 1980, p. 1360-1366. 50 refs. Research supported by the Department of Transport/Department of the Environment.

A81-12244 **Managing state energy conservation programs - The Minnesota experience.** E. Hirst (Oak Ridge National Laboratory, Oak Ridge, Tenn.) and J. R. Armstrong (Minnesota Energy Agency, Conservation Div., St. Paul, Minn.). *Science*, vol. 210, Nov. 14, 1980, p. 740-744. 20 refs. Research supported by the Minnesota Energy Agency; Contract No. W-7405-eng-26.

The development and operation of energy conservation programs in the Minnesota Energy Agency (MEA) are discussed. The MEA has responsibility for voluntary conservation efforts, regulating energy efficient devices, and grant programs to audit and retrofit public buildings. The MEA has developed the plan under which the Minnesota utilities will provide conservation services to residential customers, including an on-site home energy audit. The relation between the Department of Energy (DOE) and state energy offices in implementing programs is considered. The DOE has provided technical assistance to the states through the development of a model audit. Steps are discussed to reduce the burdens imposed on the states by program planning, funding, and management responsibilities, including the consolidation of several existing state conservation programs. Improved policy analysis is suggested to correct inefficiencies in government programs. R.C.

A81-12258 **Technical and economic aspects of the struggle against atmospheric pollution in the road transportation sector (Aspects techniques et économiques de la lutte contre la pollution atmosphérique dans le secteur du transport routier).** W. Hecq and L. Sempoux (Bruxelles, Université Libre, Brussels, Belgium). *Pollution Atmosphérique*, vol. 22, July-Sept. 1980, p. 299-312. 34 refs. In French.

Several processes for reducing atmospheric pollutants (CO, NOx, SO2, Pb) of exhaust emission from automobiles from Belgium are evaluated using data based on the major emission pollutants observed in Belgium in 1977, and European emission control standards. The processes are described, emphasizing their relative effectiveness, while the investment and utilization costs of the various devices for the processes are compared as functions of their respective guaranteed emission standards. Based on both economic and environmental aspects, the most efficient processes are found to be the controlled combustion motor, the turbocompressor and the diesel motor. A.C.W.

A81-12739 **Low-head hydro power.** E. J. Lemer. *IEEE Spectrum*, vol. 17, Nov. 1980, p. 37-39.

With a view toward increasing the U.S. electric output, the Army Corps of Engineers has estimated that 55 GW can be obtained immediately from new capacity at existing dams and 40 GW more over the long term. Given the long lead times needed to build new dams, most interest has centered on the existing dams. The Corps of Engineers has established that 21 GW can be obtained from hydroelectric and 34 GW from nonpower dams. Existing hydroelectric sites are being expanded by the utilities, but exploitation of the nonpower dams will require governmental encouragement, because the vast majority are low-head sites (dams less than 40 m high). In the present paper, the question of economics and national policy is examined. The advantages which would accrue from substituting axial turbines for the Kaplan turbine are noted. V.P.

A81-12894 **Clean air and economic development - An urban initiative.** J. A. Kurtzweg and C. J. Nelson (U.S. Environmental Protection Agency, Washington, D.C.). *Air Pollution Control Association, Journal,* vol. 30, Nov. 1980, p. 1187-1193. 13 refs.

The Air Quality Technical Assistance Demonstration (AQTAD) program is designed to assist urban areas to improve air quality standards, while enhancing their potential to attract business and industry. The program administrative practices, site selection criteria, reductions of emissions required to meet national ambient air quality standards (NAAQS), and ranking of economic problems in Boston, Bridgeport, Erie County, N.Y., Philadelphia, and Chicago areas are discussed. The characteristics of the dependence on manufacturing in Newark, N.J., Seattle, Wash., and Portland, Ore., are considered in the AQTAD awards of up to $500,000 for clean air and economic development. A.T.

A81-13107 **Energy options: Real economics and the solar-hydrogen system.** J. O'M. Bockris (South Australia, Flinders University, Adelaide, Australia; Texas A & M University, College Station, Tex.). New York, Halsted Press, 1980. 455 p. 521 refs. $32.95.

The book focused on energy perspectives, exhaustion of fossil fuels, fluidization of coal, fission, fusion, solar energy, energy transmission over long distances, hydrogen economy, splitting of water, and materials problems. Topics covered included oil and its recovery, world reserves of coal, heating value of fossil fuels, coal gasification to methane, safety of fission reactors, the breeding of uranium fission products, disposal of nuclear wastes, the basic concepts of attaining fusion in plasma reactions, and transmission of energy through microwave radiation. A.T.

A81-13197 **Choice of smallest car by multi-vehicle households and the demand for electric vehicles.** S. D. Beggs and N. S. Cardell (Charles River Associates, Boston, Mass.). *Transportation Research, Part A: General,* vol. 14A, no. 5-6, Oct.-Dec. 1980, p. 389-404. 12 refs.

A81-13198 **Energy use of electric vehicles.** W. Hamilton (General Research Corp., Santa Barbara, Calif.). *Transportation Research, Part A: General,* vol. 14A, no. 5-6, Oct.-Dec. 1980, p. 415-421. 10 refs. Contract No. DE-AC03-76CS-51180.

Although electric vehicles are not more energy-efficient than conventional vehicles (of comparable performance), they do offer two substantial possibilities for conserving fossil fuels. First, much of the electricity used for recharging electric cars will be generated from non-petroleum sources. Second, if we consider the tradeoff between using coal to produce synfuels for conventional cars, or using the coal to produce electricity for electric cars, there is substantially greater transformation-efficiency in the production of electricity. Regarding the first point, projections of fuel use by U.S electric utilities indicate that even for total electrification of light-duty vehicles, less than 25% of recharge power would be generated from oil in the 1990s. In many areas of the country, little or no petroleum would be used to generate recharge power. Thus the potential for petroleum conservation through vehicular electrification is immense. Regarding the second point, cars powered by coal-produced electricity would require about 40% less coal than cars powered by coal-produced synfuels, because of the relatively low efficiency with which gasoline can be synthesized from coal. (Author)

A81-13447 **The economics of optimal geothermal-resource extraction for electric power.** P. Blair (Pennsylvania, University; Technecon Analytic Research, Inc., Philadelphia, Pa.), T. A. V. Cassel (Technecon Analytic Research, Inc., Philadelphia, Pa.), R. H. Edelstein (Pennsylvania, University, Philadelphia, Pa.; Southern California, University, Los Angeles, Calif.), and I. Paik (U.S. Department of Energy, Washington, D.C.). *Energy Systems and Policy,* vol. 4, no. 3, 1980, p. 157-173. 8 refs. Contract No. ET-78-S-02-4713.

This paper presents a theoretical framework for estimating optimal rates of extraction of geothermal resources from a hydrothermal reservoir for the production of electricity. The formulation integrates the technological characteristics of hydrothermal-reservoir management and electric-power generation into an optimal economic investment-production model. Of particular interest is the incorporation of time-dependent resource decline phenomena into the model. Assuming an objective of maximizing net present value, the solution provides optimal rates over time of electric-power production, of capital investment in well-field equipment, and of hydrothermal resource extraction. (Author)

A81-13448 **Application of classical and optimal control theories to energy-economics systems.** B. W. Mar (Washington, University, Seattle, Wash.) and O. A. Bakken (Boeing Co., Seattle, Wash.). *Energy Systems and Policy,* vol. 4, no. 3, 1980, p. 175-195. 27 refs.

It is viewed that the conjunctive use of control theory and simulation provides a better insight into the behavior of social systems than simulation models alone. Two examples of control theory are presented to indicate the effectiveness of such methods in analyzing an energy-economic simulation model. Classical control theory is used to reveal model sensitivities and dynamics without exhaustive simulation runs, while optimal control theory examines whether proposed policies have been designed to satisfy objectives. The model chosen to demonstrate classical and optimal control theories is the COAL 1 base model designed by Naill (1976). In addition, the combination of control theory and simulation will reduce analytical costs and enrich interpretation of simulation modeling studies. A.C.W.

A81-13656 **Aerosols: Anthropogenic and natural, sources and transport; Proceedings of the Conference, New York, N.Y., January 9-12, 1979.** Conference sponsored by the New York Academy of Sciences and Air Pollution Control Association. Edited by T. J. Kneip and P. J. Lioy (New York University, Medical Center, New York, N.Y.). New York, New York Academy of Sciences *(New York Academy of Sciences, Annals.* Volume 338), 1980. 628 p. $108.

The papers deal with such uses as the size distribution, trace element abundance, and chemistry of urban atmospheric aerosols; technique for treating multielement particulate data to obtain information on sources; the aerosol composition of urban plumes; the formation and transport of ozone and aerosols in power plant plumes; the organic constituents of natural aerosols; mesoscale and synoptic scale transport of aerosols; and the origin and transport of the winter arctic aerosol. Some future problems associated with energy are examined. V.P.

A81-13667 **A review of urban plume studies.** F. A. Schiermeier. In: Aerosols: Anthropogenic and natural, sources and transport; Proceedings of the Conference, New York, N.Y., January

9-12, 1979. New York, New York Academy of Sciences, 1980, p. 198-201. 6 refs.

An overview is given of recent urban-plume field studies sponsored by the EPA and of related studies sponsored by the Department of Energy (DOE) and by the Electric Power Research Institute (EPRI). The EPA studies were aimed at determining pollution transport, transformation, and removal rates. The studies and projects discussed include the Regional Air Pollution Study (RAPS; EPA), the Midwest Interstate Sulfur Transport and Transformation (MISTT) project (EPA), the Sulfur Transport and Transformation in the Environment (STATE) program (EPA), the Visibility Impairment due to Sulfur Transport and Transformation in the Atmosphere (VISTTA) program (EPA), the Multi-State Atmospheric Power Production Pollution Study (MAP3S; DOE), and the Sulfate Regional Experiment (SURE; EPRI). It is noted that the projects of the EPA, DOE, and EPRI are coordinated and, taken together, provide a comprehensive national program to study the transport, transformation, and removal of energy-related pollution. F.G.M.

A81-13670 Size and composition of visibility-reducing aerosols in southwestern plumes. E. S. Macias, D. L. Blumenthal, J. A. Anderson (Meteorology Research, Inc., Santa Rosa, Calif.), and B. K. Cantrell (SRI International, Menlo Park, Calif.). In: Aerosols: Anthropogenic and natural, sources and transport; Proceedings of the Conference, New York, N.Y., January 9-12, 1979. New York, New York Academy of Sciences, 1980, p. 233-257. 21 refs. U.S. Environmental Protection Agency Grant No. R-802160.

Results are presented for Project VISTTA aircraft measurements that were made on seven days within the mixing layer in the southwestern U.S. The data, obtained in the plumes of a copper smelter and a coal-fired power plant, are used to characterize the atmospheric visibility-reducing aerosol in the Southwest with respect to particle size, composition, and contribution to light scattering. The results indicate that: (1) visibility impairment was of regional extent; (2) the regional aerosol size distribution was bimodal; (3) sulfur and silicon were in nearly equal concentrations in the background data and had the highest concentrations in the fine particles; (4) nearly all the coarse particles originated from either windblown dust or a material such as fly ash; (5) the plume excess fine-particle aerosol was composed largely of sulfur and silicon compounds for both the smelter and the power-plant plumes; and (6) sulfate aerosol was formed in both plumes. F.G.M.

A81-13679 Regional scale air pollution - Sources and effects. R. B. Husar and D. E. Patterson (Washington University, St. Louis, Mo.). In: Aerosols: Anthropogenic and natural, sources and transport; Proceedings of the Conference, New York, N.Y., January 9-12, 1979. New York, New York Academy of Sciences, 1980, p. 399-417. 18 refs. U.S. Environmental Protection Agency Grant No. R-803896.

Several independent types of information relating to the sources and effects of regional-scale air pollution are reviewed. Much of the information was obtained by in situ observations of plumes and field studies of individual pollution episodes. Attention is given to anthropogenic pollution sources in the U.S. (primarily fossil fuel combustion), rates of SOx and NOx emission from such sources, ambient concentrations of sulfur compounds, the long-range transport of sulfate aerosol, and visibility trends in the eastern U.S. It is concluded that an episode of extreme haziness covering multistate regions of the eastern U.S. appeared to have been largely caused by secondary sulfate aerosol; that coal combustion and sulfate are only one factor in the production of optical effects; and that spatial and temporal aerosol trends and distributions of coal use, sulfate, light extinction, turbidity, and solar radiation exhibit reasonable internal consistency. F.G.M.

A81-13681 The fate of particulate emissions from an isolated power plant in the oil sands area of western Canada. L. A. Barrie (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada). In: Aerosols: Anthropogenic and natural, sources and transport; Proceedings of the Conference, New York, N.Y., January 9-12, 1979. New York, New York Academy of Sciences, 1980, p. 434-452. 14 refs. Research supported by the Alberta Oil Sands Environmental Research Program.

The nature and fate of particulate emissions from an isolated power plant in the Athabasca oil sands area of western Canada are investigated on the basis of measurements of particulate elemental concentrations in the air 80 km from the source late one winter and close to the source early the next summer, of dry deposition patterns of particulate sulfur and heavy metals in the early summer, and of total (wet and dry) deposition patterns of major ions and metals during two winters. Results of plume chemistry studies to investigate SO2 oxidation during summer and winter and of fly-ash analyses for heavy metals are also used. It is found that: (1) many elements in particulate matter deposited around the plant originate primarily from a different source in summer and in winter; (2) deposition near the source is more alkaline than in outlying areas; (3) wet and dry deposition of acidic oxides of sulfur and nitrogen from the power-plant emissions appear to be the main source of snowpack acidification in downwind areas; and (4) acidic compounds can be transported over long distances before being removed. F.G.M.

A81-13687 Potential effects of the projected increase in coal use. A. M. Squires (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: Aerosols: Anthropogenic and natural, sources and transport; Proceedings of the Conference, New York, N.Y., January 9-12, 1979. New York, New York Academy of Sciences, 1980, p. 563-568.

The effects of an expected return to the use of coal for many energy needs that are now met by oil and gas are considered. Air pollution by new coal-fired equipment is discussed, along with relatively clean ways to burn coal for electric power generation, household space heating, and district heating. It is suggested that chicken farmers be targeted for prompt conversion to coal, since three-quarters of chicken growers now heat with propane. F.G.M.

A81-13689 Future aerosols of the southwest - Implications for fundamental aerosol research. S. K. Friedlander (California, University, Los Angeles, Calif.). In: Aerosols: Anthropogenic and natural, sources and transport; Proceedings of the Conference, New York, N.Y., January 9-12, 1979. New York, New York Academy of Sciences, 1980, p. 588-598. 20 refs. U.S. Environmental Protection Agency Grant No. R-805736.

It is shown that substantial increases in the use of coal in the U.S. will lead to substantial increases in emissions of particulate matter, SOx, and NOx in the part of the U.S. west of the Mississippi. A shift in the primary particulate emissions from coarse to submicron particles is predicted. Attention is given to the nature of the submicron aerosol in the southwest, the distribution of sulfur with respect to particle size, the formation of new particles in the atmosphere, and the ammonium nitrate equilibrium. It is concluded that increased coal use will result in a 50% increase in SOx emissions and a doubling of NOx emissions in the western U.S. by the year 2000, that ambient levels of aerosol sulfates and nitrates will increase, and that a large increase in submicron aerosol mass is likely. F.G.M.

A81-14228 // Energy conservation through cogeneration. J. C. Solt (Solar Turbines International, San Diego, Calif.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 22-29.

The use of gas turbine engines to provide site-generated electric power in industrial applications is discussed and a methodology for evaluating the benefits of a cogeneration system is presented.

Analysis indicates that the economics of cogeneration type systems is particularly favorable for process industries with a high usage factor and a high thermal requirement, such as natural gas processing; petrochemical and refining; paper and pulp; food processing; textiles, clay, cement, and glass; lumber and wood products; and metals. V.L.

A81-14446 # **Multi-use botanonchemical crops, an economic analysis and feasibility study.** R. A Buchanan, F. H. Otey, and G. E. Hamerstrand (Science and Education Administration, Northern Regional Research Center, Peoria, Ill.). *(American Chemical Society, Symposium on Fuels and Chemical Feedstocks from Renewable Resources, Columbus, Ohio, May 7-9, 1979.) I & EC - Industrial and Engineering Chemistry, Product Research and Development,* vol. 19, Dec. 1980, p. 489-496. 19 refs.

Dwindling reserves and increasing costs of petroleum have brought the realization that agricultural production of substitutes may be both feasible and the best long-term alternative. Multi-use oil- and hydrocarbon-producing (botanochemical) crops, specially designed for an adaptive agricultural system, appear to offer potential for combining the production of both food and industrial raw materials with increased overall productivity. Processing methods are being developed for extraction of primary botanochemicals, i.e., soluble polyphenols, whole-plant oils, and isoprene polymers that could serve as chemical feedstocks. The extractive-free residues are promising raw materials for papermaking fibers, animal feeds, fermentation substrates, chemical feedstocks, fuels, and soil amendments. Preliminary cost assessments of crop production, collection, and processing compared with projected produce values suggest that a new and radically different agricultural system would be economically attractive. (Author)

A81-15159 **Embodied energy and economic valuation.** R. Costanza (Louisiana State University, Baton Rouge, La.). *(American Association for the Advancement of Science, Annual Meeting, San Francisco, Calif., Jan. 3-8, 1980.) Science,* vol. 210, Dec. 12, 1980, p. 1219-1224. 33 refs. Contract No. EY-76-S-05-4398.

The concept of embodied energy is discussed as an empirically accurate common denominator in ecological and economic systems. Embodied energy is defined as the total (direct and indirect) energy required to produce goods and services in the economy. This paper presents results to show that with the appropriate perspective and boundaries, market-determined dollar values and embodied energy values are proportional for all but the primary energy sectors. A systems view is required that considers humans to be a part of, and not apart from their environment. R.C.

A81-15349 **Chemical species in fly ash from coal-burning power plants.** L. D. Hulett, Jr., A. J. Weinberger, K. J. Northcutt, and M. Ferguson (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Science,* vol. 210, Dec. 19, 1980, p. 1356-1358. 5 refs. Research supported by the Electric Power Research Institute.

Fly ash specimens from four power plants in the Tennessee Valley Authority system have been separated into three matrices: glass, mullite-quartz, and magnetic spinel. Chemical species of trace elements are defined to a large extent by the matrices that contain them. The magnetic component of fly ash is ferrite. The mullite-quartz phase is relatively pure and can be recovered as a resource. (Author)

A81-15719 # **Fuel economy and extension of the service life of aircraft gas turbine engines (Rasshirenie resursov i ekonomiia topliv dlia aviatsionnykh-gazoturbinnykh dvigatelei).** A. F. Gorenkov, E. P. Seregin, I. G. Kliuiko, and E. I. Domkin. *Khimiia i Tekhnologiia Topliv i Masel,* no. 11, 1980, p. 38-40. In Russian.

The paper deals with current work conducted in an effort to reduce the fuel consumption and extending the service life of aircraft gas turbine engines by optimizing engine design and fuel production, and introducing improved technological and organizational measures. Some aspects of the substitution of liquid hydrogen for hydrocarbon fuels are examined. V.P.

A81-15760 **Light rail/rapid transit - New approaches for the evaluation of energy savings. I - Life-cycle cost from synthetic routes/operational models.** J. B. Forsythe (AiResearch Manufacturing Company of California, Torrance, Calif.). *IEEE Transactions on Industry Applications,* vol. IA-16, Sept.-Oct. 1980, p. 655-678. 37 refs.

A method is described of comparing the energy consumption of different traction systems which provide the purchase price plus energy consumption to compute the economics of each type of transit car. The concept of a synthetic route is used for comparing energy consumption during the bidding stage and predicting the annual traction energy consumption of the Toronto Transit Commission (TCC) streetcar fleet. The calculations showed that retrofitting the fleet with fully regenerative chopper systems would reduce energy consumption by more than 50%. Another approach predicted that the peak rush hour power demand for the TTC fleet would be reduced by 48% if the streetcars were converted to regenerative chopper systems. A.T.

A81-15761 **Modeling land use conflicts and constraints for energy development.** K. O'Banion (California, University, Livermore, Calif.). *Environmental Science and Technology,* vol. 14, Dec. 1980, p. 1438-1444. Contract No. W-7405-eng-48.

The use of formal, analytic models in the evaluation of the suitability of various sites for energy extraction, transportation and utilization facilities with respect to their land-use impact is discussed. Advantages of formal models for the identification and resolution of environmental problems are outlined, and their limitations are pointed out. The suitability of land for a given development is discussed in terms of the constraints and conflicts posed by use of the land, and criteria adopted to evaluate the intrinsic value of the land for the various functions it may sustain are indicated. The identification and relative scaling of potential conflicts and constraints is considered, and the evaluation of land suitability on the basis of the scalings for various functions is discussed, with attention given to evaluation by the conjunctive, lexicographic, factor profile and the sum of weighted values methods. The application of a formal land-use model to the evaluation of the site for the Geysers hydrothermal energy plant in California is then examined, and it is concluded that even in the near absence of local input into a model, the analysts can often draw reasonable conclusions without projecting his own values. A.L.W.

A81-17044 # **Airline flight departure procedures - Choosing between noise abatement, minimum fuel consumption and minimum cost.** R. E. Jones. *Canadian Aeronautics and Space Journal,* vol. 26, 3rd Quarter, 1980, p. 181-199. 13 refs.

A performance computer program was developed to analyze reduced noise takeoff procedures for the B-737 and B-747 aircraft. The IATA procedure was quieter by 5 dB within 10 nm of the airport (where noise levels are highest) than the more fuel efficient ATA method which uses 80 lb less of fuel in a B-737 and 450 lb less in the B-747. The operational cost of a B-747 using the ATA method for full-power takeoff is higher because of greater maintenance charges; a decision basis is proposed for the B-747 which uses IATA procedures for heavyweight takeoffs and ATA recommendations for lightweight takeoffs. A.T.

A81-17143 # **Fuel conservation in the air transportation industry - General and operational aspects (Il contenimento del consumo di carburante nell'industria del trasporto aereo - Aspetti generali ed operativi).** A. Schiavo. *Ingegneria,* Sept.-Oct. 1980, p. 257-266. 8 refs. In Italian.

A81-17166 # **Rolls-Royce engines status report.** *Aircraft Engineering*, vol. 52, Dec. 1980, p. 2-7.

The article presents a survey of various Rolls-Royce engines including RB211 Turbofan, Pegasus Vectored-Thrust Turbofan, Olympus 593 Turbojet, Dart Turboprop, RB 401 Demonstrator and Business Jet Engine, Viper Turbojet, Tyne Turboprop, Conway Turbofan, Gnome Turboshaft Engine, and Turmo III C4. All of the engines have undergone extensive testing and are reviewed for their individual features. The RB211 Turbofan models have a take-off thrust of about 50,000 lb and improved fuel consumption and have been used in the Lockheed L.1011-1 Tristar, and the Boeing 747. The RB211-535, being developed for the new Boeing 757 twinjet airliner is discussed together with the Adour Turbofan model which powers the Anglo-French Jaguar supersonic strike/trainer aircraft. The latter has a take-off thrust of 5,115 lb. for the Adour Mk. 102 and of 5,700 lb for the Adour -56. The major feature of these engines is a significant increase in reheat thrust. The Olympus 593 Turbo-jet has a take-off thrust of 38,000 lb and is the most extensively tested commercial engine. The Dart Turboprop is a long-serving commercial gas turbine noted for its fuel economy and low noise levels. Finally the Gem Turboshaft Engine which powers the twin engine Westland Lynx helicopter has a fuel consumption significantly better than similar engines in service. B.R.K.

A81-17250 **Atomic waste storage in outer space - The final solution for inexpensive and safe disposal (Atommüll-Lagerung im Weltraum - Die endgültige Lösung für billige und sichere Entsorgung).** D. Hayn, H. O. Ruppe (München, Technische Universität, Munich, West Germany), and R. H. Schmucker (Bayern-Chemie GmbH, Ascham, West Germany). *(Hermann-Oberth-Gesellschaft, Raumfahrtkongress, 29th, Feucht, West Germany, June 25-29, 1980.) Astronautik*, vol. 17, no. 3, 1980, p. 72-81. 11 refs. In German.

Various methods for deposition of atomic waste are investigated. Disposal through direct transport to the sun is considered along with transport outside the solar system, disposal on the back side of the moon, or into a high earth orbit. Possible solutions for disposal on the earth are also examined. Procedures for safe disposal of the waste are discussed along with economic considerations for employing space travel technology. A mathematical evaluation for security procedures is presented and the problem of collision with meteors or satellites is also taken into account. R.C.

A81-18175 * **Response of the global climate to changes in atmospheric chemical composition due to fossil fuel burning.** S. Hameed, R. D. Cess, and J. S. Hogan (New York, State University, Stony Brook, N.Y.). *Journal of Geophysical Research*, vol. 85, Dec. 20, 1980, p. 7537-7545. 45 refs. NSF Grant No. CME-79-09065; Grant No. NCC5-7.

Recent modeling of atmospheric chemical processes (Logan et al, 1978; Hameed et al, 1979) suggests that tropospheric ozone and methane might significantly increase in the future as the result of increasing anthropogenic emissions of CO, NO(x), and CH4 due to fossil fuel burning. Since O3 and CH4 are both greenhouse gases, increases in their concentrations could augment global warming due to larger future amounts of atmospheric CO2. To test the possible climatic impact of changes in tropospheric chemical composition, a zonal energy-balance climate model has been combined with a vertically averaged tropospheric chemical model. The latter model includes all relevant chemical reactions which affect species derived from H2O, O2, CH4, and NO(x). The climate model correspondingly incorporates changes in the infrared heating of the surface-troposphere system resulting from chemically induced changes in tropospheric ozone and methane. This coupled climate-chemical model indicates that global climate is sensitive to changes in emissions of CO, NO(x) and CH4, and that future increases in these emissions could augment global warming due to increasing atmospheric CO2. (Author)

A81-18229 **Lunetta system analysis.** K. A. Ehricke (Space Global Co., La Jolla, Calif.). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-11.* 56 p. 10 refs.

The results of a Lunetta Space Light system analysis are presented. Lunetta orbiting reflectors are the only earth-related energy structures of socio-economic importance realizable in the 1980s, because they are relatively small and light, although they are larger than any structure built so far in space. They represent a stepping stone in space industrialization with potentially important applications, particularly as far as assistance to higher local food production in many parts of the world are concerned. Lunetta applications are summarized and the favorable environmental characteristics of the system shown. A comprehensive number of conflicting requirements and parameters, necessitating numerous trade-offs, are discussed. (Author)

A81-18252 **Status report on nuclear waste disposal in space.** D. Hayn, J. Kotnik, and H. O. Ruppe (München, Technische Universität, Munich, West Germany). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-44.* 16 p. 37 refs.

Existing space-flight technological concepts of disposing high-activity waste in space are reviewed, and current status of international system studies in examined. The various problem areas involved in the space disposal concept are discussed, and the technological feasibility of the concept is demonstrated. V.P.

A81-18254 **A plaidoyer for nuclear waste disposal in space.** P. Natenbruk (ERNO Raumfahrttechnik GmbH, Bremen, West Germany). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-47.* 16 p.

Public opposition to terrestrial storage of nuclear wastes on the grounds that it is irreversible makes extraterrestrial disposal a reasonable if feasible alternative. Using chemical propulsion modes, a modified Shuttle could transfer a payload of approximately 30,000 kg into low earth orbit, whereas a Shuttle-Tug combination could augment that figure by as much as 15,000 kg. High-orbit delivery (55,000 km) could be accomplished with a heavy-lift vehicle (HLV) by 1995, and, depending on the mix of the processed waste, the Shuttle's payload could be tripled. Although a program using only the HLV would delay commencement of extraterrestrial storage by some 5 to 10 years, it would be approximately $15 billion cheaper than a program based on Shuttle operations beginning in 1990. With the concept of space disposal yet to be defined in its entirety, however, cost estimates are to be considered preliminary and subject to change. R.S.

A81-18421 **A practical approach to the disposal of highly toxic and long-lived spent nuclear fuel waste between Venus and earth.** K. A. Ehricke (Space Global Co., La Jolla, Calif.). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-IAA-45.* 29 p. 11 refs.

The paper presents an argument for extraterrestrial nuclear-waste disposal in which the Shuttle would be used to transport solidified spent fuel to sectors between the sun and interstellar space. A Nuclear Waste Carrying Orbiter (NWCO) with a special booster would represent a safe and (at disposal mission costs of less than 0.5 cents/kwhe) economical transportation system for so-called exo-disposal. An average of 10-15 MWCO missions would be required annually to service the waste produced by the 173 reactors operating around the world in 1978, with the Orbiter's gross payload weight ranging from 14.5 to 29.5 tons. Waste selection criteria are listed, as well as disposal site options and their accompanying data. R.S.

A81-18424 * **U.S. program assessing nuclear waste disposal in space - A status report.** E. E. Rice (Battelle Columbus Laboratories, Columbus, Ohio), C. C. Priest (NASA, Marshall Space Flight Center, Advanced Systems Office, Huntsville, Ala.), and A. L. Friedlander (Science Applications, Inc., Schaumburg, Ill.). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-IAA-50.* 18 p. 13 refs. Contract No. NAS8-32391.

Various concepts for the space disposal of nuclear waste are discussed, with attention given to the destinations now being considered (high earth orbit, lunar orbit, lunar surface, solar orbit, solar system escape, sun). Waste mixes are considered in the context of the 'Purex' (Plutonium and Uranium extraction) process and the potential forms for nuclear waste disposal (ORNL cermet, Borosilicate glass, Metal matrix, Hot-pressed supercalcine) are described. Preliminary estimates of the energy required and the cost surcharge needed to support the space disposal of nuclear waste are presented (8 metric tons/year, requiring three Shuttle launches). When Purex is employed, the generated electrical energy needed to support the Shuttle launches is shown to be less than 1%, and the projected surcharge to electrical users is shown to be slightly more than two mills/kW-hour. C.R.

A81-18562 **Upsurge in baghouse development.** W. Nesbitt. *EPRI Journal*, vol. 5, Nov. 1980, p. 15-20.

Fabric filters known as baghouses, first used in the 1880's, have been found to be able to filter fly ash at efficiency rates of up to 99.99%. This ability is of great importance in making coal more acceptable as a fuel. The baghouse is 'forgiving'; that is, it will accept a range of coals, boiler operating conditions, and ash compositions with no major upsets. At one utility, it was found that baghouse emission control performance was relatively insensitive to the properties of the ash from the boiler. Research is presently being carried out on gas flow and gas distribution in the bags, on bag cleaning, on bag design and finish, on startup and shutdown procedures, and on continuous real-time monitoring. Details on costs and baghouse parameters (air-to-cloth ratio and system pressure drop) are given. C.R.

A81-18636 # **A global solar power satellite system.** P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). *American Society of Mechanical Engineers, Century 2 Aerospace Conference, San Francisco, Calif., Aug. 13-15, 1980, Paper 80-C2/Aero-6.* 8 p. 29 refs. Members, $1.50; nonmembers, $3.00.

A survey is presented of the potential of solar energy satellites for global needs including production of solar energy in space for applications on earth. The solar power satellite (SPS) system is compared with terrestrial solar energy methods, noting that the power generated by SPS can be transmitted to earth by microwave or laser beams. The space transportation system, orbital assembly and maintenance, and the SPS/utility power pool interface are discussed; the economic considerations of SPS based on a classical risk/decision analysis, the environmental impact, and the legal questions relating to possible accidents are examined. A.T.

A81-18725 # **The economic vs. energetics techniques of forecasting the true costs of solar energy.** S. Baron (Burns and Roe, Inc., Oradell, N.J.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-24.* 5 p. 21 refs. Members, $1.50; nonmembers, $3.00.

Energetics, or net energy analysis, is a useful tool for estimating the amount of energy to be invested for a new energy technology in relationship to the energy it will produce. The technique is considered a valuable supplement to traditional economic techniques. In comparing the results of energetic analysis to economic analysis for solar energy installations, the energetic technique shows that the projection of solar energy costs to come down based on mass production is invalid, unless there are drastic changes in the material quantities used in solar installations. The paper concludes that the government's present program subsidizing solar energy will not achieve the projected conservation and economic goals. It also concludes that the U.S. solar energy development program must concentrate on designs that are less energy-intensive, if solar energy is to be competitive with present energy alternatives. (Author)

A81-18736 # **NOx reduction from a gas turbine combustor using exhaust gas recirculation.** C. Wilkes and B. Gerhold (General Electric Co., Gas Turbine Div., Schenectady, N.Y.). *American Society of Mechanical Engineers, Joint Power Generation Conference, Phoenix, Ariz., Sept. 28-Oct. 2, 1980, Paper 80-JPGC/GT-5.* 10 p. 7 refs. Members, $1.50; nonmembers, $3.00.

This paper describes laboratory tests performed on a combustion chamber typical of that now in use in large industrial gas turbines. The tests were designed to investigate the effects of EGR on NOx emissions from distillate and propane fuel. The results presented here show that substantial reductions in NOx concentration at the exit of the combustor are achievable without any modification to the combustion system. Additional reductions in NOx emission rate at the gas turbine exhaust are also obtained due to the reduced mass flow discharged to the atmosphere. NOx compliance with the proposed EPA New Source Performance Standards is possible due in part to the lowered exhaust oxygen concentration resulting from the lowered inlet oxygen concentration. The results from these tests confirm earlier data obtained with an atmospheric pressure turbulent diffusion flame spray burner, also presented here. (Author)

A81-18765 **Geophysical aspects of the energy problem.** Edited by A. Rapolla (Napoli, Università, Naples, Italy), G. V. Keller (Colorado School of Mines, Golden, Colo.), and D. J. Moore (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England). Amsterdam and New York, Elsevier Scientific Publishing Co. (Energy Research. Volume 1), 1980. 336 p. $65.75.

Papers are presented on geophysical aspects of the development and operation of conventional and alternative energy sources. Specific topics include the thermodynamic aspects of geothermal energy, geophysical methods used in prospecting for geothermal resources, the potential of low-enthalpy geothermal fields in France, the exploitation of geothermal energy contained in dry hot rocks by the creation of artificial reservoirs, the physical and geophysical aspects of solar energy, the geology and geochemistry of uranium deposits, the security of nuclear plants in light of the risk of earthquakes, and the air and water pollution caused by fuel-burning power plants. A.L.W.

A81-18772 **Atmospheric and water pollution from power plants.** D. J. Moore (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England). In: Geophysical aspects of the energy problem. Amsterdam and New York, Elsevier Scientific Publishing Co., 1980, p. 290-325. 11 refs.

Factors influencing the emission and dispersion of atmospheric pollutants from fuel-burning power plants are discussed along with the environmental effects of various modes of power plant cooling with water. Consideration is given to the impacts on the environment and on energy production of fuel purification and combustion gas cleaning, and to emission problems associated with boiler-fed steam turbine plants, gas turbine plants and nuclear plants. The subsequent dispersion in the atmosphere of purified and untreated power plant emissions is then examined, and removal processes for atmospheric pollutants are considered, including dry and wet deposition, homogeneous and heterogeneous chemical reactions, and accumulation in the atmosphere. The disposal of waste heat from power stations by direct cooling, in which cooling water is dispersed into a larger body of water, and by indirect cooling using cooling towers is then discussed in relation to the impact of the heat on the atmospheric and water environment. A.L.W.

A81-18801 **Annual review of energy. Volume 5.** Edited by J. M. Hollander (California, University, Berkeley, Calif.), M. K.

Simmons (General Electric Co., Schenectady, N.Y.), and D. O. Wood (MIT, Cambridge, Mass.). Palo Alto, Calif., Annual Reviews, Inc., 1980. 447 p. $20.

Studies included in the volume provide an overview of recent developments in solar photovoltaic technology and inertial confinement fusion, progress in some nearer-term energy supply areas, and some social, economic, and environmental aspects of energy technologies. Papers are presented on the secondary batteries for electrical energy storage, the technological and economic development of photovoltaics, and the renewable energy resources for developing countries. V.L.

A81-18804 **Environmental aspects of renewable energy sources.** J. P. Holdren, G. Morris, and I. Mintzer (California, University, Berkeley, Calif.). In: Annual review of energy. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1980, p. 241-291. 198 refs. Research supported by the U.S. Department of Energy and Executive Office of the President.

Research related to the environmental aspects of renewable energy sources is reviewed with reference to the origins of environmental effects, information required for their assessment, and technical characteristics of the principal renewable-energy technologies. Several technologies, including passive solar heating and cooling, increased electricity generation by adding generators to certain existing dams, electricity generation by wind turbines, and biogasification of sewage and feedlot manures, are shown to be most attractive environmentally. V.L.

A81-18805 **Emerging energy technologies in an island environment - Hawaii.** J. W. Shupe (Hawaii, University, Honolulu, Hawaii) and J. M. Weingart (California, University, Berkeley, Calif.). In: Annual review of energy. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1980, p. 293-333. 34 refs.

The energy policy of Hawaii is reviewed along with the current status of energy research, development, and demonstration programs. Energy supply alternatives examined include biomass, geothermal energy, wind energy, direct solar radiation, and ocean thermal energy conversion. Technical, legal, regulatory, social, and environmental factors affecting the commercialization of new energy systems are briefly discussed. V.L.

A81-18807 **Coal clean-up technology.** K. E. Yeager (Electric Power Research Institute, Palo Alto, Calif.). In: Annual review of energy. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1980, p. 357-387. 67 refs.

The review focuses on (1) the status of environmental control technology for direct coal combustion and (2) the legislative and regulatory requirements that govern the development and application of this technology in the United States. Emphasis is placed on conventional pulverized coal fired plants which will continue to provide the capability for new coal power generation over at least the next 10-15 yr. V.L.

A81-18808 **Renewable energy resources for developing countries.** N. L. Brown (U.S. Agency for International Development, Washington, D.C.). In: Annual review of energy. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1980, p. 389-413. 53 refs.

The review examines the needs of the less-developed countries for energy, the uses to which energy is put, and the role that renewable energy resources are likely to play in these countries in the near future. It is shown that renewable energy resources, more appropriate to decentralized systems than to central-station power generation, are particularly attractive for developing countries many of which are characterized by dispersed rural populations. V.L.

A81-19277 **Safety related research required to support future fusion research reactors.** K. E. Lind, J. D. Levine, L. Yemin (Ebasco Services, Inc., Princeton, N.J.), J. J. Mauro (Ebasco Services, Inc., New York, N.Y.), H. J. Howe, Jr., and C. W. Pierce (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 4. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 2198-2203. 25 refs. Contract No. EY-76-C-02-3093.

Areas of research related to the safety of magnetic confinement fusion devices with large tritium inventories have been identified in the course of the design and engineering of the Tokamak Fusion Test Reactor. Some of these areas are: the radiotoxicity of tritium gas, the development of protective clothing for high tritium concentration atmospheres, identification and quantification of tritium's compatibility with polymeric materials, and determination of occupational exposure limits and environmental transport mechanisms for potentially volatilized radioactive and chemically toxic first wall and blanket materials. V.L.

A81-19324 # **Prospects for the development of unconventional energy sources (Perspektywy rozwoju niekonwencjonalnych zrodel energii).** J. Krzyzanowski (Polska Akademia Nauk, Instytut Maszyn Przeplywowych, Gdansk, Poland). *Instytut Maszyn Przeplywowych, Prace,* no. 78, 1980, p. 63-81. 21 refs. In Polish.

Recent progress in the fields of nuclear fusion, solar energy, and novel fuels is reviewed, and future developmental trends are indicated. Attention is given to the establishment of a rational approach to the development of unconventional energy sources under conditions typical for Poland. V.P.

A81-19670 # **Hydrogen-fueled heat engines - Economic effect (Stvorennia teplovikh dviguniv na vodnevomu pal'nomu - Ekonomichnii efekt).** A. M. Pidgornii, V. S. Zolotushkin, and V. K. Prokopenko. *Akademiia Nauk Ukrains'koi RSR, Visnik,* vol. 44, Nov. 1980, p. 67-70. In Ukrainian.

Economic and ecological advantages of hydrogen-fueled heat engines are examined in terms of fossil fuel savings and reduction of air pollutants produced by internal combustion engines. It is estimated that the replacement of a one-tenth part of automotive engines currently produced in the USSR would provide an annual gasoline savings of 4.5 million tons. V.I

N81-10068# General Electric Co., Lynn, Mass. Aircraft Engine Group.

MARITIME PATROL AIRCRAFT ENGINE STUDY. GENERAL ELECTRIC DERIVATIVE ENGINES. VOLUME 2: APPENDIX A. PERFORMANCE DATA - GE27/T3 STUDY A1 TURBOPROP Final Report, Oct. 1978 - Apr. 1979

R. Hirschkron, R. H. Davis, and R. E. Warren 30 Apr. 1979 81 p

(Contract N62269-78-C-0414)

(AD-A089336; R79AEG052-Vol-2; NADC-79133-60-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 21/5

This study developed data on General Electric common core derivative engines for use in Maritime Patrol Aircraft (MPA) concept formulation studies. The study included the screening of potential General Electric turbofan and turboprop/turboshaft engines and the preparation of technical and planning information on three of the most promising engine candidates. Screening of General Electric derivative candidates was performed utilizing an analytical MPA model using synthesized mission profiles to rank the candidates in terms of fuel consumption, weight, cost and complexity. The three turboprop engines selected for further study were as follows: TF34 growth derivative version with boost and new LPT (TF34/T7 Study A1), F404 derivative with booster stages and new LPT (F404/T1 Study A1), and GE27 scaled and boosted study engine (GE27/T3 Study A1). Volume 1 summarizes the screening analysis and contains technical, planning, installation, cost and development data for the three selected turboprop engines. Volumes 2, 3 and 4 of this report contain the detailed performance data estimates for the GE27/T3 Study A1, TF34/T7 Study A1 and F404/T1 Study A1 turboprop engines, respectively. GRA

N81-10069# General Electric Co., Lynn, Mass. Aircraft Engine Group.
MARITIME PATROL AIRCRAFT ENGINE STUDY. GENERAL ELECTRIC DERIVATIVE ENGINES. VOLUME 3: APPENDIX B. PERFORMANCE DATA - TF34/T7 STUDY A1 TURBOPROP Final Report, Oct. 1978 - Apr. 1979
R. Hirschkron, R. H. Davis, and R. E. Warren 30 Apr. 1979 81 p
(AD-A089279; R79AEG052-Vol-3; NADC-79133-60-Vol-3) Avail: NTIS HC A05/MF A01 CSCL 21/5
This study developed data on General Electric common core derivative engines for use in Maritime Patrol Aircraft (MPA) concept formulation studies. The study included the screening of potential General Electric turbofan and turboprop/turboshaft engines and the preparation of technical and planning information on three of the most promising engine candidates. Screening of General Electric derivative candidates was performed utilizing an analytical MPA model using synthesized mission profiles to rank the candidates in terms of fuel consumption, weight, cost and complexity. The three turboprop engines selected for further study were as follows: TF34 growth derivative version with boost and new LPT (TF34/T7 Study A1), F404 derivative with booster stages and new LPT (F404/T1 Study A1), and GE27 scaled and boosted study engine (GE27/T3 Study A1). Volume 1 summarizes the screening analysis and contains technical, planning, installation, cost and development data for the three selected turboprop engines. Volumes 2, 3 and 4 of this report contain the detailed performance data estimates for the GE27/T3 Study A1, TF34/T7 Study A1 and F404/T1 Study A1 turboprop engines, respectively. GRA

N81-10194# Department of Energy, Washington, D. C. Gasohol Study Group.
REPORT OF THE ENERGY RESEARCH ADVISORY BOARD ON GASOHOL
29 Apr. 1980 37 p refs
(DOE/TIC-11238) Avail: NTIS HC A03/MF A01
Ethanol production as a near term (mid 1980's) partial solution to the liquid fuels problem (based on current incentives) will probably reach 200 to 300 million gallons per year by 1985. Thereafter, about 800 million gallons of ethanol could be produced per year. This level of ethanol production would displace an equivalent of 26,000 barrels of oil per day or less than one percent of US gasoline consumption; and utilizing the best available technology before 1985 the net energy balance is about zero for ethanol produced from corn and other crops in fermentation/distillation plants. If the fermentation/distillation plants are fueled by coal or wood, each gallon of ethanol produced could save roughly 0.5 gallons of oil. DOE

N81-10198# General Electric Co., Schenectady, N. Y. Energy Technology Operations.
TEXACO-BASED GASIFICATION-COMBINED-CYCLE SYSTEM PERFORMANCE STUDIES Final Report
J. J. Olova and S. D. Shemo Jun. 1980 167 p refs
(EPRI Proj. 986-3)
(EPRI-AP-1429) Avail: NTIS HC A08/MF A01
An investigation of the effects on system thermal efficiency of major design variables and configuration options in combined cycle power plants based on air or oxygen-blown Texaco gasifiers is presented. The plants are sized to process 10,000 tons per day of Illinois No. 6 coal. Design parameters considered were: steam cycle steam conditions; gasification system pressure, oxidant temperature and composition, coal/water slurry ratio and temperature; ambient temperature; and fuel temperature. Configuration options considered were: the quantity of raw gas cooler by-pass flow; recirculation of cold gas to temper the raw gas product before entering the raw gas cooler; clean gas resaturation; use of a clean gas expander; plant size; use of steam turbines or electric motors for oxygen plant compressors; supplementary firing of the heat recovery steam generator. The system performance estimates and sensitivity studies were conducted for integrated gasification-combined cycle systems. DOE

N81-10224# Joint Publications Research Service, Arlington, Va.
EEC RESEARCHERS TEST ALTERNATIVE ENERGY TECHNOLOGIES
In its West Europe Rept.: Sci. and Technol., No. 3 (JPRS-74565) 14 Nov. 1979 p 1-6 Transl. into ENGLISH from Wirtschaftswoche (West Germany), no. 38, 17 Sep. 1979 p 46-52

Avail: NTIS HC A05/MF A01
An overview of the energy situation in the European community and the efforts directed towards the development of alternative energy technologies is given. Solar thermal conversion, photovoltaics, hydrogen production, and biomass conversion prospects are examined in terms of their technological and economical feasibility. M.G.

N81-10227# Joint Publications Research Service, Arlington, Va.
DEVELOPMENT OF NEW VEHICLE ENGINE REPORTED

In its West Europe Rept.: Sci. and Technol.,No. 3 (JPRS-74565) 14 Nov. 1979 p 16-17 Transl. into ENGLISH from Unsere Umwelt (Vienna), no. 32, 1979 p 28

Avail: NTIS HC A05/MF A01
The development of a combustion method with direct fuel injection for the diesel engine, which will both reduce fuel consumption by 15 to 20 percent and reduce the burden on the environment is briefly described. A model of a 2 liter prototype engine with four cylinders and direct fuel injection with 46 horsepower was produced. The development costs for the engine are given. M.G.

N81-10229# Joint Publications Research Service, Arlington, Va.
CHARACTERISTICS, EFFICIENCY OF MODULAR ENGINES
In its West Europe Rept: Sci. and Technol., No. 3 (JPRS-74565) 14 Nov. 1979 p 63-79 refs Transl. into ENGLISH from Ata (Italy), no. 4, Apr. 1979 p 177-184

Avail: NTIS HC A05/MF A01
Tests aimed at quantifying the fuel savings to be achieved with automobile engines adopting different techniques for deactivating the cylinders (reduction of displacement, reduction of fuel mixture flow, reduction of fuel) are discussed. The reduction of the displacement amounts to disconnecting the shaft linkage of the modules deactivated. Reduction of fuel mixture flow consists in preventing fuel mixture cycling in the deactivated cylinders by keeping the relative intake and exhaust valves closed. With fuel reduction, modest results are accompanied by considerable constructional simplicity, without appreciable added costs for engines equipped with electronic ignition. Reduction of fuel mixture flow permits greater savings, so that it appears quite promising for short term realization, inasmuch as it does not require redesign of the entire engine. Far superior are the benefits offered by displacement reduction. The necessity of radical redesign for such an engine, together with the time needed for developing and testing the intermodular coupling, puts the application possibilities some time into the future. M.G.

N81-10439# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.
VEHICLE FUEL ECONOMY: TRACK VERSUS DYNAMOMETER
Bruce Grugett Jun. 1980 9 p refs
(PB80-197791; EPA-AA-SDSB-80-8) Avail: NTIS HC A02/MF A01 CSCL 10A
A 1979 Cheverolet Nova was operated over EPA driving cycles on a test track at the Transportation Research Center in Ohio and on a chassis dynamometer at the U.S. Environmental Protection Agency's Motor Vehicle Emission Laboratory in Ann Arbor. The data obtained provide an opportunity to compare road and dynamometer fuel economy. A dynamometer modifica-

tion which would make the dynamometer fuel economy a more accurate predictor of fuel economy obtained by the vehicle on the road is discussed. GRA

N81-10443# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.
CARBON BALANCE AND VOLUMETRIC MEASUREMENTS OF FUEL CONSUMPTION
Terry Newell Apr. 1980 11 p refs
(PB80-200801; EPA-AA-SDSB-80-05) Avail: NTIS HC A02/MF A01 CSCL 13F

A recently completed EPA test program investigated the effects on emissions and fuel consumption of different types and brands of tires. In that program, fuel consumption was measured using both the carbon balance and volumetric methods. The number of tests conducted provided adequate data for a comparison of the results obtained by these different methods. A previously conducted investigation into the differences between carbon balance and volumetric measurements of fuel consumption concluded that a consistent difference exists between them. Fuel consumption measured volumetrically was found to average three percent higher than when measured by the carbon balance method. This report presents another analysis of this question. GRA

N81-10444# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.
AN INVESTIGATION OF THE FUEL ECONOMY EFFECTS OF TIRE RELATED PARAMETERS
Glenn Thompson and Marty Reineman May 1980 35 p refs
(PB80-201007; EPA-AA-SDSB-80-9) Avail: NTIS HC A03/MF A01 CSCL 13F

A program was conducted on a test track to determine the fuel consumption effects of radial vs. bias-ply tires, two radial tires from different manufacturers, and increased tire pressure. The program was designed to eliminate ambient effects by running two identical test vehicles simultaneously and alternating the parameter of interest between the two vehicles. Five different tire types were used (including the original equipment manufacturer tires from the vehicles). It was demonstrated that radial tires were six percent more fuel efficient than bias-ply tires; the radial tires from one manufacturer were four percent more fuel efficient than radial tires from a different manufacturer; and radial tires inflated to 28 psig were three percent more fuel efficient than radial tires inflated to 20 psig. It was also determined that laboratory measurements of rolling resistance are good predictors of track fuel consumption. GRA

N81-10497# Joint Publications Research Service, Arlington, Va.
WEST EUROPE REPORT: SCIENCE AND TECHNOLOGY, NO. 14
5 Feb. 1980 60 p refs Transl. into ENGLISH from various European articles
(JPRS-75070) Avail: NTIS HC A04/MF A01

The need for standards and other regulations to assure product quality, to prevent ecological imbalance from genetic manipulation, and to promote the development and use of passive solar heating systems is discussed. Progress is reportd in the construction of the world's first solar electric power plant and in the design of a plant using metal hydrides for energy storage.

N81-10501# Joint Publications Research Service, Arlington, Va.
OBSTACLES TO DEVELOPMENT OF PASSIVE SOLAR SYSTEMS
Aldo Fanchiotti *In its* West Europe Rept.: Sci. and Technol., No. 14 (JPRS-75070) 5 Feb. 1980 p 23-34 refs Transl. into ENGLISH from Fonti de Energia Alternative (Rome), Jul. - Aug. 1979 p 54-59

Avail: NTIS HC A04/MF A01

Factors responsibile for the delay of implementation of passive systems for heating buildings in Italy may be grouped into four categories: (1) technical obstacles, such as the lack of products on the market, the lack of design tools, the lack of experimental data, and the lack of climate data; (2) economic obstacles, such as initial cost, resistance by existing interests, uncertainty about criterion of evaluation, and the price structure of energy sources; (3) obstacles to startup such as insufficient awareness, lack of experienced designers, and inertia of the construction sector; and (4) institutional obstacles related to legislation and standardization. Actions to be taken for product development and demonstration require intervention by protagonists in both government and industry. A.R.H.

N81-10517*# United Technologies Corp., South Windsor, Conn. Power Systems Div.
COGENERATION TECHNOLOGY ALTERNATIVES STUDY (CTAS) VOLUME 5: ANALYTICAL APPROACH AND RESULTS Final Report
Jan. 1980 176 p refs
(Contracts DEN3-30; EC-77-A-31-1062)
(NASA-CR-159763; DOE/NASA/0030-80/5; UTC-FCR-1333) Avail: NTIS HC A09/MF A01 CSCL 10B

Data and information in the area of advanced energy conversion systems for industrial cogeneration applications in the 1985 to 2000 time period are provided. Six current and thirty-six advanced energy conversion systems were defined and combined with appropriate balance of plant equipment. Twenty-six industrial processes were selected from among the high energy consuming industries to serve as a framework for the study. Each conversion system was analyzed as a cogenerator with each industrial plant. Fuel consumption, costs, and environmental intrusion were evaluated and compared to corresponding traditional values. Various cogeneration strategies were analyzed and both topping and bottoming (using industrial by-product heat) applications were included. The advanced energy conversion technologies indicated reduced fuel consumption, costs, and emissions. Typically fuel energy savings of 10 to 25 percent were predicted compared to traditional on site furnaces and utility electricity. Gas turbines and combined cycles indicated high overall annual cost savings. Steam turbines and gas turbines produced high estimated returns. In some applications, diesels were most efficient. The advanced technologies used coal derived fuels, or coal with advanced fluid bed combustion or on site gasification systems. R.K.G.

N81-10525# PTL Consulting Services, Frederick, Md.
THE HIGHWAY ENGINEER'S GUIDE TO ALTERNATIVE ENERGY SOURCES AND APPLICATIONS
Marian F. Eilers and John C. Laughland Jan. 1980 154 p refs Sponsored by Federal Highway Adminstration
(FHWA-TS-80-212) Avail: NTIS HC A08/MF A01

A summary of historical energy use patterns is presented. Alternative energy sources and their applications to highway design and construction are presented. T.M.

N81-10527*# Rockwell International Corp., Columbus, Ohio.
SATELLITE POWER SYSTEMS (SPS) LASER STUDIES. VOLUME 1: LASER ENVIRONMENTAL IMPACT STUDY Final Report, Oct. 1978 - Mar 1979
R. E. Beverly, III Washington Nov. 1980 87 p refs
(Contract NAS8-32475)
(NASA-CR-3346; SSD-80-0119-1) Avail: NTIS HC A05/MF A01 CSCL 10A

The environmental impact of space to Earth power transmission using space borne laser subsystems is emphasized. A laser system is defined, estimates of relevant efficiencies for laser power generation and atmospheric transmission are developed, and a comparison is made to a microwave system. Ancillary issues, such as laser beam spreading, safety and security, mass and volume estimates and technology growth are considered. R.K.G.

N81-10543# Brookhaven National Lab., Upton, N. Y.
FUSION UTILIZATION PROJECTIONS IN THE UNITED STATES ENERGY ECONOMY
J. R. Powell and J. A. Fillo Nov. 1979 89 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51212) Avail: NTIS HC A05/MF A01

Potential uses of fusion technology are presented. Specific topics discussed in some detail are: (1) applications of fusion energy, (2) fusion implementation in the US energy system, (3) reactor performance requirements, (4) technology for electric applications, and (5) technology for synthetic fuel/chemical applications. DOE

N81-10546# Institute of Gas Technology, Chicago, Ill.
PEAT AS AN ENERGY ALTERNATIVE
D. V. Punwani Jul. 1980 10 p Submitted for publication
(Contract DE-AC01-76ET-10283)
(DOE/ET-10283/T1) Avail: NTIS HC A02/MF A01

Although peat is used as an energy source in some countries including Russia, Ireland, and Finland, it is virtually unexploited in many countries such as the United States. An understanding of peat: its varieties, abundance, and distribution; its value as an energy alternative; its current and future role as an energy alternative; and the environmental and socioeconomic impacts of large-scale peat utilization are provided. DOE

N81-10553# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
OPTIMAL CONTROL STUDIES OF SOLAR HEATING SYSTEMS
C. Byron Winn [1980] 119 p refs
(Contracts DE-AS02-77CS-34519; EG-77-S-02-4519)
(COO-4519-1) Avail: NTIS HC A06/MF A01

The control scheme that is used in a solar heated building has an effect on the performance of the solar system and presents several problems. The first of these is to control the inside temperature of the building and to minimize the fuel consumption. This applies to both solar and conventionally heated buildings. The second problem is to control the collector fluid flow to maximize the difference between the useful energy collected and the energy required to pump the fluid. The third problem is to control the enclosure temperature of a building which has two sources of heat, one solar and the other conventional. DOE

N81-10562# Sandia Labs., Albuquerque, N. Mex.
FINITE ELEMENT STRATEGIES FOR THE EFFICIENT ANALYSIS AND EVALUATION OF SOLAR COLLECTOR STRUCTURES
J. R. Koteras and Richard James 1980 13 p refs Presented at 1st Chautauqua on Finite Element Modeling and MSC/Nastran, Cape Cod, Mass., 15 Sep. 1980
(Contracts DE-AC04-76DP-00789; AT(29-1)-789)
(SAND-80-0381C; CONF-800925-1) Avail: NTIS HC A02/MF A01

Concentrating or reflecting structures for solar energy systems must be evaluated as to their structural integrity and optical performance. Computer studies can be used as an integral part of these evaluations. The computer studies make use of finite element structural codes coupled with post-processors that calculate optical data. If the analysis of a solar structure is to be carried out in an efficient manner, these computer codes must have certain capabilities. A number of solar energy projects at Sandia National Laboratories make extensive use of finite element methods to evaluate design concepts which hold promise for large scale use in solar energy projects. Analysis procedures for heliostats and parobolic reflectors are considered. DOE

N81-10564# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
SYSTEM MODELING USING TRNSYS COMPUTER SIMULATION
N. Connor (Univ. of Southern Calif., Los Angeles) 1980 23 p refs Presented at VKI Lecture Ser. on Heat Exchange and Solar Energy, Rhode-Saint-Genese, Belgium, 28 Jan. - 1 Feb. 1980 Submitted for publication
(VKI-Preprint-1980-11) Avail: NTIS HC A02/MF A01

The TRNSYS program contains a collection of mathematical models of solar thermal systems components as separate modules, and is used as a comprehensive tool to simulate and predict system performance when the operating conditions vary continuously with time. An example showing the simulated performance of a swimming pool solar heating system is presented. Author (ESA)

N81-10565# National Bureau of Standards, Washington, D.C. National Engineering Lab.
AN ECONOMIC MODEL FOR PASSIVE SOLAR DESIGNS IN COMMERCIAL ENVIRONMENTS
Jeanne W. Powell Jun. 1980 150 p refs Sponsored in part by DOE, Washington, D.C.
(PB80-199532; NBS-BSS-125; LC-80-600081) Avail: NTIS HC A07/MF A01; Also avail: SOD CSCL 13A

The model incorporates a life cycle costing approach that focuses on the costs of purchase, installation, maintenance, repairs, replacement, and energy. It includes a detailed analysis of tax laws affecting the use of solar energy in commercial buildings. Possible methods of treating difficult to measure benefits and costs, such as effects of the passive solar design on resale value of the building and on lighting costs, rental income from the building, and the use of commercial space, are presented The model is illustrated in two case examples of prototypical solar design for low rise commercial buildings in an urban setting. GRA

N81-10568# Woods Hole Oceanographic Institution, Mass. Dept. of Physical Oceanography.
SEASONAL PERFORMANCE OF A BRINE POND SOLAR HEAT COLLECTOR IN NEW ENGLAND
William S. VonArx Mar. 1980 34 p refs
(Grant NOAA-04-7-158-44104)
(PB80-198278; WHOI-80-16; NOAA-80051304) Avail: NTIS HC A03/MF A01 CSCL 10A

The principles of a modified plot scale Bloch-Tabor brine pond solar heat collector and its operation over the course of a New England winter are described. By stratifying the pond using calcium chloride, a 'cat eye' effect was produced which enabled the pond to act as a whole-sky radiation trap; the freshwater cap served as both an optical and mechanical barrier to heat loss. The pond operated at 24 percent efficiency in collecting solar radiation. The minimum temperature observed in the brine layer at a time when the pond was covered by ice, was 24 C and the summer maximum was 58 C. Modifications to full scale systems, their shortcomings and the environmental constraints associated with this approach are discussed. GRA

N81-10574 Pennsylvania State Univ., University Park.
A MODEL OF THE FORMATION OF ACID IN COAL-FIRED POWER PLANT PLUMES Ph.D. Thesis
Carl Robert Chelius 1980 114 p
Avail: Univ. Microfilms Order No. 8024435

A one dimensional model was constructed to predict the growth and acidity of droplets in the stack plumes of coal fired power plants. Standard cloud physics droplet growth equations were applied to the droplet size section of the model and a noncatalytic oxidation of SO2 in an aqueous solution was used to predict the hydrogen ion concentration. Sensitivity tests were performed on the model and it was found that any factor which increased droplet growth (relative humidity, increase of solute in the droplet, for example) increased the pH of the droplet. The amount of gaseous ammonia in the atmosphere also has an effect on the pH. The model was checked to see if dispersion or dilution of the plume would change the predicted values. The model was applied to conditions simulating stratus and cumulus clouds. Two 'special cases' were modeled. A low pH situation where conditions were specified which kept droplet growth at a minimum in the presence of low ammonia amounts and a situation where the stack plume merged with the cooling tower plume about 500 m downwind from the source.
Dissert. Abstr.

N81-10580# Air Force Engineering and Services Center, Tyndall AFB, Fla. Environics Div.
FUEL JETTISONING BY U.S. AIR FORCE AIRCRAFT. VOLUME 1: SUMMARY AND ANALYSIS Final Technical

Report, Feb. 1972 - Dec. 1979
Harvey J. Clewell, III Mar. 1980 60 p refs
(AF Proj. 1900)
(AD-A089010; AFESC/ESL-TR-80-17-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 13/2

An analysis of 3 1/2 years of data on fuel jettisoning by US Air Force aircraft was performed to provide the basis for an accurate assessment of the environmental effects associated with this practice. The nature and extent of US Air Force jettisoning was examined, and the principal commands, aircraft, locations, altitudes, and quantities were identified. The reasons for fuel jettisoning were also investigated, and the relative importance of fuel jettisoning as a source of hydrocarbon pollution was estimated, considering both the possibility of ground contamination by liquid fuel, and the potential for production of photochemical oxidant pollution from the vapors. The analysis indicates that current Air Force policies concerning fuel jettisoning are adequate to minimize any negative environmental consequences, and that Air Force operational practices are in keeping with these policies. Fuel jettisoning as carried out by Air Force aircraft does not appear to produce any serious environmental consequences. GRA

N81-10581# Air Force Engineering and Services Center, Tyndall AFB, Fla. Environics Div.
FUEL JETTISONING BY U.S. AIR FORCE AIRCRAFT. VOLUME 2: FUEL DUMP LISTINGS Final Technical Report, Feb. 1972 - Dec. 1979
Harvey J. Clewell, III Mar. 1980 186 p refs 2 Vol.
(AF Proj. 1900)
(AD-A089076; AFESC/ESL-TR-80-17-Vol-2) Avail: NTIS HC A09/MF A01 CSCL 13/2

An analysis of 3 1/2 years of data on fuel jettisoning by US Air Force aircraft was performed to provide the basis for an accurate assessment of the environmental effects associated with this practice. This volume contains complete listings of all reported fuel dumps by Air Force aircraft for the period 1 Jan 75 through 30 Jun 78, sorted by Air Force command and by aircraft. A third section presents the distribution of fuel jettisoning by latitude and longitude coordinates. GRA

N81-10584# Argonne National Lab., Ill.
ENVIRONMENTAL CONTROL IMPLICATIONS OF COAL USE
K. E. Wilzbach, C. D. Livengood, and P. S. Farber 17 Mar. 1980 20 p refs Presented at the 2d DOE Environmental Control Symp., Reston, Va., 17-19 Mar. 1980
(Contract W-31-109-ENG-38)
(CONF-800334-18) Avail: NTIS HC A02/MF A01

The Environmental Control Technology for Coal Utilization program provides information required in the planning and guidance of R and D programs for coal utilization technologies and the associated environmental controls. Both available and developing technologies for the entire energy system from the mine mouth through ultimate waste disposal are analyzed. The tools of technology assessment and systems analysis are used to provide balanced evaluations of the engineering, environmental, and economic aspects of the technologies, as well as identification of synergistic effects and secondary or indirect impacts. The assessments performed to date that indicate the nature of the current work are briefly reviewed. The computerized models and data bases utilized in assessments are described. Some of the results from a major ongoing study of environmental controls for industrial boilers are presented and their implications discussed. DOE

N81-10600# Environmental Sciences Research Lab., Research Triangle Park, N.C. Emissions Measurement and Characterization Div.
PASSENGER CAR HYDROCARBON EMISSIONS SPECIATION Final Report
Frank Black and Larry High May 1980 25 p refs
(PB80-203136; EPA-600/2-80-085) Avail: NTIS HC A02/MF A01 CSCL 13B

Emission factors for over 60 individual hydrocarbon compounds were determined for four passenger cars. The cars included a 1963 Chevrolet, a 1977 Mustang, and 1978 Monarch, and 1979 LTD 2. The speciation data are reported for both tailpipe and evaporative emissions. The tailpipe emissions were for the urban driving conditions of the Federal Test Procedure used in motor vehicle certification. The evaporative emissions were for both diurnal and hot soak conditions also prescribed in the Federal Test Procedure for certification. The vehicle tests involved four gasoline fuels of varying composition. GRA

N81-10604# National Bureau of Standards, Washington, D.C. Center for Analytical Chemistry.
RAMAN MICROPROBE ANALYSIS OF STATIONARY SOURCE PARTICULATE POLLUTANTS Final Report, 1 Aug. 1977 - 31 Jul. 1979
John J. Blaha, Edgar S. Etz, and Kurt F. J. Heinrich 1979 33 p refs
(Contracts EPA-IAG-D7-F1186; EPA-IAG-78-D-F0367)
(PB80-202708; EPA-600/2-80-173) Avail: NTIS HC A03/MF A01 CSCL 07D

The application of Raman spectroscopy to the molecular characterization of individual particles from stationary sources is described. The NBS developed Raman microprobe was used to characterize microparticles of oil and coal fired power plant emissions and boiler samples. The samples were examined on an 'as received' basis and the results reported do not take into account any sample modifications that may have occurred during sample collection. Raman microprobe analyses of a number of dense agglomerations of largely submicrometer particles, from a sample collected by the EPA and described as coal fly ash, show no Raman spectral features to indicate a glassy material when the particles are first exposed to laser excitation. GRA

N81-10609# Radian Corp., Austin, Tex.
SURVEY OF AIR POLLUTION CONTROL TECHNOLOGY, RESEARCH AND DEVELOPMENT, PUBLIC AND PRIVATE ROLES IN UNDERTAKING AND STIMULATING INNOVATION: SURVEY OF EIGHT AIR POLLUTION CONTROL TECHNOLOGY INNOVATIONS Final Report
May 1980 62 p refs
(Contract NCAQ-15-AQ-7421)
(PB80-199177; AQ-7421-15A; RAD-80-203-003-01) Avail: NTIS HC A04/MF A01 CSCL 13B

Fabric filters; spray drying; atmospheric and pressurized atmospheric fluidized bed combustion; hydrodesulfurization; side stream separators; cat-ox scrubbing; and physical coal cleaning are discussed. Regulatory, political, and market climate concerning air pollution control technology is examined. GRA

N81-10896# International Energy Associates Ltd., Washington, D.C.
APPLICATION OF SPACE AND AVIATION TECHNOLOGY TO IMPROVE THE SAFETY AND RELIABILITY OF NUCLEAR POWER PLANT OPERATIONS Final Report
Apr. 1980 271 p refs
(W-31-109-eng-38)
(DOE/TIC-11143) Avail: NTIS HC A12/MF A01

Various technologies that have been developed and utilized by the aerospace community are examined, particularly the National Aeronautics and Space Administration (NASA) and the aviation industry. Potential for contributing to improved operational safety and reliability at commercial nuclear power plants of the type being built and operated in the United States today is emphasized. Transfer and application of technology developed by NASA, as well as other public and private institutions, may well help to decrease the likelihood of reactor accidents in the future. DOE

N81-10898# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.
ELECTRONIC ENGINE CONTROLS: AVAILABILITY, DURABILITY, AND FUEL ECONOMY EFFECTS ON 1983

AND LATER MODEL YEAR LIGHT-DUTY TRUCKS
Thomas Nugent, Zachary Diatchum, and Timothy Cox Jun. 1980 19 p refs
(PB80-199185; EPA-AA-SDSB-80-11) Avail: NTIS HC A02/MF A01 CSCL 13F

The application of microprocessor technology to optimize the functions of the internal combustion engine is discussed. Passenger car model years 1980 and 1981 experienced the widespread introduction of electronic engine controls of varying degrees of complexity. These controls hold the promise of lowering engine emissions and raising engine fuel economy through the optimization of the combustion processes at all engine operational conditions. The potential of this technology for use in the future light duty truck fleet is examined. The implications of this technology on fleet fuel economy, in conjunction with the more stringent emission standards in 1983, are exmained along with projections as to the future availability and durability of these microprocessors and their associated engine sensors. GRA

N81-10994# Joint Publications Research Service, Arlington, Va.
WEST EUROPE REPORT: SCIENCE AND TECHNOLOGY NO. 5
27 Nov. 1979 85 p refs Transl. into ENGLISH from various European journals
(JPRS-74642) Avail: NTIS HC A05/MF A01

Welding techniques for underwater pipelines are examined. Computer controlled manufacturing and industrial energy conservation techniques are discussed. Other topics include long range heating sources, coal burning technologies, and nuclear power facilities.

N81-10997# Joint Publications Research Service, Arlington, Va.
INDUSTRIAL ENERGY CONSERVATION TECHNIQUES EXPLORED
G. Baller *In its* West Europe Rept: Sci. and Technol., No. 5 (JPRS-74642) 27 Nov. 1979 p 41-46 Transl. into ENGLISH from Energie, Graefelfing, West Germany nos. 8-9, Aug. - Sep. 1979 p 110-114
Avail: NTIS HC A05/MF A01

It is well known that of the total terminal energy purchased in the industrial area, on the average, only about 55 percent is converted into useful energy. Types of useful energy are heat, mechanical energy, light, and useful energy for physical/chemical processes. About 45 percent of the paid for energy are therefore to be accounted as losses, in the conversion, transport, distribution, storage, and application of energy. Naturally, part of these losses is unavoidable for purely physical reasons. However, a considerable potential for savings remains which should challenge every operations engineers. E.D.K.

N81-10998# Joint Publications Research Service, Arlington, Va.
FEASIBILITY OF LONG-RANGE HEAT TRANSFER EXAMINED
E. Windorfer *In its* West Europe Rept.: Sci. and Technol., No. 5 (JPRS-74642) 27 Nov. 1979 p 50-57 refs Transl. into ENGLISH from Brennstoff-Waerme Kraft (Duesseldorf), Aug. 1979 p 334-336
Avail: NTIS HC A05/MF A01

The problems connected with the initial phase in the construction of a long range heating supply, the dependence of its expansion on the price level, and accompanying measures for accelerating customary hook up activity are described. An example of such a system is the long range heat supply system of the city of Flensburg. E.D.K.

N81-10999# Joint Publications Research Service, Arlington, Va.
STATES CONSIDER NEW COAL-BURNING TECHNOLOGIES
In its West Europe Rept.: Sci. and Technol., No. 5 (JPRS-74642) 27 Nov. 1979 p 58-61 Transl. into ENGLISH from Energie (Graefelfing, West Germany), Jul. 1979 p 228-229

Avail: NTIS HC A05/MF A01

The proportion of plants operating with petroleum products must be reduced in order to more completely decouple the electric power supply from the imponderables of the petroleum supply. In this connection, the resolute expanding of long range heating systems is being heavily stressed in the energy policy of Berlin. Ecologically safe technologies such as the fluidized bed furnace are already an element of Berlin's deliberations with respect to coal. E.D.K.

N81-11000# Joint Publications Research Service, Arlington, Va.
USE OF NUCLEAR POWER FOR COAL CONVERSION PROPOSED
In its West Europe Rept.: Sci. and Technol., No. 5 (JPRS-74642) 27 Nov. 1979 p 62-65 Transl. into ENGLISH from Energie (Graefelfing, West Germany), Jul. 1979 p 264

Avail: NTIS HC A05/MF A01

It is proposed that through a combined action of coal and nuclear energy the problem of a secure energy supply in the late 20th century can be solved. A study comparing electricity costs between coal and nuclear energy, carried out by the Battelle Institute on behalf of the Land of North Rhine-Westphalia, found that if indirect costs are ignored, nuclear energy has a price advantage of 3.27 pfennigs/kWH in the base load range. Only in the peak load range is electricity generation with coal cheaper, by 2.02 pfennigs/kWH. E.D.K.

N81-11231# Committee on Commerce, Science, and Transportation (U. S. Senate).
AUTOMOBILE FUEL ECONOMY AMENDMENTS OF 1979
Washington GPO 1980 99 p Hearing on S. 1583, S. 2010 and S. 2035 before the Comm. on Com., Sci., and Transportation, 96th Congr., 2nd Sess., 23 Jan. 1980
(GPO-58-783) Avail: Committee on Commerce, Science, and Transportation

The Senate hearings before the Committee on Commerce, Science, and Transportation concerning amendments to the Motor Vehicle Information and Cost Savings Act are presented. Two of the amendments hold promise of added employment opportunity, or job preservation in some segments of the automobile industry. One amendment provides added flexibility for industry planning, which may serve to reduce the cost of compliance with fuel economy standards. Another amendment eliminates several provisions of fuel economy regulation from a sector of the automobile industry wherein experience has shown that such regulation is nonproductive. M.G.

N81-11232# Committee on Energy and Natural Resources (U.S. Senate).
SYNTHETIC FUELS LEGISLATION
Washington GPO 1980 411 p refs Hearings on S. 932, S. 1308 and S. 1377 before the Comm. on Energy and Nat. Resources, 96th Congr., 1st Sess., 23-24 Jul. 1979
(GPO-58-320; Publ-96-88) Avail: Committee on Energy and Natural Resources

The Senate hearings before the Committee on Energy and Natural Resources concerning synthetic fuels legislation are presented. An act to extend the Defense Production Act of 1950 to include a greater emphasis on developing energy independence is discussed. Also, a bill to set forth a national program for the full development of energy supply, in addition to a bill to establish a synthetic fuels and alternative fuels production authority are examined. M.G.

N81-11238# Science Applications, Inc., McLean, Va.
TECHNICAL-ECONOMIC ASSESSMENT OF THE PRODUCTION OF METHANOL FROM BIOMASS. ASSESSMENT OF BIOMASS RESOURCE AND METHANOL MARKET, VOLUME 2 Final Research Report
Edward I. Wan, John A. Simmons, Joseph D Price, and Tien D. Nguyen 12 Jul. 1979 70 p refs 3 Vol.
(Contract ET-78-C-01-3002)
(DSE-3002-T1-Vol-2) Avail: NTIS HC A04/MF A01

Detailed information is presented on the following: feasibility of biomass feedstocks for methanol production; biomass availability and costs; potential demand for methanol from biomass; comparison of potential methanol demand and supply; and market penetration assessment. DOE

N81-11243# Brookhaven National Lab., Upton, N. Y.
CROP RESIDUES AS A FUEL FOR POWER GENERATION
N. Bhagat, H. Davitian, and R. Pouder 1979 20 p refs
(Contract DE-AC02-76CH-00016)
(BNL-50982) Avail: NTIS HC A02/MF A01

Crop residues could serve as an alternative energy source for producing electric power and heat in agricultural regions of the United States. Nearly 2 quads of residues are estimated to be available as a sustainable annual yield. These can substitute for up to one quad of conventional fuels used to generate electricity and up to an additional quad of petroleum and natural gas currently used for producing heat. The most promising routes to residue conversion appear to be regional generators sized in the megawatt range, and the mixing of residues with coal for burning in coal power plants. Costing farmers from $0.70 to $1.25 per million Btu. to harvest and prepare for use as a fuel, residues can be a competitive renewable energy supply. DOE

N81-11244# RAND Corp., Santa Monica, Calif.
VALUES IN CONFLICT: DESIGN CONSIDERATIONS FOR A TWO-STAGE SYNFUELS DEVELOPMENT STRATEGY
David Seidman Apr. 1980 38 p refs
(Contract DE-AC01-79PE-70078)
(RAND/N-1469-DOE) Avail: NTIS HC A03/MF A01

Some features of the design of a two stage synfuels development program serving to reduce potential conflict between the values served by synfuels development and other important public values are considered. The potential conflict between synfuels development and values protected or implemented by existing laws and regulations is discussed. The design of the first stage of development might substantially reduce conflict among these values and conflict between synfuels promoters and defenders of other values. It also suggests how first stage design might help generate information to inform decisions concerning the scope and scale of the second state and facilitate further protection of values in the event of second stage development. Approaches to avoiding unnecessary damage to competing values in second stage planning are discussed. Approaches to site selection that allow accommodation of national interests and the legitimate interests of the states are considered. DOE

N81-11254# Office of Technology Assessment, Washington, D. C.
ENERGY FROM BIOLOGICAL PROCESSES
Jul. 1980 204 p refs
(PB80-211477; OTA-E-123) Avail: NTIS HC A10/MF A01 CSCL 21D

Analysis of prominent biomass issues is presented, as well as summaries of four biomass fuel cycles, a description of biomass' place in two plausible energy futures; and discussions of policy options for promoting energy from biomass. The four fuel cycles (wood, alcohol fuels, grasses and crop residues, and animal wastes) were chosen because of their near to midterm energy potential. GRA

N81-11393 Stanford Univ., Calif.
OPTIMAL CLOSED-LOOP CONTROL OF AN INTERNAL COMBUSTION ENGINE Ph.D. Thesis
Itshak Glaser 1980 248 p
Avail: Univ. Microfilms Order No. 8024662

A closed loop scheme was designed which maintains a spark ignited engine operating at minimum fuel consumption for a given emissions level regardless of any external disturbances or mechanical degradation. It was found that for a given speed and load, this optimal condition can be closely achieved by holding the angle of the cylinder peak pressure constant. The optimum angle is also a function of engine power with open loop control. Any deterioration or external disturbance will change this angle. But a closed loop system can be made to restore this angle to its optimum value by properly controlling spark timing. An inexpensive piezoelectric sensor installed between the engine head and the spark plugs is used as the feedback element. As an example of system effectiveness, the open loop controlled engine yielded 4% increase in fuel consumption while relative humidity was increased to 75% in 90F whereas the closed loop system demonstrated only 2% deterioration. Dissert. Abstr.

N81-11398# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ASSESSMENTS OF EXTERNAL COMBUSTION BRAYTON-CYCLE ENGINE POTENTIAL IN TOTAL AND INTEGRATED ENERGY SYSTEMS
T. J. Marciniak, J. C. Bratis, A. Davis, M. L. Jain, T. L. Ashe (AiReseach Manufacturing Co., Phoenix, Ariz.), L. D. Six (AiResearch Manufacturing Co., Phoenix, Ariz.), and S. W. Trimble (AiResearch Manufacturing Co., Phoenix, Ariz.) Mar. 1980 112 p refs
(Contract W-31-109-eng-38)
(ANL/ES-96) Avail: NTIS HC A06/MF A01

The history, advantages, disadvantages, and performance and cost characteristics of the external combustion, Brayton engine are discussed. A development program that would lead to a commercializable external combustion, Brayton engine using an atmospheric fluidized bed combustor is described. The fluidized bed offers a method for burning coal in an environmentally acceptable manner at a fairly reasonable cost so that the external combustion Brayton concept can be used in the residential/commercial sector. Based on this study, it appears that the external combustion, Brayton engine, using a fluidized-bed combustion system, offers a technologically sound alternative for developing an economically viable, environmentally acceptable method for using non-scarce fuels. Although the efficiency of the engine is not as high as that projected for large diesel and Stirling engines, the capital cost advantages, fuel flexibility, relatively low developmental costs, and high chance of success make it an attractive alternative. DOE

N81-11446 Missouri Univ. -Columbia.
AN ANALYSIS OF PERCEPTUAL RESPONSES TO SOLAR ENERGY ADAPTATION IN RESIDENTIAL DESIGN Ph.D. Thesis
Jo Ann Asher Thompson 1979 192 p
Avail: Univ. Microfilms Order No. 8024402

In order to investigate the manner in which people perceive their built environment with and without an adaptation for solar energy, a questionnaire was developed which consisted of fifteen adjective pairs, called a semantic differential. Each of the adjective pairs represent opposites of each other; i.e., large versus small. A sample was taken of 181 people from those attending the 1979 Columbia, Missouri Home Show. From the analysis of variance and the multivariate analysis of variance, it was found that on the perceptual level, there was little to no difference between the solar and the nonsolar residence. In other words, the responses of the individuals did not show anything statistically significant in the manner in which people perceived the solar and the nonsolar representation. Dissert. Abstr.

N81-11447*# General Electric Co., Schenectady, N. Y. Energy Technology Operation.
COGENERATION TECHNOLOGY ALTERNATIVES STUDY (CTAS). VOLUME 5: COGENERATION SYSTEMS RESULTS Final Report
H. E. Gerlaugh, E. W. Hall, , D. H. Brown, R. R. Priestley, and W. F. Knightly May 1980 175 p refs
(Contract DEN3-31)
(NASA-CR-159769; DOE/NASA/0031-80/5; GE80ET0102) Avail: NTIS HC A08/MF A01 CSCL 10B

The use of various advanced energy conversion systems is examined and compared with each other and with current technology systems for savings in fuel energy, costs, and emissions in individual plants and on a national level. About fifty industrial processes from the largest energy consuming sectors were used as a basis for matching a similar number of energy conversion systems that are considered as candidate which can be made available by the 1985 to 2000 time period. The sectors considered included food, textiles, lumber, paper, chemicals, petroleum, glass, and primary metals. The energy conversion systems included steam and gas turbines, diesels, thermionics, stirling, closed cycle and steam injected gas turbines, and fuel cells. Fuels considered were coal, both coal and petroleum based residual and distillate liquid fuels, and low Btu gas obtained through the on site gasification of coal. The methodology and results of matching the cogeneration energy conversion systems to approximately 50 industrial processes are described. Results include fuel energy saved, levelized annual energy cost saved, return on investment, and operational factors relative to the noncogeneration base cases. J.M.S.

N81-11471# Oak Ridge Associated Universities, Tenn. Inst. for Energy Analysis.
STOCHASTIC SUN: UNDERSTANDING THE INTERMITTENT RESOURCE
David A. Boyd Jun. 1980 49 p refs
(Contract DE-AC05-76OR-00033)
(ORAU/IEA-80-10(M)) Avail: NTIS HC A03/MF A01

The concept of the ideal system is introduced as a device for separating resource limits from system effects. The limitations on ideal system performance arising from intermittency are examined and the relationship between real systems and ideal systems is discussed. The general nature of the results of such an approach and of their implications for solar utilization is illustrated. DOE

N81-11473# California Univ., Berkeley. Lawrence Berkeley Lab.
SIMULATION MODEL FOR THE PERFORMANCE ANALYSIS OF ROOF POND SYSTEMS FOR HEATING AND COOLING
Mehdi Tavana, Ron Kammerud, Hashem Akbari (Abadan Inst. of Tech., Iran), and Tom Borgers (California State Univ., Arcata) Jun. 1980 8 p refs Presented at the Am. Sect. of the ISES Conf., Phoenix, Ariz., 2-6 Jun. 1980
(Contract W-7405-eng-48)
(LBL-9292-Rev; CONF-800604-34-Rev) Avail: NTIS HC A02/MF A01

A detailed computer model was developed for simulating the dynamic thermal behavior of roof pond systems. The model is composed of outer movable insulation, an optional evaporative water layer over water bags on steel decking, and an inner movable insulation. A control stategy for the movable insulations which provides near optimum thermal performance is included in the model. An hourly thermal balance analysis of the system is performed using theoretical and/or empirical expressions to determine the heat transfer coefficients for each of the surfaces in the model. The model was used to study the effect on system thermal performance of (1) the R-value of both the top and bottom movable insulations, (2) the depth of the pond water, and (3) the depth of the evaporative layer. The heating and cooling potentials of the roof pond were also investigated in four climates. The model was developed for incorporating into the public domain building energy analysis computer program BLAST. DOE

N81-11479# State Univ. of New York at Stony Brook. Inst. for Energy Research.
NEW YORK STATE ENERGY-ANALYTIC INFORMATION SYSTEM: FIRST-STAGE IMPLEMENTATION
J. Allentuck, Owen Carroll, Linda Fiore, Niel Katz, Robert Malone, Robert Nathans, Michael Owen, Drazen Prelec, Robert Raymond, Ann Reisman et al Sep. 1979 307 p refs Prepared in cooperation with Brookhaven National Lab.
(Contract DE-AC02-76CH-00016)
(BNL-51138) Avail: NTIS HC A14/MF A01

The design of an energy information/analytic system for New York State, the data for a base year, 1976, and projections of these data are presented. At the county level, 1976 energy supply demand data and electric generating plant data are provided as well. Data base management is based on System 2000. Three computerized models provide the system's basic analytic capacity. The Brookhaven Energy System Network Simulator provides an integrating framework while a price response model and a weather sensitive energy demand model furnished a short term energy response estimation capability. The operation of these computerized models is described. DOE

N81-11482# Los Alamos Scientific Lab., N. Mex. Solar Energy Group.
OVERVIEW OF THE US PROGRAM FOR NONCONVECTING SOLAR PONDS
D. A. Neeper 1980 7 p refs Presented at the Nonconvecting Solar Pond Workshop, Washington, D.C., 30-31 Jul. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2134; CONF-800757-2) Avail: NTIS HC A02/MF A01

A brief history of research on solar ponds in the US is given. LASL's role in solar pond development is reviewed, and suggestions for future solar pond research are given. DOE

N81-11483# JBF Scientific Corp., Wilmington, Mass.
WIND ENERGY SYSTEMS APPLICATION TO REGIONAL UTILITIES
Sep. 1979 339 p
(Contracts DE-AC01-76ET-20063; EX-76-C-01-2438)
(DOE/ET-20063-T1/Vol-2) Avail: NTIS HC A15/MF A01

The computer programs used to analyze the economic impact of wind energy conversion systems (WECS) on a utility are described. The methodology requires extrapolating both historical utility load data and historical wind power into a year of analysis; calculating the total amount of funds made available in that year, as a result of the inclusion of wind power in the utility mix; and then estimating the present value of the total funds made available to the utility over the life of the WECS. Wherever possible, a typical input/output file is shown. DOE

N81-11493# Burns and Roe, Inc., Woodbury, N. Y.
PRELIMINARY ASSESSMENT OF ALTERNATIVE PFBC POWER PLANT SYSTEMS Final Report
J. Wysocki and R. Rogali Jul. 1980 114 p refs
(EPRI Proj. 1645-2)
(EPRI-CS-1451) Avail: NTIS HC A06/MF A01

Design and economic comparisons of the following nominal 1000 MWe pressurized fluidized bed combustion (PFBC) power plants are presented for both eastern and western coal: Curtiss-Wright PFBC power plants with an air-cooled design; General Electric RFBC power plants with a steam-cooled design; and AEP/Stal-Laval PFBC power plants with a steam-cooled design. In addition, reference pulverized coal-fired (PCF) power plants are included for comparison purposes. The results of the analysis indicate: (1) the steam-cooled PFBC designs show potential savings of 10% and 11% over PCF plants for eastern and western coal, respectively, in terms of busbar power cost; (2) the air-cooled PFBC designs show potential savings of 1% and 2% over PCF plants for eastern and western coal, respectively, in terms of busbar power cost. DOE

N81-11500# Exxon Research and Engineering Co., Linden, N.J. Government Research Labs.
ALTERNATIVE ENERGY SOURCES FOR NON-HIGHWAY TRANSPORTATION, APPENDICES
E. N. Cart, Jr., ed. Jun. 1980 560 p
(Contract DE-AC05-77CS-05438)
(DOE/CS-05438/T1-Vol-3) Avail: NTIS HC A24/MF A01

A planning study was made for DOE on alternate fuels for nonhighway transportation (aircraft, rail, marine, and pipeline). DOE is provided with a recommendation of what alternate fuels may be of interest to nonhighway transportation users from now through 2025 and the research and development needed to allow nonpetroleum derived fuels to be used in nonhighway transportation. DOE

N81-11501# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
RESIDENTIAL VENTILATION WITH HEAT RECOVERY: IMPROVING INDOOR AIR QUALITY AND SAVING ENERGY
G. D. Roseme, J. V. Berk, M. L. Boegel, H. I. Halsey, C. D. Hollowell, A. H. Rosenfeld, and I. Turiel May 1980 30 p refs
Presented at the ASHRAE/DOE Conf. on Thermal Performance of the Exterior Envelopes of Bldgs. Orlando, Fla., 3-5 Dec. 1979
Submitted for publication
(Contract W-7405-Eng-48)
(LBL-9749; CONF-791233-4; EEB-Vent-80-10) Avail: NTIS HC A03/MF A01

Residential air quality measurements were made and the use of mechanical ventilation systems with air-to-air heat exchangers is discussed as a promising means of pollutant control. A particular advantage of this control strategy is that the heat exchanger permits recovery of a large portion of the heat that would normally be lost in a simple exhaust ventilation system, and therefore maintains the energy efficiency of the house. An economic analysis is presented showing that installation of these systems in newly constructed homes is cost effective in most regions of the country. DOE

N81-11506# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
EFFECTS OF ATMOSPHERIC VARIABILITY ON ENERGY UTILIZATION AND CONSERVATION Final Report, 1 Jan. - 31 Dec. 1979
Elmar R. Reiter, C. C. Burns, H. Cochrane, G. R. Johnson, H. Leong, J. McKean, J. D. Sheaffer, A. M. Starr, and J. Webber Apr. 1980 113 p refs
(Contract DE-AS02-76EV-01340)
(COO-1340-69) Avail: NTIS HC A06/MF A01

An interdisciplinary approach towards a detailed assessment of energy consumption in urban space heating and cooling is presented in terms of measurement and modeling results. Modeling efforts concentrated on the city of Minneapolis, MN, using data from the winter seasons 1977/78 and 1978/79. Mean absolute daily errors of gas consumption estimated by the physical model applied to Minneapolis are 6.26% when compared to actual energy usage for the period 12/1/77 to 2/28/78. The mean daily absolute errors for the statistical reference model for the same period were 5.54%. Modeling of the energy consumption required detailed input of meteorological parameters from a special network of stations. As a spin-off, an assessment was obtained of the effects of anthropogenic heat on urban heat island generation under various synoptic conditions. A detailed building census, comprised of 105,722 heated structures, was obtained. DOE

N81-11507# Stein (Richard G.) and Associates, New York.
HANDBOOK OF ENERGY USE FOR BUILDING CONSTRUCTION
Richard G. Stein, C. Stein, M. Buckley, and M. Green Mar. 1980 211 p
(Contract DE-AC02-79CS-20220)
(DOE/CS-20220/1) Avail: NTIS HC A10/MF A01

The construction industry accounts for over 11.14% of the total energy consumed in the US annually. This represents the equivalent energy value of 1 1/4 billion barrels of oil. Within the construction industry, new building construction accounts for 5.19% of national annual energy consumption. The remaining 5.95% is distributed among new nonbuilding construction (highways, railroads, dams, bridges, etc.), building maintenance construction, and nonbuilding maintenance construction. Emphasis is given to new building construction; however, some information for the other parts of the construction industry is also included. Building designers are provided with information to determine the energy required for buildings construction and to evaluate the energy required for alternative materials, assemblies, and methods. It is also applicable to large-scale planning and policy determination in that it provides the means to estimate the energy required to carry out major building programs. DOE

N81-11508# Radian Corp., Austin, Tex.
ENERGY CONSERVATION IN DISTILLATION: A TECHNOLOGY APPLICATIONS MANUAL
May 1980 54 p refs
(Contract W-31-109-eng-38)
(DOE/CS-4431/T2) Avail: NTIS HC A04/MF A01

Distillation is the most widely practiced technique for separating mixtures of chemical species, but it is an energy intensive process. A 10 percent reduction in distillation energy consumption would effect a significant savings. On a national basis, this would be an annual savings of 200 trillion Btu, or the equivalent of 36.5 million barrels of oil per year. Technology to achieve these savings in distillation energy is available and measures are presented to assist process engineers in technical and economic analysis of the energy conservation measures most suitable for particular distillation applications. The manual catalogs all of the energy conservation options applicable to distillation and the options by the investment required; describes in detail the options having a significant potential to reduce distillation energy requirements economically; provides guidelines that will allow the plant engineer to quickly screen each option for his application; and provides short cut calculation procedures for use in a preliminary economic analysis of promising options. DOE

N81-11513# Exxon Research and Engineering Co., Linden, N.J. Government Research Labs.
ALTERNATIVE ENERGY SOURCES FOR NON-HIGHWAY TRANSPORTATION, VOLUME 1
E. N. Cart, Jr., ed. Jun. 1980 26 p refs
(Contract DE-AC05-77CS-55438)
(DOE/CS-05438/T1-Vol-1) Avail: NTIS HC A03/MF A01

Alternate fuels for nonhighway transportation (aircraft, rail, marine, and pipeline) were investigated. A recommendation of what alternate fuels may be of interest to nonhighway transportation users from now through 2025 is made. The research and development needed to allow nonpetroleum derived fuels to be used in nonhighway transportation is discussed. In the near term (present-1985), there is unlikely to be any major change in the fuels used in any of the four modes of transportation except that the average quality of the marine fuel is likely to get worse. In the midterm period (1985-2000), there will be a transition to nonpetroleum fuels, based primarily on shale oil derived liquids assuming a shale oil industry is started during this time. DOE

N81-11514# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
ANNUAL HEATING AND COOLING REQUIREMENTS AND DESIGN-DAY PERFORMANCE FOR A RESIDENTIAL MODEL IN SIX CLIMATES: A COMPARISON OF NBSLD, BLAST 2, AND DOE-2.1
William L. Carroll Jun. 1980 68 p refs Presented at the Conf. on Thermal Performance of the Exterior Envelopes of Bldgs., Orlando, Fla., 3-5 Dec. 1979
(Contract W-7405-eng-48)
(LBL-9270; EEB-ENV-79-11; CONF-791233-5) Avail: NTIS HC A04/MF A01

A comparison was made of heating and cooling load predictions made by three public domain building energy analysis computer programs: NBSLD, BLAST 2, and DOE-2.1. Three different kinds of comparisons were made: (1) monthly and annual load calculations were compared for six locations spanning the range of climates in the continential US (2) predicted changes in annual heating and cooling loads (BLAST 2 and DOE-2.1 from a baseline case were compared for a single climate (Washington, DC)); and (3) hourly heating and cooling load predictions were compared for design days that are representative of summer, winter, and transitional season weather conditions for a temperate climate. Annual heating load predictions show generally good agreement for all climates and consistent predicted changes from one climate to another, with the exception of the DOE-2.1 predictions, which show marked underestimates for mild heating climates. DOE

N81-11515# Little (Arthur D.), Inc., Cambridge, Mass.
ASSESSMENT OF THE POTENTIAL FOR HEAT RECOVERY AND LOAD LEVELING ON REFRIGERATION SYSTEMS. VOLUME 1. SUMMARY Final Report
R. L. Merriam, W. D. Lee, J. E. Carr, S. E. Boyce, and H. S. Bierenbaum Mar. 1980 47 p refs Prepared in cooperation with PRC, Systems Service Co., Cocoa Beach, Fla., and Applied Energy Systems, Inc., Cape Canaveral, Fla.
(EPRI Proj. 1087-1)
(EPRI-EM-1348-Vol-1) Avail: NTIS HC A08/MF A01

The potential energy savings from refrigerant heat recovery in the residential, commercial and industrial sectors and its impact on electric utilities were assessed. It was concluded that the technology for heat recovery is well established in all sectors and in comparison with solar water heating equivalent energy savings can be achieved at a fraction of the cost. In the absence of barriers, the potential market for heat recovery could be substantial, with an annual energy savings of 0.25 x 10 to the 15th power Btu in 1990. The economic impacts on summer peaking electric utilities were found to be favorable in all regions in central air conditioner applications. Annual net cost savings to the utility were estimated to be $10 to $50 per residential application. In the commercial sector and food processing segment of the industry sector, refrigerant heat recovery could reduce total energy consumption by about 0.28 x 10 to the 15th power Btu, with the major savings from applications in existing buildings. DOE

N81-11517# Little (Arthur D.), Inc., Cambridge, Mass.
POTENTIAL FOR ENERGY TECHNOLOGIES IN RESIDENTIAL AND COMMERCIAL BUILDINGS
Martin M. Glesk Nov. 1979 153 p
(Contract DE-AC01-76PE-03871)
(DOE/PE-03871/T1) Avail: NTIS HC A08/MF A01

The residential commercial energy technology model was developed as a planning tool for policy analysis in the residential and commercial building sectors. The model and its procedures represent a detailed approach to estimating the future acceptance of energy using technologies both in new construction and for retrofit into existing buildings. The model organizes into an analytical framework all relevant information and data on building energy technology, building markets, and government policy, and it allows for easy identification of the relative importance of key assumptions. The outputs include estimates of the degree of penetration of the various building energy technologies, the levels of energy use savings associated with them, and their costs both private and government. The model was designed to estimate the annual energy savings associated with new technologies compared with continued use of conventional technology at 1975 levels. DOE

N81-11520# Department of Energy, Washington, D. C. Energy Information Administration.
ENERGY DATA REPORT: ANNUAL ENERGY BALANCE, 1978
Apr. 1979 8 p
(DOE/EIA-0181) Avail: NTIS HC A02/MF A01

US energy production in 1978 increased for the third consecutive year. The 61.0 quadrillion Btu produced in 1978 was 0.63 quadrillion Btu or 1.0% greater than that during 1977 and represented the largest annual increase since 1972. Petroleum (including crude oil, lease condensate and natural gas plant liquids) was the nation's principal domestic energy source in 1978, supplying 33.8% of total production. Electricity production from nuclear powerplants increased 10% in 1978 to a record 276 billion kWh, 12.5% of total energy output. Hydropower electricity production totaled 281 billion kWh, 27.1% above the 1977 level when output was its lowest in recent years because of drought conditions in western states. US energy consumption in 1978 totaled 78.01 quadrillion Btu, 1.9% higher than that during 1977. Consumption of refined petroleum products, the major item of energy consumption was 37.79 quadrillion Btu in 1978. DOE

N81-11522# Midwest Research Inst., Golden, Colo.
DEVELOPING COMMON INFORMATION ELEMENTS FOR RENEWABLE ENERGY SYSTEMS: SUMMARY AND PROCEEDINGS OF THE SERI/AID WORKSHOP
John H. Ashworth and Jean W. Neuendorffer Jun. 1980 125 p refs Conf. held at Golden, Colo., 20-22 Feb. 1980
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-744-661; CONF-800250) Avail: NTIS HC A06/MF A01

The primary objectives were to explore whether it was possible to establish common information elements that would describe the operation and impact of renewable energy projects in developing countries. Such information could be shared among institutions and used to make informed judgments on the economic, technical, and social feasibility of the technologies. Because developing countries and foreign assistance agencies will be financing an increasing number of renewable energy projects, these organizations need information on the field experience of renewable energy technologies. DOE

N81-11524# Department of Energy, Washington, D. C.
DEPARTMENT OF ENERGY SOLAR ENERGY OBJECTIVES, CALENDAR YEAR 1980
Apr. 1980 432 p refs
(DOE/CS-0155) Avail: NTIS HC A19/MF A01

The goals of the Department of Energy for calendar year 1980 with respect to the output of each of the solar energy programs authorized by Congress are presented. The solar activities of the Department are described by the sector of the economy they are designed to serve. DOE

N81-11535# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
NATIONAL COMMERCIAL SOLAR HEATING AND COOLING DEMONSTRATION: PURPOSES, PROGRAM ACTIVITIES, AND IMPLICATIONS FOR FUTURE PROGRAMS
Richard Koontz, Michael Genest, and Becky Bryant May 1980 34 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/RR-431-328) Avail: NTIS HC A03/MF A01

The Commercial Demonstration Program was assessed in terms of its stated goals and objectives. The primary data base was DOE contractor reports on commercial demonstration projects. The program did not provide data to support a positive decision for the immediate construction or purchase of commercial solar systems. However, the program may have contributed to other goals in the subsequent legislation; i.e., research and development information, simulation of the solar industry, and more informed policy decisions. DOE

N81-11536# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
FUTURE OF PHOTOVOLTAIC ENERGY CONVERSION IN DEVELOPING COUNTRIES
Steve Hogan Apr. 1980 52 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-611-407) Avail: NTIS HC A04/MF A01

Recent studies reveal that photovoltaic energy conversion is economically viable for usage in developing countries. An overview of programs designed to lower the costs of such conversion systems is presented. Government goals are reviewed, as well as application projects relative to rural usage. A summary of the state of the art in both advanced research and commercially available technology is presented. It is concluded that with the range of the work being done, such systems will be viable for many rural applications within 5 years. DOE

N81-11539# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PERFORMANCE TESTING AND ECONOMIC ANALYSIS ON A PHOTOVOLTAIC FLYWHEEL ENERGY STORAGE AND CONVERSION SYSTEM
R. D. Hay, A. R. Millner, and P. O. Jarvinen 1980 9 p refs Presented at the Flywheel Technol. Symp., Scottsdale, Ariz., 26-30 Oct. 1980
(Contract DE-AC02-76ET-20279)
(COO-4094-91; CONF-801022-2) Avail: NTIS HC A02/MF A01

A subscale prototype of a flywheel energy storage and conversion system for use with photovoltaic power systems of residential and intermediate load-center size was designed, built and tested. System design, including details of such key components as magnetic bearings, motor generator, and power conditioning electronics, is described. Performance results of prototype testing are given and indicate that this system is the equal of or superior to battery-inverter systems for the same application. Results of cost and user worth analysis show that residential sytems are economically feasible in stand alone and in some utility interactive applications. DOE

N81-11542# Los Alamos Scientific Lab., N. Mex.
CONSERVATION AND SOLAR: WORKING TOGETHER
J. Douglas Balcomb 1980 8 p refs Presented at the 5th Natl. Passive Solar Conf., Amherst, Mass., 19-26 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2330; CONF-802026-11) Avail: NTIS HC A02/MF A01

A methodology is developed for optimally allocating resources between conservation and solar strategies in building design. Formulas are presented for a constrained optimum in which the initial investment is limited. A global optimum procedure is also described in which life cycle cost is minimized. The procedure is amenable to hand analysis if tables are available which give the solar savings fraction as a function of the load collector ratio for the locality. DOE

N81-11543# Brookhaven National Lab., Upton, N. Y. Energy Data and Models Group.
COMPARATIVE REVIEW OF THE TIME-STEPPED ENERGY SYSTEM OPTIMIZATION MODEL (TESOM) AND THE IEA MARKET ALLOCATION MODEL (MARKAL)
Andy S. Kydes Apr. 1980 16 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51199) Avail: NTIS HC A02/MF A01

The two principal energy system models used in the National Center for Analysis of Energy Systems at Brookhaven National Laboratory are described and their important differences are discussed. DOE

N81-11545# Total Environmental Action, Inc., Harrisville, N.H.
PASSIVE SOLAR DESIGN HANDBOOK. VOLUME 1: PASSIVE SOLAR DESIGN CONCEPTS
Bruce Anderson Mar. 1980 374 p refs
(Contract W-7405-eng-36)
(DOE/CS-0127/1) Avail: NTIS HC A16/MF A01

The following topics are covered: background to passive solar building design; the basics of solar building design; five passive solar heating techniques: direct gain, convective loops, thermal storage walls, thermal storage roofs, and attached sunspaces, passive solar cooling; and new developments for future use. A glossary and bibliography are included. DOE

N81-11557# Hudson Inst., Inc., Croton-on-Hudson, N. Y.
FUTURE ROLE OF GEOPRESSURED RESOURCES IN US ENERGY POLICY. A SCENARIO APPROACH AND ANALYSIS Final Report, 1 Jul. 1978 - 31 Mar. 1979
William M. Brown Apr. 1979 66 p refs
(Contract DE-AC02-78ET-28474)
(COO-4955-1) Avail: NTIS HC A04/MF A01

The potential contribution of future geopressured energy, especially methane, to the US and the world's needs is examined through several scenarios. Although such production may not become competitive, if it does the eventual productible reserves from the Gulf Coast region seem likely to fall between 100 and 10,000 quads. The world's potential from similar resources is not known but may well be 10 times as great. The contribution to the projected future demand for hydrocarbons is found to become substantial in most of the success scenarios. The potential impact on fuel imports and their future prices is discussed. DOE

N81-11558# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
EFFECTS OF ATMOSPHERIC VARIABILITY ON ENERGY UTILIZATION AND CONSERVATION
Elmar R. Reiter, C. C. Burns, H. Cochrane, G. R. Johnson, H. Leong, and J. D. Sheaffer Jul. 1980 86 p refs
(Contract DE-AS02-76EV-01340)
(COO-1340-76) Avail: NTIS HC A05/MF A01

Atmospheric circulation and climate variability, urban mesoclimate, energy demand modeling, and economic implications of weather variability and energy demand are studied. DOE

N81-11559# Department of Energy, Washington, D. C. Regulatory and Competitive Analysis Div.
ENERGY POLICY STUDY. VOLUME 12: GOVERNMENT ACTIONS AFFECTING THE ENVIRONMENT AND THEIR EFFECTS ON ENERGY MARKETS
Charlie McCormick Aug. 1980 52 p refs
(DOE/EIA-0201/12) Avail: NTIS HC A04/MF A01

The energy/environment tradeoff is described. The relationship between energy production and consumption and environmental pollution is discussed. Data are presented showing some of the pollutants which arise from the production and use of energy. The data indicate that the most severe problems with energy pollution are associated with coal production and consumption. A description is given of the major environmental laws which restrict energy production and uses to protect air, water, land, and life forms. The environmental laws are most likely to effect energy production and consumption activities which produce large quantities of pollutants or small quantities of toxic and hazardous pollutants. As energy prices continue to rise and domestic oil and natural gas supplies continue to decline, the lands withdrawn from energy development will become increasingly valuable as potential sources of energy. DOE

N81-11560# National Technical Information Service, Springfield, Va.
ENERGY CONSERVATION: INDUSTRY. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Jun. 1980
Audrey S. Hundemann Jul. 1980 45 p Supersedes NTIS/PS-79/0648
(PB80-812910; NTIS/PS-79/0648) Avail: NTIS HC $30.00/MF $30.00 CSCL 10A

The 335 citations, 37 of which are new entries, discuss potential methods of conserving energy. Many abstracts deal with reports that also cover processes used, amount of energy consumed, and environmental considerations of energy conserving options. Industries covered include food, paper, chemical, cement, metals, petroleum refining, contract construction, synthetic rubber, plastics, drug manufacturing, and stone, clay, and glass. Energy conservation through the use of waste heat is covered in a related Published Search entitled Waste Heat Utilization. GRA

N81-11562# Office of Technology Assessment, Washington, D. C.
AN ASSESSMENT OF OIL SHALE TECHNOLOGIES
Jun. 1980 522 p refs
(PB80-210115; OTA-M-118; LC-80-600101) Avail: NTIS HC A22/MF A01 CSCL 10A

The means of developing the oil shale resources of the western United States is explored and the consequences of development in terms of impact on the physical and social environments is reviewed. Background information on the nature of oil shale is provided as is an evaluation of technologies for recovery of shale oil. Policy options which address barriers that could hinder the establishment of the industry are presented. GRA

N81-11563# Office of Technology Assessment, Washington, D. C.
AN ASSESSMENT OF OIL SHALE TECHNOLOGIES. VOLUME 2: A HISTORY AND ANALYSIS OF THE FEDERAL PROTOTYPE OIL SHALE LEASING PROGRAM
Jul. 1980 83 p refs
(PB80-210123; OTA-M-119; LC-80-600102) Avail: NTIS HC A05/MF A01 CSCL 10A

The Federal Prototype Oil Shale Leasing Program that began in 1974 when the U.S. Department of the Interior sold leases to four tracts in the oil shale regions of Colorado and Utah is discussed. A prior leasing attempt in 1968 is also described because it provides an historical perspective about the imperatives and the restraints that have inhibited such development. The report includes discussions of political, economic, environmental, and energy-related factors that affected both the 1968 leasing attempt and its successor, and status are examined to determine if those goals have been met or are likely to be met in the foreseeable future. DOE

N81-11568# Los Angeles-Orange County Metropolitan Area Project, Whittier, Calif.
EVALUATION OF FAST RESPONSE AEROSOL MASS MONITORS
C. I. Fairchild, M. I. Tillery, and H. J. Ettinger Jun. 1980 76 p refs
(Contract W-7405-eng-36)
(LA-8220) Avail: NTIS HC A05/MF A01

Five commercially available mass monitors were evaluated against aerosols of coal dust, silica, fiber glass, welding fume, oil shale, polystyrene latex, dioctyl phthalate, and fluorescein dye. The RDM-201 was a long term sampler (sampling up to 8 h), whereas the other monitors employed sampling periods generally 2 min or less. Each mass monitor sampled from uniform aerosol concentrations ranging from less than 0.1 to greater than 10 mg/cubic meters. The aerosols were also sampled by three membrane filters collecting 2, 5, and 20 to 37 L/min. Mass monitor readings were compared to gravimetric concentrations of samples between 1 to 10 min duration. Statistical techniques were applied to determine significant differences between gravimetric and mass monitor results. The RDM-201 mass monitor displayed zero mass concentration of 27 of 73 measurements and an accuracy of +-74 percent for 27 other measurements, when gravimetric information indicated mass concentrations ranging from 0.3 to 5 mg/cubic meters. DOE

N81-11573# Argonne National Lab., Ill.
ENVIRONMENTAL CONTROL TECHNOLOGY SURVEY OF SELECTED UNITED STATES STRIP MINING SITES. VOLUME 2B: ALABAMA. WATER QUALITY IMPACTS AND OVERBURDEN CHEMISTRY OF ALABAMA STUDY SITE Technical Report, May 1976 - Jul. 1977
J. D. Hendricks, J. E. Bogner, R. D. Olsen, J. P. Schubert, A. A. Sobek, and D. O. Johnson May 1980 112 p refs
(ANL/EMR-2-Vol-2B) Avail: NTIS HC A06/MF A01

An intensive study of water, coal, and overburden chemistry was conducted at a surface coal mine in Alabama from May 1976 through July 1977. Sampling sites included the pit sump, a stream downgrade from the mine, the discharge from the water treatment facility, and a small stream outside the mine drainage. Water samples were collected every two weeks and analysed for the following parameters: specific conductance, pH, temperature, acidity, bicarbonate, carbonate, chloride, total dissolved solids, suspended solids, sulfate, and 20 metals. No potential acid problem exists at this mine. Water quality is good in both streams sampled, and high levels of dissolved elements are found only in water collected from the pit sump. The mine effluent is in compliance with Office of Surface Mining water quality standards. DOE

N81-11575# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ENVIRONMENTAL ASSESSMENT OF A PROGRAM TO REDUCE OIL AND GAS CONSUMPTION BY ELECTRIC UTILITIES
Mar. 1980 117 p refs
(Contract W-31-109-eng-38)
(ANL/EES/TM-97) Avail: NTIS HC A06/MF A01

An environmental assessment is presented of a program aimed at reducing oil and gas consumption in electric utility power plants by the equivalent of approximately 1,000,000 barrels per day by 1990. The program would mandate the conversion of 45 power plants (approximately 21 GW) to coal and would provide financial incentives for the accelerated replacement of other existing oil and gas fired plants (estimated to be 30 GW) by new coal fired plants or other acceptable alternatives. The air quality impacts of potential increases in sulfur dioxide, nitrogen oxides, and particulate matter emissions associated with the program are analyzed. Potential solid waste, coal production and transportation, and public health and welfare impacts are also considered. Impacts at the national and regional levels, with some discussion of possible local air quality effects of conversion of specific plants are presented. DOE

N81-11577# Los Alamos Scientific Lab., N. Mex. Modeling and Economic Analysis Group (S-2).
AIR QUALITY REGULATION IN SPATIAL EQUILIBRIUM MODELS
Charles D. Kolstad 1980 27 p refs Presented at 5th Intern. Clean Air Congr., Buenos Aires, 20-26 Oct. 1980
(Contract W-7405-eng-37)
(LA-UR-80-1753; CONF-801015-1) Avail: NTIS HC A03/MF A01

Methods for including a wide variety of air pollution regulations within the class of economic equilibrium models where allocation is based on constrained optimization is presented. The first part of the paper discusses current air pollution regulation in the United States and possible future regulation. A prototype spatial equilibrium model within which a number of regulatory mechanisms are explicitly represented is also described. These include efficient and zoned charges, statically and dynamically efficient permit systems, technological control and hybrid permit charge systems. DOE

N81-11579# Lovelace Biomedical and Environmental Research Inst., Albuquerque, N. Mex. Inhalation Toxicology Research Inst.
LOW Btu GASIFIER EMISSIONS TOXICOLOGY PROGRAM Status Report, Oct. 1979
George J. Newton, ed. Oct. 1979 47 p refs
(Contract DE-AC04-76EV-01013; EY-76-C-04-1013)
(LMF-75) Avail: NTIS HC A03/MF A01

Results to date from the physical, chemical, and biological characterization of potential toxicants in liquid, solid, and gaseous process streams of an experimental low Btu gasifier are summarized. These results were obtained with a limited data base for a small experimental gasifier. DOE

N81-11580# Oak Ridge National Lab., Tenn. Energy Div.
ENVIRONMENTAL AND HEALTH ASPECTS OF BIOMASS ENERGY SYSTEMS
H. M. Braunstein and F. C. Kornegay 1980 8 p refs Presented at the 180th ACS Meeting, San Francisco, 24 Aug. 1980
(Contract W-7405-eng-26)
(CONF-800814-11) Avail: NTIS HC A02/MF A01

Production of biomass as well as conversion can lead to environmental impact, and although most impacts will be site specific, some generic effects can be identified. Since biomass-related impacts cover a very broad spectrum of materials, processes, end products, and effects, the discussion presented here, except for an overview of generic effects and comment on production impacts, is directed primarily to those resulting from residential wood combustion. DOE

N81-11957# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
MODELING APPROACHES TO LONG-RUN INTEGRATED TECHNOLOGICAL IMPACT ANALYSIS
Paul J. Croncki Dec. 1979 24 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51126) Avail: NTIS HC A02/MF A01

Analysis of the energy economic environmental impacts of energy policies, such as a major synthetic fuels program, requires methodologies that reflect the potential benefits and costs of proposed policy alternative. Energy policies typically have secondary economic and environmental effects as well as direct effects on energy itself, and these must collectively be assessed to provide a complete basis for policy selection. The focus of this report is on approaches to the analysis of long term impacts that may result from current decisions regarding energy policy. The interrelationships among the energy, economic, and environmental systems and alternative ways of analyzing long term impacts within an integrated framework are discussed. An application of such a framework to the assessment of a major synthetic fuels program is presented as an example. The use of idealized problem formulations is a necessary part of technology assessment, particularly in considering highly integrated policy issues, such as a synfuels policy. DOE

N81-11963# Calspan Corp., Buffalo, N. Y.
CALSPAN/CHRYSLER RESEARCH SAFETY VEHICLE. PHASE 3, VOLUME 1: EXECUTIVE SUMMARY Final Technical Report
G. J. Fabian, ed. Apr. 1980 62 p refs
(Contract DOT-HS-7-01551)
(PB80-188428; DOT-HS805-322; CALSPAN-ZN-6069-V-32-1) Avail: NTIS HC A04/MF A01 CSCL 13F

A five passenger family car was designed to be fabricated by mass production techniques from materials chosen to minimize energy content, rare mineral requirements, and facilitate recycling for recovery and reuse. Using a combination of mathematical modeling on the computer with static and dynamic testing, design issues that remained at the completion of phase 2 were resolved; validation tests were conducted to demonstrate performance resulting from these design improvements; and the results were incorporated in the final design. Additional investigations defined emissions and fuel economy, documented the degree of RSV compliance with current Federal Motor Vehicle Standards, and studied the effect of the RSV design on collision repair, producibility, and cost of program goals. GRA

N81-11964# Falcon Research and Development Co., Buffalo, N. Y.
STUDY OF AUTOMOTIVE EMISSION CONTROL TECHNOLOGY: FUEL SWITCHING ANALYSIS Final Report
30 Jun. 1980 236 p refs Prepared in cooperation with Energy and Environmental Analysis, Inc., Arlington, Va. Sponsored in part by the National Commission on Air Quality
(PB80-207947; AQ-7243-2E; IR-5) Avail: NTIS HC A11/MF A01 CSCL 13F

The switching of fuel in operating vehicles designed to use unleaded gasoline or leaded gasoline is one of the major factors responsible for the failure of in-use vehicles to meet emission standards. The number of vehicles subject to fuel switching, the frequency at which it occurs and the impact on individual vehicle emissions were analyzed. A methodology is developed for predicting the total vehicle emissions impact of fuel switching, and projections are made of the increase in vehicle emissions from 1975 through 1990. GRA

N81-11995*# Alabama Univ. in Huntsville. Dept. of Mechanical Engineering.
VALIDATION OF THE SOLAR HEATING AND COOLING HIGH SPEED PERFORMANCE (HISPER) COMPUTER CODE
Donald B. Wallace *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 23 p refs

Avail: NTIS HC A99/MF A01 CSCL 10A

Developed to give a quick and accurate predictions HISPER, a simplification of the TRNSYS program, achieves its computational speed by not simulating detailed system operations or performing detailed load computations. In order to validate the HISPER computer for air systems the simulation was compared to the actual performance of an operational test site. Solar insolation, ambient temperature, water usage rate, and water main temperatures from the data tapes for an office building in Huntsville, Alabama were used as input. The HISPER program was found to predict the heating loads and solar fraction of the loads with errors of less than ten percent. Good correlation was found on both a seasonal basis and a monthly basis. Several parameters (such as infiltration rate and the outside ambient temperature above which heating is not required) were found to require careful selection for accurate simulation. A.R.H.

N81-12267# Operations Research, Inc., Silver Spring, Md.
ALTERNATIVE TRANSPORTATION FUELS
W. S. Askew, T. M. McNamara, and D. P. Maxfield 1980 16 p refs Presented at 5th Symp. on Automotive Propulsion Systems, Dearborn, Mich., 14-18 Apr. 1980
(Contract DE-AC02-78CS-54894)
(CONF-800419-5) Avail: NTIS HC A02/MF A01

The commercialization of alternative fuels was analyzed. Following a synopsis of U.S. energy use, the concept of commercialization, the impacts of supply shortages and demand inelasticity upon commercialization, and the status of alternative fuels commercialization to date in the U.S. are discussed. However, the level of consumption, the projected growth in demand, and the inordinate dependence upon foreign fuels dictate that additional fuel supplies in general be brought to the US energy marketplace. Commercialization efforts encompass a range of measures designed to accelerate the arrival of technologies or products in the marketplace. Such a union of willing buyers and willing sellers requires that three general conditions be met: product quality comparable to existing products; price competitiveness; and adequate availability of supply. DOE

N81-12274# International Research and Technology Corp., McLean, Va.
INDIRECT LIQUEFACTION OF COAL
30 Jun. 1980 47 p refs
(Contract DE-AC01-79EV-10291)
(DOE/EV-10291/T1) Avail: NTIS HC A03/MF A01

The most important potential environmental problems uniquely associated with indirect liquefaction appear to be related to the protection of occupational personnel from the toxic and carcinogenic properties of process and waste stream constituents, the potential public health risks from process products, by products and emissions and the management of potentially hazardous solid wastes. The seriousness of these potential problems is related partially to the severity of potential effects (i.e., human mortality and morbidity), but even more to the uncertainty regarding (1) the probable chemical characteristics and quantities of process and waste streams; and (2) the effectiveness and efficiencies of control technologies not yet tested on a commercial scale. Based upon current information, it is highly improbable that these potential problems will actually be manifested or pose serious constraints to the development of indirect liquefaction technologies, although their potential severity warrants continued research and evaluation. DOE

N81-12279# Argonne National Lab., Ill. Special Projects Group.
GRAIN ETHANOL AS A PETROLEUM SUBSTITUTE: A PERSPECTIVE
T. G. Alston Apr. 1980 29 p refs
(ANL/SPG-9) Avail: NTIS HC A03/MF A01

The use of grain ethanol to supplement petroleum supplies is examined. Upper bound prices for feed grains resulting from gasohol tax exemptions are estimated. It is concluded that grain price increases could be substantial. Industrial uses constitute a more economical market for grain ethanol, one in which the product is now competitive with ethanol derived from petroleum and natural gas liquids. Without tax exemptions for gasohol, grain ethanol would now be displacing petroleum in the industrial market at a net economic gain, rather than in the fuel market at a net economic loss. Results indicate that this industrial market for ethanol could grow significantly, principally by use of grain ethanol as an intermediate in production of chemicals now derived from petroleum and natural gas. M.G.

N81-12384# Thermal Systems Engineering, Inc., Woburn, Mass.
HEAT RECOVERY DEVICES, NEW Final Report, 1 Mar. - 31 Oct. 1979
Andrew J. Syska and A. Brzezinski Apr. 1980 50 p refs
(Contract GRI-5011-341-0121)
(PB80-205438; GRI-78/0041) Avail: NTIS HC A03/MF A01 CSCL 13A

A concept was developed for a compact and lightweight jet impingement recuperator suitable for recovering heat from residential and commercial gas fired heating systems. Heat transfer and pressure drop analyses were completed confirming feasibility of the concept. Preliminary, cost effective design for the recuperator was also completed and optimized for compactness and for low pressure drop compatible with natural chimney drafts. GRA

N81-12543*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SATELLITE POWER SYSTEM CONCEPT DEVELOPMENT AND EVALUATION PROGRAM. VOLUME 1: TECHNICAL ASSESSMENT SUMMARY REPORT

Nov. 1980 116 p refs

(NASA-TM-58232) Avail: NTIS HC A06/MF A01 CSCL 10A

Candidate satellite power system (SPS) concepts were identified and evaluated in terms of technical and cost factors. A number of alternative technically feasible approaches and system concepts were investigated. A reference system was defined to facilitate economic, environmental, and societal assessments by the Department of Energy. All elements of the reference system were defined including the satellite and all its subsystems, the orbital construction and maintenance bases, all elements of the space transportation system, the ground receiving station, and the associated industrial facilities for manufacturing the required hardware. The reference conclusions and remaining issues are stated for the following topical areas: system definition; energy conversion and power management; power transmission and reception; structures, controls, and materials; construction and operations; and space transportation. R.C.T.

N81-12555# Committee on Interstate and Foreign Commerce (U. S. House).

PRIORITY ENERGY PROJECT ACT OF 1979

Washington GPO 1980 253 p refs Hearings on H. R. 4499, H. R. 4573, and H. R. 4862 before the Comm. on Interstate and Foreign Com., 96th Congr., 1st Sess., 18 and 20 Jul. 1979

(GPO-58-154) Avail: Subcommittee on Energy and Power

Legislation is proposed to hasten and simplify the procedure for Federal approval of nonnuclear energy facilities. Development of synthetic fuels and synthetic chemical feedstocks is stressed. S.F.

N81-12557# Committee on Energy and Natural Resources (U.S. Senate).

THE WESTERN HEMISPHERE ENERGY SYSTEM

Melvin A. Conant Washington GPO 1979 163 p refs Rept. presented to the Comm. on Energy and Nat. Resources, 96th Congr., 1st Sess., Nov. 1979

(GPO-51-683; PUBL-96-45) Avail: Committee on Energy and Natural Resources

Oil exploration and production by the Western Hemisphere countries of Mexico, Venezuela, Canada and the United States are discussed. International cooperation in developing shale oil, tar sands and heavier oils is presented as an alternative to the current energy dependent state. S.F.

N81-12560*# Rockwell International Corp., Columbus, Ohio. Space Operations and Satellite Systems Div.

SATELLITE POWER SYSTEM (SPS) LASER STUDIES. VOLUME 2: METEOROLOGICAL EFFECTS ON LASER BEAM PROPAGATION AND DIRECT SOLAR PUMPED LASERS FOR THE SPS Final Report

R. E. Beverly, III Columbus, Ohio NASA Nov. 1980 143 p refs

(Contract NAS8-32475)

(NASA-CR-3347; SSD-80-0119-2-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 10A

The primary emphasis of this research activity was to investigate the effect of the environment on laser power transmission/reception from space to ground. Potential mitigation techniques to minimize the environment effect by a judicious choice of laser operating parameters was investigated. Using these techniques, the availability of power at selected sites was determined using statistical meteorological data for each site. Author

N81-12561# Committee on Agriculture, Nutrition, and Forestry (U. S. Senate).

AGRICULTURAL WASTE PRODUCTS AS ALTERNATIVE ENERGY SOURCES

Washington GPO 1980 77 p Hearing before the Subcomm. on Agr. Res. and Gen. Legislation of the Comm. on Agr., Nutrition, and Forestry, 96th Congr., 2nd Sess., 21 Mar. 1980, Tallahassee, Fla.

(GPO-62-991) Avail: Subcommittee on Agricultural Research and General Legislation

The hearings before the Senate Subcommitte on Agricultural Research and General Legislation concerning the utilization of agricultural waste products as energy sources are presented. The production of biomass derived fuels, particularly alcohol, is discussed with regard to its technical and economic feasibility. Attention is also given to the problems relating to the use of gasohol. M.G.

N81-12562# Committee on Agriculture, Nutrition, and Forestry (U. S. Senate).

ENERGY RESEARCH AND EXTENSION

Washington GPO 1980 59 p Hearing before the Subcomm. on Agr. Res. and Gen. Legislation of the Comm. on Agr., Nutrition, and Forestry, 96th Congr., 2nd Sess., 11 Mar. 1980

(GPO-61-544) Avail: Subcommittee on Agricultural Research and General Legislation

The role of energy research and extension activities in the development of alternative energy technology is discussed. The impact of alcohol fuels upon the future of the agricultural community was examined. T.M.

N81-12563# Committee on Public Works and Transportation (U. S. House).

REVIEW OF TITLE 5 OF THE NATIONAL ENERGY CONSERVATION POLICY ACT

Washington GPO 1980 244 p Hearings before the Subcomm. on Public Buildings and Grounds of the Comm. on the Public Works and Transportation, 96th Congr., 1st Sess., 26-27 Sep. 1979

(GPO-57-523) Avail: Subcommittee on Public Buildings and Grounds

The administration's efforts and achievements in implementing PL 95-619 are reviewed with emphasis on those sections of the energy policy dealing with the development, demonstration and promotion of energy conservation, the use of solar heating and solar cooling and other renewable energy sources in Federal buildings, and the acquisition of photovoltaic solar electric systems for electric production in Federal facilities. A.R.H.

N81-12565# Committee on Commerce, Science, and Transportation (U. S. Senate).

OCEAN THERMAL ENERGY CONVERSION ACT OF 1980

GPO 1980 167 p refs Hearings on S. 2492 before the Comm. on Com., Sci. and Transportation, 96th Congr., 2nd Sess., 10 Apr. and 1 May 1980

(GPO-64-551) Avail: Committee on Commerce, Science and Transportation

The hearings before the Senate Committee on Commerce, Science, and Transportation concerning the Ocean Thermal Energy Conversion Act of 1980 are presented. The text of the bill is given. It proposes to regulate commerce, promote energy self sufficiency, and protect the environment by establishing procedures for the location, construction, and operation of ocean thermal energy conversion facilities and plantships to produce electricity and energy intensive products off the coasts of the United States. M G

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

N81-12566# Committee on Science and Technology (U. S. House).
ENERGY FROM MUNICIPAL SOLID WASTES
Paul F. Rothberg Washington GPO 1980 30 p refs Rept. presented by the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., Jun. 1980 Prepared by Congressional Research Service, Library of Congress
(GPO-61-252) Avail: SOD HC

A summary of the hearings before the House Subcommittee on Energy Development and Applications concerning the utilization of municipal solid wastes as an energy source is given. The processes available to convert solid wastes into energy are reviewed as well as the problems and opportunities associated with commercialization of these products. M.G.

N81-12567# Committee on Science and Technology (U. S. House).
OVERSIGHT OF ENERGY DEVELOPMENT IN AFRICA AND THE MIDDLE EAST
Washington GPO 1980 135 p Presented to the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., Apr. 1980
(GPO-60-580) Avail: SOD HC

Energy development in South Africa, Nigeria, the Ivory Coast and Saudi Arabia is discussed. Synthetic fuels, coal liquefaction, solar energy and ocean thermal energy conversion are emphasized. S.F.

N81-12570# Institute of Gas Technology, Chicago, Ill. Engineering and Science Research Dept.
WASTES AND BIOMASS AS ENERGY RESOURCES
Donald L. Klass 1979 15 p refs Presented at the 14th World Gas Conf., Toronto, 27 May - 1 Jun. 1979
(CONF-790512-1) Avail: NTIS HC A02/MF A01

Organic fuels can be manufactured by converting major sources of continuously renewable nonfossil carbon to synfuels that are interchangeable with, or can be substituted for, natural gas and petroleum-derived fuels. Promising sources of this carbon are waste materials, such as urban refuse, and biomass produced from solar energy by photosynthesis. The development of this concept is presented in this paper. The broad scope of the technology and its potential impact on energy supplies are reviewed. The renewable feature of both wastes and biomass makes them valuable natural resources that inevitably will be fully developed and commercialized as sources of energy-intensive products and synfuels. The perpetual availability of organic fuels will permit the conservation of valuable fossil fuel reserves, and, as time passes, offer a long-term solution to independence from foreign energy supplies and fossil fuel depletion. Author

N81-12572# Midwest Research Inst., Golden, Colo.
US DEPARTMENT OF ENERGY SOLAR THERMAL ENERGY SYSTEMS PROGRAM. AN OVERVIEW PRESENTATION
G. W. Braun 1980 38 p refs Presented at Solar Energy Industries Assoc. Meeting, San Jose, Calif., 9 Aug. 1979
(Contract DE-AC02-77CH-00178)
(SERI/SP-733-526; CONF-7908122-1) Avail: NTIS HC A03/MF A01

Intended as both a position paper and a progress report to industry, a comprehensive overview of the US Department of Energy's Solar Thermal Program is provided. Cost goals, systems design parameters, applications considerations, and the potential for industry involvement in solar thermal development and commercialization are described in detail. Decentralized management of R & D functions is linked to priorities and strategies of the evolving program. DOE

N81-12578# Midwest Research Inst., Golden, Colo.
SOLAR ENERGY IN AUSTRALIA: A PROFILE OF RENEWABLE ENERGY ACTIVITY IN ITS NATIONAL CONTEXT
Glenna L. Case Aug. 1980 83 p refs
(Contract DE-AC02-77CH-00178)
(SERI/SP-763) Avail: NTIS HC A05/MF A01

The development of solar energy technology in Australia is examined. The following topics are included: country overview; energy summary; geopolitical, economic, and cultural aspects of Australia; the energy profile; and international agreements, contacts, manufacturers, and projects. DOE

N81-12579# University of Southeastern Massachusetts, North Dartmouth.
GEOTHERMAL ENERGY AS A SOURCE OF ELECTRICITY. A WORLDWIDE SURVEY OF THE DESIGN AND OPERATION OF GEOTHERMAL POWER PLANTS
R. DiPippo Jan. 1980 377 p refs
(Contract DE-AS02-76ET-28320)
(DOE/RA-28320/1) Avail: NTIS HC A17/MF A01

An overview of geothermal power generation is presented. A survey of geothermal power plants is given for the following countries: China, El Salvado, Iceland, Italy, Japan, Mexico, New Zealand, Philippines, Turkey, USSR, and USA. A survey of countries planning geothermal power plants is included. DOE

N81-12580# Raytheon Service Co., Arlington, Va.
WIND ENERGY SYSTEMS: PROGRAM SUMMARY
May 1980 237 p refs
(Contract DE-AC01-78ET-20097)
(DOE/CS-20097/01) Avail: NTIS HC A11/MF A01

The Federal Wind Energy Program (FWEP) was initiated to provide focus, direction and funds for the development of wind power. Each of the Department of Energy's (DOE) current wind energy projects initiated or renewed during FY 1979 (October 1, 1978 through September 30, 1979) are summarized and their status as of April 30, 1980 is described. The summary highlights ongoing research, development and demonstration efforts and serves as a record of progress towards the program objectives. It also provides the program's general management structure; review of last year's achievements; forecast of expected future trends; documentation of the projects conducted during FY 1979; and list of key wind energy publications. DOE

N81-12582# American Association for Vocational Instructional Materials, Athens, Ga.
PROVIDING FOR ENERGY EFFICIENCY IN HOMES AND SMALL BUILDINGS. PART 1: UNDERSTANDING AND PRACTICING ENERGY CONSERVATION IN BUILDINGS
Jun. 1980 87 p refs
(Contracts DE-AC01-77IR-06065; EX-77-R-01-6065)
(DOE/IR-06065/1-Pt-1) Avail: NTIS HC A05/MF A01

A training program to educate students and individuals in the importance of conserving energy and to provide for developing skills needed in the application of energy saving techniques that result in energy efficient buildings is described. Topics included understanding the importance of energy, developing a concern for conserving energy, and understanding the use of energy in buildings. DOE

N81-12588# Department of Energy, Washington, D. C. International Affairs Office of Current Reporting.
INTERNATIONAL ENERGY INDICATORS
Elizabeth K. Bauer, ed. Aug. 1980 30 p
(DOE/IA-0010/2) Avail: NTIS HC A03/MF A01

Data are compiled in tables and graphs on Iran and Saudi Arabia: crude oil capacity, production, and shut-in, June 1974 to July 1980; OPEC (Ex-Iran and Saudi Arabia): capacity, production, and shut-in, June 1974 to June 1980; non-OPEC Free World and US production of crude oil, January 1973 to May 1980; oil stocks: Free World, US, Japan, and Europe (landed), 1973 - 1st quarter 1980; petroleum consumption by industrial countries, January 1973 to February 1980; USSR crude oil production, January 1974 to July 1980; Free World and US nuclear generation capacity, January 1973 to June 1980; US import of crude oil and products, January 1973 to July 1980; landed cost of Saudi crude in current and 1974 dollars, April 1974 to May 1980; US trade in coal, January 1973 to June 1980; summary of US merchandise trade, 1976 to June 1980; and energy/GNP ratio, 1974-1st quarter 1980. The highlight of each is summarized in the table of contents. DOE

N81-12590# Department of Energy, Washington, D. C. Office of Energy Research.
DOD-DOE WORKSHOP ON JOINT ENERGY ACTIVITIES
1980 113 p refs Workshop held at Gaithersburg, Md., 10-12 Mar. 1980
(CONF-800383) Avail: NTIS HC A06/MF A01

The general conditions for DOD-DOE interactions were delineated in an October 1978, Memorandum of Understanding (MOU) that identified two basic goals: improving energy efficiency and availability within DOD, and utilizing DOD and DOE expertise and facilities to carry out projects of mutual interest. A DOD-DOE Workshop on Joint Energy Activities was held on March 10 to 12, 1980. The workshop was structured into five working groups (mobility fuels, conservation, fossil fuels for fixed facilities, solar and renewable energy sources, and special projects) with DOD and DOE cochairmen for each. The workshop accomplished its goals, these being to: (1) improve communication among the appropriate key DOD and DOE personnel at all levels and promote information exchange; (2) review ongoing and already proposed joint DOD and DOE programs; (3) initiate a coordinated, systematic effort to establish joint DOD-DOE energy security programs; and (4) propose specific programs and projects of mutual interest for inclusion in a follow-on joint implementation plan. DOE

N81-12593# General Electric Co., Washington, D. C. Power Systems Strategic Planning and Development Operation.
ENERGY USE IN OFFICE BUILDINGS. VOLUME 1: ANALYSIS OF 1977 OFFICE BUILDING ENERGY USE AS REPORTED IN THE BUILDING OWNERS AND MANAGERS ASSOCIATION DATA BASE
29 Aug. 1980 136 p refs
(DOE/CS-20189/1) Avail: NTIS HC A07/MF A01

The results of task IA of the Energy Use in Office Buildings Project: an analysis in tabular form of the 1977 office building energy use data base of the Building Owners and Managers Association (BOMA) are presented. BOMA's approximately 4000 members directly manage over 500 million sq ft of commercial office space which is approximately 16% of total commercial office building space. Energy use data were reported by BOMA in terms of kWh of electricity, cu ft of gas, gal of oil, and lb of steam. The data were converted to BTu's, and all building energy measures were expressed in terms of Btu per sq ft. Analysis for commercial office buildings and government office buildings is presented. DOE

N81-12594# Brookhaven National Lab., Upton, N. Y. Applied Mathematics Dept.
EXPERIMENT IN MULTIPLE-CRITERIA ENERGY POLICY ANALYSIS
James K. Ho Jul. 1980 18 p refs Presented at Intern. Conf. on Multiple Criteria Decision Making, Newark, Del., 11 Aug. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28154; CONF-800847-1) Avail: NTIS HC A02/MF A01

An international panel of energy analysts participated in an experiment to use HOPE (holistic preference evaluation): an interactive parametric linear programming method for multiple criteria optimization. The criteria of cost, environmental effect, crude oil, and nuclear fuel were considered, according to BESOM: an energy model for the US in the year 2000. DOE

N81-12600# Black and Veatch Consulting Engineers, Kansas City, Mo.
SOLAR REPOWERING FOR ELECTRIC GENERATION. NORTHEASTERN STATION UNIT 1, PUBLIC SERVICE COMPANY OF OKLAHOMA Final Report
1980 292 p Prepared in cooperation with the Public Service Co. of Oklahoma, Tulsa and Babcock and Wilcox Co., Lynchburg, Va.
(Contract DE-AC03-79SF-10738)
(DOE/SF-10738-1/2) Avail: NTIS HC A13/MF A01

The conceptual design and evaluation of solar repowering and electric generating unit of Public Service Company of Oklahoma (PSC) are described in detail. The solar additon would permit, at the design point, a 20% reduction of the fossil fuel consumed by PSO's 150 MWe Northeastern Station Unit 1. The proposed system comprises a tower focus power plant with a water/steam central receiver. The trade studies, conceptual design, system performance, economic analysis, and development plan as well as a description of a test program to determine the magnitude of impact that environmental factors have on plant design and performance are presented. DOE

N81-12604# Coury and Associates, Inc., Lakewood, Colo.
RESIDENTIAL AND COMMERCIAL SPACE HEATING AND COOLING WITH POSSIBLE GREENHOUSE OPERATION: BACA GRANDE DEVELOPMENT, SAN LUIS VALLEY, COLORADO Final Report
Steven W. Goering, Kenneth L. Garing, Glenn E. Coury, and Eugene A. Fritzler May 1980 288 p refs
(Contract DE-AC07-78ET-28455)
(DOE/ET-28455/3) Avail: NTIS HC A13/MF A01

A feasibility study was performed to evaluate the potential of multipurpose applications of moderate temperature geothermal waters in the vicinity of the Baca Grande community development in the San Luis Valley, Colorado. Engineering designs were developed for geothermal district heating systems for space heating and domestic hot water heating for residences, including a mobile home park, an existing motel, a greenhouse complex, and other small commercial uses such as aquaculture. In addition, a thorough institutional analysis of the study area was performed to highlight factors which might pose barriers to the ultimate commercial development of the resource. Finally, an environmental evaluation of the possible impacts of the proposed action was also performed. The institutional and environmental analyses indicate that no significant barriers to development are apparent. DOE

N81-12611# Franklin Pierce Law Center, Concord, N. H.
SUMMARY OF THE MIDWEST CONFERENCE ON SMALL-SCALE HYDROPOWER IN THE MIDWEST: AN OLD TECHNOLOGY WHOSE TIME HAS COME
May 1980 147 p Conf. held in Detroit, 14-16 Nov. 1979
(Contract DE-AS02-78RA-04934)
(DOE/RA-04934/05; CONF-791199-Summ) Avail: NTIS HC A07/MF A01

Legal and institutional obstacles to small scale hydroelectric development in Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia, and Wisconsin were examined in during four workshop sessions. Prospects and efforts to reform federal, state, and local regulatory systems are discussed as well as the economics of small scale hydroelectric development and relationships with electric systems. The usefulness of a computer model of system dynamics was also considered. A.R.H.

N81-12612# Brookhaven National Lab., Upton, N. Y. Economic Analysis Div.
A STRATEGIC COST-BENEFIT ANALYSIS OF ENERGY POLICIES: OVERVIEW
Harry Davitian, Richard J. Goettle, IV (Jorgenson (Dale W.) Associates), Paul J. Groncki, Edward A. Hudson (Jorgenson (Dale W.) Associates), Peter Kleeman, and Joan Lukachinski Oct. 1979 24 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51105) Avail: NTIS HC A02/MF A01

Three possible energy strategies are described and each is analyzed in terms of its economic, environmental, and national security benefits and costs. Each strategy is represented by a specific policy. The results indicate that conservation can substantially reduce import dependence and slow the growth of energy demand, with only a small macroeconomic cost and with substantial benefits; the synfuels policy reduces inports by a smaller amount, does not reduce the growth in energy demand, involves substantial environmental costs and slows the rate of economic growth. These relationships could be different if the energy savings per unit cost for conservation are less than anticipated, or if the costs of synthetic fuels can be significantly lowered. A brief discussion of the motivation for the study, the assumptions and methodologies employed, the results, and the policy implication are presented. E.D.K.

N81-12613# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.
A STRATEGIC COST-BENEFIT ANALYSIS OF ENERGY POLICIES: DETAILED PROJECTIONS
Harry Davitian, Richard J. Goettle, IV, Paul J. Groncki, Edward A. Hudson, Peter Kleeman, and Joan Lukachinski Oct. 1979 75 p refs Sponsored by DOE
(BNL-51127) Avail: NTIS HC A04/MF A01

Three possible energy strategies are described and each is analyzed in terms of its economic, environmental, and national security benefits and costs. Each strategy is represented by a specific policy. In the first strategy no additional programs or policies are initiated beyond those currently in effect or announced. The second is directed toward reducing the growth in energy demand, i.e., energy conservation. The third promotes increased domestic supply through accelerated development of synthetic and unconventional fuels. The analysis focuses on the evaluation and comparison of these strategy alternatives with respect to their energy, economic, and environmental consequences. The results indicate that conservation can substantially reduce import dependence and slow the growth of energy demand, with only a small macroeconomic cost and with substantial environmental benefits; the synfuels policy reduces imports by a smaller amount, does not reduce the growth in energy demand, involves substantial environmental costs and slows the rate of economic growth. Author

N81-12620# Midwest Research Inst., Kansas City, Mo.
ASSESSMENT OF ENERGY AND ECONOMIC IMPACTS OF PARTICULATE CONTROL TECHNOLOGIES IN COAL-FIRED POWER GENERATION
V. Ramanathan, S. Reigel, P. Gorman, Paul S. Farber, M. Tisue, and Floyd C. Bennett Apr. 1980 249 p refs Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(ANL/ECT-9) Avail: NTIS HC A11/MF A01

Models were derived which to assess the economic and energy impacts of particulate control systems for coal fired power plants. The models take into account the major functional variables, including plant size and location, coal type, and applicable particulate emission standards. The algorithms obtained predict equipment and installation costs, as well as operating costs (including energy usage), for five control devices: (1) cold side electrostatic precipitators; (2) hot side electrostatic precipitators; (3) reverse flow baghouse; (4) shake baghouses; and (5) wet scrubbers. A stream generator performance model was developed, and the output from this model was used as input for the control device performance models that specify required design and operating parameters for the control systems under study. These parameters were used as inputs to the cost models. E.D.K.

N81-12632# Open Univ., Milton (England). Energy Research Group.
PASSIVE SOLAR IN MILTON KEYNES, ENGLAND. A DESCRIPTION OF SOME OF THE MORE NUMERICAL ASPECTS OF THE DESIGN OF AN ESTATE OF LOW ENERGY HOUSES
R. Everett Jul. 1980 152 p refs Prepared in cooperation with Milton Keynes Development Corp.
(ERG-031) Avail: NTIS HC A08/MF A01; Secr. Energy Res. Group, Milton Keynes, England

The numerical aspects of the design of low energy consumption houses using passive solar energy collection and high levels of insulation are described. Two housing energy conservation projects were begun, one involving the construction of 177 low energy houses on a cost-effective basis, and the other involving the detailed monitoring of eight highly insulated passive solar houses. Both experimental data and theoretical analysis are presented, and the relative effectiveness of the various design alternatives are discussed. Author (ESA)

N81-12636# National Technical Information Service, Springfield, Va.
ENERGY CONSERVATION: POLICIES, PROGRAMS, AND GENERAL STUDIES. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1979 - Jul. 1980
Audrey S. Hundemann Aug. 1980 143 p Supersedes NTIS/PS-79/0846; NTIS/PS-78/0693
(PB80-813793; NTIS/PS-79/0846; NTIS/PS-78/0693) Avail: NTIS HC$30.00/MF$30.00 CSCL 10A

National policies, programs, and general studies of ways to conserve energy are presented. Topic areas cover such subjects as electric load management, effects of price and taxation on energy conservation, public attitudes and behavior toward energy saving, energy savings through reduction in hot water consumption, and telecommunications substitutability for travel. GRA

N81-12637# National Technical Information Service, Springfield, Va.
ENERGY CONSERVATION: POLICIES, PROGRAMS, AND GENERAL STUDIES. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - 1978
Audrey S. Hundemann Aug. 1980 249 p
(PB80-813785) Avail: NTIS HC $30.00/MF $30.00 CSCL 10A

National policies, programs, and general studies or ways to conserve energy are presented. Topic areas cover such subjects as electric load management, effects of price and taxation on energy conservation, public attitudes and behavior toward energy saving, energy savings through reduction in hot water consumption, and telecommunications substitutability for travel. GRA

N81-12652# Air Force Engineering and Services Center, Tyndall AFB, Fla. Engineering and Services Lab.
THE IMPLICATIONS OF ALTERNATIVE AVIATION FUELS ON AIRBASE AIR QUALITY Final Report, Nov. 1977 - Aug. 1980
Harold A. Scott, Jr. Aug. 1980 48 p refs
(AF Proj. 2103)
(AD-A090283; AFESC/ESL-TR-80-38) Avail: NTIS HC A02/MF A01 CSCL 21/4

Aircraft alternative fuel emission factors from turbine engine combustor performance tests are integrated into the Air Quality Assessment Model (AQAM) to predict the air quality impact of alternative fuels use in the vicinity of Air Force bases. AQAM computes the alternative fuel emission factors from fuel property inputs, enabling the model to predict concentrations for any proposed alternative fuel blend. In addition to aircraft alternative fuel emissions calculations, AQAM was modified to calculate alternative fuel handling and breathing loss emissions from the fuel properties. Using AQAM with two aircraft engine models, the aircraft alternative fuel annual emissions and resulting short-term pollutant concentrations are computed for a typical Air Force base. The analysis indicates that alternative fuel emissions cause a slight increase in pollution concentrations when compared with the baseline JP-4 fuel. A reduction of evaporative hydrocarbon emissions is predicted due to the alternative fuels' lower volatility in comparison with JP-4. GRA

N81-12655# Department of Energy, Washington, D. C. Assistant Secretary for Resource Applications.
ENVIRONMENTAL ASSESSMENT: GEOTHERMAL DIRECT HEAT PROJECT, MARLIN, TEXAS
Aug. 1980 68 p refs
(DOE/EA-0117) Avail: NTIS HC A04/MF A01

The Federal action addressed by this environmental assessment is joint funding the retrofitting of a heating and hot water system in a hospital at Marlin, Texas, with a geothermal preheat system. The project will be located within the existing hospital boiler room. One supply well was drilled in an existing adjacent parking lot. It was necessary to drill the well prior to completion of this environmental assessment in order to confirm the reservoir and to obtain fluids for analysis in order to assess the environmental effects of fluid disposal. Fluid from operation will be disposed of by discharging it directly into existing street drains, which will carry the fluid to Park Lake and eventually the Brazos

River. Environmental impacts of construction were small because of the existing structures and paved areas. Construction run off and geothermal flow test fluid passed through a small pond in the city park, lowering its water quality, at least temporarily. Construction noise was not out of character with existing noises around the hospital. DOE

N81-12656# Argonne National Lab., Ill. Integrated Assessments and Policy Evaluation Group.
IN PURSUIT OF CLEAN AIR: A DATA BOOK OF PROBLEMS AND STRATEGIES AT THE STATE LEVEL. VOLUME 3: FEDERAL REGIONS 4 AND 6
D. B. Garvey and D. G. Streets Feb. 1980 338 p refs
(Contract W-31-109-eng-38)
(ANL/EES-TM-90-Vol-3) Avail: NTIS HC A15/MF A01

Possible areas of conflict between the implementation of a national energy policy calling for the increased use of coal and the pursuit of clean air are examined. Information is presented for each state in Federal regions 4 and 6 under the following section headings: state title page (includes a summary of air quality data); revised state implementation plan outline; maps of nonattainment areas, as designated; storage and retrieval of aerometric data; SAROAD data maps; power plant data; power plant maps; and county maps. States in Federal region 4 include Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. Those in Federal region 6 include Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. DOE

N81-12658# Mitre Corp., McLean, Va. Metrek Div.
GEOTHERMAL ENERGY ENVIRONMENTAL PROBLEMS AND CONTROL METHODS: REVIEW OF RECENT FINDINGS
Van Thanh Nguyen, John F. Caskey, Richard T. Pfundstein, and Susan B. Rifkin Jun. 1980 72 p refs
(Contract DE-AC01-79ET-27224)
(DOE/ET-27224/T1; MTR-80W108) Avail: NTIS HC A04/MF A01

The findings of a literature review on the environmental concerns and associated control methods of geothermal energy utilization are presented. Environmental problems associated with geothermal energy utilization are introduced; the current status of control methods are assessed; appropriate environmental documents; and areas where additional environmental research is needed are identified. The review attempts to consolidate current understanding of the environmental impact of geothermal energy development. Reports written by authors in industry, government and academia were reviewed in the areas of air emissions, surface and subsurface liquid discharges, solid wastes, noise, subsidence, and induced seismicity. DOE

N81-12659# Environmental Resources Group, Los Angeles, Calif.
PROTOTYPE ENVIRONMENTAL ASSESSMENT OF THE IMPACTS OF SITING AND CONSTRUCTING A SATELLITE POWER SYSTEM (SPS)
Aug. 1980 272 p refs
(Contract W-31-109-eng-38)
(DOE/ER-0072) Avail: NTIS HC A12/MF A01

The study objectives were: (1) to develop a comprehensive prototype assessment of the nonmicrowave related impacts on the natural and human environments of the reference system SPS GRS; (2) to assess the impacts of GRS construction and operations in the context of actual baseline data for a site in the California desert which, while it has not been selected as eligible for GRS siting, has many features that are optimal for SPS; and (3) to identify critical GRS characteristics or parameters that are most significant in terms of both the natural and human environment. Critical project parameters revealed include: the sheer size and intensity of use of the contiguous land area required by an SPS GRS; the lack of flexibility in siting individual rectenna structures once the rectenna boundaries are established; the difficulties in finding suitable sites that do not conflict with other societal needs and values; uncertainties relating to reestablishing native ecosystems following total ecosystem modification during construction, and the related need for further research into microclimatic effects near the ground surface beneath the rectenna panels. DOE

N81-12662# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.
ENERGY-ENVIRONMENTAL IMPACTS OF FIVE ENERGY CONSERVATION MEASURES IN THE MIDDLE ATLANTIC AND PACIFIC STATES
P. D. Moskowitz, E. Edelson (Pacific Northwest Lab.), T. Q. Le, W. A. Sevian, J. E. Smith, and A. Struth Oct. 1979 76 p refs
(BNL-51110) Avail: NTIS HC A05/MF A01

Estimates of some energy and environmental impacts for five different energy conservation measures (district heating, industrial cogeneration, retrofit, rate reform, and vehicle redesign) were prepared for two different regions (Middle Atlantic and Pacific) and two different time periods (1985 and 2000) based upon data presented in regional reference energy systems developed at Brookhaven National Laboratory. Results of the analysis indicate that regional energy use can be reduced by 1 to 6%. Vehicle redesign produces the greatest oil savings. Retrofit and district heating can each reduce oil and natural gas use. Industrial cogeneration can significantly reduce use of fuels consumed in central station electricity production (e.g., coal and nuclear) but at an energy penalty incurred by industry; increased dependence on oil and natural gas could result. Rate reform and retrofit each reduce emissions production in rough proportion to the quantities of energy saved. Vehicle redesign reduces only supply sector emissions; end-use emissions are not affected even though gasoline use significantly decreases. District heating may reduce regional emissions but increase local emission burdens where waste heat is being produced. Author

N81-12952# City of Los Angeles, Calif.
SOLAR ENVELOPE ZONING: APPLICATION TO THE CITY PLANNING PROCESS. LOS ANGELES CASE STUDY
Jun. 1980 192 p refs
(Contract DE-AC02-77CH-00178)
(SERI/SP-98156-1) Avail: NTIS HC A09/MF A01

Solar envelope zoning represents a promising approach to solar access protection. A solar envelope defines the volume within which a building will not shade adjacent lots or buildings. The feasibility of translating the concept of solar envelopes into zoning techniques was examined. Envelope zoning is a fair and consistent method of guaranteeing solar access, but problems of complexity and uncertainty may limit its usefulness. Envelope zoning may be inappropriate for the development of high density centers and for more restrictive community plans. Some combination of approaches, including publicly recorded easements, subdivision approval and envelope zoning, need to be adopted to encourage solar use in cities. DOE

N81-12986*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE FEDERAL ELECTRIC AND HYBRID VEHICLE PROGRAM
Harvey J. Schwartz *In its* Impact for the 80's: Proc. of a Conf. on Selected Technol. for Business and Ind. Nov. 1980 p 105-109
Avail: NTIS HC A11/MF A01 CSCL 13F

The commercial development and use of electric and hybrid vehicles is discussed with respect to its application as a possible alternative transportation system. A market demonstration is described that seeks to place 10,000 electric hybrid vehicles into public and private sector demonstrations. R.C.T.

N81-12987*# Jet Propulsion Lab., California Inst. of Tech.; Pasadena.
JPL'S ELECTRIC AND HYBRID VEHICLES PROJECT: PROJECT ACTIVITIES AND PRELIMINARY TEST RESULTS
Thomas A. Barber *In* NASA. Lewis Research Center Impact for the 80's: Proc. of a Conf. on Selected Technol. for Business and Ind. Nov. 1980 p 111-122

Avail: NTIS HC A11/MF A01 CSCL 13F

Efforts to achieve a 100 mile urban range, to reduce petroleum usage 40% to 70%, and to commercialize battery technology are discussed with emphasis on an all plastic body, four passenger car that is flywheel assisted and battery powered, and on an all metal body, four passenger car with front wheel drive and front motor. For the near term case, a parallel hybrid in which the electric motor and the internal combustion engine may directly power the drive wheels, is preferred to a series design. A five passenger car in which the electric motor and the gasoline engine both feed into the same transmission is discussed. Upgraded demonstration vehicles were tested using advanced lead acid, nickel zinc, nickel iron, and zinc chloride batteries to determine maximum acceleration, constant speed, and battery behavior. The near term batteries demonstrated significant improvement relative to current lead acid batteries. The increase in range was due to improved energy density, and ampere hour capacity, with relatively 1 small weight and volume differences. A.R.H.

N81-12989*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE DOE PHOTOVOLTAICS PROGRAM
Robert R. Ferber *In* NASA. Lewis Research Center Impact for the 80's: Proc. of a Conf. on Selected Technol. for Business and Ind. Nov. 1980 p 133-143 Sponsored in part by DOE

Avail: NTIS HC A11/MF A01 CSCL 10A

As part of the National Solar Energy program, the US Department of Energy is now engaged in the development of technically feasible, low cost candidate component and system technologies to the point where technical readiness can be demonstrated by 1982. The overall strategy is to pursue parallel options that continue to show promise of meeting the program goals, thus increasing the probability that at least one technology will be successful. Included in technology development are both flat plate solar collectors and concentrator solar collectors, as well as the balance of system components, such as structures, power conditioning, power controls, protection, and storage. Generally, these last items are common to both flat plate and concentrator systems, but otherwise there is considerable disparity in design philosophy, photovoltaic cell requirements, and possible applications between the two systems. Objectives for research activities at NASA Lewis for stand-alone applications, and at Sandia Laboratories where intermediate load center applications are addressed, are highlighted as well as college projects directed by Oak Ridge National Laboratory, and international applications managed by the Solar Energy Research Institute. Joint DOD/DOE effects for military applications are also summarized. A.R.H.

N81-12990*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLAR PHOTOVOLTAICS: STAND ALONE APPLICATIONS
James N. Deyo *In its* Impact for the 80's: Proc. of a Conf. on Selected Technol. for Business and Ind. Nov. 1980 p 145-156

Avail: NTIS HC A11/MF A01 CSCL 10A

The Lewis Research Center involvement in space photovoltaic research and development and in using photovoltaics for terrestrial applications is described with emphasis on applications in which the normal source of power may be a diesel generator, batteries, or other types of power not connected to a utility grid. Once an application is processed, technology is developed and demonstrated with a user who participates in the cost and furnishes the site. Projects completed related to instruments, communication, refrigeration, and highways, are described as well as warning systems, weather stations, fire lookouts, and village power systems. A commercially available photovoltaic powered electric fence charger is the result of Lewis research and development. A.R.H.

N81-13172# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
BASIC RESEARCH IN CRYSTALLINE AND NONCRYSTALLINE CERAMIC SYSTEMS Annual Report, 1 Aug. 1979 - 31 Oct. 1980
1980 101 p refs
(Contract DE-AS02-76ER-02390)
(DOE/ER-02390/5) Avail: NTIS HC A06/MF A01

The needs identified in the 1977 series of workshops on DOE programs in energy related materials research and by the ongoing efforts of the DOE Council on Materials Science were translated into the basic and applied research necessary to fulfill the established objectives in the effort to solve the nation's energy problems. Ceramics in numerous applications are critical in meeting national energy requirements. DOE

N81-13179# Committee on Science and Technology (U. S. House).
OVERSIGHT: ALCOHOL FUEL OPTIONS AND FEDERAL POLICIES, VOLUME 3
Washington GPO 1979 296 p Hearings before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 1st Sess., no. 26, 4 May and 2 Jun. 1979
(GPO-49-650) Avail: SOD HC

The production of alcohol from agricultural products and wastes is discussed. Establishing a federal policy concerning alcohol fuel as a substitute for imported oil was being considered. L.F.M.

N81-13180# Committee on Science and Technology (U. S. House).
OVERSIGHT. OTA'S STUDY: THE DIRECT USE OF COAL, VOLUME 2
Washington GPO 1979 245 p refs Hearing before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 1st Sess., no. 22, 3 May 1979
(GPO-47-453) Avail: SOD HC

An assessment is made of the benefits and risks of a massive shift to the use of coal. It deals with the social, economic, physical, and biological impacts of such a shift. It examines the complete coal system from extraction to combustion, including the key steps and institutions that policy can influence. The environmental impacts and possible effects on the public health are documented. L.F.M.

N81-13181# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
INFLUENCE OF MICO FUELS ON ENGINE PERFORMANCE, EXHAUST EMISSIONS, AND ENDURANCE Interim Report
K. Tataiah and S. J. Lestz Dec. 1979 87 p refs
(Contracts DAAK70-78-C-0001; DAAK70-80-C-0001)
(AD-A090977; AFLRL-125) Avail: NTIS HC A05/MF A01 CSCL 21/4

The influence of Micronized Coal-in-Oil (MICO) fuels on engine performance and exhaust emissions was experimentally studied in a single cylinder Hatz diesel engine. One of these fuels, which contained 20 wt% coal, was also examined for its effects on engine endurance and wear in a four cylinder Mercedes diesel engine. The performance and emissions tests were conducted at twelve different steady-state conditions covering the operating speed-load range of the engine. In each test, the exhaust emissions (including particulates, sulfates, and smoke), crankcase blowby, and temperatures were measured, and brake thermal efficiency and air-fuel ratio was calculated. The results obtained with the single cylinder engine indicate that the coal in MICO fuel hinders the combustion of the diesel component and decreases the overall brake thermal efficiency of the engine. Although the coal reduces the consumption of diesel fuel component, the total energy consumption is higher. GRA

N81-13199# Woodard-Clyde Consultants, San Francisco, Calif.
ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS OF GEOPRESSURED METHANE DEVELOPMENT Final Report, Jul. 1979 - Mar. 1980
Kamal Golabi Mar. 1980 300 p refs Prepared in cooperation with ESCOR, Inc., Northfield, Ill. Sponsored by Gas Research Inst.
(PB80-210701; GRI-79/0025) Avail: NTIS HC A13/MF A01 CSCL 10A

A critical examination of available information on the characteristics of geopressured methane resources is presented. Potential environmental impacts and regulatory constraints that may influence the development and commercial use of the resource are assessed. Issues unique to geopressured methane development are defined. A list of recommendations for planning future research efforts is given. GRA

N81-13203# Institute for Defense Analyses, Arlington, Va. Program Analysis Div.
PAPERS, RELATED TO GASOLINE SUPPLY, MISFUELING AND ENVIRONMENTAL AIR QUALITY FOR THE SUMMER OF 1979 Final Report
D. Dacy, P. Cutchis, F. Giertz, R. Kuenne, J. Magnin, R. Oliver, and H. Steele Oct 1979 170 p refs
(Contract EPA-68-01-5150)
(PB80-212798; IDA-P-1445) Avail: NTIS HC A08/MF A01 CSCL 21D

Nine back-up essays to the study, 'Analysis of Options to Limit Air Quality Degradation Due to Misuse of Leaded Gasoline in Cars Equipped with Catalytic Converters,' IDA P-1426 are presented. The essays pertain to the problem of 'misfueling' which was a prominent feature of the gasoline shortage in the summer of 1979. GRA

N81-13204# Institute for Defense Analyses, Arlington, Va. Program Analysis Div.
ANALYSIS OF OPTIONS TO LIMIT AIR QUALITY DEGRADATION DUE TO MISUSE OF LEADED GASOLINE IN CARS EQUIPPED WITH CATALYTIC CONVERTERS
D. Dacy, P. Cutchis, R. Kuenne, J. Magnin, and R. Oliver Oct. 1979 67 p refs
(Contract EPA-68-01-5150)
(PB80-212780; IDA-P-1426) Avail: NTIS HC A04/MF A01 CSCL 21D

Three short term and eight intermediate term options to limit the use of leaded gasoline in cars equipped with catalytic converters are analyzed. The short term options analyzed are: (1) mandated price differential between leaded and unleaded gasoline; (2) temporary suspension of ban on the additive MMT; and (3) increased lead use in leaded gasoline. The intermediate term options analyzed are: (1) delay in introducing the three way catalytic converter; (2) tax subsidy schemes; (3) closing down self-service stations; (4) federal law against misfueling; (5) inspection-down self-service stations; (6) public relations program; (7) gasoline rationing; and (8) use of additives and blending materials to increase supply of unleaded gasoline. GRA

N81-13206# Environmental Protection Agency, Research Triangle Park N.C. Office of Air Quality Planning and Standards.
NATIONAL EMISSIONS DATA SYSTEM (NEDS) FUEL USE REPORT (1977) Final Report
Mar. 1980 127 p
(PB80-212723; EPA-450/4-80-004) Avail: NTIS HC A07/MF A01 CSCL 21D

Annual estimates of total consumption of major fuels such as coal, fuel oil, natural gas, gasoline, and diesel fuel. Estimates of the consumption of a number of other comparatively minor fuels are also included. The data are distributed according to major categories of air pollutant emissions sources and are reported for the nation as a whole and for individual states, territories, and the District of Columbia. GRA

N81-13234# National Bureau of Standards, Washington, D.C. National Engineering Lab.
GEOGRAPHICAL EXTRAPOLATION OF TYPICAL HOURLY WEATHER DATA FOR ENERGY CALCULATION IN BUILDINGS Final Report
Edward A. Arens, Larry E. Flynn, Daniel N. Nall, and Kalev Ruberg Aug. 1980 124 p refs Prepared in cooperation with Berkeley Solar Group, Calif.
(Contract EA-77-A-01-6010)
(PB80-213424; NBS-BSS-126; LC-80-600059) Avail: NTIS HC A06/MF A01 CSCL 10A

Two techniques are developed and tested for creating composite and synthetic hourly weather data for a wide range of sites. The first technique selects real weather data segments from a source multiyear weather record, and links them into a composite synthetic year, in which the hourly values are unchanged from the source. The second technique adjusts the real hourly data values of the source to create a more completely synthetic year. The resulting synthetic year or years can be used to provide data that is representative of long term climate for building energy prediction either at the first order station or at a nearby second order station. GRA

N81-13304*# Sigma Research, Inc., Richland, Wash.
HIGH-PERFORMANCE HEAT PIPES FOR HEAT RECOVERY APPLICATIONS Final Report
E. W. Saaski and J. H. Hartl Aug. 1980 80 p refs
(Contract NAS5-25357)
(NASA-CR-163816) Avail: NTIS HC A05/MF A01 CSCL 20D

Methods to improve the performance of reflux heat pipes for heat recovery applications were examined both analytically and experimentally. Various models for the estimation of reflux heat pipe transport capacity were surveyed in the literature and compared with experimental data. A high transport capacity reflux heat pipe was developed that provides up to a factor of 10 capacity improvement over conventional open tube designs; analytical models were developed for this device and incorporated into a computer program HPIPE. Good agreement of the model predictions with data for R-11 and benzene reflux heat pipes was obtained. A.R.H.

N81-13444# Center for Renewable Resources, Washington, D.C.
RENEWABLE RESOURCES: A NATIONAL CATALOG OF MODEL PROJECTS. VOLUME 1: NORTHEAST SOLAR ENERGY CENTER REGION
Jul. 1980 414 p 4 Vol.
(Contract DE-FG01-79CS-30098)
(DOE/CS-30098/01-Vol-1) Avail: NTIS HC A18/MF A01

This compilation of diverse conservation and renewable energy projects across the United States was prepared through the enthusiastic participation of solar and alternate energy groups from every state and region. Compiled and edited by the Center for Renewable Resources, these projects reflect many levels of innovation and technical expertise. In many cases, a critique analysis is presented of how projects performed and of the institutional conditions associated with their success or failure. DOE

N81-13445# Center for Renewable Resources, Washington, D.C.
RENEWABLE RESOURCES: A NATIONAL CATALOG OF MODEL PROJECTS. VOLUME 2: MID-AMERICAN SOLAR ENERGY COMPLEX REGION
Jul. 1980 444 p 4 Vol.
(Contract DE-FG01-79CS-30098)
(DOE/CS-30098/01-Vol-2) Avail: NTIS HC A19/MF A01

The projects reflect the research and development in solar technology. An analysis of each project's efficiency and success is presented. A wide range of technology utilization is shown. T.M.

N81-13446# Center for Renewable Resources, Washington, D.C.
RENEWABLE RESOURCES: A NATIONAL CATALOG OF MODEL PROJECTS. VOLUME 3: SOUTHERN SOLAR ENERGY CENTER REGION
Jul. 1980 779 p 4 Vol.
(Contract DE-FG01-79CS-30098)
(DOE/CS-30098/01-Vol-3) Avail: NTIS HC A99/MF A01

The research management and technological utilization of each project was analyzed. The research and development of solar technologies is emphasized. T.M.

N81-13447# Center for Renewable Resources, Washington, D.C.
RENEWABLE RESOURCES: A NATIONAL CATALOG OF MODEL PROJECTS. VOLUME 4: WESTERN SOLAR UTILIZATION NETWORK REGION
Jul. 1980 542 p 4 Vol.
(Contract DE-FG01-79CS-30098)
(DOE/CS-30098/01-Vol-4) Avail: NTIS HC A23/MF A01

The catalog presents an analysis of each project's research management effort and utilization of solar enrgy technologies. Information is presented to aid learning from these experiments. T.M.

N81-13451# Harvard Univ., Cambridge, Mass. Inst. for Conservation Archaeology.
A SUMMARY AND ANALYSIS OF CULTURAL RESOURCE INFORMATION ON THE CONTINENTAL SHELF FROM THE BAY OF FUNDY TO CAPE HATTERAS. VOLUME 4: MANAGEMENT Final Report
Michael E. Roberts 1979 387 p refs 4 Vol.
(Contract DI-AA551-CT8-18)
(PB80-220148; ICA-88-Vol-4; BLM/YL/SR-79/04-Vol-4) Avail: NTIS HC A17/MF A01 CSCL 13B

The late Quaternary geology of the U.S. Continental Shelf from New England to North Carolina was reviewed as it relates to cultural resources in an effort to provide guidelines for land users and those having jurisdiction over lands on abutting the Continental Shelf. Specific approaches to cultural resource management are recommended to minimize the impact upon resources of the many types of activities taking place within the study area. The recommendations include initiating locational surveys, developing public education programs, identifying impacts to resources in environmental impact assessments, advising federal agencies on the types of expected impacts to archaeological properties, evaluating the effects of chemical dumping, and specifying the general levels of survey that will be required in the various stages of oil and gas development. A.R.H.

N81-13468# Committee on Science and Technology (U. S. House).
OVERSIGHT: ENERGY SUPPLY AND DEMAND FORECASTS, VOLUME 4
Washington GPO 1979 646 p refs Hearings before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 1st Sess., no. 19, 23-24 May 1979
(GPO-47-986) Avail: SOD HC

The Department of Energy presents a forecast of United States energy supply and demand up to the year 2000. Particular attention is given to the use of mathematical models in making the forecast. World oil prices, domestic coal use, domestic nuclear capacity, and growth in domestic energy demand are discussed in detail. L.F.M.

N81-13470# Committee on Science and Technology (U. S. House).
OVERSIGHT: BIOMASS
Washington GPO 1980 178 p refs Hearing before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 116, 10 Mar. 1980
(GPO-63-224) Avail: Subcommittee on Energy Development and Applications

The use of the biomass as a renewable energy source is discussed in detail. Estimates of what percentage of our future energy needs can be supplied by biomass are presented and recommendations are made for additional research needed for optimum biomass energy conversion. L.F.M.

N81-13480# Indian Inst. of Management, Ahmedabad.
RESEARCH PLANNING WORKSHOP ON ENERGY FOR RURAL DEVELOPMENT
1979 264 p refs Workshop held at Ahmedabad, India, 27-29 Dec. 1979 Sponsored in part by Tata Energy Research Inst., Jyoti Solar Energy Inst., Jyoti Ltd., and Dept. of Science and Technology
(CONF-791251) Avail: NTIS (US Sales Only) HC A12/MF A01; DOE Depository Libraries

An integrated need based research and implementation program consisting of projects for energy supply in rural areas of India, with emphasis on renewable sources which can be implemented in 2 to 3 years is described. Papers are presented on the following: Rural Energy Demand Supply Data Base Development; Introduction to New and Renewable Energy Technologies in Rural Energy Mix; Fuel Plantation for Rural Areas; Techno-Economic Analysis of Rural Energy Systems; and Energy Policy for Rural Areas and Development Strategy. DOE

N81-13481# Hauptberatungsstelle fuer Elektrizitaetsanwendung e.V., Frankfurt am Main (West Germany).
ELECTRIC POWER REPLACING OIL: THE DEVELOPMENT OF HOT WATER SUPPLIES TO PRIVATE HOUSEHOLDS IN THE FEDERAL REPUBLIC OF GERMANY
Oct. 1979 12 p refs In GERMAN
(NP-25125) Avail: NTIS (US Sales Only) HC A02/MF A01; DOE Depository Libraries

Generally available statistics and analyses were the basis as well as a market enquiry covering 35,000 households, the evaluation of which was conducted in 1979. This material clearly shows that 27% of the total final energy consumption in the FRG go to the consumption area household, out of which 9% - corresponding to 2.4% of the total needs of final energy - go to hot water supplies. At first glance, this figure seems small. However, households use as much energy as, e.g., the total traffic of rail, ship and air in the FRG. DOE

N81-13495# Los Alamos Scientific Lab., N. Mex.
ENERGY-RELATED APPLICATIONS OF HELIUM: A REVISION OF THE ERDA-13 DATA BASE
Edward F. Hammel and Milton C. Krupka Aug. 1980 180 p refs
(Contract W-7405-eng-36)
(LA-8455-MS) Avail: NTIS HC A09/MF A01

A re-examination, revision, and re-evaluation of the data base contained within ERDA-13, The Energy-Related Applications of Helium, were completed and results are presented. New technical and resource data, current legislative proposals, updated supply and demand relationships, latest legal developments, programmatic changes affecting the future demand for helium, socio-economic aspects, and the effects of the latest energy consumption projections were considered and are discussed. In contrast to ERDA-13, however, explicit recommendations with respect to the formulation of Federal helium policy, as it pertains to the energy related applications of helium, are not given. DOE

N81-13497# Systems Control, Inc., Palo Alto, Calif.
STUDY OF DISPERSED SMALL WIND SYSTEMS INTERCONNECTED WITH A UTILITY DISTRIBUTION SYSTEM Interim Report
David Curtice, Jim Patton, Jeff Bohn, and Neil Sechan Mar. 1980 114 p refs
(Contract DE-AC04-76DP-03533)
(RFP-3093/94445/3533/80/7) Avail: NTIS HC A06/MF A01

Operating problems for various penetrations of small wind systems connected to the distribution system on a utility are defined. Protection equipment, safety hazards, feeder voltage regulation, line losses, and voltage flicker problems are studied, assuming different small wind systems connected to an existing distribution system. To identify hardware deficiencies, possible solutions provided by off-the-shelf hardware and equipment are assessed. Results of the study indicate that existing techniques are inadequate for detecting isolated operation of a small wind system. Potential safety hazards posed by small wind systems are adequately handled by present work procedures although these procedures require a disconnect device at synchronous generator and self commutated inverter small wind systems. DOE

N81-13499# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
ENERGY-CONSUMPTION MODELLING
Elmar R. Reiter 1980 81 p refs Presented at the NOAA Workshop, Columbia, Mo., 11 Apr. 1980
(Contract DE-AS02-76EV-01340)
(COO-1340-73; CONF-8004113-1) Avail: NTIS HC A05/MF A01

A sophisticated and accurate approach is described to compute on an hourly or daily basis the energy consumption for space heating by individual buildings, urban sectors, and whole cities. The need for models and specifically weather-sensitive models, composite models, and space heating models are discussed. Development of the Colorado State University Model, based on heat transfer equations and on a heuristic, adaptive, self-organizing computation learning approach, is described. Results of modeling energy consumption by the city of Minneapolis and Cheyenne are given. Some data on energy consumption in individual buildings are included. DOE

N81-13503# DCS Corp., Arlington, Va.
STATUS OF THERMAL IMAGING TECHNOLOGY AS APPLIED TO CONSERVATION-UPDATE 1
Frank J. Snow, James T. Wood, and Robert C. Barthle Jul. 1980 200 p
(Contract DE-AC01-78CS-20413)
(DOE/CS-20413/01) Avail: NTIS HC A10/MF A01

Thermal imaging technology is discussed in terms of airborne surveys, ground survey programs, and application needs such as standards development and lower cost equipment. Information on the various thermal imaging devices was obtained from manufacturer's standard product literature. Listings are provided of infrared projects of the DOE building diagnostics program, of aerial thermographic firms, and of aerial survey programs. DOE

N81-13511# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.
SOLAR HEATING AND COOLING OF BUILDINGS (SHACOB): REQUIREMENTS DEFINITION AND IMPACT ANALYSIS, 2 Final Report
C. K. Cretcher Sep. 1980 53 p 4 Vol.
(EPRI Proj. 553-2)
(EPRI-EM-1506-SY) Avail: NTIS HC A04/MF A01

A study conducted to determine the potential impact of the widespread implementation of solar heating and cooling systems on the utility load, utility operating costs, and customer costs for the years 1990 and 2000 is summarized. Although results and recommendations vary among the utilities and regions studied, SHACOB installations can result in reduced electric demand. In addition, savings in utility operating costs and capital requirements for new plant construction may accrue to the utilities. DOE

N81-13513# Battelle Human Affairs Research Centers, Seattle, Wash.
INSTITUTIONAL ANALYSIS FOR ENERGY POLICY
F. A. Morris and R. J. Cole Jul. 1980 178 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3529) Avail: NTIS HC A09/MF A01

The Regional Issues Identification and Assessment (RIIA) program identifies environmental, health, safety, socioeconomic, and institutional issues that could accompany hypothetical future scenarios for energy consumption, and production on a regional basis. Theoretical grounding in institutional analysis and information on constructing institutional maps of the processes for bringing on line energy technologies and facilities contemplated in RIIA scenarios is presented. The institutional constraints, opportunities and impacts that affect whether these technologies and facilities would in fact be developed were assessed. DOE

N81-13527# Prototech, Inc., Newton Highlands, Mass.
ENERGY SAVINGS BY MEANS OF FUEL CELL ELECTRODES IN ELECTRO-CHEMICAL INDUSTRIES Progress Report, 1 Nov. 1979 - 31 Jan. 1980
Amicam Bar-Ilan, Walter Juda, Robert J. Allen, and Robert W. Lindstrom 18 Apr. 1980 42 p refs
(Contract DE-AC02-78ET-25309)
(COO-4881-16) Avail: NTIS HC A03/MF A01

Zinc electrowinning data, obtained with hydrogen depolarized anodes operating in a plant feed electrolyte at 55 C, are presented. Performance of an anode containing a low platinum loading and an anode catalyzed with palladium instead of platinum is described. A feed and bleed system to maintain a constant electrolyte composition was developed. The effect upon cell voltage of decreasing the hydrogen flowrate to the anode by dilution of the feed gas with nitrogen was studied. The effect upon energy consumption and current efficiency of varying the current density and the Zn ion concentration was determined. DOE

N81-13529# Oak Ridge National Lab., Tenn.
ROLE OF CONSERVATION IN PLANNING FOR AN ENERGY EMERGENCY: HOME AND WORK PLACE ENERGY USE
Roger S. Carlsmith Jun. 1980 29 p refs Presented at the Contingency Planning for an Energy Emergency Conf., Stanford, Calif., 16-18 Jun. 1980
(Contract W-7405-eng-26)
(CONF-8006120-1) Avail: NTIS HC A03/MF A01

Prospects for making substantial reductions in energy consumption in the residential, commercial, and industrial sectors are discussed. Steps to deal with an emergency and with preparations that can be started now to reduce our vulnerability are described. Higher energy prices will continue to be the principal driving force for conservation. Congress has promulgated a program of encouraging conservation through regulations, financial measures, and information programs. Some of the most important are energy performance standards for new buildings, assistance in retrofitting residential buildings, and grants for institutional buildings. The planning for emergency situations remains incomplete. Proposed emergency measures (with the exception of gasoline rationing) focus largely on reduction of nonessential uses of energy. The potential reductions achievable by such measures would fall far short of the requirements in a serious emergency such as a cutoff of all imports from the mideast. DOE

N81-13530# Oak Ridge National Lab., Tenn. Energy Div.
PERFORMANCE AND ECONOMICS OF USING HEAT PUMP DESUPERHEATERS FOR RESIDENTIAL WATER HEATING
Leonard A. Abbatiello, E. A. Nephew, and M. L. Ballou 1980 14 p refs Presented at the Conf. on Waste Heat Recovery for Energy Conserv.: Residential and Light Com. Heat Pumps, West Lafayette, Ind. 15-17 Sep. 1980
(Contract W-7405-eng-26)
(CONF-800966-1) Avail: NTIS HC A02/MF A01

The homeowner using a desuperheater water heater system should expect effective annual water heating COPs which range from 1.3 for northern cities to 2.9 in southern cities. The average consumer could expect to save between 800 and 2500 kWh/year if he is presently heating water with a conventional electric water heater. Should the homeowner elect to install a heat pump water heater within the thermal envelope of his air-to-air heat pumped home, he could expect similar savings. The major economic conclusions of this study are: the desuperheater water heater can save a significant amount of energy at attractive life cycle costs and acceptable first costs if the owner is choosing between electrically powered alternatives; heat pump water heaters offer savings which are comparable to those of the desuperheater system in all regions of the country; water heating with natural gas still offers the lowest first and life cycle costs of all alternatives. DOE

N81-13542# Bureau of Economic Analysis, Washington, D. C. Regional Economic Analysis Div.
THE ESTIMATION OF ECONOMIC AND DEMOGRAPHIC IMPACTS FOR DEPARTMENT OF ENERGY ALTERNATIVE SCENARIOS
Kenneth P. Ballard Apr. 1980 171 p refs
(Contract EL-78-C-01-6399)
(PB80-208325; BEA/REA-80/01) Avail: NTIS HC A08/MF A01 CSCL 10A

A multistate interactive econometric model of the U.S. economy is used to estimate the spatial distribution of impacts from model forecasts of energy development alternatives. The model is overviewed to familiarize the reader with the structure, advantages, and limitations of this multiregional modeling system. The linking methodology between the energy forecasting model and the multiregional economic-demographic model is described. The results of the application of this methodology are presented. General conclusions follows. GRA

N81-13546# SRI International Corp., Menlo Park, Calif.
NUMERICAL STUDY OF LOCAL/REGIONAL ATMOSPHERIC CHANGES CAUSED BY A LARGE SOLAR CENTRAL RECEIVER POWER PLANT Final Report, 29 Sep. 1978 - 31 May 1980
Chandrakant M. Bhumralkar, Arthur J. Slemmons, and Kenneth C. Nitz May 1980 72 p refs
(Contract DE-AT03-76ET-20537)
(DOE/ET-20537/1) Avail: NTIS HC A04/MF A01

A two dimensional, vertical cross section, numerical atmospheric mesoscale model applied to study the potential atmospheric effects of the installation of a 100 MW/sub e/solar thermal central receiver power plant at Barstow, California. The results for typical summer conditions at Barstow and the surrounding region show that the power plant has the potential to increase local humidity and wind circulation but cannot induce the formation of clouds or rain. The results for typical summer conditions show that the solar power plant has the potential to increase the wind circulation and to form clouds and rain. However, the life cycle of such formations is only 2 to 3 hours. The results for typical winter conditions do not indicate significant atmospheric perturbations. The atmospheric effects of a dry cooling tower located upwind are not as significant and intense as those produced using a wet cooling tower. The effect of a wet cooling tower located at the downwind edge of the power plant is an increase in humidity in the downwind portion of the model atmosphere. DOE

N81-13547# Midwest Research Inst., Golden, Colo.
ENVIRONMENTAL ASPECTS OF SOLAR ENERGY TECHNOLOGIES
Carl L. Strojan Sep. 1980 21 p refs Presented at the Symp. on Energy and Ecology in the West, Tucson, Ariz., 3-8 Aug. 1980
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-743-826; CONF-800867-2) Avail: NTIS HC A02/MF A01

Solar energy technologies have environmental effects, and these may be positive or negative compared with current ways of producing energy. In this respect, solar energy technologies are no different from other energy systems. Where solar energy technologies differ is that no unresolvable technological problems (e.g., CO2 emissions) or sociopolitical barriers (e.g., waste disposal, catastrophic accidents) were identified. Some of the environmental aspects of solar energy technologies and ongoing research designed to identify and resolve potential environmental concerns are reviewed. It is important to continue research and assessment of environmental aspects of solar energy to ensure that unanticipated problems do not arise. It is also important that the knowledge gained through such environmental research be incorporated into technology development programs and policy initiatives. DOE

N81-13548# Department of Energy, Washington, D. C. Office of Health and Environmental Research.
SUMMARY OF THE CARBON DIOXIDE EFFECTS RESEARCH AND ASSESSMENT PROGRAM
Jul. 1980 34 p refs
(DOE/EV-T0002/1) Avail: NTIS HC A03/MF A01

A brief management-oriented summary is presented. Goals, strategies, selected facts and predictions are presented. DOE

N81-13549# Argonne National Lab., Ill.
ENVIRONMENTAL ASSESSMENT FOR THE SATELLITE POWER SYSTEM (SPS) CONCEPT DEVELOPMENT AND EVALUATION PROGRAM (CDEP)
Anthony R. Valentino Aug. 1980 128 p refs
(Contract W-31-109-eng-38)
(DOE/ER-0069) Avail: NTIS HC A07/MF A01

In the satellite power system (SPS), satellite in geosynchronous Earth orbit would collect solar energy in space, convert it to microwaves, and transmit the microwaves to receiving antennas (rectennas) on earth. At the rectennas, the microwave energy would be converted to electricity. This SPS environmental assessment considers the microwave and nonmicrowave effects on the terrestrial environmental and human health, atmospheric effects, and effects on electromagentic systems. No environmental problem was identified that would preclude the continued study of SPS technology. To increase the certainty of the assessment, some research was initiated and long-term research is being planned. DOE

N81-13559# Southern Research Inst., Birmingham, Ala.
ASSESSMENT OF DIESEL PARTICULATE CONTROL: PARTICLE SIZE MEASUREMENTS Final Report, Nov. 1978 - Nov. 1979
Joseph D. McCain and M. Gregory Faulkner Dec. 1979 26 p refs
(Contract EPA-68-02-2610)
(PB80-224256; SORI-EAS-79-778; EPA-600/7-79-232C) Avail: NTIS HC A03/MF A01 CSCL 13B

Results of tests on an Oldsmobile 98 diesel automobile obtain data on parameters typical of a light duty vehicle are reported. Data are presented for operations under four simulated driving conditions. The increasing appearance of the diesel engine on the passenger car market had led to concern over particulate emissions (smoke) from these engines. Possible control strategies involving particulate collection in the hot exhaust stream requires knowledge of the concentrations and size distributions of the particulate matter at exhaust conditions. GRA

N81-13560# Wisconsin Univ. - Madison. Dept. of Mechanical Engineering.
AIR POLLUTION STUDIES NEAR A COAL-FIRED POWER PLANT: WISCONSIN POWER PLANT IMPACT STUDY Final Report, Jul. 1975 - Jul. 1978
Kenneth W. Ragland, Bradley D. Goodell, and Terry L. Coughlin May 1980 117 p refs Prepared in cooperation with Wisconsin Public Service Corp., Green Bay, Wis.
(Grant EPA-R-803971)
(PB80-205792; EPA-600/3-80-048) Avail: NTIS HC A06/MF A01 CSCL 13B

Concentrations of dry deposition of sulfur dioxide were investigated near a new 540-MW coal-fired generating station located in a rural area 25 miles north of Madison, Wisconsin. Monitoring data for 2 years before the start-up in July 1975 and for the year 1976 were used to assess the impact of the plume and to investigate the hourly performance of the Gaussian plume model. GRA

N81-13722# International Atomic Energy Agency, Vienna (Austria).
INTERNATIONAL ATOMIC ENERGY AGENCY BULLETIN, VOLUME 22, NO. 5 AND 6
Oct. 1980 158 p refs
(ISSN-0020-6067) Avail: NTIS HC A08/MF A01

The assessment of benefits and risks associated with various energy sources and systems is considered in relation to human needs. Particular emphasis is given to occupational hazards connected with coal mining, the handling of natural and liquified petroleum gases, and the use of nuclear energy for electric power generation. A method of energy risk comparison is examined as well as the approach of a regulatory agency to the concept of risk. Reports of international conferences on the management of alpha contaminated waste and on plasma physics and controlled nuclear fusion research are included. A.R.H.

N81-13803*# Cummins Engine Co., Inc., Columbus, Ind.
VEHICLE TESTING OF CUMMINS TURBOCOMPOUND DIESEL ENGINE Final Report
Michael C. Brands, John R. Werner, and John L. Hoehne Jun. 1980 64 p refs
(Contracts EM-78-C-02-4936; EC-77-A-31-1011)
(NASA-CR-159840; DOE/NASA/4936-80/1; CTR-0746-80002) Avail: NTIS HC A04/MF A01 CSCL 13F

Two turbocompound diesel engines were installed in Class VIII heavy-duty vehicles to determine the fuel consumption potential and performance characteristics. One turbocompound powered vehicle was evaluated at the Cummins Pilot Center where driveability, fuel consumption, torsional vibration, and noise were evaluated. Fuel consumption testing showed a 14.8% benefit for the turbocompound engine in comparison to a production NTC-400 used as a baseline. The turbocompound engine also achieved lower noise levels, improved driveability, improved gradeability, and marginally superior engine retardation. The second turbocompound engine was placed in commercial service and accumulated 50,000 miles on a cross-country route without malfunction. Tank mileage revealed a 15.92% improvement over a production NTCC-400 which was operating on the same route. Author

N81-13807# Committee on Science and Technology (U. S. House).
OVERSIGHT: APPROPRIATE TECHNOLOGY, VOLUME 1
Washington GPO 1979 231 p refs Joint hearing before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol. and the Subcomm. on Energy Conserv. and Supply of the Comm. on Energy and Nat. Resources, 96th Congr., 1st Sess., no. 20, 30 Apr. 1979
(GPO-47-419) Avail: SOD HC

The importance of management and public relations in energy development is discussed. Solar energy technology and synthetic fuels technology were examined. Conservation of energy in homes is viewed as the major resolution of energy problems facing society. T.M.

N81-14051# Mound Lab., Miamisburg, Ohio.
COMBINED ELECTROLYSIS CATALYTIC EXCHANGE (CECE)
Robert E. Ellis, Thomas K. Mills, and Michael L. Rogers 30 Sep. 1980 19 p refs
(Contract DE-AC04-76DP-00053)
(MLM-2774) Avail: NTIS HC A02/MF A01

Starting from an effort to control airborne emissions, the Mound tritium containment program evolved to include development of the Combined Electrolysis Catalytic Exchange process. This process separates tritiated aqueous streams into detritiated water and an enriched hydrogen stream that is suitable for use by other tritium recovery processes. Experimentation showed that the process performs as predicted by bench scale measurements, and that available process components exhibit acceptable resistance to damage by radiation from tritium exposure. Planned future efforts are concentrated on finalizing automatic control of the process and on developing feed treatment methods for the protection of process components. DOE

N81-14055# California Univ., Berkeley.
ON-LINE ZEEMAN ATOMIC ABSORPTION SPECTROSCOPY FOR MERCURY ANALYSIS IN OIL SHALE GASES
D. C. Girvin Jun. 1980 112 p refs
(Contract EPA-68-03-2667)
(PB80-216922; EPA-600/7-80-130) Avail: NTIS HC A06/MF A01 CSCL 14B

The development and initial testing of instrumentation for continuous online analytical measurement of mercury concentrations in complex gas streams or in ambient air, in the presence of smoke, organic vapors, and oil mist from oil shale processing plants is described. The technique was Zeeman atomic absorption spectroscopy. The mercury monitor described is not susceptible to interferences which plague other methods and thus may be used to characterize mercury emissions on a realtime basis. This mercury monitor will find immediate application for the characterization of synfuel and other industrial emissions, mobile source identification, and environmental health monitoring. GRA

N81-14122# Department of Energy, Washington, D. C. Office of Technology Impacts.
SYNTHETIC FUELS AND THE ENVIRONMENT: AN ENVIRONMENTAL AND REGULATORY IMPACT ANALYSIS
Jun. 1980 652 p refs
(DOE/EV-0087) Avail: NTIS HC A99/MF A01

Deployment of synthetic fuels facilities to produce gaseous and liquid products from coals, shale, and biomass of approximately 1.5 million barrels per day by 1995 appears feasible in terms of successfully resolving critical environmental constraints. This success assumes that most effective environmental control technologies and practices are applied in these new facilities, and full utilization of operational monitoring information is made to identify and resolve unforeseen problem areas and uncertainties. The greatest areas of regulatory uncertainty are impacts of yet to be defined regulations. Such regulations include visibility, short term nitrogen regulations, hazardous waste standards, toxic product regulations, and occupational safety standards. Author

N81-14134# Science Applications, Inc., Canoga Park, Calif. Combustion Science and Advanced Technology Dept.
EFFICIENT UTILIZATION OF ALTERNATE FUELS: DEVELOPMENT OF MODELS FOR THE PREDICTION OF INTERCHANGEABILITY, DESIGN, AND PERFORMANCE OF GAS BURNER/COMBUSTOR SYSTEMS Final Report
P. T. Harsha, R. B. Edelman, and D. H. France 15 Apr. 1980 139 p refs Prepared for Gas Research Inst., Chicago, Ill.
(PB80-218282; SAI-80-018-CP; GRI-79/0034) Avail: NTIS HC A07/MF A01 CSCL 21D

A thorough survey and review of the state of the art of burner design techniques and gas interchangeability problems and prediction techniques was carried out. For burner design, a major problem area was shown to be the potential for conflicting requirements of increased efficiency and reduced emissions. The interchangeability assessment indicates that current methods are limited to the empirical data bases used for their development. In both areas a need exists for the establishment of more direct relationships between flame performance parameters and controllable design and operating parameters. An improved methodology for addressing this need with respect to residential, commercial, and industrial systems was defined. GRA

N81-14296# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
AN OPTICAL WATTHOUR METER DIGITIZER
W. H. Andrews Oct. 1980 18 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7355) Avail: NTIS HC A02/MF A01

An optical watthour meter digitizer was developed which meets these criteria. Based on the induction-type watthour meter, the digitizer provides an output pulse for a fixed amount of energy use. The digitizer senses the motion of the rotor disc of the meter by optically detecting passage of a nonreflective area painted on the underside of the disc. The passage of such area initiates a logic compatible output pulse that can be used to measure power or energy usage in a variety of ways The accuracy of the measurement is determined by the watthour meter. The resolution of the measurement is determined by the K/sub h/constant (in watthours per revolution) of the meter and the number of equally spaced targets painted on the disc. The resolution of this device can be as small as a fraction of a watthour; the resolution of the manually read register on a watthour meter is typically a fraction of a kilowatthour. Several digitizers were fabricated, bench tested, and installed in the field for long-term performance testing. All are performing satisfactorily. DOE

N81-14390# Committee on Science and Technology (U. S. House).
FORESIGHT. VOLUME 3: THE ECONOMIC IMPACT OF ENERGY CONSERVATION
Alvin Kaufman and Susan J. Bodilly, ed. Washington GPO 1979 499 p refs Proc. of an Eng. Found. Conf., Henniker, N.H., 23-28 Jul. 1978 Presented to the Subcomm. on Advan. Energy Technol. and Energy Conserv. Res., Develop. and Demonstration of the Comm. on Sci. and Technol., 95th Congr., 2nd Sess., Dec. 1978 Prepared by the Congressional Research Service, Library of Congress
(GPO-41-483) Avail: SOD HC

Various economic ramifications of energy conservation are discussed. The impact of conservation of various major sections of the economy are considered. L.F.M.

N81-14391*# Motorola, Inc., Phoenix, Ariz.
MARKET DEFINITION STUDY OF PHOTOVOLTAIC POWER FOR REMOTE VILLAGES IN DEVELOPING COUNTRIES
Clyde Ragsdale and Prosper Quashie Oct. 1980 208 p refs

(Contracts DEN3-49; DE-A101-79ET-20485)
(NASA-CR-159880; DOE/NASA/0049-80/2; EDR-1110) Avail: NTIS HC A10/MF A01 CSCL 10B

The potential market of photovoltaic systems in remote village applications in developing countries is assessed. It is indicated that photovoltaic technology is cost-competitive with diesel generators in many remote village applications. The major barriers to development of this market are the limited financial resources on the part of developing countries, and lack of awareness of photovoltaics as a viable option in rural electrification. A comprehensive information, education and demonstration program should be established as soon as possible to convince the potential customer countries and the various financial institutions of the viability of photovoltaics as an electricity option for developing countries. J.M.S.

N81-14397*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICABILITY OF ADVANCED AUTOMOTIVE HEAT ENGINES TO SOLAR THERMAL POWER
Donald G. Beremand, David G. Evans, and Donald L. Alger 1981 26 p refs Presented at SAE Intern. Eng. Congr. and Exposition, Detroit, 23-27 Feb. 1981
(Contract EX-76-A-29-1060)
(NASA-TM-81658; E-675; DOE/NASA/1060-4) Avail: NTIS HC A03/MF A01 CSCL 10B

The requirements of a solar thermal power system are reviewed and compared with the predicted characteristics of automobile engines under development. A good match is found in terms of power level and efficiency when the automobile engines, designed for maximum powers of 65-100 kW (87 to 133 hp) are operated to the nominal 20-40 kW electric output requirement of the solar thermal application. At these reduced power levels it appears that the automotive gas turbine and Stirling engines have the potential to deliver the 40+ percent efficiency goal of the solar thermal program. M.G.

N81-14403# Kernforschungsanlage, Juelich (West Germany).
ENERGY ANALYSIS OF SOLAR ENERGY SYSTEMS, HEAT PUMPS AND OF IMPROVED INSULATION OF SINGLE FAMILY HOUSES Final Report
Hermann Josef Wagner and Roland Turowski Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 31 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-101; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 6,30

In the evaluation criteria such as economic competitiveness, environmental impact and ease of use were taken into account along with the energy economy of a system. This criterion compares the energy output of a system with the energy required for its installation and operation. The methods of the process chain analysis and the systematics of input-output tables permit the evaluation of the net energy production. It was found that the energy amortization period for insulation improvement (ca. 2 months), for heat pump systems (5-14 months) and for solar systems (16-23 months) are much shorter than the anticipated life expectancy of the systems. From the point of view of energy economy it follows that even with accelerated market introduction there is no restriction for the market introduction rate. T.M.

N81-14406# Centro Informazioni Studi Esperienze, Milan (Italy). CISE Documentation Service.
THE RETE PROJECT. INTEGRATED PUBLIC AND PRIVATE COGENERATION
P. Alia, F. Dallavalle, C. DeNard, M. Genova, G. Salimbeni (Aerimpianti, Milan), G. Spagni (Azienda Gas Acqua Consorziale, Reggio Emilia, Italy), and S. Veneziani (Azienda Gas Acqua Consorziale, Reggio Emilia, Italy) Nov. 1979 63 p refs Presented at 2nd. Intern. Total Energy Congr., Copenhagen, 8-12 Oct. 1979
(CISE-1527) Avail: NTIS HC A04/MF A01

The results of the technical and economic feasibility study done for a total energy plant to be built for the San Pellegrino neighborhood in Reggio Emilia are given. Once the energy requirements (thermal and electric) of the users was established, the kind of plant to be used was selected and some hourly energy analyses were done for such a plant to determine the best kind of operation. On the basis of economic considerations, too, the kind of operation proposed is 'mixed', that is, compulsory electrical for the winter season and compulsory thermal for the remaining months of the year. Under these operating conditions the plant realizes about a 38% annual saving of primary fuel (in comparison to a conventional system satisfying the same energy demand) with a profit of about 8% (recovery time 12 to 13 years). A larger number of users would make it possible to increase profitability to something around 10% (recovery time ten years). Author

N81-14423# Department of Energy, Washington, D. C. Energy Information Administration.
ENERGY POLICY STUDY. VOLUME 10: NUCLEAR POWER REGULATION
Z. D. Hikodam 1980 259 p refs
(DOE/EIA-0201/10) Avail: NTIS HC A12/MF A01

Federal and State regulatory procedures are described. The legal foundations for the Federal licensing process and the associated State activities are also described. The aspects of these procedures that affect the cost and supply of nuclear generated electricity were analyzed. The effects of nuclear safety regulations on the planning and construction lead time for nuclear power stations, the cost of nuclear power, and the decision to invest in nuclear power were investigated. T.M.

N81-14424# Department of Energy, Washington, D. C. Energy Information Administration.
ENERGY INFORMATION REFERRAL DIRECTORY, SECOND QUARTER 1980
1980 161 p
(DOE/EIA-0205/80-2Q) Avail: NTIS HC A08/MF A01

The Directory, which includes organizational charts and an index of building locations, summarizes information and referral services for the following: business and labor affairs; consumer affairs; education affairs; international affairs; public affairs; information services; energy information; energy policy and legislation; regulation; energy conservation; environment; coal; petroleum; natural gas; electric power; renewable energy sources; oil shale. S.F.

N81-14426# Department of Energy, Washington, D. C. Office of Environmental Assessments.
TECHNOLOGY CHARACTERIZATIONS: ENVIRONMENTAL INFORMATION HANDBOOK
1980 198 p refs Supersedes DOE/EV-0061/1 Prepared in cooperation with Aerospace Corp., Washington, D.C. and Mitre Corp., Washington, D.C.
(DOE/EV-0072; DOE/EV-0061/1) Avail: NTIS HC A09/MF A01

Assessments of energy technologies are presented along with examples of systems representing each technology. The specific energy systems for which information is provided are grouped as follows: nuclear energy, coal, petroleum, gas, synthetic fuels, solar energy, geothermal energy, and hydroelectricity. T.M.

N81-14449# Department of Energy, Washington, D. C.
PREDESIGN ENERGY ANALYSIS: A NEW GRAPHIC APPROACH TO ENERGY CONSCIOUS DESIGN FOR BUILDINGS
Sep. 1980 84 p refs
(Contract EC-88-C-01-8694)
(DOE/CS-0171) Avail: NTIS HC A05/MF A01

An energy efficient design includes two interrelated elements: physical design characteristics which minimize testing, cooling, and lighting loads; and mechanical and electrical subsystems which meet energy loads efficiently. The technique described focuses on the first aspect: manipulation of design variables to effectively reduce excessive heat gains and losses. T.M.

N81-14456# Department of Energy, Washington, D. C.
LOW ENERGY FUTURES FOR THE UNITED STATES
Jun. 1980 152 p refs
(DOE/PE-0020) Avail: NTIS HC A08/MF A01

The range of available technologies and public policies which can reduce future U.S. primary energy consumption to below current levels while contributing to continued improvements in the standard of living was examined. Estimates of the efficiency improvements in buildings and appliances, industrial processes, and transportation are summarized. Brief summaries of ten major studies of possible low energy futures are included. T.M.

N81-14462# Tennessee Univ., Knoxville.
AN ENERGY AND COST ANALYSIS OF RESIDENTIAL HEAT PUMPS IN NORTHERN CLIMATES
J. K. Martin and D. L. ONeal 1980 6 p refs
(Contract W-7405-eng-26)
(DOE/TIC-11275) Avail: NTIS HC A02/MF A01

Lack of natural gas and high oil prices, combined with the large energy costs of electric resistance heat have forced renewed attention to the heat pump in colder climates. The diversity in heating energy use and cost effectiveness of forty-one currently retailed heat pumps in three northern cities, Boston, Denver, and Minneapolis, were examined. Heat pump heating energy use and annualized life cycle costs were compared with other forms of space heating equipment in those same cities. Author

N81-14464# Battelle Pacific Northwest Labs., Richland, Wash.
RESIDENTIAL HEATING COSTS: A COMPARISON OF GEOTHERMAL SOLAR AND CONVENTIONAL RESOURCES
Clem H. Bloomster, Bobi A. Garrett-Price, and Linda L. Fassbender Aug. 1980 202 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3200) Avail: NTIS HC A10/MF A01

The costs of residential heating throughout the United States using conventional, solar, and geothermal energy were determined under current and projected conditions. These costs are very sensitive to location, being dependent on the local prices of conventional energy supplies, local solar insolation, climate, and the proximity and temperature of potential geothermal resources. The sharp price increases in imported fuels during 1979 and the planned decontrol of domestic oil and natural gas prices have set the stage for geothermal and solar market penetration in the 1980's. DOE

N81-14467# Synergic Resources Corp., Bala-Cynwyd, Pa. Utilization and Conservation Program.
INDUSTRIAL COGENERATION CASE STUDIES Final Report
D. R. Limaye, S. Isser, B. Hinkle, and N. R. Friedman Sep. 1980 129 p Prepared for Electric Power Research Inst., Palo Alto, Calif.
(EPRI Proj. 1276-1)
(EPRI-EM-1531) Avail: NTIS HC A07/MF A01

Studies were performed on a number of operating cogeneration systems to determine application, economics, and attitudes of industrial and utility executives toward cogeneration. A literature survey was conducted and an identification of candidate cogeneration sites was carried out. This was followed by a screening of these sites down to 20 to 30 candidate sites. The screening was carried out on the basis of cogeneration capacity, geographical diversity, generation type, and industrial diversity. The remaining sites were contacted as to their willingness to work with EPRI, and an industrial questionnaire was developed on technical, economic, and institutional cogeneration issues. Each of the seventeen sites was visited during this task. A utility questionnaire was developed and utilities with cogeneration systems studied in this survey were contacted as to their attitudes toward cogeneration. In addition, a compilation of a list of operating cogeneration systems was performed. DOE

N81-14469# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.
STRATEGIC COST-BENEFIT ANALYSIS OF ENERGY POLICIES: COMPARATIVE ANALYSIS
Harry Davitian, Paul J. Groncki, Peter Kleeman, Joan Lukachinski, Richard J. Goettle, IV (Jorgensen (Dale W.) Associates), and Edward A. Hudson (Jorgensen (Dale W.) Associates) Oct. 1979 37 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51128) Avail: NTIS HC A03/MF A01

This study describes three possible energy strategies and analyses each in terms of its economic, environmental, and national security benefits and costs. Each strategy is represented by a specific policy. In the first strategy no additional programs or policies are initiated beyond those currently in effect or announced. The second is directed toward reducing the growth in energy demand, i.e., energy conservation. The third promotes increased domestic supply through accelerated development of synthetic and unconventional fuels. The analysis focuses on the evaluation and comparison of these strategy alternatives with respect to their energy, economic, and environmental consequences. The results indicate that conservation can substantially reduce import dependence and slow the growth of energy demand, with only a small macroeconomic cost and with substantial environmental benefits; the synfuels policy reduces imports by a smaller amount, does not reduce the growth in energy demand, involves substantial environmental costs and slows the rate of economic growth. E.D.K

N81-14474# United Engineers and Constructors, Inc., Philadelphia, Pa. Engineering Technology Div.
DISTRICT HEATING/COGENERATION APPLICATION STUDIES FOR MINNEAPOLIS-ST. PAUL AREA. MODIFICATIONS OF THE EXISTING UNITS AT THE HIGH BRIDGE POWER PLANT TO COGENERATION FOR HOT WATER DISTRICT HEATING
G. A. Englesson, M. C. Casapis, G. F. Pavlenco, B. Menaker, N. H. Lee, L. Denesdi, and D. E. Williamson Oct. 1980 148 p refs Sponsored in part by Northern States Power Co.
(Contract W-7405-eng-26)
(ORNL/TM-6830/P9) Avail: NTIS HC A07/MF A01

This evaluation required examinations of the equipment, the operating reports, and the technical manuals and drawings. The evaluation also included discussions with the plant staff and with the major vendors of the operating equipment. Units 3, 5, and 6 were recommended for conversion to cogeneration unit 3 to be converted to back pressure operation and units 5 and 6 to be converted to condensing tail operation. Unit 4 was not recommended for conversion. DOE

N81-14479# Washington Scientific Marketing, Inc., Washington, D.C.
PROCEEDINGS OF THE DEPEARTMENT OF ENERGY ADVANCED GAS TURBINE CENTRAL POWER SYSTEMS WORKSHOP
S. DAngelo, ed. 1980 196 p refs
(Contract DE-AC01-76-ET-10354)
(CONF-8004103) Avail: NTIS HC A09/MF A01

Technology for increasing the use of coal in central station electric power generation in an economical and environmentally acceptable manner is discussed. The two major research and development areas are the Open Cycle Gas Turbine System and the Closed Cycle Gas Turbine System. The following topics are examined: technical considerations of the Open Cycle and of the Closed Cycle Gas Turbine program; commercialization of both systems; and regulatory impacts on the development of both systems. DOE

N81-14481# Midwest Research Inst., Golden, Colo.
COMMUNITY ENERGY SELF-RELIANCE
Jul. 1980 568 p refs Presented at Community Renewable Energy Sys. Conf., Boulder, 20 Aug. 1979
(Contract DE-AC02-77CH-00178)
(SERI/CP-354-421; CONF-790864) Avail: NTIS HC A24/MF A01

Goals of a workshop/conference on community renewable energy systems are: (1) to encourage decentralization in attacking energy problems, (2) to show how renewable energy can meet community goals, (3) to present examples of successful projects,

(4) to discuss the planning and management of renewable energy systems, (5) to identify sources of financial support, (6) to share legal strategies, and (7) to examine utility roles. DOE

N81-14488# Little (Arthur D.), Inc., Cambridge, Mass.
DISTRIBUTED ENERGY SYSTEMS: A REVIEW OF RELATED TECHNOLOGIES
Nov. 1979 558 p refs
(Contract EX-76-C-01-3871)
(DOE/PE-03871/01) Avail: NTIS HC A25/MF A01
An assessment of energy producing systems is presented. A balanced description of various energy technologies along with expectations for their growth and problems that may be encountered are also included. Estimates of equipment capital and operating costs are also provided. L.F.M.

N81-14501# National Bureau of Standards, Washington, D.C. Office of Testing Lab.
INFORMATION AND GUIDELINES FOR A PROPOSED LABORATORY ACCREDITATION AND PRODUCT CERTIFICATION PROGRAM FOR PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS
Douglas B. Thomas Aug. 1980 36 p refs
(PB80-217615; NBSIR-80-2028) Avail: NTIS HC A03/MF A01 CSCL 10B
An overview of the advantages and disadvantages of laboratory accreditation and product certification including economic factors that should be considered for such programs is presented. Detailed information is also provided on the two national programs for accrediting laboratories, the Department of Commerce National Voluntary Laboratory Accreditation Program and the American Association for Laboratory Accreditation. Information on the California and Florida state programs for laboratory accreditation and product certification of solar collector systems is given as examples of programs that were in operation for several years. GRA

N81-14502# Council on Environmental Quality, Washington, D.C.
GLOBAL ENERGY FUTURES AND THE CARBON DIOXIDE PROBLEM
Jan. 1981 94 p refs
Avail: NTIS HC A05/MF A01
The continued rise in atmospheric carbon dioxide concentration poses potentially severe long term risks to the global climate and to the biological systems that depend on it. The regional and socioeconomic impacts of long range CO2 induced global warming were examined. The potential risks from even moderate increases in the burning of fossil fuels over the coming decades are discussed. Recommendations for dealing with the CO2 problem in a global context are presented. T.M.

N81-14507# Institute for Telecommunication Sciences and Aeronomy, Boulder, Colo.
ENVIRONMENTAL ASSESSMENT FOR THE SATELLITE POWER SYSTEM. CONCEPT DEVELOPMENT AND EVALUATION PROGRAM: EFFECTS OF IONOSPHERIC HEATING ON TELECOMMUNICATIONS
Aug. 1980 97 p refs
(Contract DE-A102-79CH-10003)
(DOE/ER-10003/T2) Avail: NTIS HC A05/MF A01 CSCL 13B
A program of national scope involving Government laboratories, industrial resources, and university personnel, was formulated. The effect of SPS operation upon the ionosphere was simulated by use of existing ground-based high-power transmitter facilities and the necessary formulations to permit the extrapolation of the simulations to the SPS operational scenario were developed. The programs of research and exploratory development undertaken for this assessment were grouped into three categories: simulation of telecommunication impacts, experimental studies of the physics of heating the ionosphere by radio waves, and theoretical studies. Author

N81-14508*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ENVIRONMENTAL IMPACTS OF THE SATELLITE POWER SYSTEM (SPS) ON THE MIDDLE ATMOSPHERE
Oct. 1980 39 p refs
(Contract DE-AI01-79ER-10035)
(NASA-TM-82228; DOE/ER-10035/01) Avail: NTIS HC A03/MF A01 CSCL 13B
The heavy lift launch vehicles (HLLV) proposed for use in constructing satellite power systems (SPS) would deposit various contaminants in the middle atmosphere, contaminants that would conceivable have adverse effects on climate and upper air structure. These contaminants consist of the major constituents of water vapor, hydrogen, carbon dioxide, and carbon monoxide, and the minor constituents of sulfur dioxide and nitric oxide in the rocket effluent, as well as nitric oxide formed during reentry. To assess the magnitudes of the effects, new models or modified existing models were constructed. Author

N81-14512# Oak Ridge National Lab., Tenn. Energy Div.
THE ENVIRONMENTAL ASSESSMENT OF SYNFUELS PROJECTS
C. R. Boston 24 Sep. 1980 9 p refs Presented to the Joint Legislative Study Subcomm. on Synfuels, Senate Energy and Natural Resources Comm., Knoxville, Tenn., 24 Sep. 1980
(Contract W-7405-eng-26)
(DOE/TIC-11286) Avail: NTIS HC A02/MF A01
Environmental assessments of synfuels demonstration projects including the preparation of environmental impact statements for all six of DOE's demonstration plants are presented. The synfuels technologies include high Btu gasification, medium Btu gasification and liquefaction. Author

N81-14515# Argonne National Lab., Ill.
OVERVIEW OF THE ENVIRONMENTAL CONCERNS OF COAL TRANSPORTATION
K. Bertram, P. Dauzvardis, L. Fradkin, and T. Surles Feb. 1980 75 p refs
(Contract W-31-109-eng-38)
(ANL/EES/TM-99) Avail: NTIS HC A04/MF A01
More than 30 environmental concerns were analyzed for the transportation of coal by rail, roads (truck), high voltage transmission lines, from mine-mouth generating plants to distribution networks), coal slurry pipelines, and barges. The following criteria were used to identify these problem: (1) real physical environmental impacts for which control technologies must be developed, or regulation made effective where control technologies presently exist; (2) the level of impact is uncertain, although the potential impact may be moderate to high; (3) the concerns identified by the first two criteria are specific to or exacerbated by coal transportation. The significant environmental problems identified as a result of this study are: (1) rail transport; (2) coal haul roads; (3) high voltage transmission lines; (4) slurry pipelines; and (5) barge transport. DOE

N81-14519# Radian Corp., Austin, Tex.
TRACE METALS AND STATIONARY CONVENTIONAL COMBUSTION PROCESSES. VOLUME 1: TECHNICAL REPORT Final Report, May 1979 - May 1980
Larry O. Edwards, Charles A. Muela, Ralph E. Sawyer, Carol May Thompson, Damon H. Williams, and R. Dean Delleney Aug. 1980 454 p refs
(Contract EPA-68-02-2608)
(PB80-216161; RAD-80-202-187-54-23; EPA-600/7-80-155A; IERL-RTP-1079) Avail: NTIS HC A20/MF A01 CSCL 13B
A survey reporting the trace metal concentration in combustible fuels, identified coal as the fuel of most concern; generally, trace metal levels in coal are similar to their crustal abundances. It reviewed conventional combustion technology. It discusses trace metal flows and partitioning around various types of boilers and pollution control devices, and reports data from cited studies. In addition to coal, the report gives data for oil, municipal refuse, and wood. It also covers emissions to air, water, and soil,

including trace metal leaching. It documents the health and environmental effects of trace metals. GRA

N81-14521# Monsanto Research Corp., Dayton, Ohio.
AN EVALUATION OF EMISSION FACTORS FOR WASTE-TO-ENERGY SYSTEMS Final Report, Nov. 1978 - 1979
K. M. Tackett, T. R. Balckwood, D. L. Harris, and K. M. Tackett Jul. 1980 53 p refs
(Contract EPA-68-03-2550)
(PB80-226665; MRC-DA-921; EPA-600/7-80-135) Avail: NTIS HC A04/MF A01 CSCL 13B

This report contains a summary of emission factors for the combustion of refuse for the purpose of providing energy recovery or volume reduction. This study was conducted to provide an up to date compliance of these factors for use in planning and assessing the benefits and risks from this industry. GRA

N81-14799# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A PRELIMINARY ANALYSIS OF THE AUDIBLE NOISE OF CONSTANT SPEED, HORIZONTAL AXIS WIND TURBINE GENERATORS
D. N. Keast and R. C. Potter Jul. 1980 72 p refs
(Contract DE-AP01-79EV-10014)
(DOE/EV-0089) Avail: NTIS HC A04/MF A01

A preliminary analytical procedure developed for calculating certain aerodynamic sound levels produced by large, horizontal axis wind turbine generators (WTG's) such as the DOE/NASA Mods- 0, 0A, 1, and 22. It postulates a noise component due to the (constant) rotation of the blades of the WTG, plus a wake-noise component that increases with the square of the power produced by the WTG. Sounds from machinery, and low frequency impulsive sounds produced by blade interaction with the wake of the support tower are not considered. In order to evaluate the acceptability of the sounds from WTG's, three noise limits were selected: the noise regulations of the states of Minnesota and Illinois and a U.S. EPA guideline for avoiding noise complaints from the public. The impact of WTG noise was evaluated against these three limits by computing acceptability distances. It is concluded that the infrasonic component of WTG sound, occurring at the blade passage rate, is at a very low level compared with existing limits of acceptability for human health. On the other hand, they could be a source of annoyance to people inside light weight structures (such as some residences) at a WTG site. A.R.H.

N81-14906# National Bureau of Standards, Washington, D.C.
RELEVANCE OF THE SECOND LAW OF THERMODYNAMICS TO ENERGY CONSERVATION, VOLUME 2
Jan. 1980 275 p refs Sponsored in part by DOE
(DOE/CS-40178/1-Vol-2) Avail: NTIS HC A12/MF A01

The 2nd law of thermodynamics (and the entropy concept) distinguishes a grade or quality of the energy being considered as well as quantity. From this distinction flow two important considerations: the losses at each point in a system can be assessed and measured in units that are directly proportional to input or purchased fuel energy; and the minimum energy required to perform a given function or process is ascertainable as well as the maximum energy available from a given source. The explicit use of 2nd law concepts is examined for: (1) energy monitoring; (2) process and system design and modification; (3) component design and modification. The use of the law in evaluating industrial processes, transportation systems, energy conversion systems, and HVAC systems is discussed as well as the design of heat exchangers, petroleum heaters, multieffect evapotrators, and distillation equipment. Particular emphasis is given to the Kraft process, production of ethylene, the manufacture of Portland cement, the melting and casting of aluminum, and the determining of automobile efficiency. A.R.H.

N81-14913# National Bureau of Standards, Washington, D.C. National Engineering Lab.
A REPORT ON THE RELEVANCE OF THE SECOND LAW OF THERMODYNAMICS TO ENERGY CONSERVATION Final Report
David Didion, David Garvin, and Jack Snell Aug. 1980 56 p refs Sponsored in part by DOE
(PB80-216914; NBS-TN-1115) Avail: NTIS HC A04/MF A01 CSCL 10A

The concept of energy efficiency as being the ratio of the minimum available work necessary for accomplishing a given task to the available work in the actual fuel used to accomplish this task is explored in terms of its relevance to federal energy conservation programs. Included is a review of selected elements of thermodynamics and efficiency concepts, and identification of the technology pertinent to energy conservation programs. The potential benefits, if any, that would accrue from the application of Second Law to Thermodynamics principles to these technologies are examined. Needs for advancing the acceptance and use of the Second Law analytical techniques are identified. GRA

N81-14928# Sandia Labs., Albuquerque, N. Mex.
THE CASE AGAINST ELECTRIC VEHICLES IS RUNNING OUT OF GAS
Richard R. Bassett Jul. 1980 17 p Presented at a Colloq. held at Sandia Lab., Albuquerque, 19 Sep. 1979 Sponsored by DOE
(SAND-79-1770; CONF-7909175-1) Avail: NTIS HC A02/MF A01

Internal combustion vehicles are hampered by scarce, expensive fuel supplies and ever more restrictive pollution controls. The alternative is the electric vehicle. If oil is used to generate electricity, the system efficiency of the electric vehicle is 20 percent as compared to 10 percent for the internal combustion car. It is a multifueled vehicle because electricity may be generated by using nuclear, coal, solar, wind, hydro, etc. An overview of the status of the electric and hybrid vehicles is presented. Public Law 94-413, 'The Electric and Hybrid Vehicle Program', is reviewed. The state of programs of electric vehicle technology (controls, drive systems, energy storage) is discussed. Available electric vehicles will be noted with their specifications. S.F.

N81-14929# Battelle Pacific Northwest Labs., Richland, Wash.
CONCEPTUAL FRAMEWORK FOR DESCRIBING SELECTED URBAN AND COMMUNITY IMPACTS OF FEDERAL ENERGY POLICIES
F. A. Morris, A. A. Marcus, and D. Keller Jun. 1980 122 p refs Prepared in cooperation with Battelle Human Affairs Research Center, Seattle
(Contract DE-AC06-76RL-01830)
(PNL-3492) Avail: NTIS HC A06/MF A01

Analysis of the impact of a particular policy requires the following: identifying the policy and its effects (as estimated by others), isolating any effects that themselves constitute an urban and community impact, identfying any effects that change the value of determinants, and describing the impact with reference to the new values of determinants. Three impacts addressed were neighborhood stability, housing availability, and quality and availability of public services. For each, a definition and measure for the impact were specified; its principal determinants were identified; how the casual model can be used to estimate impacts by applying it to three illustrative Federal policies (domestic oil price decontrol, building energy performance standards, and increased Federal aid for mass transit) is demonstrated. DOE

N81-15054# TRW Defense and Space Systems Group, Redondo Beach, Calif. Engineering Sciences Lab.
WALL QUENCH AND FLAMMABILITY LIMIT EFFECTS ON EXHAUST HYDROCARBON EMISSIONS Final Technical Report, 1 Aug. 1979 - 30 Jun. 1980
Jun. 1980 42 p refs
(Contract DE-AC03-78ET-13329)
(TRW-32512-6002-RU-00; FTR-P4) Avail: NTIS HC A03/MF A01

Both numerical simulation and laser Raman spectroscopy experimentation were undertaken to examine quantitatively the generation and fate of unburned hydrocarbons. In general, these investigations involve thin layers near the cylinder walls and piston crown, and flame wall interaction, although some bulk gas phenomena during combustion were also examined. The relative contribution of wall quench, of nonpropagation of flame into wall crevices, and of absorption/desorption of hydrocarbon vapors by thin motor oil film coating side walls was examined. One practical innovation examined is use of ceramic capped cylinder components in place of conventional metallic alloy components. L.F.M.

N81-15136# Pacific Northwest Lab., Richland, Wash.
LIQUEFIED GASEOUS FUELS SAFETY AND ENVIRONMENTAL CONTROL ASSESSMENT PROGRAM, VOLUME 1: EXECUTIVE SUMMARY AND ANNOTATED BIBLIOGRAPHIES Status Report
Oct. 1980 233 p Prepared for DOE, Washington, D.C. 3 Vol.
(DOE/EV-0085-Vol-1; SR-2) Avail: NTIS HC A11/MF A01

Liquefied gaseous fuels are an integral part of our energy system. They are compact, clean burning and have the potential for reducing some of the impacts on energy supply, transportation and storage that may be caused by shortages of other fuels. The storage of liquefied natural gas at critical regional locations (peakshaving and satellite facilities) within the United States can supply natural gas during seasonal periods of high demand and during emergencies when other sources of energy are disrupted. Safety and environmental control aspects of liquefied gaseous fuels are discussed. Technical information that will aid future decisions made by industry, regulatory agencies and the general public on facility siting, system operations, and accident prevention and mitigation is given. S.F.

N81-15137# Pacific Northwest Lab., Richland, Wash.
LIQUEFIED GASEOUS FUELS SAFETY AND ENVIRONMENTAL CONTROL ASSESSMENT PROGRAM. VOLUME 2: LNG REPORTS Status Report
Oct. 1980 561 p refs Prepared for DOE, Washington, D.C. 3 Vol.
(DOE/EV-0085-Vol-2; SR-2) Avail: NTIS HC A24/MF A01

Two finite element models: one based on solving the time dependent, two dimensional conservation equations of mass, momentum, and energy, with buoyancy effects included via the Boussinesq approximation; the other based on solving the otherwise identical set of equations except using the hydrostatic assumption, are described and applied to predict some aspects of the vapor dispersion phenomena associated with liquefied spills. A number of controlled numerical experiments, representing a reasonable expected range of LNG spill scenarios and atmospheric conditions, were carried out. Data regarding the applicability and limitations of the hydrostatic assumption for predicting LNG vapor spread and dispersion are established. S.F.

N81-15138# Pacific Northwest Lab., Richland, Wash.
LIQUEFIED GASEOUS FUELS SAFETY AND ENVIRONMENTAL CONTROL ASSESSMENT PROGRAM. VOLUME 3: LPG, AMMONIA, HYDROGEN REPORTS Status Report
Oct. 1980 229 p refs Prepared for DOE, Washington, D.C. 3 Vol.
(DOE/EV-0085-Vol-3; SR-2) Avail: NTIS HC A11/MF A01

The rates of boiling and spreading of liquefied petroleum gas (LPG) on a water surface are measured and an analytical model to describe the phenomena is developed. Design, fabrication, testing and modification of various spill apparatus components are designed. The apparatus is designed for one dimensional studies. A long, narrow, water filled channel was constructed for measuring the boiling and spreading rates of liquefied petroleum gas spilled on water. Vapor concentrations and temperatures of vapor and liquid are used to quantify the results. Spills of pentane and liquid nitrogen on water were conducted, and the spreading rates were measured as a function of time. S.F.

N81-15152# National Alcohol Fuels Commission, Washington, D.C.
ALCOHOL FUELS AND THE ENERGY SECURITY ACT
Birch Bayh and Robert A. Roe Aug. 1980 47 p
(PB80-221864; NAFC/80-06) Avail: NTIS HC A03/MF A01 CSCL 21D

Title 2 of the Energy Security Act (PL 96-294), the alcohol fuels and biomass energy provisions, and those applicable portions of Title 1 dealing with the production of alcohol from nonbiomass resources (e.g., methanol from coal) are summarized. The financial assistance programs for alcohol fuels projects are explained. GRA

N81-15333# International Research and Development Co. Ltd., Fossway (England).
COMPARATIVE STUDY OF ROTATING REGENERATORS AND HEAT-PIPE HEAT EXCHANGERS Final Report
D. B. A. MacMichael, D. A. Reay, and E. L. Foster 1980 34 p refs Sponsored by Commission of the European Communities
(EUR-6792-EN) Avail: NTIS HC A03/MF A01

A heat wheel was purchased and installed for air to air heat recovery on a Terylene fiber drying and setting oven at ICI Wilton. At the same time a heat pipe heat exchanger was prepared at IRD and tested under controlled conditions. The heat wheel was then replaced by the heat pipe unit. During this procedure measurements were made regularly to monitor the performance of the oven and the heat exchangers. Neither of the heat exchangers attained their rated conditions. It was concluded that recuperative energy conservation is technically and economically feasible, provided that attention is paid to the problems of air flow control and minimizing installation costs. It was also realized that a good saving could be made by paying attention to stray leaks from the oven and by reducing the exhaust air flow from the setting sections. On the question of comparative performance of the two heat exchangers it is not possible to propose that one type is preferable to the other, although the heat wheel created more problems in respect of maintaining airflow. E.D.K.

N81-15335# United Technologies Research Center, East Hartford, Conn. Power Systems Technology Dept.
ENHANCEMENT OF HEAT TRANSFER IN WASTE-HEAT HEAT EXCHANGERS Final Report
Richard C. Stoeffler Jul. 1980 64 p refs
(Contract DE-AC03-77ET-11348)
(DOE/ET-11348/T1; R80-914653-15) Avail: NTIS HC A04/MF A01

The Fluidfire shallow fluidized bed heat transfer facility was modified to give increased air flow capacity and to allow testing with different distributor plates and with two stage heat exchangers. The effect of reduced distributor plate pressure loss and amount and type of bed material on the heat transfer performance of a single stage fluidized bed heat exchanger is explored. Elutriation from the bed was measured for different bed materials and distributor plates; alternate heat exchanger surfaces having different fin spacings were also tested. Two types of two stage fluidized bed heat exchangers were tested: one having a baffle (having almost no pressure loss) located between the stages and which allowed bed material to recirculate between upper and lower beds; the second having two distributor plates, in series with no recirculation of the bed material. S.F.

N81-15381# Automotive Testing Labs., Inc., Aurora, Colo.
A STUDY OF THE EFFECTS OF FUEL SWITCHING ON CATALYST EQUIPPED VEHICLES Final Report
Aug. 1980 220 p
(Contract EPA-68-03-2693)
(PB81-102808; EPA-460/3-80-023) Avail: NTIS HC A10/MF A01 CSCL 13F

Results from a series of emission and fuel economy tests on seven 1979 vehicles are given. The objectives were: (1)to assess the effect of operating a catalyst equipped vehicle on commercially available leaded fuel, (2)to evaluate the emission characteristics of the vehicle at a point where gross catalystic poisoning and stabilization had occurred, (3)to examine catalyst rejuvenation efforts, and (4)to examine misfueling and rejuvenation effects on the oxygen sensor for vehicles equipped with a three way catalyst. Each of the seven vehicles received a series of baseline tests, mileage accumulation tests using unleaded fuel, catalyst evaluation tests, mileage accumulation tests using leaded fuel and a final series of tests utilizing various combinations of fuel, catalyst status and oxygen sensor status. GRA

N81-15468# Oak Ridge National Lab., Tenn.
CHARACTERIZATION OF SELECTED APPLICATION OF BIOMASS ENERGY TECHNOLOGIES AND A SOLAR DISTRICT HEATING AND COOLING SYSTEM
Sep. 1980 136 p Sponsored by DOE
(DOE/EV-0104) Avail: NTIS HC A07/MF A01

An assessment is made of four applications of biomass and solar energy conversion technologies. The first is an energy self-sufficient farm that provides all of its space heating and hot water needs by burning wood obtained by selective timber cutting on the farm acreage. The heating system is a commerical boiler furnace. A Purox gasification system is described which uses wood feedstock with a capacity of 850 dry tons/day. This system requires 2,000 farms, each with 30 acres of wooded land having a sustainable capacity of 5 dry tons/day per acre. The efficiency of silviculture plantations is then addressed in regard to different conversion strategies. Finally, a solar heat and cooling system designed for a one story school building is assessed. Land and materials requirements, climatology, and economic factors are discussed. M.G.

N81-15478# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environmental Div.
ENERGY BUDGETS AND MASONRY HOUSES: A PRELIMINARY ANALYSIS OF THE COMPARATIVE ENERGY PERFORMANCE OF MASONRY AND WOOD-FRAME HOUSES
David B. Goldstein, Mark D. Levine, and Jim Mass Sep. 1980 24 p refs
(Contract W-7405-eng-48)
(LBL-10440) Avail: NTIS HC A02/MF A01

Procedures for evaluating energy performance in terms of heat storage were reviewed. The cost effectiveness for masonry houses to conform to optimum energy budgets was determined. The insulation levels and costs were also determined. Life cycle costs for masonry houses were calculated and compared to values for wood frame houses. To conform with the optimal energy budgets, masonry houses must be insulated to almost as large an R-value as frame walls. T.M.

N81-15492# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
TRANSPARENT HEAT MIRRORS FOR WINDOWS: THERMAL PERFORMANCE
Michael Rubin, Richard Creswick, and Stephen Selkowitz Aug. 1980 7 p refs Presented at the 5th Natl. Passive Solar Conf., Amherst, Mass., 19-26 Oct. 1980
(Contract W-7405-eng-48)
(LBL-11408; EEB-W-80-13; W-69) Avail: NTIS HC A02/MF A01

The thermal performance of a window system can be improved by the application of a transparent heat mirror coating. Ways in which optimum thermal performance can be achieved for a variety of conventional and advanced window designs are discussed. Residential applications are emphasized. Author

N81-15495# Argonne National Lab., Ill.
ENVIRONMENTAL AND ECONOMIC EVALUATION OF ENERGY RECOVERY FROM AGRICULTURAL AND FORESTRY RESIDUES
Sep. 1980 118 p refs
(DOE/EV-0106) Avail: NTIS HC A06/MF A01

An analysis of capital and environmental costs of energy recovery from cotton ginning residues through direct combustion is given. The analysis concentrates on data from Arkansas, Mississippi, and Texas, which are representative of the country's major cotton producing areas. A model system for seed cotton drying based on current designs is used to evaluate the conversion technology. Use of cotton ginning residues for drying cotton lint would conserve significant quantities of natural gas and other fuels used but excess removal of residues has a deleterious effect on the soil. Maintaining favorable chemical and structural properties of the soil over several crop years is potentially more costly, in terms of energy required for fertilizer, than the amount of energy in the residues. Author

N81-15500# Colorado Univ., Boulder.
SENSITIZATION AND QUENCHING IN THE CONVERSION OF LIGHT ENERGY INTO CHEMICAL ENERGY Progress Report, 1 Feb. 1980 - 31 Jan. 1981
Stanley J. Cristol Sep. 1980 18 p refs
(Contract DE-AC02-79ER-10366)
(DOE/ER-10366/2) Avail: NTIS HC A02/MF A01

Extensive data from quenching kinetics were accumulated on photosolvolysis in t-butyl alcohol for benzyl chloride and a number of meta and para substituted benzyl chlorides. Evidence for the existence of two triplet states, one relatively short lived which gives solvolysis product and a second, relatively long lived which does not give product but instead is energy wasting, was accumulated. The system, p-acetobenzyl chloride, was investigated in detail. A method for quenching of singlet states for measurement of singlet lifetimes in the 100 picosecond to nanosecond range is being developed. Preliminary work on benzyl acetate photosolvolysis was conducted. Some work on the geometrical requirements for intra-molecular excitation transfer in bichromophoric molecules was conducted. Several dienes related to norbornadiene were prepared and preparative photoisomerizations to quadricyclene analogues were carried out. E.D.K.

N81-15508# EUS, Inc., Pittsburgh, Pa.
DUAL ENERGY USE SYSTEMS: DISTRICT HEATING SURVEY Final Report, Dec. 1979
Jul. 1980 161 p refs Sponsored by EPRI Prepared in cooperation with Hittman Associates, Inc., Columbia, Md
(EPRI Proj. 1276-3)
(EPRI-EM-1436) Avail: NTIS HC A08/MF A01

The current status of and problems facing district heating systems operated by electric utilities were identified. The technical and economic factors which can affect the present and future success of district heating systems in the United States were evaluated. A survey of 59 district heating electric utilities was conducted to determine the current status of the industry. Questions developed to obtain data on technical, economic, regulator, and marketing factors were included in the survey. Literature on district heating in the U.S. and abroad was collected from governments, industry and foreign sources and reviewed to aid in evaluating the current and future potential of the industry. Interviews were held with executives of 16 utilities that operate district heating systems in order to determine corporate attitudes. A summary of the literature obtained is provided. Survey results are tabulated and described. The interviews and survey data were used to compile 10 case studies of utilities operating district heating systems under a braod range of circumstances. T.M.

N81-15511# Stanford Linear Accelerator Center, Calif.
ALTERNATE POLICY AND ENERGY SOURCE ECONOMICS
F. F. Hall Sep. 1980 4 p refs Presented at 3rd Miami Intern. Conf. on Alternative Sources, Miami Beach, Fla., 15-17 Dec. 1980
(Contract DE-AC03-76SF-00515)
(SLAC-PUB-2609; CONF-801210-1) Avail: NTIS HC A02/MF A01

A number of alternate energy sources which exist in abundance and/or can be recycled endlessly using existing technology are reported. These include heat tapped from geothermal sources, velocity of winds, solar energy, biomass energy conversion, combustion of electrolytic hydrogen, and heat from fusing atoms. Alternate energy policies are discussed with emphasis on the feasibility of such policies from an economic standpoint. T.M

N81-15512# Rocket Research Corp., Redmond, Wash.
A STUDY OF THE FEASIBILITY OF COGENERATION USING WOOD WASTE AS FUEL Final Report
William F. Thorn, Randel L. Hoskins, and David Wilson 10 Apr. 1980 238 p refs Sponsored in cooperation with DOE, EPRI, Bonneville Power Administration, Lewis County, Wash., Mount Adams Veneer, Pacific Lumber and Shipping Co., Champian International Corp., Tubafor, RDW, Inc., and Max West, Inc.
(DOE/TIC-11322) Avail: NTIS HC A11/MF A01

The objective of this study was to evaluate the feasibility of establishing a wood and refuse burning thermal/electrical cogeneration facility in eastern Lewis County, Washington. The work was sponsored by 10 industrial, federal, county, and utility organizations and was carried out in a 6 task, 5 month program. The types, forms, sources, costs, and availability of fuels in the area were studied along with local thermal markets and regional electrical markets. Conceptual designs, including the selection and sizing of the principal pieces of equipment, were developed for both a cogeneration and condensing cycle plant. An assessment was made of the environmental and regulatory requirements applicable to the facilities. The estimated capital and operating costs of each facility were established. Energy costs and standard capital investment economic parameters for various ownership forms were determined. The results of the study clearly indicate the feasibility of establishing a 25 MW generation facility in this area. The primary location recommended is in the town of Morton, Washington. The cost of producing electrical energy is lowest with the public utility form of ownership and is estimated at 29.0 mills/kWh in 1979 dollars. Author

N81-15514# National Academy of Sciences - National Research Council, Washington, D. C.
MATERIALS ASPECTS OF WORLD ENERGY NEEDS
1980 581 p refs Presented at Intern. Mater. Congr. Sponsored in cooperation with DOE, Dept. of Agriculture, Ford Foundation, and EPRI
(Contract DI-BM-J0-188121; Grant NSF C-310)
(CONF-7903123; ISBN-0-309-03042-0; LC-80-81124) Avail: NTIS HC A25/MF A01

Plenary session papers presented by participants from both developed and developing countries contributed to the information base on materials and energy outlook, international cooperation, economic aspects, and environmental considerations and established the theme for the subsequent workshop sessions. Workshops on ten major aspects of materials energy interrelationships provided the opportunity for open and informal discussion of critical issues in each area and the development of reasonable consensus on problems and potential solutions. Summaries of the workshop discussions and closing plenary papers were presented on the final data of the Congress. The plenary papers, the workshop reports, the issue summaries prepared as preprints, some selected papers used in the workshops, and a summary of the meeting of the International Advisory Committee are presented. E.D.K.

N81-15516# Polytechnic Inst. of New York, Brooklyn. Transportation Training and Research Center.
THE ENERGY ADVANTAGES OF PUBLIC TRANSPORTATION
William R. McShane, Arnold Bloch, and William Ihlo Mar. 1980 84 p refs
(PB80-226129; UMTA-NY-11-0021-80-2) Avail: NTIS HC A05/MF A01 CSCL 10A

The total energy advantage of public transportation as well as residential energy consumption and residential mix is examined. The relative modal efficiencies, spatial structure, and residential energy consumption are considered in some detail. The focus is on petroleum based energy. Regional variations are noted. GRA

N81-15523# Los Alamos Scientific Lab., N. Mex.
HIGH TEMPERATURE HEAT PIPES FOR WASTE HEAT RECOVERY
M. A. Merrigan and E. S. Keddy 1980 8 p refs Presented at AIAA 15th Thermophysics Conf., Snowmass, Colo., 14-16 Jul. 1980
(Contract W-7405-eng-36)
(LA-UR-80-1481; CONF-800712-2) Avail: NTIS HC A02/MF A01

Operation of heat pipes in air at temperatures above 1200 K. was accomplished using SiC as a shell material and a chemical vapor deposit (CVD) tungsten inner liner for protection of the ceramic from the sodium working fluid. The CVD tungsten was used as a distribution wick for the gravity assisted heat pipe through the development of a columnar tungsten surface structure, achieved by control of the metal vapor deposition rate. Wick performance was demonstrated in tests at approximately 2 was throughput with a 19-mn-i.d. SiC heat pipe. Operation of ceramic heat pipes in repeated start cycle tests demonstrated their ability to withstand temperature rise rates of greater than 1.2 K/sec. Author

N81-15526# Oak Ridge National Lab., Tenn. Office of Integrated Assessment and Policy Analysis.
IMPACTS OF THE RESOURCE CONSERVATION AND RECOVERY ACT ON ENERGY SUPPLY
S. A. Carnes, E. D. Copenhaver, D. W. Weeter, F. J. Calzonetti, C. W. Tevepaugh, and D. C. Parzyck Oct. 1980 58 p refs
(Contract W-7405-eng-26)
(ORNL/OIAPA-15) Avail: NTIS HC A04/MF A01

The signficant characteristics of the waste streams of representative technologies of different energy supply alternatives are reported, including coal combustion and conversion, solar, geothermal, oil sands, oil shales, and petroleum refining. The overall relationship of RCRA and energy issues was examined, with special emphasis on how RCRA's hazardous waste provisions impact with these technologies. The issues addressed were: the magnitude of energy related waste; public and private sector responses to RCRA and energy waste problems; the relationship of RCRA to other environmental and public health protection policies; the effect of RCRA on the deployment of energy supply; the role of reuse, recovery, and utilization of energy waste; and possible health and environmental effects associated with solid or hazardous wastes of various energy supply systems. T.M.

N81-15536# Oak Ridge Associated Universities, Tenn. Inst. for Energy Analysis.
THE SOCIAL CONTROL OF ENERGY: A CASE FOR THE PROMISE OF DECENTRALIZED SOLAR TECHNOLOGIES
Robert W. Gilmer May 1980 42 p refs
(ORAU/IEA-80-2(M)) Avail: NTIS HC A03/MF A01

Decentralized solar technology and centralized electric utilities were contrasted in the ways they assign property rights in capital and energy output; in the assignment of operational control; and in the means of monitoring, policing, and enforcing property rights. An analogy was drawn between the decision of an energy consumer to use decentralized solar and the decision of a firm to vertically integrate, that is, to extend the boundary of a the firm to vertically integrate, that is, to extend the boundary of the firm by making inputs or further processing output. Decentralized solar energy production offers the small energy consumer the chance to cut ties to outside suppliers--to vertically integrate energy production into the home or business. The development of this analogy provides insight into important noneconomic aspects of solar energy, and it points clearly to the lighter burdens of social management offered by decentralized solar technology. T.M.

N81-15551# Science Applications, Inc., McLean, Va.
COMPARISON OF SOLAR HEAT PUMP SYSTEMS TO CONVENTIONAL METHODS FOR RESIDENTIAL HEATING, COOLING, AND WATER HEATING, VOLUME 2 Final Report

P. J. Hughes and J. H. Morehouse Apr. 1980 249 p refs
Prepared for Midwest Research Inst., Golden, Colo.
(Contract EG-77-C-01-4042)
(SERI/TR-98150-2-Vol-2) Avail: NTIS HC A11/MF A01

The series and parallel combined solar heat pump systems investigated are at best marginally competitive, on a 20 year life cycle cost basis, with conventional oil and electric furnace systems. The combined solar heat pump systems are not economically competitive with conventional gas furnace or stand alone heat pump systems for residential space heating, cooling and water heating. The combined solar heat pump systems do offer the potential for significant energy savings as compared to conventional furnace systems and the stand alone heat pump. The cost of that savings, however, is beyond that which the average consumer can be expected to pay. Barring unforeseen manufacturing process or materials breakthroughs, parallel systems prices are firm. The prices listed for series systems already include low cost site built collectors and an optimistic estimate of the liquid to air heat pump costs, and prices on other series system components are firm. A collector cost sensitivity analysis did not offer any encouraging directions towards significant systems cost reduction. T.M.

N81-15565# Midwest Research Inst., Golden, Colo. Community and Consumer Branch.
DECENTRALIZED ENERGY STUDIES: COMPENDIUM OF U.S. STUDIES AND PROJECTS
James Quinn and James M. Ohi Jun. 1980 47 p refs
(Contract EG-77-C-01-4042)
(SERI/TR-744-450) Avail: NTIS HC A03/MF A01

A brief description of studies and projects in the United States that are devoted to decentralized energy systems is presented. The listings are subdivided into general categories of multistate, regional, or statewide studies; technology assessments; community studies; neighborhood development and self-help projects. L.F.M.

N81-15571# Polytechnic Inst. of New York, Brooklyn. Transportation Training and Research Center.
THE ENERGY ADVANTAGES OF PUBLIC TRANSPORTATION: EXECUTIVE SUMMARY
William R. McShane, Arnold Bloch, and William Ihlo Mar. 1980 12 p
(PB80-226111; UMTA-NY-11-0021-80-1) Avail: NTIS HC A02/MF A01 CSCL 10A

Both auto and transit energy consumption as well as residential energy consumption and residential mix were considered. The relative modal efficiencies, spatial structure, and residential energy consumption were considered in some detail. The focus was on petroleum based energy; regional variations are noted. T.M.

N81-15576# Economics, Statistics and Cooperatives Service, Washington, D. C. Natural Resource Economics Div.
WESTERN ENERGY: THE INTERREGIONAL COAL ANALYSIS MODEL
John W. Green Aug. 1980 264 p refs
(PB81-106288; TB-1627; EPA-600/7-79-139) Avail: NTIS HC A12/MF A01 CSCL 10A

A method for anticipating some of the impacts of coal development under different policy options. The Interregional Coal Analysis Model is described for the Western States, projects the likely shifts in the patterns of coal production, transportation, and utlization which might result from alternative policy strategies. It describes the structure of and the data in two models. The 1975 model describes the coal mining-large electrical generation plant interactions which existed in 1975. It develops a base solution against which alternative scenario solutions are compared. The 1985 model portrays a reasonable reference case for 1985. It also develops a base solution for use in comparing scenario analyses. GRA

N81-15582# Argonne National Lab., Ill.
ENVIRONMENTAL ASSESSMENT OF DOE TRANSPORTATION PROGRAMS
Martin J. Bernard and Margaret K. Singh 1980 12 p Presented at 2d DOE Environ. Control Symp., Reston, Va., 17-19 Mar. 1980
(Contract W-31-109-eng-38)
(CONF-800334-17) Avail: NTIS HC A02/MF A01

The process of environmental planning, assessment, research and control for the projects of the DOE Assistant Secretary for Conservation and Solar's Office of Transportation Programs was presented. Natural resources (in particular for transportation assessment, materials and energy), ecosystem, physical environment, occupational and public health and safety, and socioeconomic (social, institutional and economic) are discussed. S.F.

N81-15585# California Univ., Livermore. Lawrence Livermore Lab. Engineering-Applied Science Dept.
EVOLUTION OF PARTICULATE EMISSIONS FROM A COAL-FIRED POWER PLANT Ph.D. Thesis
Helen Ting-Yee Buckholtz 15 Aug. 1980 179 p refs
(Contract W-7405-eng-48)
(UCRL-52989) Avail: NTIS HC A09/MF A01

A numerical model was developed for the dispersal of aerosols downwind from a coal fired power plant. The evolution of the spatial extent and particle size distribution of the aerosol material are evaluated and settling rates affecting the surface environment in the downwind path are predicted. The hot air plume coming out of the power plant stack includes a large quantity of aerosol particles. The plume rises with initial upward emission speed until it reaches thermal and kinetic equilibria with the ambient air, then it is transported by the wind current. The plume disperses vertically and horizontally by wind-turbulence. The numerical simulation studies the importance of particulate coagulation and turbulent dispersion on the downwind plume profile. At 20 miles downwind, most of the particles with diameter larger than 10 micrometers have settled to the ground. The size distribution is still bimodal. The distribution of larger particles remains almost unchanged, except for the departure of the super micronic particles, because coagulation losses are approximately balanced by coagulation gains. DOE

N81-15588# Oak Ridge National Lab., Tenn. Environmental Sciences Div.
ANALYSIS OF ENVIRONMENTAL ISSUES RELATED TO SMALL-SCALE HYDROELECTRIC DEVELOPMENT. 1: DREDGING
J. M. Loar, L. L. Dye, R. R. Turner, and S. G. Hildebrand Jul. 1980 148 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7228; PUBL-1565) Avail: NTIS HC A07/MF A01

The physical and chemical effects of dredging and disposal, their causes, and the biological effects engendered by these physical and chemical changes are discussed. Factors that could affect the severity (magnitude) of these effects (impacts) are emphasized. A discussion of environmental contraints and mitigation, as well as guidelines for the early evaluation of the environmental feasibility of dredging, are included. A general introduction on dredging equipment and disposal practices is given with emphasis on those practices that would be applicable to small reservoirs. Applicable regulations related to dredged material disposal and wetlands protection are also discussed, and a preliminary analysis of the economic costs associated with dredging and disposal is presented. J.M.S.

N81-15590# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
ENVIRONMENTAL IMPACT ASSESSMENT FOR METHANE UTILIZATION FROM COALBEDS FOR POWER GENERATOR AT BETHLEHEM MINES CORPORATION, MARIANNA MINE NO. 58, MARIANNA, PENNSYLVANIA

Jul. 1980 47 p ref
(Contract DE-AC21-77ET-13133)
(AESD-TME-3031) Avail: NTIS HC A03/MF A01

The gas normally vented to the atmosphere prior to a mining operation can be used as a fuel source to drive a gas turbine/generator assembly to produce electrical power. This power can then be fed back to the mining operation which reduces the dependence of the mine on electrical power supplied by the utilities company. The gas turbine/generator assembly is portable and mounted on a trailer van. The relative small size of the system and rural location combine to minimize the environmental impact. The installation will not have any effect on any threatened or endangered species of wildlife or vegetation. Author

N81-15602# Bureau of Mines, Pittsburgh, Pa. Pittsburgh Research Center.
SCRUBBERS FOR DUST CONTROL: A COMPARISON OF SIX MEDIUM ENERGY USE TYPES
Edward F. Divers and Joseph T. Janosik 1980 35 p refs
(PB81-104291; BM-RI-8449) Avail: NTIS HC A03/MF A01 CSCL 13B

The Bureau of Mines report describes the results of a program to develop small, rugged scrubbers with high dust collection efficiency for use in underground coal mines. The Bureau's Pittsburgh research center has developed and assisted in the development of several types of improved scrubbers that are especially suitable for various underground mining applications. The dust collection efficiency of six scrubbers (a venturi, two flooded fibrous bed, a venturi impaction plate, a wetted fan, and a rotating flooded bed) were compared. GRA

N81-15606# Midwest Research Inst., Kansas City, Mo.
ENVIRONMENTAL ASSESSMENT OF A WASTE-TO-ENERGY PROCESS: UNION CARBIDE PUROX (TRADEMARK) SYSTEM
Paul Gorman, Mark Marcus, K. P. Ananth, and Mark Golembiewski Sep. 1980 283 p refs
(Contract EPA-68-02-2166)
(PB81-100711; EPA-600/7-80-161) Avail: NTIS HC A13/MF A01 CSCL 13B

In assessing the environmental impacts of various waste to energy conversion systems, on site testing was carried out at Union Carbide Corporation's Purox facility at South Charleston, West Virginia. The Purox system pyrolyzes municipal solid waste, using oxygen, to produce a fuel gas with a heating value of 14.6 MJ/N cu m (370 Btu/scf). Sampling at the facility included four input/output streams (refuse, slag, water, and stack emissions). Water sampling included the pilot scale Unox washwater treatment system. The boiler stack emissions were sampled when firing the Purox gas and when firing natural gas. Analysis was carried out for most conventional pollutants (CO, NOx, etc.), but included many special analyses (polynuclear aromatic hydrocarbons). GRA

N81-15642*# Lockheed Electronics Co., Houston, Tex. Systems and Services Div.
AN ASSESSMENT OF POTENTIAL WEATHER EFFECTS DUE TO OPERATION OF THE SPACE ORBITING LIGHT AUGMENTATION REFLECTOR ENERGY SYSTEM (SOLARES)
Norman C. Allen Apr. 1978 154 p refs
(Contract NAS9-15200)
(NASA-CR-160752; JSC-13919; LEC-12027) Avail: NTIS HC A08/MF A01 CSCL 04B

Implementation of SOLARES will input large quantities of heat continuously into a stationary location on the Earth's surface. The quantity of heat released by each of the SOIARES ground receivers, having a reflector orbit height of 6378 km, exceeds by 30 times that released by large power parks which were studied in detail. Using atmospheric models, estimates are presented for the local weather effects, the synoptic scale effects, and the global scale effects from such intense thermal radiation. T.M.

N81-15901# Decision Focus, Inc., Palo Alto, Calif.
ANALYSIS OF THE NEED FOR INTERMEDIATE AND PEAKING TECHNOLOGIES IN THE YEAR 2000 Final Report
Stephen M. Barrager and Gregory L. Campbell Apr. 1980 256 p refs
(Contract DE-AC02-79ET-29999; DFI Proj. 1086)
(DOE/ET-29999/T1) Avail: NTIS HC A12/MF A01

The impact of load management is assessed in terms of the future need for intermediate and peak generating technologies such as combustion turbines, pumped storage, and cycling coal plants. There would be a reduced need for IPTs if load management activities such as time of use pricing, together with customer-owned energy storage devices, hot water heater controls, and interruptible service, can economically remove most of the variation from electric power demands. The need for IPTs in an uncertain future, which will probably include load management and time differentiated electricity prices is assessed. S.F.

02
SOLAR ENERGY

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

A81-10101 **Degradation in solar cells; Proceedings of the Meeting, University of Southampton, Southampton, England, September 7, 1979.** Meeting sponsored by the U.S. Air Force. Edited by P. T. Landsberg and T. Markvart (Southampton, University, Southampton, England). *Solar Cells,* vol. 2, Sept. 1980. 86 p.

Topics discussed include photodegradation in silicon, proton-to-electron damage ratios for some modern types of solar cells, and changes in lifetime and diffusion length due to the electron and proton bombardment of silicon solar cells. Consideration is also given to the theory of recombination-enhanced processes in solar cells, photon-induced degradation in crystalline silicon Schottky barrier solar cells, and bias-dependent radiation damage in diffused silicon solar cells. B.J.

A81-10102 **Degradation in solar cells - Introductory remarks.** P. T. Landsberg (Southampton, University, Southampton, England). *(U.S. Air Force, Meeting on Degradation in Solar Cells, Southampton, England, Sept. 7, 1979.) Solar Cells,* vol. 2, Sept. 1980, p. 3-10. 20 refs. Grant No. AF-AFOSR-77-3437.

Solar cell degradation phenomena are surveyed, and possible forms for photon degradation theories are outlined. Situations in which semiconductor degradation is important in solar cells are considered, including in the dark under forward bias, under optical irradiation, under particle bombardment and under irradiation by light following particle bombardment, and the possibility of annealing radiation damage is discussed. The occurrence of damage under optical irradiation following particle bombardment, usually referred to as photon degradation, is then examined in terms of the transformation of previously existing complex defects, and a simple theory of the enhanced diffusion or dissociation of oscillator defects is presented. Finally, some basic questions concerning the degradation of solar cells are formulated. A.L.W.

A81-10104 **Proton-to-electron damage ratios for some modern types of solar cells.** M. W. Walkden (Royal Aircraft Establishment, Space Dept., Farnborough, Hants., England). *(U.S. Air Force, Meeting on Degradation in Solar Cells, Southampton, England, Sept. 7, 1979.) Solar Cells,* vol. 2, Sept. 1980, p. 25-29.

The ratio of the 1 MeV electron fluence required to reduce solar cell maximum power by a certain percentage to those fluences of protons of various energies required to produce the same amount of degradation, i.e. the electron-to-proton damage ratio, was found for four types of modern solar cell. The results of photon exposure following these irradiations and those of elevated cell temperature on cell performance (and hence damage ratio) are discussed. (Author)

A81-10105 **Changes in lifetime and diffusion length due to the electron and proton bombardment of silicon solar cells.** D. Bielle-Daspet, L. Castaner, G. Gasset, and M. Benzohra (Centre d'Etude Spatiale des Rayonnements, Toulouse, France). *(U.S. Air Force, Meeting on Degradation in Solar Cells, Southampton, England, Sept. 7, 1979.) Solar Cells,* vol. 2, Sept. 1980, p. 31-42. 28 refs. European Space Research and Technology Centre Contracts No. 1786/72-AK; No. 2072/73-AK.

The transient photoexcitation measurement methods can characterize induced degradation of lifetime and diffusion length in solar cells which result from particle bombardment, processing, and thermal treatment. The proton-induced degradation in the base lifetime in the 10 to 37 MeV range depends on the base resistivity; the irradiation fluence affects the amount and nature of the base lifetime degradation in 2 ohm-cm solar cells. The processing of a solar cell influences the type of defects responsible for carrier recombination; after particle bombardment, the lifetime degradations for cell bases were very different from those of bulk samples for both proton and electron irradiation. Finally, changes in the operational carrier lifetime of the emitter region and in the carrier mobility of the region close to the space charge were recorded in cells irradiated with 10 MeV protons. A.T.

A81-10106 **Recombination-enhanced processes in solar cell degradation.** A. M. Stoneham (Atomic Energy Research Establishment, Theoretical Physics Div., Harwell, Oxon, England). *(U.S. Air Force, Meeting on Degradation in Solar Cells, Southampton, England, Sept. 7, 1979.) Solar Cells,* vol. 2, Sept. 1980, p. 43-47. 16 refs.

Processes in semiconductors which are enhanced by raising carrier densities are discussed in relation to the degradation of solar cells. Characteristics of these recombination-enhanced processes, including the facts that they are athermal or weakly temperature dependent, and generally occur during device operation, are pointed out. Criteria for distinguishing among the three main types of mechanisms for recombination enhancement (local excitation, local heating and the Bourgoin-Corbett mechanism) are discussed, with attention given to pre-exponential factors determining the enhanced jump rate, and the efficiencies in local heating. It is shown that whether or not the reaction coordinate is a normal mode of the defect lattice is of considerable importance. Finally, cases in which recombination enhancement is possible in silicon, III-V and CdS/Cu2S solar cells are identified. A.L.W.

A81-10270 **Measurement of concentrator solar cell series resistance by flash testing.** R. J. Chaffin and G. C. Osbourn (Sandia Laboratories, Albuquerque, N. Mex.). *Applied Physics Letters,* vol. 37, Oct. 1, 1980, p. 637-639. Contract No. DE-AC04-76DP-00789.

A simple technique for the measurement of the series resistance of concentrator solar (photovoltaic) cells is described. This technique makes use of the fact that the 'short circuit' current of a solar cell as a function of light intensity will begin to saturate at an intensity determined by the series resistance of the cell and circuit. In this region the series resistance of the cell can easily be found from a measurement which is relatively independent of illumination intensity and spectrum. Experimental data are presented that verify this result. (Author)

A81-10271 **Textured thin-film Si solar selective absorbers using reactive ion etching.** H. G. Craighead, R. E. Howard, and D. M. Tennant (Bell Telephone Laboratories, Inc., Holmdel, N.J.). *Applied Physics Letters,* vol. 37, Oct. 1, 1980, p. 653-655. 12 refs.

Solar selective surface photothermal absorbers consisting of thin-film Si with a submicron surface texture have been produced by reactive ion etching an evaporated Si film on a Mo layer. Such surfaces formed on 316 stainless steel and other substrates have solar absorptivities of 0.9 and calculated thermal emissivities of about 0.2 at 200 C. These selective surfaces are stable in air to 500 C. (Author)

A81-10492 * **Apparent luminosity of solar power satellites.** L. E. Livingston (NASA, Johnson Space Center, Houston, Tex.). *Space Solar Power Review,* vol. 1, no. 3, 1980, p. 175-190. 6 refs.

The objective of this investigation was a quantitative characterization of solar power satellite luminosity as seen from the earth. The reflective characteristics of the reference photovoltaic satellite configurations are defined. Diffuse reflection from a single satellite will, at maximum, fall between magnitudes -4 and -5. A 60-satellite fleet will have a maximum total luminosity equivalent to a single object of magnitude -9. Specular reflections from the array and antenna will be of magnitude -12 to -15, but visible only occasionally for about 2 minutes at a given location. Methods of preventing specular reflections from striking the earth are presented. Thermal cycle power conversion systems are discussed qualitatively as a means of reducing diffuse luminosity. (Author)

02 SOLAR ENERGY

A81-10757 **Solar energy conversion by photoelectrochemical cells using chemical-bath-deposited CdS films.** S. Chandra, R. K. Pandey, and R. C. Agrawal (Banaras Hindu University, Varanasi, India). *Journal of Physics D - Applied Physics,* vol. 13, Sept. 14, 1980, p. 1757-1760. 8 refs.

Two solar cell configurations based on CdS films chemical-bath-deposited on titanium or stainless steel substrates have been tested: (1) CdS/Ti - electrolyte - Pt and (2) CdS/stainless steel - electrolyte - Pt. The values of open circuit voltage and the short circuit current are 240 mV and 0.28 mA/sq cm for cell 1, and 205 mV and 0.18 mA/sq cm for cell 2, respectively, at 100 mW/sq cm illumination from a tungsten lamp. The maximum derivable power from these cells is 21 microwatt/sq cm and 12 microwatt/sq cm, respectively. The performance of the cells is comparable to that of cells using spray deposited CdS films. V.L.

A81-10852 **Solar heating and the electric utilities.** M. A. Maidique (Harvard University, Cambridge, Mass.) and B. Woo. *Technology Review,* vol. 82, May 1980, p. 25-33. 18 refs.

The article considers the effect of widespread use of solar thermal systems on the role of electric utilities, emphasizing the foreseen short term economic problems. While the average electricity demand will be reduced, infrequent high demand peaks could occur when on nights and certain days, solar users with inadequate storage capacity are forced to depend upon conventional energy sources. Since utility costs are closely related to changes in peak demands, the modification of electricity rate structures as a load management technique is discussed. Some advantages of wide solar energy application for electric utilities are cited including the possibility of their key role in the development of solar heating. A.C.W.

A81-11030 **Ga/x/In/1-x/P /n/ /x between 0 and 1/ semiconducting alloys studies in photoelectrochemical cells.** A. M. Redon and J. Vigneron (CNRS, Laboratoire d'Electrochimie Interfaciale, Meudon, Hauts-de-Seine, France). *(Electrochemical Society, Meeting, Boston, Mass., May 6-11, 1979.) Electrochemical Society, Journal,* vol. 127, Nov. 1980, p. 2347-2351. 28 refs. Délégation Générale à la Recherche Scientifique et Technique Contract No. 65-01617.

The Ga(x)In(1-x)P (n) (x between 0 and 1) alloys are very interesting semiconducting compounds for solar energy conversion purposes as their bandgaps vary from 1.30 to 2.25 eV. Studies are performed in acidic pH (approximately equal to 1) (0.5M KCl plus 0.1M HCl), as the photocurrents observed are only stable in this medium. Photodecomposition gives rise to the formation of In (OH)3 and Ga (OH)3 which are soluble products at low pH, but insoluble at higher pH. A maximum efficiency is obtained with the reducing agent Fe(2 plus). This result was interpreted as depending on the relative positions of the bands. A maximum efficiency was also observed for the composition x equals 0.36 in all the media investigated. This was interpreted as a change in the different parameters of the alloys. (Author)

A81-11102 * **A unifying study of tandem-junction, front-surface-field, and interdigitated-back-contact solar cells.** J. G. Fossum, A. Neugroschel, and F. A. Lindholm (Florida, University, Gainesville, Fla.). *Solid-State Electronics,* vol. 23, Nov. 1980, p. 1127-1138. 23 refs. Research supported by the Solar Energy Research Institute, U.S. Department of State, and NASA.

A81-11103 **Surface recombination effects in an improved theory of a p-type MIS solar cell.** P. T. Landsberg and C. M. Klimpke (Southampton, University, Southampton, England). *Solid-State Electronics,* vol. 23, Nov. 1980, p. 1139-1145. 12 refs. NATO-supported research.

A model of a p-type Schottky barrier solar cell with an insulating interfacial layer is described. It takes into account a constant distribution of interfacial states, and the electron quasi-Fermi level is able to rise above the Fermi level in the metal when the device is illuminated. The theory, described for the first time, is an improvement on that previously available. It is applied to an evaluation of the effect of the recombination coefficients for the surface states on the device performance. Device performance was found to depend fairly subtly on the relative magnitudes of the trap-conduction band and the trap-valence band recombination coefficients. (Author)

A81-11105 **The impact of molybdenum on silicon and silicon solar cell performance.** A. Rohatgi, R. H. Hopkins, J. R. Davis, R. B. Campbell (Westinghouse Research and Development Center, Pittsburgh, Pa.), and H. C. Mollenkopf (Hemlock Semiconductor Corp., Hemlock, Mich.). *Solid-State Electronics,* vol. 23, Nov. 1980, p. 1185-1190. 20 refs. Research sponsored by the U.S. Department of Energy.

Deep level transient spectroscopy coupled with dark and lighted I-V measurements were used to study the electrical properties of silicon crystals and solar cells purposely contaminated with controlled amounts of molybdenum. Mo severely degrades minority carrier lifetime, and hence solar cell performance, by inducing a recombination center at Ev + 0.30 eV. Neither HCl nor POCl3 gettering at temperatures as high as 1100 C and times up to five hours mitigate the effects of Mo. Because the Mo segregation coefficient is small, 4.5 x 10 to the -8th, impurity contamination of silicon during crystal growth can be kept below the levels for which electrical properties are affected. (Author)

A81-11317 **Measurement of diffusion length in CuInSe2 and CdS by the electron beam induced current method.** J. Piekoszewski, J. J. Loferski, J. Beall (Brown University, Providence, R.I.), W. Giriat (Instituto Venezolano de Investigaciones Cientificas, Caracas, Venezuela), and L. Castaner. *Journal of Applied Physics,* vol. 51, Oct. 1980, p. 5375-5379. 10 refs. Research supported by the Solar Energy Research Institute; NSF Grant No. INT-77-23753.

The minority-carrier diffusion length L(e) for electrons in p-CuInSe2 was determined by analyzing the magnitude of the electron beam induced current as a function of distance from the p/n junction in an n-CdS/p-CuInSe2 solar cell whose solar energy conversion efficiency was about 8%. Data obtained for electron beam energies of 10, 20, and 30 keV showed that L(e) was at least 0.92 micron. Analysis of the data in terms of a model in which the injection process is approximated by a point source results in a value of L(e) of about 2.5 microns and a surface recombination velocity of about 1.4 x 10 to the 6th cm/sec on an as-cut surface. The analysis leads to the inference that the 'point source' is located at a depth equal to about 0.06 times the electron range below the surface on which the beam is incident. (Author)

A81-11355 **Novel materials and devices for sunlight concentrating systems.** H. J. Hovel (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). *Materials in Engineering,* vol. 2, Sept. 1980, p. 45-51. 38 refs.

An economic analysis of photovoltaic conversion under concentrated sunlight has been performed which demonstrates that solar cell efficiency, concentrator efficiency, and concentrator cost are the most important parameters in a concentrating photovoltaic system; solar cell cost is only of secondary importance. Six novel structures are described, including modified conventional Si cells Ga(1-x)Al(x)As/GaAs, interdigitated cells, vertical and horizontal multijunction cells and 'multicolor' devices. (Author)

A81-11543 **Central Receiver Test Facility, Albuquerque, New Mexico.** C. E. Moeller (Black and Veatch, Kansas City, Mo.), T. D. Brumleve (Sandia Laboratories, Livermore, Calif.), C. Grosskreutz (Solar Energy Research Institute, Golden, Colo.), and L. O. Seamons (Sandia Laboratories, Albuquerque, N. Mex.). *Solar Energy,* vol. 25, no. 4, 1980, p. 291-302. 8 refs.

The Central Receiver Test Facility (CRTF) was constructed at Albuquerque, NM for the U.S. Dept of Energy (DOE) and is operated by Sandia Laboratories. A primary goal of the CRTF is to provide experimental engineering data for the design, construction, and operation of receivers and other components for proposed large scale, solar powered, electrical generation or process heat plants. A secondary goal is to provide a solar test facility for evaluating concepts and processes in high-temperatue technology. The basic concept philosophy is outlined for the facility and defines the capabilities of the CRTF. A general description of the facility is given with details of all support systems; the tower, the heliostat array, the control building with its computer control and data acquisition systems, and the meteorology station and tower. Maximum energy delivery is 6.5 MW thermal so that 5 MW can be provided under a reasonable range of conditions. Operating tests with a working receiver absorbing over 1 MW of thermal energy are summarized. Present and future tests are outlined with a listing of proposed high-temperature experiments by university and industrial investigators. Tests completed include evaluation of a 1 MW air reciever and a 3 MW steam generating receiver. (Author)

A81-11545 **Design and test of non-evacuated solar collectors with compound parabolic concentrators.** A. Rabl, J. O'Gallagher, and R. Winston (Chicago, University, Chicago, Ill.). *Solar Energy,* vol. 25, no. 4, 1980, p. 335-351. 21 refs. Contract No. EY-77-S-02-2446.

The design, construction and testing of two prototype non-evacuated compound parabolic concentrator (CPC) solar collectors with concentration ratios of 6.5 and 3.0 are discussed. Considerations of heat losses, heat transfer into the reflector structure and the placement of the absorber relative to the reflector lead to the selection of a panel of seven CPC troughs with tube absorbers of diameter 0.64 and 0.79 cm, resulting in concentration ratios of 6.5 and 5.2, respectively, and a two-trough vertical fin CPC module for the 3X concentrator intended for heating applications. Results of measurements of collector performance as indicated by operating efficiency and the angular acceptance properties are presented which are in good agreement with calculations and predictions derived from preliminary measurements of optical properties, heat loss and stagnation temperature. The CPC collectors are also found to outperform typical double and single glazed flat plate collectors above temperatures 10 C above ambient for the 5.2X collector and 35 C above ambient for the 3X. The low cost potential of the CPC prototypes is also pointed out. A.L.W.

A81-11546 **Solar gasification of coal, activated carbon, coke and coal and biomass mixtures.** D. W. Gregg, R. W. Taylor, J. H. Campbell, J. R. Taylor, and A. Cotton (California, University, Livermore, Calif.). *Solar Energy,* vol. 25, no. 4, 1980, p. 353-364. 5 refs. Contract No. W-7405-eng-48.

The gasification of subbituminous coal, activated carbon, coke and a mixture of coal and biomass by direct solar irradiation in a solar furnace is investigated. Sunlight concentrated by a 23-kW solar furnace was focused directly on the fuel being gasified in a gravity-fed gasifier through a window in the reactor, and steam or CO2 was passed through the bed to react with the fuel and form a combustible product gas. Experiments performed with coal and steam resulted in the conversion of more than 40% of the sunlight arriving at the reactor focus into chemical fuel, with production rate increasing with solar power and product gas composition and thus gas heating value remaining constant. A typical moisture-free gas composition obtained consists of 54% H2, 25% CO, 16% CO2, 4% CH4 and 1% higher hydrocarbons. Experiments with activated carbon and a uniform mixture of coal and biomass resulted in similar conversion efficiencies but slightly different product gas compositions, while coke showed a lower efficiency. Advantages of solar gasification over conventional oxygen-biown gasifiers are indicated. A.L.W.

A81-11547 **Solar simulator.** W. Pekruhn and R. Germer (Berlin, Technische Universität, Berlin, West Germany). *Solar Energy,* vol. 25, no. 4, 1980, p. 381-383.

A solar simulator lamp has been designed to overcome the difficulties associated with the xenon high-pressure lamp in the simulation of the solar spectrum and intensity in the development of solar energy conversion technology. The 250-W lamp has a spectrum more similar to that of the sun as seen from the earth's surface than does a xenon lamp, with deviations mainly at wavelengths from 800-1000 nm, 530 nm and below 450 nm. This spectrum can be corrected by the use of an absorbing filter, a heat protection filter and an interference filter, which results in a spectrum which is a good approximation to the solar spectrum. A light intensity of 6250 lx has been measured at a distance of 20 cm from the lamp, which may be increased to the solar intensity by the use of a lens. The lamp may be operated on either alternating or direct current. A.L.W.

A81-11549 **Schottky barrier at a Mo-GaAs contact.** P. M. Batev (B'lgarska Akademiia na Naukite, Institut po Fizika na Tv'rdoto Tialo, Sofia, Bulgaria), M. D. Ivanovitch, E. I. Kafedjiiska, and S. S. Simeonov. *International Journal of Electronics,* vol. 48, June 1980, p. 511-517. 13 refs.

Schottky barrier structures have been prepared by chemical vapor deposition of molybdenum (MoCl5 reaction with H2 at 500 C) on a GaAs substrate. It is shown that the Mo-GaAs contact has near-ideal properties: the value of n is close to unity, and the barrier height deduced from I-V and C-V measurements is identical. Heat treatment of the Mo-GaAs structures at 100, 200, and 300 C did not alter their I-V and C-V characteristics, which indicates that the Mo-GaAs structure is more stable than the commonly used AuGaAs and Pt-GaAs Schottky barrier contacts. V.L.

A81-12385 **A comparison of the interface energetics for n-type cadmium sulfide/ and cadmium telluride/nonaqueous electrolyte junctions.** A. Aruchamy and M. S. Wrighton (MIT, Cambridge, Mass.). *Journal of Physical Chemistry,* vol. 84, Oct. 30, 1980, p. 2848-2854. 21 refs. Research supported by the U.S. Department of Energy.

The interface energetics of n-type CdS and CdTe in electrolyte solutions containing various, fast, one-electron redox couples differing in formal potential are compared. Cyclic voltammograms were obtained for the redox couples at Pt and dark and illuminated n-type CdS and CdTe electrodes in quiet CH3CN/0.1 M (n-Bu4N)ClO4 solutions containing low concentrations of the redox reagents. Results indicate that n-type CdTe exhibits Fermi level pinning for redox couples with potentials from -2.0 to +0.7 V vs. SCE. A nearly constant output voltage of 0.6 V is obtained which is comparable to those of n-type CdTe/metal Schottky barriers and n-type GaAs proposed for use in solar energy conversion devices. The CdS photoanode, on the other hand, is found to behave as a semiconductor essentially free of surface states, with a photovoltage only observed at redox potentials greater than the flat-band potential of -1.0 V vs. SCE. Although, due to its high bandgap, CdS is not suitable as a photoanode, comparisons of the behavior of semiconductor/liquid interfaces with those of Schottky barriers reveals no differences in barrier energetics. A.L.W.

A81-12593 **Thermal performance of a south facing wall as solar collector storage system.** A. Srivastava, A. Kumar, and G. N. Tiwari (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research,* vol. 4, Oct.-Dec. 1980, p. 309-316.

A81-12594 **Photothermal performance of selective black nickel coatings.** P. K. Gogna, K. L. Chopra, and S. C. Mullick (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research,* vol. 4, Oct.-Dec. 1980, p. 317-322. 12 refs.

Selective black nickel coatings with solar absorptance 0.94 and thermal emittance 0.08 at 100 C have been developed on galvanized steel using electroplating and chemical conversion techniques. Thermal performance tests have been conducted on selective and nonselective collectors with a single glass cover. A suitable collector test assembly has been constructed for thermal performance study. Measurements have been made under clear sky conditions over a wide range of inlet temperatures. For comparison, measurements have been carried out on an identical collector painted black. Thermal efficiencies of about 28% at an operating water temperature of approximately 100 C, ambient temperature of approximately 35 C and incident insolation of approximately 1000 W/sq m have been obtained. (Author)

A81-12595 **Physics of shallow solar pond water heater.** M. S. Sodha, J. K. Nayak, and S. C. Kaushik (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research,* vol. 4, Oct.-Dec. 1980, p. 323-337. 11 refs.

A81-12596 **Photogalvanic effect in riboflavin-ethylenediaminetetraacetic acid system.** A. S. N. Murthy, H. C. Dak, and K. S. Reddy (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research,* vol. 4, Oct.-Dec. 1980, p. 339-343. 9 refs.

The photogalvanic cell making use of the photoreduction of riboflavin with ethylenediaminetetraacetic acid has been examined. Appreciable photoinduced voltage has been observed. The photoinduced current is, however, low. The estimated sunlight engineering efficiency has been estimated to be approximately 0.018%. (Author)

A81-12922 **Vacuum deposited selective absorber coatings for solar receivers.** J. A. Thornton (Telic Corp., Santa Monica, Calif.). *SAMPE Quarterly,* vol. 12, Oct. 1980, p. 33-38. 31 refs.

Vacuum processing and sputtering applications for medium temperature solar collectors are promising because of the large area capability of these processes. The flat plate and the solar concentrating collectors are classified according to their operating temperatures; an analysis of the overall collector energy balance shows that the performance of low and intermediate temperature collectors can be improved by coatings. The selective absorber coating configuration is examined, and the microstructure of sputter-deposited coatings for solar applications is described. Finally, the batch-type production coating equipment for tubular collectors is depicted, and hemispherical reflectance is plotted vs wavelength for sputter-deposited Al_2O_3-Mo-Al_2O_3 coatings. A.T.

A81-13139 **Efficiency calculations for thin-film polycrystalline semiconductor p-n junction solar cells.** C. Lanza and H. J. Hovel (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). *IEEE Transactions on Electron Devices,* vol. ED-27, Nov. 1980, p. 2085-2088. 12 refs.

Numerical calculations have been made of the effect of grain size on the short-circuit current and the AM1 efficiency of polycrystalline thin-film GaAs and InP (2 microns thick) and silicon (25 microns thick) p-n junction solar cells. Junction solar cells are seen to be more efficient than Schottky-barrier cells, due to the higher dark current associated with Schottky diodes. GaAs shows the highest efficiency, and both GaAs and InP attain 90 percent of their maximum efficiencies at a grain size of 10 microns, while silicon requires grain sizes of 200 microns to attain 90 percent of maximum efficiency. However, the deleterious effect of poor lifetimes and mobilities is less for silicon polycrystalline cells than for the direct-bandgap devices. (Author)

A81-13143 **Nondestructive SEM measurement of minority-carrier transport parameters of Cu/x/S/CdS solar cells as a function of heat treatment.** L. D. Partain, G. A. Armantrout, and D. Okubo (California, University, Livermore, Calif.). *IEEE Transactions on Electron Devices,* vol. ED-27, Nov. 1980, p. 2127-2133. 33 refs. Contract No. W-7405-eng-48.

A81-13144 **Tunneling currents in the copper sulfide/cadmium sulfide heterojunction.** W. G. Haines (Thin Film Specialists, Santa Clara, Calif.) and R. H. Bube (Stanford University, Stanford, Calif.). *IEEE Transactions on Electron Devices,* vol. ED-27, Nov. 1980, p. 2133-2140. 20 refs. Research supported by the U.S. Department of Energy.

Experimental studies of parameters controlling the photovoltaic properties of the Cu_2S/CdS solar cell are presented. It is shown that deep levels can greatly increase tunneling currents by producing large electric fields near the interface and by shortening the required tunneling distance. They can also act as interface recombination centers and cause a reduction in the short-circuit current. The deep donor-like levels in CdS appear to be due to junction formation and cause the low open-circuit voltages observed before heat treatment. With heat treatment, copper diffuses into the CdS and forms acceptor levels that compensate the deep donors. B.J.

A81-13190 **Conditions and requirements for a potential application of solar power satellites /SPS/ for Europe.** W. Westphal, J. Ruth (Berlin, Technische Universität, Berlin, West Germany), and D. Kassing (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands). *British Interplanetary Society, Journal (Space Technology),* vol. 33, Dec. 1980, p. 411-418.

The potential problems of a future introduction of Solar Power Satellites (SPS) as baseload power plants for Western European countries are considered, emphasizing the differences of SPS utilization in Europe compared with that in the USA as a result of geographical, orbital organizational, and industrial conditions. If estimated SPS safety zone areas are required, then the SPS system incorporating the 2.45 GHz microwave power transmission appears crucial for utilization in Western Europe in order to eliminate the large rectenna area requirements of an SPS 5 GW power system. A frequency variation of up to 5 or 10 GHz, and the application of either laser power transmission or solid state devices which could alleviate rectenna siting problems and restrictions on the use of the geosynchronous orbit are discussed. A.C.W.

A81-13746 **Solar cells.** F. C. Treble. *IEE Proceedings, Part A - Physical Science, Measurement and Instrumentation, Management and Education, Reviews,* vol. 127, pt. A, no. 8, Nov. 1980, p. 505-527. 80 refs.

The history, state of the art, and future prospects of solar cells are reviewed. Solar cells are already competitive in a wide range of low-power applications, and during the 1980's they are expected to become cheaper to run than diesel or gasoline generators, the present mainstay of isolated communities. At this stage they will become attractive for water pumping, irrigation, and rural electrification, particularly in developing countries. With further cost reduction, they may be used to augment grid supplies in domestic, commercial, institutional, and industrial premises. Cost reduction to the stage where photovoltaics becomes economic for large-scale power generation in central stations depends on a technological breakthrough in the development of thin-film cells. DOE aims to reach this goal by 1990, so that by the end of the century about 20% of the estimated annual additions to their electrical generating capacity will be photovoltaic. F.G.M.

A81-13834 **Thermal-electric performance analysis for actively cooled, concentrating photovoltaic systems.** M. J. O'Leary and L. D. Clements (Texas Tech University, Lubbock, Tex.). *Solar Energy,* vol. 25, no. 5, 1980, p. 401-406. 11 refs.

The photovoltaic cell within a composite stack of the receiver for a concentrating photovoltaic electrical power system is modelled as a combination electricity and waste heat generator. The waste heat generator concept leads to analytical solutions describing temperature and power production profiles for the photovoltaic receiver. The analytical solutions considered the cases where convective losses to the surroundings may either be neglected or included. Examples of operating modes using the model are given. (Author)

A81-13835 **Thermal performance of the distributed flow, subatmospheric pressure, flat plate solar collector.** T. F. Smith, P. A. Jensen, and D. L. Spencer (Iowa, University, Iowa City, Iowa). *Solar Energy,* vol. 25, no. 5, 1980, p. 429-436. 15 refs.

Experimental thermal efficiencies for the distributed flow, subatmospheric pressure, flat plate solar collector are reported for a wide range of environmental and operational conditions, and for corrugated Filon and glass covers. Efficiencies for near normal solar incidence are correlated with a parameter formed from the difference between inlet fluid and air temperatures divided by incident solar energy. A mathematical model based on heat transfer concepts applicable to the collector yielded efficiencies which are in close agreement with the corresponding experimental efficiencies when the experimental measurements are inserted into the model. (Author)

A81-13836 **Solar storage systems using salt hydrate latent heat and direct contact heat exchange. I - Preliminary design considerations.** A. E. Fouda, G. J. G. Despault, J. B. Taylor, and C. E. Capes (National Research Council, Div. of Chemistry, Ottawa, Canada). *Solar Energy,* vol. 25, no. 5, 1980, p. 437-444. 20 refs.

The operating characteristics of a salt hydrate latent heat storage system, using Glauber's salt and direct contact heat exchange through an immiscible heat transfer fluid, have been studied theoretically. Drop dynamics and heat transfer models from the literature were used to predict the system behavior for a range of conditions involving heat transfer fluid inlet temperature and drop size, composition and crystallization temperature of the salt and vessel contact height. The results of these calculations are used to guide the specification of an approx. 1/10 scale pilot heat storage unit which has been constructed and operated successfully. (Author)

A81-13837 **The two-solarimeter method for insolation on inclined surfaces.** B. Steinmüller (Philips GmbH, Forschungslaboratorium, Aachen, West Germany). *Solar Energy,* vol. 25, no. 5, 1980, p. 449-460. 9 refs.

A two-solarimeter method is presented that offers an alternative way of determining the insolation data on inclined surfaces. It is shown how the two-solarimeter method for a horizontal surface can be optimized in combination with a correlation procedure. For vertical surfaces, which are of special interest in the determination of the solar contribution to the energy requirement of buildings, it has been shown that the deviations between calculated and measured global values are within the error limit. The method uses equations developed for the efficiency of a solar pond and the optimum depth of the boundary between the insulating and storage zones. A comparison is made between theory and experimental results. S.S.

A81-13838 **The influence of the extinction coefficient on the effectiveness of solar ponds.** M. N. A. Hawlader (University College, Cardiff, Wales). *Solar Energy,* vol. 25, no. 5, 1980, p. 461-464. 10 refs. Research supported by the Science Research Council.

A81-13839 **Temperature-dependent collector properties from stagnation measurements.** J. M. Gordon, D. Govaer, and Y. Zarmi (Negev, University, Sede Boger, Israel). *Solar Energy,* vol. 25, no. 5, 1980, p. 465, 466. Research supported by the Ministry for Immigrant Absorption of Israel.

Experiments are discussed which examine the dependence of a collector heat loss coefficient on plate temperature. It is shown that stagnation-point measurements for flat-plate solar collectors can provide a direct measurement of the temperature dependence of the heat loss coefficient. Both experimental results and theoretical calculations indicate a 20-30 per cent change in a heat loss coefficient with temperature in the temperature range from 30 to 40 C. S.S.

A81-13840 **A simple method to establish salt gradient solar ponds.** F. Zangrando (New Mexico, University, Albuquerque, N. Mex.). *Solar Energy,* vol. 25, no. 5, 1980, p. 467-470. 5 refs. Research supported by the U.S. Department of Energy.

A technique is presented for establishing a salinity gradient for salt gradient solar ponds. The procedure consists of partially filling the pond with high salinity brine; fresh water is then pumped through a diffuser which is immersed in the upper portion of the existing solution. The technique does not require additional storage tanks and may be applicable to ponds of any size. The same equipment, with a different procedure, can be applied to modify an existing gradient, thus simplifying operation and maintenance of a solar pond. S.S.

A81-13841 **The use of sodium sulfate in solar ponds.** J. Mangussi, G. Lesino (Salta, Universidad Nacional, Salta, Argentina), and L. Saravia (Salta, Universidad Nacional, Salta; Comisión Nacional de Investigaciones Espaciales, Buenos Aires, Argentina). *Solar Energy,* vol. 25, no. 5, 1980, p. 475-477. Research supported by the Secretaría de Ciencia y Tecnología.

Experiments performed in a small surface saturated solar pond model, under several conditions of temperature and concentration for a period of 1 year, are described. Concentration profiles of the pond are discussed. Some recommendations regarding the maintenance of the pond have been worked out and at present, a pond with a mixed solution of Na_2SO_4 and NaCl is being studied. S.S.

A81-14229 # **Design and performance of a lakewater-to-water solar boost heat pump system in a large residence in the Midwest.** G. E. Clark (Indiana University; Purdue University, Indianapolis, Ind.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 190-194.

A hand-built lakewater-to-water heat pump with a wet-type solar boost has been in operation in an Indiana residence for nearly two years. Reasons for selection of this system, design and installation problems, and solutions for unexpected difficulties are discussed. (Author)

A81-14230 # **Energy analysis of an existing solar assisted heat pump installed in a mid-Missouri residence.** D. W. Schulte, A. Charles, and R. H. Howell (Missouri-Rolla, University, Rolla, Mo.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 195-203.

This paper summarizes a simulation study performed on an actual solar heat supplemented residence. The effects of the solar heating system, and variations in parameters of the residence and the solar heating system, are investigated. A comparison of the actual system to total electric heat by the model predicted a savings of 29% in kWh (27% in dollars) while the measured savings were 27% in kWh (26% in dollars). (Author)

A81-14231 # **The electrical and optical characterization of semiconducting materials for photovoltaic utilization.** J. L. Boone, T. Van Doren, R. D. Engelken, G. J. Seiter (Missouri-Rolla, University, Rolla, Mo.), and P. L. Cole. In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy. Rolla, Mo., October 16-18, 1979. Volume 6.
Rolla, Mo., University of Missouri-Rolla, 1980, p. 310-312. 19 refs.

Optical and electrical parameters essential for photovoltaic materials are identified and their relationship to solar cell performance is discussed. These parameters include energy gap, reflection coefficient, transmission coefficient, absorption coefficient, and the mobility and lifetime of charge carriers. Techniques for measuring these parameters are examined, and results obtained for BAs and CdTe are briefly discussed. V.L.

A81-14232 # **Economic evaluation of design options for a 20 kW photovoltaic power system.** A. S. M. Masud (New Mexico Solar Energy Institute, Las Cruces, N. Mex.). In: Energy alternatives:

An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979., Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 313-318. Contract No. DE-AC04-79ET-23062.

Economic evaluation necessary to select the optimum design of a 20 kW photovoltaic power system for an Uninterruptible Power Supply Load in El Paso, Texas, is described in this paper. The economic criterion used to select the desired alternative was Levelized Busbar Energy Cost (BBEC). The first step in the design process was to generate design alternatives by various combinations of possible subsystem design options. Next, nonpromising alternatives were eliminated in a series of prior tentative analyses using 'soft' data. This reduced set of alternatives were then tested for 'nondominance'. Finally, all nondominated alternatives were ranked using BBEC. (Author)

A81-14234 # The potential of combined wind-solar energy conversion systems for electric utility capacity displacement. L. Icerman, K. Myers, and A. Swift (Washington University, St. Louis, Mo.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 399-406. 11 refs.

An hourly computer simulation model is developed to evaluate the performance of commercial-scale combined wind-solar systems and to make comparisons with simulated performance data for solar-only systems. A major feature of the model is the capability to conduct a first-order assessment of the potential for electric utility capacity displacement by the introduction of combined wind-solar systems. (Author)

A81-14235 # Wind and solar energy combination for agricultural applications in South Dakota. L. R. Verma (Louisiana State University, Baton Rouge, La.) and M. A. Hellickson (South Dakota State University, Brookings, S. Dak.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 407-412.

A81-14620 An improved model of solar cells based on In2O3/SnO2-SiO/x/-nSi. A. I. Malik, V. B. Baraniuk, and V. A. Manasson (Akademiia Nauk Ukrainskoi SSR, Institut Prikladnykh Problem Mekhaniki i Matematiki, Chernovtsy, Ukrainian SSR). *(Geliotekhnika,* no. 1, 1980, p. 3, 4.) *Applied Solar Energy,* vol. 16, no. 1, 1980, p. 1-3. Translation.

A81-14621 Analysis of thermal losses - Some ways of improving the efficiency of solar thermoelectric generator /STEG/ panels. I. I. Kokhova, Iu. N. Malevskii, and A. I. Tsvetkov (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). *(Geliotekhnika,* no. 1, 1980, p. 5-11.) *Applied Solar Energy,* vol. 16, no. 1, 1980, p. 4-10. 9 refs. Translation.

Ways to improve the efficiency of solar thermoelectric generators by reducing heat losses are discussed. Different heat transfer conditions are examined: single and double layer glass coatings, selective coatings on the collector, ordinary and vacuum-type heat insulation, and air and water cooling. B.J.

A81-14622 Calculation of angular error of cylindrical solar concentrator using sheet material. M. A. Markman, L. M. Simanovskii, and O. P. Zakharova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *(Geliotekhnika,* no. 1, 1980, p. 15-18.) *Applied Solar Energy,* vol. 16, no. 1, 1980, p. 14-17. Translation.

A81-14623 Geometric and kinematic characteristics of heliostats for a tower-type solar power plant. R. R. Aparisi, D. I. Tepliakov, and B. G. Khantsis (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). *(Geliotekhnika,* no. 1, 1980, p. 19-25.) *Applied Solar Energy,* vol. 16, no. 1, 1980, p. 18-25. 5 refs. Translation.

Equations for the geometric and kinematic characteristics of solar-tower heliostats are obtained and used for the direct calculation (based on the method of angular coordinate determination) of the positions of typical heliostats. Velocities of the azimuth and zenith rotations of heliostats are determined. B.J.

A81-14624 Electronic aberration-pattern recorder. R. A. Zakhidov (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). *(Geliotekhnika,* no. 1, 1980, p. 26-29.) *Applied Solar Energy,* vol. 16, no. 1, 1980, p. 26-29. Translation.

The electronic aberrogram recorder (EAR) is an optoelectronic device designed for monitoring the operation of solar concentrators. The device is used to record the point of incidence of light beams reflected by the concentrator; this is accomplished by the transformation of incidence-point coordinates into voltages, that can be viewed on an oscillograph or plotted. Particular attention is given to an EAR system which uses a photodiode array as the photosensitive surface. B.J.

A81-14625 Investigation of light-absorbing coatings produced by joint condensation of vapors of a metal and a dielectric. U. Kh. Gaziev, Sh. A. Faiziev, V. V. Li, and V. S. Trukhov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *(Geliotekhnika,* no. 1, 1980, p. 30-32.) *Applied Solar Energy,* vol. 16, no. 1, 1980, p. 30-32. 6 refs. Translation.

The paper examines metal/dielectric light-absorbing coatings (for use on solar collectors) prepared by thermal vapor deposition in high vacuum. Results on spectral reflectance were obtained for the following materials (in the dielectric to metal concentration ratio range from 3:1 to 1:3): SiO2-Ni, CeO2-Ni, and SiO2-Cr. The study showed that the light-absorbing properties of the coatings are stable to temperatures of 400 C. B.J.

A81-14626 Some test results for a solar turbogenerator. A. K. Alimov, L. M. Drabkin, G. Ia. Umarov, and P. U. Khatamov (Vsesoiuznyi Zaochnyi Institut Inzhenerov Zheleznodorozhnogo Transporta, Moscow, USSR; Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *(Geliotekhnika,* no. 1, 1980, p. 36-38.) *Applied Solar Energy,* vol. 16, no. 1, 1980, p. 36-38. Translation.

The dynamic characteristics of a full-scale solar turbogenerator were obtained for a direct solar radiation power of 650 W/sq m, a maximum collector-wall temperature of 423 C, and an air flowrate of 0.03 kg/sec. Specifically, attention was given to the dependence of the number of rotations on the temperature of the working fluid, and to transient temperatures in the generator. B.J.

A81-14627 Using solar-energy storage units for heating and refrigeration service. A. Davletov, A. A. Petrova, and F. A. Guseinova (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *(Geliotekhnika,* no. 1, 1980, p. 39-43.) *Applied Solar Energy,* vol. 16, no. 1, 1980, p. 39-43. Translation.

The paper examines the development of solar heat storage systems for the heating and cooling of houses in desert regions (the Turkmenian SSR is considered as an example). The choice of heat storage materials is considered (the advantages of paraffin are emphasized), and the thermodynamic properties of the materials are examined. B.J.

A81-14628 Selection of cycle design parameters for solar ejector freon refrigeration machine /SEFRM/. S. Z. Zhadan and N. A. Shchetinina (Odesskii Tekhnologicheskii Institut Kholodil'noi Promyshlennosti, Odessa, Ukrainian SSR). *(Geliotekhnika,* no. 1, 1980, p. 44-47.) *Applied Solar Energy,* vol. 16, no. 1, 1980, p. 44-47. Translation.

A method for calculating the cycle parameters of a solar air conditioning system of ejector type is described; calculations are made for solar radiation conditions typical of Odessa in July. A combined analysis of the efficiencies of the solar and cooling parts of the system is used to determine the optimal temperature of the working fluid. B.J.

A81-14629 **Development of a combination solar heat-supply system using a heat pump for the conditions of the Crimea.** S. I. Smirnov and A. S. Troshin (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). *(Geliotekhnika,* no. 1, 1980, p. 75-80.) *Applied Solar Energy,* vol. 16, no. 1, 1980, p. 73-78. 9 refs. Translation.

The feasibility of developing solar-assisted heat pump systems for Crimean conditions is examined. Particular consideration is given to a solar heating system with flat-plate collectors and a compression-type heat pump; a diagram of the system is provided and the basic parameters are examined. B.J.

A81-14818 **Solar battery based on semiconductor-dielectric-semiconductor structures for ground-based applications.** A. I. Malik, V. B. Baraniuk, V. A. Manasson, and K. D. Tovstiuk. *(Pis'ma v Zhurnal Tekhnicheskoi Fiziki,* vol. 6, Jan. 1980, p. 76-79.) *Soviet Technical Physics Letters,* vol. 6, Jan. 1980, p. 34, 35. 7 refs. Translation.

A81-14891 **A new apparatus for multilayer growth by chemical vapor deposition - The sliding-boat close-spaced technique.** A. Yoshikawa, S. Yoshihara, H. Kasai, and M. Nishimaki (Chiba University, Chiba, Japan). *Applied Physics Letters,* vol. 37, Oct. 15, 1980, p. 732-734.

A new apparatus for multilayer growth by chemical vapor deposition, the sliding-boat close-spaced technique (SBCST), is presented. The structure of the SBCST growth apparatus is quite similar to that of the conventional liquid phase epitaxy sliding boat. The possibility of obtaining thin multilayer films by SBCST is shown. Preliminary experimental results for its application to the growth of n-CdS/p-InP heterojunction solar cells are also shown. (Author)

A81-15034 **Stabilization of n-CdSe photoanodes in non-aqueous Fe/CN/6/3-/4-/ electrolytes.** R. Noufi, D. Tench, and L. F. Warren (Rockwell International Electronics Research Center, Thousand Oaks, Calif.). *Electrochemical Society, Journal,* vol. 127, Dec. 1980, p. 2709-2713. 19 refs. Research supported by the U.S. Department of Energy.

The development of a nonaqueous ferro-ferricyanide electrolyte for stabilization of n-CdSe photoanodes is described. Selection of the solvent is discussed in terms of inherent stability, the rate of the redox reaction, the tendency toward specific adsorption of the redox species, and the equilibrium potential of the redox couple with respect to the flatband potential. Results are presented for cells of the n-CdSe/methanol/Fe(CN)6(3-/4-)/Pt type which have been operated for up to 700 hr at 6 mA/sq cm with no detectable degradation in the electrode surface or the photoresponse. (Author)

A81-15035 **The chemical vapor deposition of polycrystalline InP.** M. Inuishi and B. W. Wessels (Northwestern University, Evanston, Ill.). *Electrochemical Society, Journal,* vol. 127, Dec. 1980, p. 2747-2750. 9 refs. NSF Grant No. DMR-76-80847.

Homogeneous InP polycrystalline thin films were chemical vapor deposited on Mo substrates at temperatures as low as 410 C. Films prepared below 500 C have a preferred (111) orientation; their grain size ranged from 6 to less than one micron depending on the deposition temperature. Kinetic studies show that the adsorption of required for slow dynamo action are clarified, and the relation between flux helicity and the usual vortex helicity is considered. B.J.

A81-15105 # **Design and performance of a new tubular flat plate solar collector.** J. Kishore, S. S. Mathur, and M. K. Sarkar (Indian Institute of Technology, Delhi, India). *Regional Journal of Energy, Heat and Mass Transfer,* vol. 1, July 1979, p. 239-241.

A flat plate solar collector of 0.78 sq m exposed area was built by arranging flattened aluminum tubes side by side and connecting them in series with rubber tubes. The top surface was coated with ordinary black paint, and the assembly was encased in a wooden box with top surface covered with sheet glass and sides insulated with glass wool. Experiments were conducted by passing water in a once-through manner by circulating water from an insulated storage drum. From the measurements of temperatures at the inlet, outlet and storage, water flow rates and solar insolation, efficiencies of collection were calculated. (Author)

A81-15117 # **A sensitivity study of a solar heated and cooled house.** W. Tanthapanichakoon and D. M. Himmelblau (Texas, University, Austin, Tex.). *Regional Journal of Energy, Heat and Mass Transfer,* vol. 2, Apr. 1980, p. 155-172. 10 refs. NSF-supported research.

A sensitivity analysis was made of a typical solar heated and cooled house to determine which parameters in the model representing the house were significant and which could be ignored. Each component of the house was represented by algebraic and/or differential equations. A computer code was prepared that could simulate almost any flat-plate solar house configuration by simply specifying the type of house, individual components of the heating and cooling system, and the information flow diagram for material and energy flows. Seventeen parameters were examined for both winter and summer operation. A ranking of the influence of the parameters on the solar energy collected and the supplementary energy required to operate the system is provided. (Author)

A81-15151 **The principle of thin film solar cells deposited by cathodic sputtering (Principe de cellules solaires en couches minces déposées par pulvérisation cathodique).** H. Murray, A. Piel, and J. Launey (Rouen-Haute Normandie, Université, Le Havre, France). *Solar Cells,* vol. 2, Oct. 1980, p. 87-99. 12 refs. In French.

The preparation of thin-film photovoltaic structures by means of cathodic sputtering, which results in reliable structures at low cost, is discussed. The physics of the photovoltaic effect is reviewed and it is pointed out that it is primarily the photoconduction gain which determines the photovoltaic output. The use of cathodic sputtering for the deposition of thin films with perfectly defined dielectric and electronic properties is considered, and results of laboratory studies defining a stabilization cycle including electrical stabilization under illumination to equilibrate the system and remove internal defects are presented. Various methods under investigation for increasing the energy efficiency of Al/ZnS/Au sandwich structures are described including those based on the deposition of dielectric films with a Fabry-Pérot optical resonance and of dielectric multilayers separated by a transparent conductive film. The utilization of sputtered sandwich structures in practical solar energy conversion systems is also discussed, with attention given to the arrangement of the cells and their encapsulation. A.L.W.

A81-15152 **Characterization of thermally diffused and ion-implanted semicrystalline silicon solar cells.** M. Finetti, P. Ostoja, S. Solmi, and Q. Zini (CNR, Istituto LAMEL, Bologna, Italy). *Solar Cells,* vol. 2, Oct. 1980, p. 101-107. 12 refs. Research supported by the Consiglio Nazionnale delle Ricerche.

Solar cells were fabricated on large-area semicrystalline silicon (Silso) and, for comparison, on electronic-grade monocrystalline silicon. Three different technological processes were adopted in order to obtain n+/p junctions: (1) ion implantation; (2) a standard one-step diffusion method; and (3) a two-step diffusion method. In each case Silso cells have air mass one efficiencies in the range 10.5 - 12%; in particular, the results obtained on ion-implanted semicrystalline cells seem very promising, considering that this fabrication process is highly reproducible and suitable for total automation. The efficiency values obtained on the semicrystalline samples were lower than those of the monocrystalline material and the reasons for this are examined and discussed. (Author)

02 SOLAR ENERGY

A81-15153 **Saturation current in solar cells - An analysis.** N. M. Ravindra (Roorkee, University, Roorkee, India). *Solar Cells,* vol. 2, Oct. 1980, p. 109-113. 7 refs. Research supported by the University Grants Commission.

An analysis of the saturation current in solar cells indicates that the factor A in the Shockley equation is material independent and has a constant value of 2.95 x 10 to the 5th A per sq cm of the cell. The saturation current, I(0), and a fundamental solid state parameter, the 0 K Debye temperature, are explicitly correlated on the basis of the work of Ravindra and Srivastava (1979). It is shown that dLnI(0)/dT increases with the energy gap at 0 K. V.L.

A81-15154 **The CdS/Cu2S solar cell - Basic operation and anomalous effects.** A. Rothwarf (Delaware, University, Newark, Del.). *Solar Cells,* vol. 2, Oct. 1980, p. 115-140. 61 refs. Research supported by the U.S. Department of Energy and NSF.

A model for the basic operation of the CdS/Cu2S solar cell as a heterojunction dominated by interface recombination is presented which accounts for the observed cell behavior and allows the prediction of cell performance characteristics with sufficient accuracy to plan research efforts. It is shown that anomalous effects in the spectral properties of the cell, enhancement of the short-circuit current by short wavelength light and quenching by long wavelength light, the crossover of the light and dark current-voltage curves, and the photocapacitance behavior stem from the trapping of carriers in deep levels in the compensated region of the CdS layer near the junction. V.L.

A81-15155 **The energy cost of amorphous silicon solar cells.** F. Riddoch and J. I. B. Wilson (Heriot-Watt University, Edinburgh, Scotland). *Solar Cells,* vol. 2, Oct. 1980, p. 141-149. 12 refs. Research supported by the Science Research Council.

An analysis is given of the energy required to produce amorphous silicon MIS solar cells. The total energy content, including that for production machinery, materials and processing, is found to be about 3.5 MJ(t) ((t) stands for thermal) for a 25 sq cm cell, with reasonable assumptions of the large-scale production rate. The glow discharge process for depositing amorphous silicon films consumes less than 0.5 MJ (t) in materials, in contrast with crystalline silicon wafers which consume 26 MJ (t) for the same area. Even when the lower power conversion efficiency of amorphous silicon cells is considered, these cells should be net producers of energy within their lifetime. Crystalline silicon cells used in an array with battery storage are less likely to give a net gain. (Author)

A81-15156 **Double-sided n plus/p/n plus solar cell for bifacial concentration.** A. Luque, A. Cuevas, and J. M. Ruiz (Madrid, Universidad Politécnica, Madrid, Spain). *Solar Cells,* vol. 2, Oct. 1980, p. 151-166. 38 refs. Research supported by the Spanish Assessing Committee for Scientific and Technical Research.

The concentration gain that can be achieved with static concentrators is maximum if bifacial cells are used; it is twice the concentration gain of conventional cells. A theoretical and experimental analysis of the properties of an n plus/p/n plus transistor-like structure called Transcell is presented. In this cell the quantum collection efficiency is enhanced by the collection in the rear junction. The series resistance is increased because of the lateral flow of the current in the base. A new two-dimensional model which allows the calculation of the series resistance and the fill factor is experimentally verified. The model makes it possible to design optimum metallization grid patterns which reduce the effect of the series resistance to acceptable levels. A curve factor of 0.77 at 5 air mass one suns and 28 C was measured in the experimental cells. Potential improvements which could be made to Transcells are summarized. (Author)

A81-15205 # **Comparison of proportional and on/off solar collector loop control strategies using a dynamic collector model.** S. R. Schiller, M. L. Warren, and D. M. Auslander (California, University, Berkeley, Calif.). *ASME, Transactions, Journal of Solar Energy Engineering,* vol. 102, Nov. 1980, p. 257-262. 17 refs. Contract No. W-7405-ENG-48.

Common control strategies used to regulate the flow of liquid through flat-plate solar collectors are discussed and evaluated using a dynamic collector model. Performance of all strategies is compared using different set points, flow rates, insolation levels and patterns, and ambient temperature conditions. The unique characteristic of the dynamic collector model is that it includes the effect of collector capacitance. Short term temperature response and the energy-storage capability of collector capacitance are shown to play significant roles in comparing on/off and proportional controllers. Inclusion of these effects has produced considerably more realistic simulations than any generated by steady-state models. Simulations indicate relative advantages and disadvantages of both types of controllers, conditions under which each performs better, and the importance of pump cycling and controller set points on total energy collection. (Author)

A81-15206 # **The Mediterranean-Dead Sea project - A mathematical model and dynamic optimization of a solar-hydroelectric power plant.** D. Weiner (Israel Electric Corp., Ltd., Haifa, Israel). *ASME, Transactions, Journal of Solar Energy Engineering,* vol. 102, Nov. 1980, p. 281-286. 9 refs.

The Dead Sea, part of the Jordan Rift Valley, lies at an elevation of about 400 m below sea level at a distance of only 70 km from the Mediterranean. In this paper, a mathematical model is derived simulating the dynamic behavior of a solar-hydroelectric power plant, utilizing the difference in elevation between the Mediterranean Sea and the Dead Sea by conducting Mediterranean water to the Dead Sea, partly by tunnel. This model was applied to determine the optimal control of inlet water to the evaporation basin of the Dead Sea, through the entire life of the plant, by dynamic programming methods. The optimization results were also utilized for determination of plant engineering parameters such as the diameter and gradient of the sea water tunnel. (Author)

A81-15217 # **Variances in solar collector performance predictions due to different methods of evaluating wind heat transfer coefficients.** J. W. Ramsey and M. Charmchi (Minnesota, University, Minneapolis, Minn.). *ASME, Transactions, Journal of Heat Transfer,* vol. 102, Nov. 1980, p. 766-768. 8 refs.

The performance of several solar collector configurations has been predicted using both inappropriate and appropriate relations to evaluate the wind-related heat transfer coefficient. The combinations analyzed are: one or two covers and a selectively absorbing surface coating, and one or two covers and a nonselectively absorbing surface coating; all collectors are of the basic liquid heating type. It is shown that the optimum results are obtained by using a global correlation equation proposed by Sparrow et al. (1979). V.L.

A81-15611 **Heat transfer in a porous medium flat plate solar collector.** A. C. Cheung, C. W. Chiang, and M. S. Chen (South Dakota School of Mines and Technology, Rapid City, S. Dak.). In: Multiphase transport: Fundamentals, reactor safety, applications; Proceedings of the Multi-Phase Flow and Heat Transfer Symposium-Workshop, Miami Beach, Fla., April 16-18, 1979. Volume 5. Washington, D.C., Hemisphere Publishing Corp., 1980, p. 2407-2427. 6 refs.

Analytical and experimental results for the heat and mass transfer in an innovative flat plate solar collector using a porous medium as the absorber are presented. The proposed collector is similar to any conventional liquid heating solar collector with the exception that, instead of a metallic absorber plate with water tubes, a porous medium with good wetting characteristic is used as the absorbing medium with the liquid flowing through the porous material directly. A laboratory model was built and tested. It is shown that this porous medium absorber allows a much more uniform flow and a much thicker film of fluid through the collector than normally possible with a conventional open channel flow. The steady state performance of the collector is analyzed using separation of variable technique. Agreements between experimental and analytical results are good. Preliminary cost analysis indicates that a saving of 25% over conventional flat plate collector cost is possible. However, at present, the measured collector efficiency is still lower than a conventional high performance liquid collector. (Author)

A81-15745 **Surface texturing of copper by sputter etching with applications for solar selective absorbing surfaces.** P. M. Curmi and G. L. Harding (Sydney, University, Sydney, Australia). *Journal of Vacuum Science and Technology,* vol. 17, Nov.-Dec. 1980, p. 1320-1325. 12 refs. Research supported by the University of Sydney.

Solar selective absorbing surfaces have been produced by texturing copper specimens in a novel magnetron cosputtering system which allows high rate sputter etching of a moving metal plate seeded with low sputter rate material. Unusual topographical features have been produced on copper using titanium seed. The variation of optical properties and surface morphology of the copper as a function of sputter etching conditions has been studied. Typical selective surfaces produced have absorptances of 0.90 and emittances of about 0.10 at 300 K. (Author)

A81-15808 **Automated steady-state admittance spectroscopy for surface studies with application to solar cells.** P. Smith, A. P. Genis, R. Singh, and J. B. Dubow (Colorado State University, Fort Collins, Colo.). *IEEE Transactions on Electron Devices,* vol. ED-27, Dec. 1980, p. 2240-2244. 11 refs.

A new technique for automated admittance measurements as a function of frequency and bias has been developed and applied to characterize the insulator-base semiconductor interface of ITO semiconductor-insulator-semiconductor solar cells. The system utilizes a computer-controlled automatic network analyzer and represents an improvement over impedance bridge and/or lock-in amplifier measurements arising from higher speed with comparable accuracy. The results of C-V and G-V measurements of small indium tin oxide-SiO(x)-polycrystalline silicon solar cells, which have been used to optimize the fabrication of large-area high-efficiency solar cells are presented. (Author)

A81-15810 **Evaluation of n-GaAs polycrystalline layers for solar cells using an electrochemical technique.** A. S. Weiner, D. H. Reep, S. K. Shastry, K. N. Bhat, J. M. Borrego, and S. K. Ghandhi (Rensselaer Polytechnic Institute, Troy, N.Y.). *IEEE Transactions on Electron Devices,* vol. ED-27, Dec. 1980, p. 2281-2285. 6 refs. Research supported by the Solar Energy Research Institute.

Thin layers of n-GaAs polycrystalline material grown by metalorganic CVD have been evaluated using an electrochemical technique. The technique is based upon an analysis of the time behavior of the anodizing current and it is capable of giving spatial information about the breakdown voltage of the material. A correlation has been established between the percentage of area with low breakdown voltage and the efficiency of solar cells fabricated on the polycrystalline layers. (Author)

A81-15902 **Photovoltaic efficiency of InSe solar cells.** A. Segura (Valencia, Universidad, Valencia, Spain; Paris VI, Université, Paris, France), A. Chevy, J. P. Guesdon, and J. M. Besson (Paris VI, Université, Paris, France). *Solar Energy Materials,* vol. 2, Dec. 1979-Mar. 1980, p. 159-165. 7 refs. Research supported by the Centre National de la Recherche Scientifique.

Measurements are reported of the photovoltaic efficiencies of InSe heterojunctions prepared from industrial-grade unrefined elements. The I-V characteristics and photovoltaic spectra were determined for heterojunctions composed of n-type InSe overlain by semitransparent platinum layers on which a gold grid was deposited; indium was used as an ohmic contact on the back of the structure. Devices of different thicknesses are found to exhibit external efficiencies between 5 and 6 percent under various illumination conditions, indicating an internal junction efficiency over 10.5 percent. Improvements to the devices which may result in external efficiencies around 10 percent are indicated. A.L.W.

A81-15903 **Thermal degradation of chromium black solar selective absorbers.** I. T. Ritchie, S. K. Sharma, J. Valignat, and J. Spitz (Commissariat à l'Energie Atomique, Centre d'Etudes Nucléares de Grenoble, Grenoble, France). *Solar Energy Materials,* vol. 2, Dec. 1979-Mar. 1980, p. 167-176. 14 refs.

Chromium black solar selective surfaces which had been electroplated onto nickel substrates were annealed in air at 350 C. The composition and structure of the films were determined before and after annealing; the film is shown to consist initially of needle-like chromium oxide particles containing inclusions of chromium metal. As the film is annealed these particles become more spherical and the solar absorptance of the surface decreases dramatically. Calculations based on an idealized model of the film were able to reproduce the reflectance spectra of the surface after each annealing step and showed that the change in the shape of the particles is the most important factor in the thermal degradation of the chromium black surface. (Author)

A81-15904 ***Microstructural and mechanical property evaluation of black-chrome coated solar collectors.*** M. Valayapetre, O. T. Inal, L. E. Murr, A. E. Torma, and A. Rosenthal (New Mexico Institute of Mining and Technology, Socorro, N. Mex.). *Solar Energy Materials,* vol. 2, Dec. 1979-Mar. 1980, p. 177-199. 19 refs. Contract No. DE-AS04-78ER-04266.

The microstructural and absorptivity properties of electroplated black-chrome solar absorbers are investigated as a function of plating geometry, current density, time of plating, plating bath temperature, and several other electroplating parameters. Some of the optimum electroplating parameters determined on the basis of this study are: plating time 15-18 min, current density 37.8-48.6 A/sq dm, plating bath temperature 0-16 C, and chromic acid concentration 300.76-375.95 g/l. V.L.

A81-15906 **Photovoltaic properties of polymer films.** P. J. Reucroft and H. Ullal (Kentucky, University, Lexington, Ky.). *Solar Energy Materials,* vol. 2, Dec. 1979-Mar. 1980, p. 217-228. 23 refs. Research supported by the Ashland Oil Foundation; NSF Grant No. GK-26154.

The effect of metal electrode and film thickness on the photovoltaic energy conversion efficiency in (1:1) mole ratio films of poly (N-vinylcarbazole) (PVK) and 2,4,7-trinitrofluorenone (TNF) has been investigated. Low work function metals increase the Schottky barrier height which leads to increases in the photovoltaic energy conversion efficiency. A ten-fold decrease in film thickness produces a thousand-fold increase in photovoltaic energy conversion efficiency. A theoretical model which assumes that the photovoltaic current is limited by Child's law predicts photovoltaic efficiencies which are in good agreement with the measured efficiencies. (Author)

A81-15907 **Interface recombination phenomena and tunnel effect in Cu2S-CdS solar cells.** G. Bordure, M. Eladioui, and C. Llinares (Montpellier II, Université, Montpellier, France). *Solar Energy Materials,* vol. 2, Dec. 1979-Mar. 1980, p. 229-237. 20 refs.

A81-15908 **High temperature optical and structural degradation of black chrome coatings.** G. Zajac and A. Ignatiev (Houston, University, Houston, Tex.). *Solar Energy Materials,* vol. 2, Dec. 1979-Mar. 1980, p. 239-247. 14 refs. Research supported by the U.S. Department of Energy and University of Houston.

The microstructural basis for the optical degradation of electrodeposited black chrome coatings heated in high vacuum has been investigated via SEM and AES depth profiling. Compaction and agglomeration of the fine chromium particles comprising the film has been observed. The effect is to degrade the optical selectivity of the thin films. (Author)

A81-15909 **Maximum theoretical efficiency as a function of temperature in solar cells.** N. M. Ravindra and V. K. Srivastava (Roorkee, University, Roorkee, India). *Solar Energy Materials,* vol. 2, Dec. 1979-Mar. 1980, p. 249-251. 5 refs. Research supported by the University Grants Commission of India.

It is shown analytically that the product of the maximum theoretical efficiency of photovoltaic homojunction solar cells and the corresponding temperature is a constant up to about 473 K under ideal conditions. This constant was shown in a previous work to have a value of 8000. Based on this value, a value of 10.5 is predicted for the constant C in the maximum theoretical efficiency expression. V.L.

A81-15910 **Long time photoelectric response of photosensitive liquid membranes and chloroplast discs.** T. S. Snyder, S. H. Chiang, and G. E. Klinzing (Pittsburgh, University, Pittsburgh, Pa.). *Solar Energy Materials,* vol. 2, Dec. 1979-Mar. 1980, p. 253-264. 20 refs.

As a means to interrupt the photosynthetic process and draw off electrons for power production, Black Lipid Membranes (BLM) and chloroplast extract discs have been employed. Long time responses were studied showing the effects of open/closed circuit characteristics, voltage-load resistance responses and BLM expansion and contractions behavior. Chloroplast extract and n-octane solutions were used to form BLM on a small hole in a Mylar support submerged in a cell containing liquid bathing solutions of different ionic strengths and compositions. The chloroplast extract discs were formed at a water/n-octane interface by natural migration of the chloroplast to the interface. The photoresponse of the chloroplast discs placed on a copper mesh electrode responded similarly to the BLM on Mylar support upon illumination. In addition to electric effects, the BLM photoactivity of the film and interfacial charge accumulation were seen to interact reversibly with the BLM size and thickness. A photo-induced growth in BLM area was observed during illumination. (Author)

A81-15911 **Large grain silicon films on metallurgical silicon substrates for photovoltaic applications.** T. L. Chu, S. S. Chu, and E. D. Stokes (Southern Methodist University, Dallas, Tex.). *Solar Energy Materials,* vol. 2, Dec. 1979-Mar. 1980, p. 265-275. 10 refs. Contract No. EY-76-C-03-1285.

Metallurgical silicon at a cost of about $1/kg is an economical substrate for the deposition of silicon films for photovoltaic applications. To prepare the substrate, pulverized metallurgical silicon, purified by acid-extraction and phosphorus pentoxide treatment, was recrystallized on graphite by unidirectional solidification and zone-melting. The structural and crystallographic properties of metallurgical silicon substrates prepared at different rates of solidification were investigated. Silicon films of controlled electrical resistivity were deposited on metallurgical silicon substrates by the thermal reduction of trichlorosilane containing appropriate dopants. The concentration and distribution of metallic impurities, Hall mobilities, potential barriers and minority carrier diffusion length profile in these films were investigated. Solar cells of 9 sq cm area were prepared from silicon films of 25-30 microns thickness containing a p-n junction. By using a drift field in the surface region and a back surface field at the silicon film/substrate interface, AM1 efficiencies of up to 9.75% have been obtained. (Author)

A81-15912 **Photovoltaic materials and devices for terrestrial solar energy applications.** H. J. Hovel (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). *Solar Energy Materials,* vol. 2, Apr.-June 1980, p. 277-312. 162 refs.

The status of solar cell research and development is reviewed with reference to economic considerations, candidate technologies, and solar cell physics. The main areas of the photovoltaic program discussed include flat plate Si cells, thin film devices, concentrating systems, emerging materials, and innovative concepts. V.L.

A81-15913 **Device physics and design of a-Si ITO/p-i-n heteroface solar cells.** H. Okamoto, Y. Nitta, T. Yamaguchi, and Y. Hamakawa (Osaka University, Toyonaka, Japan). *Solar Energy Materials,* vol. 2, Apr.-June 1980, p. 313-325. 15 refs.

Effects of doped impurities on electrical, optical and optoelectronic properties in amorphous hydrogenated silicon (a-Si:H) films have been investigated. Doped and undoped a-Si:H films were prepared by plasma deposition from monosilane diluted with hydrogen containing a preset amount of phosphine or diborane as a dopant gas. A series of systematic data on the relation between preparation conditions, particularly substrate temperature and hydrogen content, photoconductivity, absorption coefficient, etc., and also solar cell design parameters are presented. Device physics and optimum design for the heteroface solar cell are discussed. On the basis of these data, ITO/p-i-n heteroface cells have been fabricated. At the present state of the experiments, a power conversion efficiency of 4.5% is obtained under a sunlight of 80 mW/sq cm. (Author)

A81-15914 **Fundamental absorption edge in PbI2:KI alloys.** A. M. Salau. *Solar Energy Materials,* vol. 2, Apr.-June 1980, p. 327-332. 19 refs.

Optical measurements at room temperature were performed near the fundamental absorption edge for thin films of a PbI2:KI alloy for various mole percent compositions. The dependence of the direct energy gap on the composition of the alloys was found to deviate downward from linearity. The change of the energy gap from the visible to the infrared region in this alloy suggests its potential use as a solar energy converter. (Author)

A81-15915 **Fluorescent window for liquid junction solar cells.** M. S. Kazacos, E. J. McHenry, A. Heller, and B. Miller (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). *Solar Energy Materials,* vol. 2, Apr.-June 1980, p. 333-342. 12 refs.

To recover part of the often substantial fraction of the sunlight lost in practical semiconductor-liquid junction solar cells by solution absorption, two designs incorporating fluorescent windows are analyzed and tested. In these schemes the luminescers absorb incident light in regions of electrolyte absorption and re-emit at wavelengths both within the semiconductor band gap and the transparent range of the solution. It is shown that complete separation of the absorption and emission spectra (large Stokes shift) is essential for useful collection of these normally lost quanta. This requirement is not met by most fluorescent dyes, including the many with high quantum efficiency used in dye lasers. It is fulfilled by a europium(III) tetrakis diketonate which was successfully applied in the window of a n-CdSe/Na2S-S-Se-NaOH/C cell. A more efficient realization employs two solar cells, one edge-mounted on the fluorescent window to utilize the absorbed light, while the second operates in the conventional mode with light transmitted through the window. (Author)

A81-15918 **RF-sputtered CuInSe2 thin films.** J. Piekoszewski (Brown University, Providence, R.I.; Instytut Badan Jadrowych, Swierk, Poland), J. J. Loferski, R. Beaulieu, J. Beall, B. Roessler, and J. Shewchun (Brown University, Providence, R.I.). *Solar Energy Materials,* vol. 2, Apr.-June 1980, p. 363-372. 12 refs. Research supported by the U.S. Department of Energy and NSF.

Thin films of CuInSe2 were prepared by RF-sputtering from targets which were fabricated from previously synthesized CuInSe2 powders subjected to various combinations of annealing and cold pressing. By judicious selection of target properties and sputtering conditions, it was possible to obtain CuInSe2 films of chalcopyrite structure, grain size up to 1 micron, resistivities in the 0.3 to 2.0 ohm cm range and Hall mobilities up to about 6 sq cm/V s. Solar cells were made by combining these films with thin CdS films fabricated by RF-sputtering without breaking the vacuum and by evaporation in a separate system. Better cells having efficiencies up to 5% were obtained by evaporating CdS onto RF-sputtered CuInSe2 films. (Author)

A81-15919 **Structural and electronic properties of three aqueous-deposited films - CdS, CdO, ZnO, for semiconductor and**

photovoltaic applications. R. L. Call, N. K. Jaber, K. Seshan, and J. R. Whyte, Jr. (Arizona, University, Tucson, Ariz.). *Solar Energy Materials,* vol. 2, Apr.-June 1980, p. 373-380. 10 refs.

A81-15920 **Thermal energy storage in salt hydrates.** M. Telkes (Solar-Riat, Killeen, Tex.). *Solar Energy Materials,* vol. 2, July-Aug. 1980, p. 381-393. 28 refs.

This article reviews the material aspects of thermal energy storage in salt hydrates. In air-circulating systems that separate the collection and storage of solar heat (the so-called 'active systems'), the backup system is an important part of the total installation. On a succession of cloudy days, phase change storage systems can be charged by using resistance heating or heat pump. In most locations, lower cost electric power is available during off-peak periods and the use of the backup electric system would be economically desirable. In passive solar heating systems, a method is described that could be incorporated into the south facing vertical wall of the building, eliminating the cost of the wall by replacing it with polyhedral glazing and a phase change Trombe wall. (Author)

A81-15921 **Selective absorber design.** B. Window, D. McKenzie, and G. Harding (Sydney, University, Sydney, Australia). *Solar Energy Materials,* vol. 2, July-Aug. 1980, p. 395-401. 17 refs. Research supported by the University of Sydney.

Using recent theoretical developments the optimum composition profiles for maximum solar absorptance of selective surfaces consisting of cermet layers with graded refractive index are found. In general, linear grading of metal volume fraction with depth gives normal absorptance close to optimum for both a dielectric and an air matrix. However, the highest absorptances at high angles of incidence are obtained with layers in which the metal particles have air as matrix rather than dielectric and in which the volume fraction increases from the substrate initially more slowly than linearly. (Author)

A81-15922 **Optical behaviour of selectively absorbing surfaces at elevated temperatures.** R. T. Kivaisi and L. E. Flordal (Institute of Optical Research, Stockholm, Sweden). *Solar Energy Materials,* vol. 2, July-Aug. 1980, p. 403-411. 11 refs. Research supported by the Statens Naturvetenskapliga Forskningsrad.

Temperature dependence of interference selective absorbers was studied experimentally. The absorbers consisted of a semiconductor (Ge or PbS) and a dielectric (SiO), both coated on a metal substrate in vacuum. The spectral reflectances of the samples were measured at room temperature and at 200 C in the wavelength range 0.35-2.5 microns. The construction of heating and temperature control units used for the present work is briefly described. Solar absorptances of a few surfaces studied did not change with temperature after their first heating cycle. (Author)

A81-15926 **Photovoltaic response of alumina M-I-S Schottky structures.** J. A. Roger, F. Soheylian, A. Mouhoub, and J. Pivot (Lyon I, Université, Lyon, France). *Solar Energy Materials,* vol. 2, July-Aug. 1980, p. 447-459. 16 refs.

M-I-S Schottky structures using thin alumina interfacial films have been fabricated on monocrystalline silicon substrates in an attempt to analyze the influence of this thin layer on photovoltaic conversion efficiencies. To try to determine the possible origins of the recorded efficiency enhancement, a comparison with theoretical prediction is carried out through the following experiments: dark I-V curves, power curves, capacitance measurements and Fowler plots. Attention is given to problems encountered if experimental data are treated in a classical (M-S) way, and corresponding analysis is improved to include the M-I-S case. (Author)

A81-15927 **The relative merits of black cobalt and black chrome as high temperature selective absorbers.** G. B. Smith (Houston, University, Houston, Tex.; New South Wales Institute of Technology, Broadway, Australia) and A. Ignatiev (Houston, University, Houston, Tex.). *Solar Energy Materials,* vol. 2, July-Aug. 1980, p. 461-467. 11 refs. Research supported by the U.S. Department of Energy and University of Houston.

Solar selectivity, with emphasis on high solar absorptance (alpha), has been measured in three distinct classes of black cobalt before and after long term exposure to high temperatures (300 to 500 C) in air. Absorption processes in black cobalt and black chrome are quite different, although surface morphology reduces front surface reflections in both systems. However, the thermal stability of the solar absorptance is comparable to black chrome for black cobalt coatings composed of cobalt oxides but not for those composed of cobalt sulphides which are found to be unsuitable at T greater than 300 C in air. None of the coatings on nickel substrates are suitable for applications at T greater than 450 C where high absorptance (alpha approximately greater than 0.95) is needed. (Author)

A81-15928 **Absorptance and emittance of metal carbide selective surfaces sputter deposited onto glass tubes.** G. L. Harding (Sydney, University, Sydney, Australia). *Solar Energy Materials,* vol. 2, July-Aug. 1980, p. 469-481. 13 refs. Research supported by the University of Sydney.

The paper presents an experimental study of the absorptance and emittance of selective absorbing surfaces based on reactively sputtered chromium carbide and stainless steel carbide films overlayed on sputtered copper (these surfaces have properties suitable for inclusion in all glass tubular evacuated collectors). Graded metal carbide surfaces have absorptance alpha = 94% compared to alpha = 82% for homogeneous surfaces, while the latter have considerably lower emittance at elevated temperature and so may be suited to high temperature operation. Enhancement of the absorptance of graded surfaces has been achieved to alpha = 96% by the application of a light coating of carbon particles to the surfaces, at the expense, however, of a 1% increase in emittance. B.J.

A81-15929 **Solar reflective materials; Proceedings of the Second Workshop, San Francisco, Calif., February 12-14, 1980.** Workshop sponsored by the Solar Energy Research Institute and Battelle Memorial Institute. Edited by M. A. Lind (Battelle Pacific Northwest Laboratories, Richland, Wash.). *Solar Energy Materials,* vol. 3, Sept. 1980. 354 p.

Reflective materials for use in solar collector systems are considered with reference to environmental contamination, glass and mirror production, degradation of second surface silver mirrors, and polymers and coatings. Particular attention is given to the use of thin glass reflectors for solar collectors, surface studies of second surface silver heliostat mirrors, and exposure testing of solar collector plastic films. B.J.

A81-15932 **Cleaning agents and techniques for concentrating solar collectors.** V. L. Morris (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 35-55. 9 refs. Research supported by the U.S. Department of Energy.

Tests were conducted to determine the nature of the soil which is irreversibly deposited on solar collectors during environmental exposure. Methods of removing this soil were investigated. The mechanism of attachment of the soil to the surface was determined as a potential aid to cleaning agent formulation. Reflector specimens were environmentally exposed at several industrial sites. Three types of reflector surfaces were studied: second surface silvered glass, aluminized FEK-244 film on aluminum substrate and RTV 670 on aluminum. Cleaning procedures were evaluated by microscopic examination of the solid surfaces before and after cleaning by measurement of specular reflectance. The effect of local environmental degradation specific to an industrial process on solar collector surfaces was investigated. (Author)

A81-15933 **Low absorption float glass for back surface solar reflectors.** J. K. Goodyear and V. L. Lindberg (Ford Motor Co., Glass Div., Lincoln Park, Mich.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 57-67. 5 refs.

It is shown that low iron float glass with relatively flat surfaces can be fabricated by the float process, and that this glass can make an excellent back surface mirror for solar energy concentrators, such as the heliostats planned for the Solar Ten Megawatt Power Project at Barstow, California. At 3 mm thickness, the low iron glass has a mean solar transmittance of 89.3%, and will produce heliostat mirrors with a calculated solar reflectance of 89.6%. The flatness of Ford 3-mm float glass is approximately 0.4 mrad, which is well below the minimum average slope angle requirement (2.5 mrad) to produce good quality heliostat reflectors. B.J.

A81-15934 **Solarization of heliostat glasses.** J. Vitko, Jr. and J. E. Shelby (Sandia Laboratories, Livermore, Calif.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 69-80. 7 refs.

A solar-induced decrease in Fe(2+) absorption was observed in heliostat glasses from the solar furnace at Odeillo, France. This decrease occurs throughout the sample and is of sufficient magnitude to result in an increase of 2.5% in solar transmittance in a period of nine years. Optical and ESR studies did not detect a corresponding increase in Fe(3+) concentration. The effect of these results on a microscopic model for the observed solarization is discussed. Solar simulation studies produced changes of magnitude and sign similar to those observed in the field exposed samples, and offer attractive means for screening samples for solarization tendencies. (Author)

A81-15935 **Natural aging of soda-lime-silicate glass in a semi-arid environment.** M. A. Lind and J. S. Hartman (Battelle Pacific Northwest Laboratories, Richland, Wash.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 81-95. 11 refs. Contract No. DE-AC06-76RL-01830.

Soda-lime-silicate glass appears to be the most durable low-cost candidate material for second surface solar mirrors in the near term. An examination of exposed and unexposed regions of several glass samples weathered in a semiarid environment for over forty years shows that significant changes have taken place. The surface morphology, the chemical composition of the surface, the surface index of refraction, and the spectral absorptance have been modified by exposure to sunlight and moisture. However, the optical properties of the glass which are important in solar applications, such as solar transmittance and specularity, showed only minor changes. The results imply that, at least as far as optical properties are concerned, commercially produced soda-lime-silica glass is suitable for solar applications with expected lifetimes in excess of thirty years. B.J.

A81-15936 **Weathering of glasses for solar applications.** J. E. Shelby, J. Vitko, Jr. (Sandia Laboratories, Livermore, Calif.), and C. G. Pantano (Pennsylvania State University, University Park, Pa.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 97-110. 6 refs. Research supported by the U.S. Department of Energy.

The weathering of several glasses being considered for solar applications has been studied by a number of surface characterization techniques including optical spectroscopy, optical and scanning electron microscopy, sputter-through Auger analysis, ESCA, SIMS, dye penetration testing, surface profile measurements and resonant nuclear reaction profiling. Significant weathering effects were observed only for the soda-lime-silicate glasses. For soda-lime-silicate glasses, the results indicate that the first stage of weathering is the formation of a low-density anti-reflection film on the glass surface. Growth of this film eventually results in spalling of the glass surface and severe degradation of the optical quality of the glass. Float glasses exhibit significantly better weathering resistance on their tin-rich surface than on the tin-poor surface. (Author)

A81-15937 **The use of thin glass reflectors for solar concentrators.** R. H. Marion (Sandia Laboratories, Albuquerque, N. Mex.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 111-116. Contract No. DE-AC04-76DP-00789.

Elastically deforming thin glass (thickness = 0.13-0.80 mm) provides an alternate method of forming a curved glass reflector which can eliminate some of the disadvantages of thicker glass. This paper describes a concept where silvered thin glass is bonded to a steel backing to form a laminate with a reflectance greater than 93%. Subsequent bending of the flat reflector laminate to a concentrating profile produces compressive stresses throughout the glass if the laminate is properly designed. These compressive stresses enhance fracture resistance and the lamination provides protection for the silver. The design of the laminate is outlined for 0.25 and 0.51 mm thickness glass and fabrication procedures are discussed. Thermal/humidity cycling, hail impact, bond strength measurements and reflectance results are presented which demonstrate the performance capabilities of this reflector laminate concept. (Author)

A81-15939 **Reflectance and aging studies of heliostat mirrors.** H. Taketani (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 127-134.

A brief review of the principles involved in making reflectance measurements of mirrors over the solar spectrum including air mass correction is given. Using these principles, reflectance measurements of different commercial silvering processes on the same glass showed no significant differences between the processes studied, including vapor-deposited silver. In addition, reflectance measurements were made of bare silver, silver/copper, silver/copper/paint over glass, together with transmission measurements on the same glass. Based on these results, a correlation between transmission and reflectance efficiency after mirroring was developed. Subsequently, these mirrors, as well as candidate first-surface mirrors, were subjected to Mojave Desert, CA environmental conditions for time periods up to 3-1/2 years. Of the mirrors tested, second-surface glass mirrors and first-surface aluminized acrylic mirrors exhibited the greatest weathering properties. (Author)

A81-15940 **Progressive changes in microstructure and composition during degradation of solar mirrors.** J. L. Daniel and J. E. Coleman (Battelle Pacific Northwest Laboratories, Richland, Wash.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 135-150. 8 refs. Contract No. DE-AC06-76RL-01830.

The microstructure and composition of several commonly observed stages of degradation of solar mirrors (soda-lime float glass covered with silver and copper) have been studied using visible light microscopy and SEM combined with an electron microprobe fluorescence analyzer. Field degradation appears first as a random distribution of fine spots in which the silver layer is thickened and a reaction has occurred with the adjacent glass surface. Continued degradation leads to enlargement or aggregation of spots, which may ultimately cover nearly the entire mirror surface. Results suggest that the extent of degradation, the composition of reaction products, and the type of microstructure are strongly influenced by the presence of water. B.J.

A81-15941 **Characterization of new and degraded mirrors with AES, ESCA and SIMS.** L. R. Pederson and M. T. Thomas (Battelle Pacific Northwest Laboratories, Richland, Wash.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar*

Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials, vol. 3, Sept. 1980, p. 151-167. 23 refs. Contract No. DE-AC06-76RL-01830.

Samples representing each production stage of second surface mirrors for solar energy concentrators were examined by AES, ESCA, and SIMS along with ion sputtering. Significant weathering occurred on a 6-month-old soda-lime-silicate glass that was intended for use in the Barstow solar pilot plant. Further glass-water reactions occurred during the silvering step, which was demonstrated by the detection of deuterium in the glass on mirrors made from D2O silver solutions. In addition, diffusion of silver into the glass matrix was observed, even on freshly prepared mirrors. On degraded specimens, sulfur was strongly associated with the reacting edge of the copper films, while chloride was similarly associated with the silver films, implying that these elements are important corrosive agents. B.J.

A81-15942 **Auger analysis of silver-glass interfaces.** R. Bastasz (Sandia Laboratories, Livermore, Calif.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 169-176. 11 refs. Research supported by the U.S. Department of Energy.

Moderate annealing in vacuum of evaporated silver films on float glass (used as mirrors in solar energy concentrators) was found to have little effect on either the composition at the silver/glass interface or the profile of the boundary region. The interface remained free of any contaminants that could be detected by Auger spectroscopy. Limited diffusion of silver with glass components was observed, but the process resulted in only slight broadening of the interface during short annealing treatments and could be described by a diffusion coefficient of less than 1 x 10 to the -15th sq cm/s at 200 C. It is concluded that moderate annealing in the absence of contamination does not significantly alter the characteristics of a silver/glass interface. B.J.

A81-15945 **Corrosion resistance and electrochemical evaluation of silver mirrors.** S. L. Pohlman and P. M. Russell (Solar Energy Research Institute, Golden, Colo.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 203-213. 10 refs.

Electrochemical methods including potentiostatic, potentiodynamic, and galvanic measurements were used to study the corrosion resistance of silver mirrors for use in solar energy concentrators. The potential driven modified scratch test appears promising as a rapid quality assurance evaluation technique. Galvanic measurements have shown that silver/copper is not an active galvanic couple and copper does provide only limited cathodic protection to the silver. Measurements have also shown that oxidation of tin or stannous ions and hydrogen formation at the silver/glass interface may occur. B.J.

A81-15947 **Reactions at the silver/polymer interface - A review.** P. Schissel and A. W. Czanderna (Solar Energy Research Institute, Golden, Colo.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 225-245. 117 refs.

One of the possible solutions for improving mirrors for long-life inexpensive solar concentrators is to coat the reactive mirror material with a polymer. This paper reviews the literature on the silver/polymer interface. The components of the interface are considered separately: studies of reactions of environmental gases with silver are summarized; several candidate fluoropolymers and PMMA are considered independently of the metal. Finally, the limited data on the silver/polymer interface itself are summarized. Results on the silver/Teflon/FEP interface are emphasized. B.J.

A81-15948 **Exposure testing of solar collector plastic films.** M. Berry and H. Dursch (Boeing Engineering and Construction Co., Seattle, Wash.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 247-261. 10 refs.

The paper summarizes BEC experimental work aimed at finding low-cost long-life highly specular plastic films for solar collectors. Samples were subjected to up to 18 months of solar exposure in both real and accelerated testing techniques at a desert site in Arizona. The fluorocarbons Kynar and Tedlar exhibit the best weatherability characteristics of the materials tested. The polyester and polycarbonates studied have the problem of not being inherently resistant to UV degradation. Preliminary results from the thermoformed domes seem to indicate that they show self-cleaning characteristics. B.J.

A81-15949 **Abrasion resistant polymer reflectors for solar applications.** R. A. Assink (Sandia Laboratories, Albuquerque, N. Mex.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 263-275. 11 refs. Contract No. DE-AC04-76DP-00789.

One of the major concerns associated with the use of metallized polymers as solar reflectors is their susceptibility to abrasion from wind blown sand and cleaning operations. In this study, three approaches to the attainment of an abrasion resistant metallized polymer were evaluated. First, a developmental abrasion resistant coating was applied to an aluminized acrylic film. The abrasion resistance, solar reflectance, weatherability and dust accumulation properties of the material were excellent. Second, an abrasion resistant cast acrylic sheet was aluminized by an ion plating process. Although the abrasion resistance of the material was excellent, its solar reflectance was lower than that of the other reflectors and the aluminum delaminated when exposed to simulated weathering conditions. Third, a first surface reflector consisting of an aluminized high temperature polymer protected with a conventional abrasion resistant coating was evaluated. Although the solar reflectance and weatherability were excellent, the specular reflectance was substantially reduced by an abrasion test. (Author)

A81-15950 **Thin film solar reflectors.** R. N. Griffin (General Electric Co., Schenectady, N.Y.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 277-283. Research supported by the U.S. Department of Energy.

Laboratory studies have demonstrated the dependence of the reflectance of aluminized plastic film reflectors on the thickness of the deposit and the vacuum level during deposition. The range of parameters commonly used in commercial deposition of aluminum did not produce significant variations in reflectance. Second-surface plastic film reflectors made with aluminum and silver were investigated along with some 'pseudo-first-surface' aluminum reflectors. It is concluded that there are serious deficiencies in current plastic reflectors and difficulties in material selection. B.J.

A81-15953 **Optical properties of disordered rare earth-aluminum alloys.** D. M. Trotter, Jr. (Cornell University, Ithaca, N.Y.). *(Solar Energy Research Institute and Battelle Memorial Institute, Solar Reflective Materials Workshop, 2nd, San Francisco, Calif., Feb. 12-14, 1980.) Solar Energy Materials,* vol. 3, Sept. 1980, p. 317-333. 18 refs. Research supported by the Solar Energy Research Institute; NSF Grant No. DMR-76-81083-A02.

An attempt has been made to create a material of high reflectivity by combining aluminum with small amounts of the rare earth metals samarium and gadolinium to form disordered alloys. The experiment is based on the observation that while the spectral reflectance of pure crystalline aluminum is 90-95% in the solar region with a pronounced minimum near 1.5 eV, the reflectivity of Al calculated on the Drude model is smooth, flat, and close to 99% in the same region. However, it is found that the alloys studied are not useful as solar reflective materials. While some gain in reflectivity over that of pure bulk Al has been achieved, the spectral region in which improvement occurs is narrow, and reductions in reflectivity in other regions lead to smaller net solar reflectivities for all the alloys. V.L.

A81-15958 **Transmission, reflexion and absorption of visible radiation by the multiple covers of flat plate solar collectors.** O. Abreu and G. Best (Universidad Nacional Autónoma de México, Mexico City, Mexico). *Solar Energy Materials,* vol. 3, Oct. 1980, p. 371-380. 6 refs.

A81-15959 **The protection of high efficiency solar thermal collectors using the ternary mixture $MnSO_4$-H_2O-$C_2H_6O_2$.** R. B. Stephens and J. Whitcomb (Exxon Corporate Research Science Laboratories, Linden, N.J.). *Solar Energy Materials,* vol. 3, Oct. 1980, p. 381-390. 8 refs.

The solubility of $MnSO_4$ in water declines as the temperature of the solution is raised. This effect can be used to coat the absorber plate of a solar collector with a layer of fine white crystals which scatter light away from the absorber if it exceeds a predetermined temperature. The solubility limits of the ternary system $MnSO_4$-H_2O-$C_2H_6O_2$ show that ethylene glycol added to the mix provided adequate antifreeze protection and also increased the coating ability of the solution. It was also found that the kinetics of nucleation and crystallization for this system are so slow that it will remain indefinitely in the supersaturated state; crystals only precipitate upon the initiation of boiling. (Author)

A81-15960 **Experimental methods for the preparation of selectively absorbing textured surfaces for photothermal solar conversion.** G. Pellegrini (Commission of the European Communities, Joint Research Centre, Ispra, Italy). *Solar Energy Materials,* vol. 3, Oct. 1980, p. 391-404. 36 refs.

Methods are presented for obtaining various types of surface microstructure (e.g., dendritic, porous, granular, or needle-like surfaces) which are characterized by spectral and directional selectivity with respect to the incident radiation. The proposed methods are based on well known mechanisms, such as liquid-solid transformations, vapor deposition, and chemical reactions in oxidizing and corrosive environments. V.L.

A81-15961 **Selective absorber using glow-discharge amorphous silicon for solar photothermal conversion.** M. Okuyama, K. Saji, T. Adachi, H. Okamoto, and Y. Hamakawa (Osaka University, Toyonaka, Japan). *Solar Energy Materials,* vol. 3, Oct. 1980, p. 405-413. 29 refs.

A spectrally selective absorber with a high absorption coefficient in the visible and near-infrared regions made of boron-doped amorphous silicon film has been fabricated. The film was deposited by the plasma decomposition of a mixed gas composed of monosilane, hydrogen and diboran deposited on aluminum substrate films. A number of basic optical properties of the amorphous silicon films deposited under different preparation conditions have been measured. The absorption coefficient near the absorption edge increases with: (1) increased substrate temperature during deposition; (2) annealing after the deposition; and (3) increased doped-boron concentration. A selective absorber made of this amorphous silicon film coated with antireflective layers of TiO_2 and SiO_2 was prepared and showed good performance with high solar absorptance and low infrared emittance. (Author)

A81-15962 **Black molybdenum photothermal converter layers deposited by pyrolytic hydrogen reduction of MoO_2Cl_2.** K. A. Gesheva, E. E. Chain, and B. O. Seraphin (Arizona, University, Tucson, Ariz.). *Solar Energy Materials,* vol. 3, Oct. 1980, p. 415-424. 26 refs. Research supported by the U.S. Department of Energy.

A81-16024 **Dynamic modelling of once-through subcritical steam generator for solar applications.** A. Ray (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.). *Applied Mathematical Modelling,* vol. 4, Dec. 1980, p. 417-423. 11 refs.

By extending an earlier work of Ray and Bowman (1976) dealing with gas-cooled nuclear power plants, model equations are derived in state-space form for a once-through subcritical steam generator. The model can be used as an element in overall system simulation and controller design of solar thermal plants. V.L.

A81-16108 **Future prospects of solar energy (Perspectives offertes par l'utilisation de l'énergie solaire).** J. Robieux (Compagnie Générale d'Electricité, Centre de Recherches, Marcoussis, Essonne, France). *(CNRS, CNES, DGRST, and DRET, Conférence Européenne sur les Horizons de l'Optique, Pont-à-Mousson, Moselle, France, Apr. 22-25, 1980.) Journal of Optics,* vol. 11, Nov.-Dec. 1980, p. 415-439. In French.

The evolution of solar energy utilization is discussed, and possible future directions of development are considered. Collection and conversion techniques are examined, and attention is given to the place of solar energy in the overall economy. Such techniques as biomass conversion, high temperature water dissociation, and optical waveguides for solar energy are described. B.J.

A81-16271 **Optimal design on front-contact metallization for photovoltaic solar cells.** M. Conti (SGS-ATES Componenti Elettronici S.p.A., Milan, Italy). *Solid-State Electronics,* vol. 24, Jan. 1981, p. 79-83. 9 refs.

A new approach to the design of the front metal grid in standard photovoltaic solar cells is presented which allows the synthesis of the optimal grid profile for an arbitrary cell geometry. An expression for the total power loss is derived taking into account ohmic losses in the metal grid, losses in the front diffused layer of the cell and losses due to grid shadowing. The loss is minimized by a variational method solving the differential Euler equation and the optimal grid profile is obtained; then the expression for the minimum total power loss is derived. Applications to rectangular and circular solar cells are presented. (Author)

A81-16273 **Effect of excess temperature on the efficiency of Au-GaAs Schottky barrier solar cells.** D. V. Kumar and S. K. Sharma (Indian Institute of Technology, New Delhi, India). *Solid-State Electronics,* vol. 24, Jan. 1981, p. 91. Research supported by the Indian National Science Academy.

A81-16484 **The Magsat power system.** W. E. Allen (Johns Hopkins University, Laurel, Md.). *Johns Hopkins APL Technical Digest,* vol. 1, July-Sept. 1980, p. 179-182.

The power generation and storage of the Magsat power system is examined along with other system functions. An array of silicon solar cells mounted on four panels, each with two curved segments generates the electrical power. The power output of the solar array is measured as a function of the angle psi between the +B spacecraft axis and the sun-earth line. The battery contains 12 series connected 8 ampere-hours nickel cadmium cells operating at a nominal voltage of 16.7 V. A lightweight shunt regulator is designed to dissipate excessive solar array power as heat. A block diagram of the Magsat power subsystem is presented with the loads divided into critical and noncritical categories. R.C.

A81-16494 **Ceramics in photovoltaic energy conversion.** H. K. Charles, Jr. (PRC Energy Analysis Co., McLean, Va.). *(American Ceramic Society, Fall Meeting, Williamsburg, Va., Sept. 17, 1979, Paper 16-E-79F.) American Ceramic Society Bulletin,* vol. 59, Dec. 1980, p. 1201-1204. 27 refs. Contract No. EG-77-C-01-4024.

The use of ceramics in photovoltaic energy conversion devices (solar cells) is widespread, both in the manufacturing process and as parts for the cells. Applications include: substrates; refractory conducting layers; cover and backing plates; hermetic encapsulants; antireflection coatings; crucibles for silicon melting and casting, and metal (electrode) evaporation; dies for ribbon pulling; abrasive for grinding, polishing, and texturing; electrical insulations; concentrator-system mirrors and lenses; and hybrid circuits and circuit boards for interconnection, measurement, and power conditioning. Particular emphasis is placed on the use of ceramics in the fabrication of solar cells and cell modules for low cost, large-area applications. (Author)

A81-16590 **Energy strategies: Toward a solar future.** Edited by H. W. Kendall and S. J. Nadis. Cambridge, Mass., Ballinger Publishing Co., 1980. 334 p. $16.50.

The book includes an assessment of energy requirements, nonrenewable and renewable energy resources, energy storage and transmission, and projections of energy demands. Topics also covered include coal gasification, oil shale, nuclear fission generators, geothermal energy, solar heating and cooling, photovoltaic cells, wind generators, biomass to gas conversion, ocean thermal energy, and wave energy extraction. A.T.

A81-16591 **Solar engineering of thermal processes.** J. A. Duffie and W. A. Beckman (Wisconsin, University, Madison, Wis.). Research supported by the University of Wisconsin. New York, Wiley-Interscience, 1980. 775 p. 514 refs. $25.95.

The book focuses on solar radiation characteristics, solar radiation available for practical applications, heat transfer, radiation characteristics of opaque materials, theory of flat-plate collectors, and concentrating collectors. Also discussed are solar process economics, solar water heating, solar heating system design, solar cooling, conversion to mechanical energy, evaporative processes, and selfgradient ponds. A.T.

A81-16926 **Solar system optimisation.** G. Ambrosone, A. Andretta, F. Bloisi, B. Coluzzi, S. De Stefano, G. Formisano, and L. Vicari (Napoli, Università, Naples, Italy). *Applied Energy*, vol. 7, Nov. 1980, p. 5-17. 7 refs. Research supported by the Consiglio Nazionale delle Ricerche.

A computation method for determining the optimal size of a solar heating plant according to the criterion of minimizing its total (capital plus running) cost is described. The resulting computer program calculates the energy output of a solar system as a function of the collector area and of the heat storage unit capacity starting from daily averages of climatic data in the localities considered. It predicts the optimal configuration and provides for it an overall cost-benefit analysis. (Author)

A81-16927 **Heat storage and solar system performance.** F. Bloisi, S. Catalanotti, V. Cuomo, S. De Stefano, and L. Vicari (Napoli, Università, Naples, Italy). *Applied Energy*, vol. 7, Nov. 1980, p. 19-29. 5 refs. Research supported by the Consiglio Nazionale delle Ricerche.

A simple method is presented for calculating the effect of a heat storage unit placed between the solar collector and the load. In the proposed method the calculation of the solar energy input is based on the hypothesis of constant input and output temperatures of the working fluid. The resulting computer program provides results with an accuracy sufficient for practical purposes. V.L.

A81-16928 **A regional evaluation of the annual cycle energy system.** J. W. MacArthur (Honeywell Energy Resources Center, Minneapolis, Minn.), D. W. Finn-Carlson (Touche Ross and Co., Minneapolis, Minn.), and K. H. Nguyen (Lockheed Electronics Co., Inc., Houston, Tex.). *Applied Energy*, vol. 7, Nov. 1980, p. 31-44. 7 refs.

The Solar Assisted Annual Cycle Energy System (ACES) is evaluated by means of a dynamic computer simulation. The operational concept of the ACES is discussed and the methodology used in evaluating the system is presented. Annual energy consumption and associated costs are investigated for the full, minimum and cost-optimized ACES in a variety of US climates. The energy and economic effectiveness of ACES is evaluated by comparing ACES with four conventional heating and cooling systems. Results show that ACES can be three to four times more energy efficient than the conventional systems investigated in this study. Under prototype equipment cost constraints, residential ACES is not, in general, cost competitive with the conventional systems. However, with realistic projections on the cost of mature components, residential ACES is far superior to conventional systems. (Author)

A81-16929 **Solar electricity storage systems.** J. Jensen and C. Perram (Odense Universitet, Odense, Denmark). *Applied Energy*, vol. 7, Nov. 1980, p. 45-66. 15 refs. Research supported by the Department of Energy of Denmark; European Economic Community Grants No. 315-78-EEDK; No. 316-78-EEUK.

Possible methods for the storage of solar-energy-generated electricity are reviewed. Attention is given to mechanical systems, including elevated weights, pumped water, compressed air, springs and flywheels, electric and magnetic field storage in a capacitor, electromagnet or superconducting coil, and chemical storage systems, including the electrolyzer hydrogen fuel cell and secondary electric storage batteries. Consideration of the advantages and disadvantages of the various systems reveals that batteries are the only technically and economically viable means of energy storage for small systems, and the design, optimization and requirements of a practical system of this type for application in Europe are discussed. It is concluded that since system demands for reliability, efficiency, long life, low self-discharge, good charge retention, the ability to overcome deep charge and low overall cost are not met by any available battery, new batteries specifically designed for solar energy storage systems must be developed. A.L.W.

A81-16930 **Prospects for solar energy for providing low temperature heat.** J. S. van Wieringen (Philips' Gloeilampenfabrieken, Philips Research Laboratories, Eindhoven, Netherlands). *Applied Energy*, vol. 7, Nov. 1980, p. 67-81. 14 refs.

An approximate formula is derived for the average annual amount of heat produced by solar collectors in different locations. A maximum price for solar installations is derived which should be competitive with other energy sources; comparison with the calculated yield shows that present-day solar hot water installations will only be competitive in sunny and mild climates. In other locations, as in Europe north of 45 deg latitude, the price of solar hot water would be too high. Cheaper collectors should be developed; because of the much lower yields in winter, solar collectors for space heating will be even less economical. Passive solar systems are promising; Trombe walls with selective surfaces should be investigated. (Author)

A81-16931 **Optimisation of the performance of a spiral solar collector.** P. K. C. Pillai and R. C. Agarwal (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 7, Nov. 1980, p. 83-91.

This paper reports on an investigation of the optimization of the performance of a spiral solar collector with respect to length and for different temperatures and flow rates. Empirical equations have been developed for predicting the temperature of the outgoing water - the inlet water being at 35 C, 25 C or 15 C - for various flow rates (6, 9, 18 or 36 kg/h). (Author)

A81-16932 **Check of a computer program for calculating long-term performance of solar flat-plate collectors.** A. Andretta, V. Cuomo (Napoli, Università, Naples, Italy), G. Barone, P. Mattarelli (SoGeSTA, Urbino, Italy), P. Brunini (SoGeSTA, Urbino; Bologna, Università, Bologna, Italy), M. Francesca, and C. Serio (Napoli, Università, Naples; APRE, Rome, Italy). *Applied Energy*, vol. 7, Nov. 1980, p. 93-108. Consiglio Nazionale delle Ricerche Contract No. 79.01747.

A81-16933 **Loss coefficients from solar flat-plate collectors.** H. P. Garg and U. Rani (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 7, Nov. 1980, p. 109-117. 8 refs.

An equation is derived for the heat loss coefficient of a solar flat-plate collector with inclusion of front, edge, and rear losses. It is shown that in the case of non-selective collectors with no glass cover, the overall heat loss coefficient varies from 14 to 60 W/sq m deg C for wind speeds of zero and 5.55 m/s, respectively. For design purposes, the value of the overall heat loss coefficient can be taken as 10 W/sq m per deg C for a single glass cover and 6 W/sq m deg C for two glass covers for a non-selective flat-plate collector. The effects of absorptivity, emissivity, and plate temperature on collector efficiency are discussed. V.L.

A81-16934 **Long-term performance of flat-plate solar collectors.** G. Ambrosone, A. Andretta, F. Bloisi, S. Catalanotti, V. Cuomo, V. Silvestrini, and L. Vicari (Napoli, Università, Naples, Italy). *Applied Energy,* vol. 7, Nov. 1980, p. 119-128. 12 refs. Research supported by the Consiglio Nazionale delle Ricerche.

A simple model is used to calculate the angular and time dependence of solar radiation. The resulting computer program is particularly suited to the evaluation of the performance of a solar system as a function of the collector area; it is used as a subroutine in a program determining the optimal dimensions of a solar system according to the criterion of minimum total (capital plus running) cost. (Author)

A81-16935 **Free convection and shading due to gap spacing between an absorber plate and the cover glazing in solar energy flat-plate collectors.** N. M. Nahar and H. P. Garg (Indian Institute of Technology, New Delhi, India). *Applied Energy,* vol. 7, Nov. 1980, p. 129-145. 11 refs.

A81-16936 **Partitioned solar pond collector/storage system.** N. D. Kaushik, P. K. Bansal, and M. S. Sodha (Indian Institute of Technology, New Delhi, India). *Applied Energy,* vol. 7, Nov. 1980, p. 169-190. 21 refs.

The performance of a partitioned solar pond is analyzed as a large-scale solar energy collection and storage system for power production. The solar radiation absorption and the temperature and heat fluxes in the pond are determined by the Fourier heat conduction equation; an expression is derived for the transient rate of heat retrieval to maintain a constant convective zone temperature. Optical retrieval efficiencies in the 26.5 to 42% range are projected for extraction temperatures from 40 to 100 C. It was concluded that the efficiency of the solar-pond for converting solar energy into mechanical work increased with collection temperature and leveled off above 90 C. A.T.

A81-16937 **Performance of a two-stage solar concentrator.** T. C. Kandpal, S. S. Mathur, and R. N. Singh (Indian Institute of Technology, New Delhi, India). *Applied Energy,* vol. 7, Nov. 1980, p. 191-199. 11 refs.

The geometrical concentration characteristics of a two-stage system employing a composite parabolic trough as a primary - and a compound parabolic concentrator as a secondary - concentrator are discussed. The relative merits of such a two-stage system over a single-stage CPT are brought out from simple thermal performance considerations. (Author)

A81-16938 **Performance of a constant flow sand solar collector.** M. S. Sodha, A. Srivastava, G. N. Tiwari, and S. C. Kaushik (Indian Institute of Technology, New Delhi, India). *Applied Energy,* vol. 7, Nov. 1980, p. 201-214.

An analysis is presented for the performance of an inexpensive sand collector for solar energy which has been validated experimentally. The collector consists of a plane network of polythene pipes buried in a sand mass which is kept in a wooden case, the top surface of the sand being fixed by mixing with sodium silicate, blackened with blackboard paint spray and suitably glazed. The heat can be extracted by fluids passing through the pipes. For a 2 cm depth of the plane of heat retrieval and 0.46 liter/min flow rate of water, the collector efficiency is about 55 per cent. The efficiency increases with the flow rate and decreases with the depth of the plane of heat retrieval. (Author)

A81-17313 **Current mechanism of tunnel M.I.S. solar cells.** O. M. Nielsen (Danmarks Tekniske Hojskole, Lyngby, Denmark). *IEE Proceedings, Part I - Solid-State and Electron Devices,* vol. 127, pt. I, no. 6, Dec. 1980, p. 301-307. 24 refs.

Dark current/voltage characteristics have been examined as a function of temperature for two structures of Al-pSi MIS solar cells. The solar cells have been prepared with interfacial oxide thickness ranging from 10 A to 20 A. The results show that the diode saturation current Jo for all oxide thicknesses behave as a majority-carrier current, highly dependent on the effective metal-to-semiconductor barrier height and the oxide-tunnel exponent. (Author)

A81-17314 **Use of V/oc//J/sc/ measurements for determination of barrier height under illumination and for fill-factor calculations in Schottky-barrier solar cells.** P. Panayotatos (Columbia University, New York, N.Y.) and H. C. Card (Manitoba, University, Winnipeg, Canada). *IEE Proceedings, Part I - Solid-State and Electron Devices,* vol. 127, pt. I, no. 6, Dec. 1980, p. 308-311. 14 refs. NSF Grant No. ENG-76-15063; Contract No. ET-78-R-03-1876.

An experimental study has been made of metal-silicon solar cells, with thin Ag, Au, Cu, Fe, and In electrodes. No intentional interfacial layers were introduced and the silicon surfaces were chemically prepared in such a way as to minimise the residual oxide layer. The characteristics of the devices were taken at various illumination levels and the effect of barrier heights, series resistance and n-value on the open-circuit voltage and the fill factor were studied. Comparison between theoretical predictions and the experimental results show that open-circuit voltage/short-circuit-current measurements that provide the n-values appropriate for the expression for the open-circuit voltage also provide a reliable method for experimental barrier-height determination under illumination and that the above 'true' n-value should also be used in fill-factor calculations. (Author)

A81-17329 **Solar concentrators with curvature determined by gravity and a variable density distribution.** C. Pontiggia and G. A. Rottigni (Genova, Università, Genoa, Italy). *Nuovo Cimento C, Serie 1,* vol. 3C, Jan.-Feb. 1980, p. 56-66.

Density distributions of the lamina of a solar concentrator whose curvature is determined by gravity are analyzed in order to determine those distributions which would result in maximum concentration along a given focal axis. For three types of gravitational concentrators, a computer program is used to determine point by point the distribution of lamina density necessary to produce a parabolic concentrator from the catenary curve for every angle of incident solar radiation, which distributions are represented as a series of curves for each concentrator. Technical means for producing the lamina density distributions, which must vary in a given mirror as the mirror is tilted with solar inclination, are considered, and it is shown that the variable density concentrators can improve concentration factors over those produced by constant density gravitational concentrators. A.L.W.

A81-17330 **Optical characterization of selective SnO2 films by a thermodynamical method.** C. Bellecci, M. Camarca, M. Conti, L. La Rotonda, A. Visentin, and R. Visentin (Calabria, Università, Cosenza, Italy). *Nuovo Cimento C, Serie 1,* vol. 3C, Jan.-Feb. 1980, p. 80-86.

A method is presented for determining the infrared spectral emissivity of a selective solar absorbing surface consisting of a conducting SnO2 film deposited on a black ceramic surface on the basis of thermal measurements. The method involves the evaluation of absorber emissivity at different temperatures, from which the spectral emissivity can be computed according to Drude's theory. For a thin SnO2 film (5000 A) doped with Sn and deposited on a black enamel coating, application of the thermodynamic method is found to result in a curve for reflectivity as a function of wavelength from 1.5 to 10 microns in agreement with results obtained spectrophotometrically for the sample. The method is noted to be applicable in the improvement of absorber film deposition techniques. A.L.W.

A81-17332 **Transient thermal behaviour of the primary circuit and the thermal storage tank of a solar-power plant.** C. Bellecci, M. Conti, M. El-Sawi, L. La Rotonda, A. Visentin, and R. Visentin (Calabria, Università, Cosenza, Italy). *Nuovo Cimento C, Serie 1,* vol. 3C, Mar.-Apr. 1980, p. 123-141. 5 refs.

A81-17452 **Materials for a solar thermal electric power system.** E. T. Myskowski (Fairchild Industries, Inc., Fairchild Stratos Div., Manhattan Beach, Calif.), H. E. Frankel (Fairchild Space and Electronics Co., Germantown, Md.), J. R. Woodward, and R. S. Mueller (Solar Turbines International, San Diego, Calif.). *SAMPE Journal,* vol. 16, Nov.-Dec. 1980, p. 6-9.

An electric power generating system using solar heat to operate a Stirling engine driven alternator is presented in detail and analyzed. The Dish Stirling Solar Thermal Electric Power System (DSSTEP) is an array of modular generating units consisting of paraboloidal concentrators which focus the incident solar flux at the focal plane to produce the high temperatures needed for efficient operation of the heat engine. The concentrator, made of back silvered glass for superior reflectivity and greater erosion resistance has a diameter of 10 m. The Stirling Engine receives the heat produced by the generating units and through heating and cooling of the working fluid (helium at 1500 F under 2500 psi pressure) drives the piston and generates power. The Dish Stirling Solar Receiver (DSSR) consists of four quadrants, each containing 12 copper tubes (coated with an Alloy 617 shell) 0.265 in O.D. and 0.145 in I.D. Metallographic studies of specimens under simulated operating conditions gave no evidence of problems and a receiver is being constructed for a full system test. B.R.K.

A81-17480 **Preparation and characterisation of a spectrally selective black chrome coating for solar energy applications.** P. K. C. Pillai and R. C. Agarwal (Indian Institute of Technology, New Delhi, India). *Applied Energy,* vol. 7, Dec. 1980, p. 299-303. 26 refs.

A81-17887 **Minimum-mirror-area single-stage solar concentrators.** D. Mills, E. Harting, J. E. Giutronich, W. Cellich, A. Morton, and I. Walker (New South Wales, University, Kensington, Australia). *Optics Letters,* vol. 5, Dec. 1980, p. 558-560. 7 refs. Research supported by the National Energy Research Development and Demonstration Council.

A means of generating a concentrating mirror of minimum size for a given average flux-concentration output is outlined. The method is useful for acceptance angles typical of those required for tilting and tracking solar concentrators and can result in substantial cost savings when expensive mirrors (i.e., glass) are used. Comparisons are made with compound parabolic concentrators. (Author)

A81-17896 **Recent developments in amorphous silicon solar cells.** D. E. Carlson (RCA Laboratories, Princeton, N.J.). *Solar Energy Materials,* vol. 3, Nov. 1980, p. 503-518. 73 refs. Research supported by RCA; Contract No. XJ9-8254.

This article reviews recent advances in the development of amorphous silicon solar cells. Both the glow-discharge deposition conditions and the solar-cell structures are discussed in some detail. The performance characteristics of present amorphous silicon cells are described, and the loss mechanisms that limit performance are considered. An effort has been made to point out those areas where further research is needed. Recently, amorphous silicon p-i-n cells with areas of 1.19 cm/sq have been fabricated with conversion efficiencies as high as 6.1%. (Author)

A81-17898 **Chemical modification of hydrogenated amorphous silicon.** D. P. Tanner, G. R. Johnson, and M. D. Sefcik (Monsanto Corporate Research Laboratories, St. Louis, Mo.). *Solar Energy Materials,* vol. 3, Nov. 1980, p. 533-546. 30 refs.

Using glow discharge decomposition of mixtures of silane and various 'modifying' gases, thin films with properties which in some cases differ significantly from those reported for glow discharge prepared hydrogenated amorphous silicon are prepared. The optical absorption edge, index of refraction, and light and dark resistivities are reported for a number of modified thin films using B, C, Ge, N, F and Cl in different molecular forms. A method is described for preparing p-type photoconductive amorphous materials which may be useful in semiconducting and photovoltaic devices. (Author)

A81-17914 **Metal-insulator-semiconductor solar cells using amorphous Si:F:H alloys.** A. Madan, J. McGill, W. Czubatyj, J. Yang, and S. R. Ovshinsky (Energy Conversion Devices, Inc., Troy, Mich.). *Applied Physics Letters,* vol. 37, Nov. 1, 1980, p. 826-828. 14 refs.

Metal-insulator-semiconductor photovoltaic devices with a conversion efficiency of 6.3% have been fabricated from amorphous Si:F:H alloys. This exceeds the maximum efficiencies reported for a-Si:H devices. The effective barrier height of the solar cells fabricated from a-Si:F:H alloys is approximately 1.0 eV. V.L.

A81-18001 # **Some aspects of antenna technology for European SPS.** R. V. Gelsthorpe, B. Claydon, and A. W. Rudge (ERA Technology, Ltd., RF Technology Centre, Leatherhead, Surrey, England). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 7 p.

The paper deals with a geostationary orbiting solar power satellite (SPS) system proposed by NASA. It consists of a 50 sq km array of photovoltaic cells which utilizes solar energy to generate electric energy for transmission to earth. The reference system design employs a 1 km-diam phased array antenna powered by over 100,000 klystrons to transmit this energy to earth in the form of a highly collimated beam of microwave energy at a frequency of 2.45 GHz. This energy is intercepted by means of a ground receiving/rectifying antenna which consists of a vast number of individual dipoles. V.P.

A81-18003 # **Potential interest in Europe in SPS development.** K. K. Reinhartz (ESA, Noordwijk, Netherlands). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 7 p. 7 refs.

The Solar Satellite Power System is a concept whereby large solar-energy converters are placed in outer space and the electrical energy produced is transmitted back to earth as microwave radiation. A number of studies, performed mainly in the United States, are aimed at assessing the technical, economic, social and health aspects of this concept. This paper does not address the feasibility of the SPS as such, but discusses the potential contribution that an SPS could make to the European energy scenario, the economic impact of the SPS as an indigenous European energy source, and the potential importance of the SPS as a technology driver. A European network of forty solar power satellites could supply electrical energy equal to Europe's present electrical energy production and significantly reduce Europe's dependence on energy imports. Additionally the development of a power satellite technology, if started by the United States, is expected to lead to such an advancement in technology in key areas, e.g., space industrialisation, photovoltaic energy conversion and wireless transmission of energy, that Europe would rapidly lose technical competence in many important fields if it were not to participate. (Author)

A81-18004 # **International dimensions of solar power satellites - Collaboration or competition.** J. M. Logsdon (George Washington University, Washington, D.C.). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 4 p.

This paper identifies the global political trends which are likely to influence a SPS system in the latter stages of its development and the early phase of its operation. It points out that such a system, both because of its technological challenge and financial dimensions and because it deals with the crucially-important area of energy supply, will be a focus of attention among the central political leadership of major countries. The politics of SPS will be marked by both competitive and collaborative forces. In order to create a framework for SPS operation, international forums, particularly the U.N. system, will become engaged in the SPS development process. (Author)

A81-18006 # **Satellite Power System Concept Development and Evaluation Program.** F. A. Koomanoff (U.S. Department of Energy, Satellite Power System Projects Office, Washington, D.C.). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 5 p.

The progress made by the Concept Development and Evaluation Program (CDEP), set up to consider the Satellite Power System (SPS) program, is assessed. It is pointed out that from a technical standpoint the SPS concept now has at least two options for each of the following subsystems: conversion of solar energy to electrical energy; conversion of electrical energy to radio frequency energy; power transmission to earth; transportation; and space construction and manufacturing. The environmental assessment carried out as part of the CDEP is analyzed with attention given to such questions as the effect of SPS microwaves at high power densities on humans, the climatic effect of SPS effluents and the effect of ionospheric heating on telecommunications. The societal assessment (availability of materials, land, and water) and comparative assessment (consideration of alternatives to SPS) that also enter into the CDEP are discussed. C.R.

A81-18008 # **The solar power satellite - Past, present and future.** P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 10 p. 5 refs.

The potential and the problems of solar energy are discussed, covering all aspects of the necessary technology and its economic and political consequences. The concept of the solar power satellite (SPS) is introduced, noting its feasibility through the space technology of the 1990's. Proposed objectives, including consideration of finite resources, environmentally benign operations and global benefits are covered, as are technical details on power transmission (microwave beams of the 2.50 GHz frequency or the laser beams at 10 MW), and on assembly in orbit through the space transportation system. From the point of view of economic possibilities, costs are estimated at between $1500 to $4000 per kW and finally, ecological and international topics are touched upon. N.D.

A81-18009 # **Integration of SPS with utility system networks.** B. M. Kaupang (General Electric Co., Fairfield, Conn.). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 23 p.

This paper will discuss the integration of SPS power in electric utility power systems. Specifically treated will be the nature of the power output variations from the spacecraft to the rectenna, the operational characteristics of the rectenna power and the impacts on the electric utility system from utilizing SPS power to serve part of the system load. (Author)

A81-18010 # **Some critical aspects of solar power satellite technology.** I. V. Franklin (British Aerospace, Dynamics Group, Bristol, England). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 5 p.

It is sometimes said that the SPS can be designed and built using an extension of existing and proven technologies. This is not quite true, and this paper seeks to identify those areas of technology which either need to be established and those areas which need extension, with an indication of the required scope. The paper does not intend to cover the whole field but rather to concentrate on some selected areas such as photovoltaic conversion which requires development leading to improved efficiency, low costs, high production rates and mass production methods for supplying finished fully integrated modules of solar array blankets. A second example concerns the development of large scale space structures and their behavior. The third area is concerned with the power transmission system, and what the requirements may be if Europe is to consider receiving SPS generated power. (Author)

A81-18011 # **Solar power satellites /SPS/ and the international community (Les satellites solaires de puissance /SPS/ et la communauté internationale).** B. H. Châtel (United Nations, New York, N.Y.). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 7 p. 18 refs. In French.

The principal characteristics of solar power satellites (SPS) are reviewed, and the implications of the implementation of SPS for the international community are considered as regards the potential for international cooperation. The SPS system is presented as consisting of a geostationary satellite which receives solar radiation by a large collector composed of photovoltaic cells or thermodynamic apparatus to produce energy transmitted to earth in the form of microwaves; the system would be assembled in space by means of reusable launch vehicles (space shuttles). The present state of SPS development is considered, with attention given to current estimates of system costs and the status of photovoltaic, energy transmission and transportation research and development programs, and the fourstage NASA/DOE program, leading to the possible implementation of an SPS system is presented. Financial, technical and organizational bases for international cooperation in the development of SPS are pointed out, and it is suggested that the United Nations would be the appropriate means for the organization of such a cooperative venture, which would represent a step towards the management of energy resources on a global scale. A.L.W.

A81-18012 # **SPS - An economic outlook.** K. P. Heiss (ECON, Inc., Princeton, N.J.). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 7 p.

Principles that may be applied to an economic analysis of the solar power satellite concept in order to substantiate allocations of funds and resources to SPS research and development are considered. The criteria of standard benefit-cost analysis, the concept of using R & D funds to buy information and the properties of unique R & D programs, in which a proposed technology offers a unique, otherwise unachievable breakthrough, are examined, and it is argued that SPS technology must be evaluated as buying information through R & D. It is pointed out that fossil fuel price structures and the price effects of long-term viable inexhaustible energy options must also be considered for the case of SPS. Estimates of the cost of generating electrical energy through satellite technology are presented which compare favorably with the estimated costs of expanding ground-based energy generating facilities, and it is concluded that with the development of space industrialization and the SPS program, the energy option represented by solar power satellites will become a viable component of world energy supply in the next century. A.L.W.

A81-18013 # **SPS environmental effects on the upper atmosphere.** L. M. Duncan (California, University, Los Alamos, N. Mex.). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 9 p. 21 refs.

This paper reviews the ionospheric effects and associated environmental impacts which may be produced during the construction and operation of a solar power satellite system. Propellant emissions from heavy lift-launch vehicles are predicted to cause wide-spread ionospheric depletions in electron and ion densities. Collisional damping of the microwave power beam in the lower ionosphere can significantly enhance the local free electron temperatures. Thermal self-focusing of the power beam in the ionosphere may excite variations in the beam powerflux density and create large-scale field-aligned electron density irregularities. These large-scale irregularities may also trigger the formation of small-scale plasma striations. Ionospheric modifications can lead to the development of potentially serious telecommunications and climate impacts. A comprehensive research program is being conducted to understand the physical interactions driving these ionospheric effects and to determine the scope and magnitude of the associated environmental impacts. (Author)

A81-18014 # Assessment of SPS photovoltaic solar array requirements. J. Rath (Telefunken AG, Wedel, West Germany). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 7 p. 7 refs.

Performance and structural requirements for photovoltaic solar arrays which would ensure the technical and economic feasibility of SPS are discussed in relation to the current state of the art of solar array technology. Consideration is given to the requirements for technology availability, satellite lifetime, transmitted and received power, solar array dimensions and operating voltage, solar cell efficiency, dimensions and radiation resistance, and mass production and costs, and it is pointed out that several of the requirements, including solar cell area and thickness and array operating voltages, are already being addressed in current R&D programs. In the areas of solar cell efficiency and radiation resistance and elevated voltage solar array technology, however, it is shown that a concentrated development effort is necessary to meet program deadlines for technology availability by 1990. A.L.W.

A81-18015 # Remarks on some legal aspects of solar satellites - An overview. I. H. P. Diederiks-Verschoor. *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 5 p. 23 refs.

A81-18016 # About the S.P.S. transmitting antenna radiation pattern. P. F. Combes (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France). *SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25-27, 1980, Paper.* 5 p.

In the present paper, the hypotheses underlying the calculation of the radiation pattern of the solar power satellite's (SPS) transmitting antenna are critically analyzed, and the factors which may affect the ideal design conditions are noted. A method for computing the 'actual' radiation pattern is proposed. V.P.

A81-18048 Photovoltaic properties of merocyanine solid-state photocells. G. A. Chamberlain, P. J. Cooney (Shell Research, Ltd., Thornton Research Centre, Chester, Ches., England), and S. Dennison (Cambridge University, Cambridge, England). *Nature*, vol. 289, Jan. 8, 1981, p. 45-47. 7 refs.

Considerable progress has been made in improving the sunlight conversion efficiency of solid-state organic photovoltaic cells. Ghosh et al (1978) report a 0.7% efficiency for a merocyanine dye Schottky barrier cell. Improvements in energy conversion efficiency may follow if merocyanines of low ionization potential are used in photovoltaic cells, in which the dye layer contains a strongly electronegative dopant such as iodine. To test these ideas the photovoltaic quantum yields and sunlight conversion efficiencies of a series of merocyanines in which the molecular properties have been varied systematically are studied. (Author)

A81-18230 Experimental compact space power station. M. Pospisil, L. Pospisilova (Ceskoslovenska Akademie Ved, Astronomicky Ustav, Ondrejov, Czechoslovakia), Z. Hanzelka (Ceskoslovenska Vedecka-Technicka Spolecnost, Uherske Hradiste, Czechoslovakia), and M. Prochazka (Vyzkumny Ustav pro Sdelovaci Techniku, Prague, Czechoslovakia). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-12.* 17 p. 12 refs.

A hexagonal structure of 1-km diameter and a weight of 500 metric tons situated at geosynchronous orbit is proposed for testing a space power station of 64 MW peak power in operation and for evaluating materials, means and methods needed for production of large stations. In this compact space power station, solar blankets and microwave sources are situated on one supporting structure, thus saving a lot of auxiliary parts, but the exploitation of solar elements is 3.3 times lower than for an earlier concept. (Author)

A81-18231 Space manufacturing in the construction of solar power satellites - Energy budget and cost calculation. J. Ruth and W. Westphal (Berlin, Technische Universität, Berlin, West Germany). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-13.* 17 p. 18 refs.

The paper presents a model of a solar Satellite Power System (SPS) in which the overall system cost and the total energy investment of ground-based construction is compared to that of space-based construction. For the purpose of testing the model's validity, the investigation is restricted to the manufacture of the satellite's silicon solar-cell components, which, at 25796 x 1000 kg, comprise approximately 50% of the SPS mass. The model specifies a three-phase implementation of 120 satellites (5 GW each) over a 50-year period, and assumes a 10 year replacement span for the production machinery. All materials used are terrestrial. Although system costs are similar, the space-manufacturing option has a 21% 'efficiency advantage' over its alternative in terms of energy investment and return. R.S.

A81-18232 Possible limitations to SSPS use due to distribution of world population and world energy consumption centers. M. J. Claverie and A. P. Dupas (CNRS, Paris, France). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-14.* 11 p. 10 refs.

Satellite solar power stations, as envisioned now, would be very large energy systems from the point of view of power output (about 5 GW) and of land requirements (more than 400 sq km for a rectenna and the associated exclusion area). These size constraints could lead to limitations in the use of SSPS in significant parts of the world, due to three main incompatibilities: too high population density, insufficient density of electrical demand, and obligation for a single power station to provide less than about 20% of the total electrical demand in a given geographical zone to assure reliability. The extent of these three possible limitations was assessed, using a future world energy model developed previously. The rationale behind this model is to divide the world into 10 deg latitude by 10 deg longitude zones, in which future electrical demands (in 2000 and 2020/2025) are computed according to energetical previsions of the Case Western Reserve University (CWRU) and of the World Energy Conference (WEC). The results are world wide maps of electrical demand densities in 2000 and 2020/2025. (Author)

A81-18238 Pre-launch simulation experiment of microwave-ionosphere nonlinear interaction rocket experiment in the space plasma chamber. N. Kaya (Kobe University, Kobe, Japan), M. Tsutsui, H. Matsumoto (Kyoto University, Uji, Japan), and I. Kimura (Kyoto University, Kyoto, Japan). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-24.* 8 p.

A pre-flight test experiment of a microwave-ionosphere non-linear interaction rocket experiment (MINIX) has been carried out in a space plasma simulation chamber. Though the first rocket experiment ended up in failure because of a high voltage trouble, interesting results are observed in the pre-flight experiment. A significant microwave heating of plasma up to 300% temperature increase is observed. Strong excitations of plasma waves by the transmitted microwaves in the VLF and HF range are observed as well. These microwave effects may have to be taken into account in solar power satellite projects in the future. (Author)

A81-18392 **Optimisation of solar power plants with rotating electric generators.** H. O. Ruppe and J. Blumenberg (München, Technische Universität, Munich, West Germany). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-G-311.* 19 p. 6 refs.

An optimization and tradeoff study is carried out for a solar energy supply system to be used in space. The class of devices considered entail the assembly of a solar reflector, an absorber, a conversion system, a radiation cooler, and associated auxiliary components. A number of optimal value formulas are given for efficiencies of the thermal conversion processes which can be employed. Mass ratings of various mirror systems are listed, and general conclusions are given based on comparisons among possible component versions. T.M.

A81-18572 **The influence of carrier generation and collection on short-circuit currents in amorphous silicon solar cells.** C. R. Wronski, B. Abeles, and G. D. Cody (Exxon Research and Engineering Co., Linden, N.J.). *(Solar Energy Research Institute, Photovoltaic Material and Device Measurements Workshop, San Diego, Calif., Jan. 3, 4, 1980.) Solar Cells,* vol. 2, Nov. 1980, p. 245-259. 15 refs.

A81-18573 **Analysis of amorphous silicon solar cells.** V. L. Dalal (Delaware, University, Wilmington, Del.). *(Solar Energy Research Institute, Photovoltaic Material and Device Measurements Workshop, San Diego, Calif., Jan. 3, 4, 1980.) Solar Cells,* vol. 2, Nov. 1980, p. 261-273. 23 refs. U.S. Department of Energy Grant No. 03-79-ET-23034.

Amorphous silicon (a-Si), although a very promising material for solar energy conversion, has generally yielded solar cells with poor efficiencies (about 4-6%). Traditionally this low efficiency has been attributed to short diffusion lengths (about 0.1 micron). The performance of a-Si solar cells is analyzed, and it is shown that the poor efficiency has been primarily due to poor designs which paid inadequate attention to the peculiar properties of a-Si and to poor engineering which resulted in excessive optical and resistive losses. The analysis shows that there is an optimum thickness of a-Si cells and that simple techniques such as a double pass of photons can result in significant increases in current densities for this optimum thickness. Methods of better antireflection coating and improved contacting are also discussed. It is shown that optimized design and engineering can lead to significant increases in efficiency to about 9-11%. (Author)

A81-18704 # **An optical study of thermal convection in a passive solar heated room.** A. B. Carlson, D. T. Harrje, and G. S. Settles (Princeton University, Princeton, N.J.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-1.* 5 p. 11 refs. Members, $1.50; nonmembers, $3.00.

Natural convection patterns associated with thermal energy storage in a passive solar heated room of the Trombe wall type were simulated with a small scale model and measured optically. The model was dynamically scaled with respect to key fluid mechanical properties. Color schlieren optics were used to obtain quantitative temperature data. Measurements from these schlieren images yielded results comparable to data generated by full-sized test facilities. Tests using this model show that hot air rising along the Trombe wall collects and remains near the ceiling, resulting in thermal stratification of the room air. Higher levels of thermal storage result in higher Trombe wall temperatures and greater differences between ceiling and floor temperatures. The study shows that vertical temperature gradients are independent of the width of the airgap between the Trombe wall and its glazing. Properly applied, the combination of reduced size room models and color schlieren optics has been demonstrated to be a useful and relatively inexpensive research tool for evaluating convective heating from thermal storage devices. (Author)

A81-18705 * # **Design optimization of sinusoidal glass honeycomb for flat plate solar collectors.** J. C. McMurrin (California Institute of Technology, Jet Propulsion Laboratory, Pasadena; California, University, Los Angeles, Calif.) and H. Buchberg (California, University, Los Angeles, Calif.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-2.* 9 p. 13 refs. Members, $1.50; nonmembers, $3.00. Research supported by the U.S. Department of Energy.

The design of honeycomb made of sinusoidally corrugated glass strips was optimized for use in water-cooled, single-glazed flat plate solar collectors with non-selective black absorbers. Cell diameter (d), cell height (L), and pitch/diameter ratio (P/d) maximizing solar collector performance and cost effectiveness for given cell wall thickness (t sub w) and optical properties of glass were determined from radiative and convective honeycomb characteristics and collector performance all calculated with experimentally validated algorithms. Relative lifetime values were estimated from present materials costs and postulated production methods for corrugated glass honeycomb cover assemblies. A honeycomb with P/d = 1.05, d = 17.4 mm, L = 146 mm and t sub w = 0.15 mm would provide near-optimal performance over the range delta T sub C greater than or equal to 0 C and less than or equal to 80 C and be superior in performance and cost effectiveness to a non-honeycomb collector with a 0.92/0.12 selective black absorber. (Author)

A81-18706 # **A study of wind effects on collector performance.** N. Onur and J. C. Hewitt, Jr. (Tennessee Technological University, Cookeville, Tenn.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-4.* 6 p. 7 refs. Members, $1.50; nonmembers, $3.00. Research supported by the U.S. Department of Energy.

Convective heat transfer experiments have been run on flat-plate collectors for tilt angles ranging from the horizontal to the vertical and for five different flow velocities. Experimental data are used to evaluate the currently used models, namely, those of Jurges (1924), Drake (1948), and Sparrow et al (1970-79), and it is shown that although none of these models provides an exact fit, they do represent bounds for the present data. It is also shown that the effect of flow from the northern quadrants provides an additional heat loss reduction of 10 to 20%. V.L.

A81-18707 # **The effect of longitudinal heat conduction on the thermal performance of the flat plate solar collector.** J. P. Chiou (Detroit, University, Detroit, Mich.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-5.* 11 p. 20 refs. Members, $1.50; nonmembers, $3.00.

Longitudinal heat conduction through the heat transfer wall in the direction of the fluid flow is known to have detrimental effect on the thermal performance of heat exchanger. For solar collector, however, the situation may be completely different. In this paper, a two-dimensional heat transfer model is used for the thermal analysis of the solar collector. Various design and operating conditions of the solar collector are used as parameters of this study. The results of this study indicate that the longitudinal heat conduction has negligible effect on the solar collector efficiency. The result suggests that the terms of longitudinal heat conduction through the heat transfer wall in the direction of the fluid flow may not be needed in the analysis of the solar collector. The elimination of this longitudinal heat conduction term, if it is justified, can simplify extensively the mathematical analysis of the solar collector. (Author)

A81-18708 # **Performance predictions for a total energy photovoltaic concentrator system.** D. F. Brink and A. K. Yasuda (Acurex Corp., Mountain View, Calif.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-7.* 7 p. Members, $1.50; nonmembers, $3.00.

The analytical modeling and resulting performance predictions are summarized for a photovoltaic total energy system to be built for the Wilcox Memorial Hospital in Hawaii. The system will demonstrate the technical feasibility of generating electricity and hot water (60 deg C) from solar energy for commercial applications. The system model characterizes the response of each system component to the control system and operating conditions. The modeling results indicate that 892 sq m of parabolic trough concentrators (using 21.9 sq m of photovoltaic cells) will supply 241 GJ (66,950 kW-hr) or electricity and 383 GJ of thermal energy to the hospital annually. The peak net electrical output will be 61 kW. (Author)

A81-18709 # **Predictions of convective losses from a solar cavity receiver.** L. L. Eyler (Battelle Pacific Northwest Laboratories, Richland, Wash.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-8.* 7 p. 7 refs. Members, $1.50; nonmembers, $3.00. Contract No. EY-76-C-06-1830.

Convective losses arising from buoyancy driven flow were calculated for a two-dimensional model simulating a solar cavity receiver. The TEMPEST code, capable of fully three-dimensional, coupled thermal-hydraulic transient calculations, was used for the simulation. Predicted velocity and temperature results for a 2.59 m deep by 2.88 m high rectangular cavity with an aperture opening of 1.72 m were used to determine convective losses for prescribed interior wall temperatures and cavity orientation. Velocity vector and temperature isotherm plots were used to analyze flow characteristics. (Author)

A81-18711 # **Conceptual design and analysis of a Dish-Rankine solar thermal power system.** R. L. Pons (Ford Aerospace and Communications Corp., Newport Beach, Calif.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-10.* 10 p. 10 refs. Members, $1.50; nonmembers, $3.00.

A Point Focusing Distributed Receiver (PFDR) solar thermal electric system which employs small Organic Rankine Cycle (ORC) engines is examined with reference to its projected technical/economic performance. With mass-produced power modules (about 100,000 per year), the projected life-cycle energy cost for an optimized no-storage system is estimated at 67 mills/kWh (Levelized Busbar Energy Cost) without the need for advanced development of any of its components. At moderate production rates (about 50 MWe/yr) system energy costs are competitive with conventional power generation systems in special remote-site types of applications. V.L.

A81-18712 # **Conceptual design of a combined cycle solar hybrid power system.** J. R. Darnell, J. H. Westsik, and E. Y. Lam (Bechtel National, Inc., San Francisco, Calif.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-11.* 10 p. 10 refs. Members, $1.50; nonmembers, $3.00. Contract No. DE-AC03-78ET-21050.

This paper summarizes the results of a DOE-funded study of a solar hybrid power system. The concept consists of an air-cooled solar central receiver which is used to displace a portion of the fossil fuel requirement of a combined cycle power plant. The conceptual design of a first of its kind, commercial-size 112.6-MWe power plant is described. Operation, performance and cost estimates are presented. The results of an assessment of the conceptual design show significant potential for utility application by the year 2000. Developmental needs are also discussed. (Author)

A81-18713 # **Comparison of heat exchanger designs for sodium-cooled solar central receivers.** B. D. Pomeroy and J. A. Bond (General Electric Co., Schenectady, N.Y.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-12.* 7 p. 8 refs. Members, $1.50; nonmembers, $3.00.

Two sodium-cooled receivers are compared; both are cylinders assembled with 24 vertically oriented rectangular heat exchange panels. In the first receiver, each panel has a bottom inlet header and an upper outlet header connected by a flat tube bundle; the second receiver has panels with an inlet header located midway between the top and the bottom outlet headers. The two-header panel is found to have superior thermal efficiency for the flux distributions evaluated and is more stable with respect to axial flux variations and sodium flow transients. The two-header design is also less complex, less costly, and less prone to failure due to axial expansion and contraction. V.L.

A81-18714 * # **Sodium heat pipe use in solar Stirling power conversion systems.** W. F. Zimmerman (General Electric Co., Advanced Energy Dept., Cincinnati, Ohio), S. M. Divakaruni (General Electric Co., Advanced Reactor Systems Dept., Sunnyvale, Calif.), and Y. S. Won (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-13.* 5 p. 6 refs. Members, $1.50; nonmembers, $3.00. Contract No. JPL-955018.

Sodium heat pipes were selected for use as a thermal transport method in a focus-mounted, distributed concentrator solar Stirling power conversion system intended to produce 15-20 kWe per unit. Heat pipes were used both to receive thermal power in the solar receiver and to transmit it to a secondary heat pipe containing both latent heat salt (for up to 1.25 hours of thermal storage) and the heat exchanger of the Stirling engine. Experimental tests were performed on five solar receiver heat pipes with various internal wicking configurations. The performance of the heat pipes at various power levels and operating attitudes was investigated at temperatures near 1550 F; the unidirectional heat transfer in these heat pipes was demonstrated in normal operating attitudes and particularly in the inverted position required during overnight stowage of the concentrator. (Author)

A81-18715 * # **Application of a reversible chemical reaction system to solar thermal power plants.** E. J. Hanseth, Y. S. Won, and L. P. Seibowitz (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-14.* 8 p. 19 refs. Members, $1.50; nonmembers, $3.00. Research sponsored by the U.S. Department of Energy and NASA.

Three distributed dish solar thermal power systems using various applications of SO2/SO3 chemical energy storage and transport technology were comparatively assessed. Each system features various roles for the chemical system: (1) energy storage only, (2) energy transport, or (3) energy transport and storage. These three systems were also compared with the dish-Stirling, using electrical transport and battery storage, and the central receiver Rankine system, with thermal storage, to determine the relative merit of plants employing a thermochemical system. As an assessment criterion, the busbar energy costs were compared. Separate but comparable solar energy cost computer codes were used for distributed receiver and central receiver systems. Calculations were performed for capacity factors ranging from 0.4 to 0.8. The results indicate that SO2/SO3 technology has the potential to be more cost effective in transporting the collected energy than in storing the energy for the storage capacity range studied (2-15 hours). (Author)

A81-18716 # **Operation of the Campbell Soup facility for solar production of industrial process hot water.** W. A. Niemeyer (Acurex Corp., Mountain View, Calif.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-15.* 7 p. Members, $1.50; nonmembers, $3.00.

A81-18717 # **A simple process heat collector system.** W. D. Batton and R. E. Barber (Barber-Nichols Engineering Co., Arvada, Colo.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-16.* 8 p. 6 refs. Members, $1.50; nonmembers, $3.00.

The direct boiling of a process fluid in a concentrating solar collector can have advantages over a conventional system using pumped oil and a heat exchanger. This paper describes such a 'boiling in the collector' (BIC) system and the test results from operating a prototype system at 350 F (177 C) using R-113, a refrigerant. These tests demonstrated the feasibility of the BIC system but the overall collector efficiency was less than expected. (Author)

A81-18718 # **Design issues for a cost-effective solar industrial process heat system.** D. M. Deffenbaugh (Southwest Research Institute, San Antonio, Tex.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-17.* 5 p. Members, $1.50; nonmembers, $3.00.

Several issues which are essential for making solar industrial process heat systems cost-effective are identified. These issues are examined under the following headings: (1) industrial process interface, (2) solar collector selection, (3) roof versus ground mounting of collectors, (4) roof-mounted structure analysis, (5) tax incentives, and (6) mass production effects. V.L.

A81-18719 # **Design aspects and optimization of intermediate temperature solar industrial process heat systems.** S. L. Hudson (Energetics Corp., Richardson, Tex.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-18.* 8 p. Members, $1.50; nonmembers, $3.00. Research supported by the U.S. Department of Energy.

This paper addresses several design aspects of intermediate temperature solar industrial process heat (IPH) systems. Engineering design decisions based on both system performance and cost are utilized to arrive at optimum cost-performance system design decisions. The analysis involves the trade-off of a solar system first cost with its annual performance such that the minimum cost, equivalent performance system can be selected. In addition, the solar system application and description and specific design decisions such as determination of the collector field configuration, collector row spacing, and system flow rate are discussed as they relate to the solar IPH system design at the Famariss Refinery near Hobbs, New Mexico. (Author)

A81-18720 # **An analysis of the influence of geography and weather on parabolic trough solar collector design.** G. W. Treadwell, N. R. Grandjean, and F. Biggs (Sandia Laboratories, Albuquerque, N. Mex.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-19.* 8 p. 10 refs. Members, $1.50; nonmembers, $3.00.

The potential performance of single-axis tracking parabolic trough solar collectors as a function of optical energy distribution and receiver size has been calculated for eleven sites using typical meteorological year input data. A simulation based on the SOLTES code was developed which includes the three-dimensional features of a parabolic trough and calculates the thermooptical tradeoffs. The capability of the thermooptical model has been confirmed by the comparison of calculated results with the experimental results from an all-day test of a parabolic trough. The results from this eleven-site analysis indicate a potential performance superiority of a north-south horizontal axis trough and, in addition, a high quality collector should be of the same geometric design for all of the sites investigated and probably for all regions of the country. (Author)

A81-18721 # **Steady-state wind loading on parabolic trough solar collectors.** D. E. Randall, D. D. McBride, and R. E. Tate (Sandia Laboratories, Albuquerque, N. Mex.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-20.* 11 p. Members, $1.50; nonmembers, $3.00. Research supported by the U.S. Department of Energy.

Two wind tunnel force and moment tests have been conducted on parabolic trough solar collector configurations. The tests were conducted in different flow field environments, one a uniform flow infinite airstream, the second a simulated atmospheric boundary layer flow with the models simulating a ground mounted installation. The force and moment characteristics of both isolated single module troughs and of trough modules within array configurations have been defined over both operational and stow attitudes. The influence of various geometric design parameters for collector modules and arrays has been established. Data indicate that forces and moments increase with mounting height and with trough aspect ratio. Collector modules interior to large arrays experience wind force reductions as high as 50-65 percent while appropriate fences or berms surrounding the arrays can provide exterior modules with protection of this order. (Author)

A81-18722 * # **Solar collector parameter identification from unsteady data by a discrete-gradient optimization algorithm.** G. B. Hotchkiss (Texas Instruments, Inc., Dallas, Tex.), L. C. Burmeister, and K. A. Bishop (Kansas, University, Lawrence, Kan.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-21.* 10 p. 22 refs. Members, $1.50; nonmembers, $3.00. Grant No. NsG-3087.

A discrete-gradient optimization algorithm is used to identify the parameters in a one-node and a two-node capacitance model of a flat-plate collector. Collector parameters are first obtained by a linear-least-squares fit to steady state data. These parameters, together with the collector heat capacitances, are then determined from unsteady data by use of the discrete-gradient optimization algorithm with less than 10 percent deviation from the steady state determination. All data were obtained in the indoor solar simulator at the NASA Lewis Research Center. (Author)

A81-18723 # **Performance evaluation of solar energy systems using a modified f-chart analysis.** J. C. Mears, Jr. and J. M. Nash (IBM Corp., Federal Systems Div., Gaithersburg, Md.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-22.* 8 p. 15 refs. Members, $1.50; nonmembers, $3.00. Contract No. EG-77-C-01-4049.

Comparison of measured and predicted solar energy system performance using a modified f-chart prediction algorithm enhances performance evolution, contributes to validation of the prediction techniques, and, when losses are considered, helps to characterize losses according to system type. The results of such comparisons are presented for selected sites in the National Solar Data Network (NSDN). Solar energy system performance predictions are executed using actual weather, subsystem loads, and system losses as provided by the Central Data Processing System of the NSDN. Discussions of the prediction techniques and treatment of losses are given. The results of the prediction process are shown for representative solar energy sites and compared to measured system performance for accuracy. (Author)

A81-18724 # **Designing solar heating systems - A statistical approach.** C. H. Joshi (MIT, Cambridge, Mass.) and J. W. Roche, IV. *American Society of Mechanical Engineers, Century 2 Solar Energy*

Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-23. 7 p. Members, $1.50; nonmembers, $3.00.

A unique and simple approach to the problem of solar heating system design is discussed. The basis of the design methodology is a probability model of the local weather. Daily sunshine is treated as a random variable and is analyzed accordingly. From this analysis, a relationship is developed between the capacity of the system and the long-term fraction of the heating load supplied by the sun. Despite the simple economic and thermal analyses, an accurate method of designing solar heating systems results. The simplicity allows an accurate determination of the effect of parameter variations - not easily accomplished by other methods. Transient simulations show close correlation between the predicted and actual system performance. (Author)

A81-18726 # **Planning for electric utility solar applications - The effects on reliability and production cost estimates of the variability in demand.** G. R. Fegan and C. D. Percival (Solar Energy Research Institute, Golden, Colo.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-25.* 11 p. 6 refs. Members, $1.50; nonmembers, $3.00. Research supported by the U.S. Department of Energy.

A81-18727 # **Solar irradiance availability in mountainous terrain.** I. Dirmhirn (Utah State University of Agriculture and Applied Science, Logan, Utah). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-26.* 6 p. 7 refs. Members, $1.50; nonmembers, $3.00. Contract No. EG-77-S-07-1656.

Solar radiation availability in mountains is more uniform than in lower elevations, since winter inversions are limited to the valleys, providing ample sunshine in higher elevations, while summer orographic clouds reduce sunshine on and near the peaks. While direct solar irradiance can be calculated, diffuse is dependent on so many parameters that more intensive work is necessary. Hence, this paper emphasizes diffuse irradiance as dependent on elevation, cloudiness (or duration of sunshine), and albedo of the ground. The variation of irradiance by the topography of the terrain, as calculated from mathematical models, is shown in examples. (Author)

A81-18728 # **Thermographic techniques applied to solar collector systems analysis.** A. Eden (Solar Energy Research Institute, Golden, Colo.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-27.* 6 p. 8 refs. Members, $1.50; nonmembers, $3.00. Research sponsored by the U.S. Department of Energy.

This paper discusses the use of thermography to analyze large solar collector array systems under dynamic operating conditions. The research at the Solar Energy Research Institute (SERI) in this area has focused on thermographic techniques and equipment to determine temperature distributions, flow patterns, and air blockages in solar collectors. The results of this extensive study, covering many sites and types of collectors, illustrate the capabilities of infrared (IR) analysis as a qualitative analysis tool and operation and maintenance procedure when applied to large arrays. Thermographic analysis of most collector systems qualitatively showed relative temperature distributions that indicated balanced flow patterns. In three significant cases, blocked or broken collector arrays, which previously had gone undetected, were discovered. Using this analysis, validation studies of large computer codes could examine collector arrays for flow patterns or blockages that could cause disagreement between actual and predicted performance. Initial operation and balancing of large systems could be accomplished without complicated sensor systems not needed for normal operations. Maintenance personnel could quickly check their systems without climbing onto the roof and without complicated sensor systems. (Author)

A81-18729 # **Buoyancy effects in the entrance region of an inclined multi-rectangular-channel solar collector.** S. M. Morcos and M. M. M. Abou-Ellail (Cairo, University, Cairo, Egypt). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-28.* 7 p. 12 refs. Members, $1.50; nonmembers, $3.00.

A numerical procedure is presented for the entrance region of an inclined multi-rectangular-channel solar collector with significant buoyancy effects. The upper wall heat flux is taken to be uniform, while the lower wall is assumed to be insulated. The heat flux distribution on the side wall of the rectangular channel is obtained by coupling a heat-conduction numerical procedure in the metallic region surrounding the channel to the main numerical procedure which solves the hydrodynamic and energy equations of the flow inside the channel. Numerical results are presented for water flowing in a multi-rectangular-channel solar collector with an aspect ratio AR = 4 inclined at an angle alpha = 30 deg to the horizontal. The resulting variable heat flux distribution on the side wall enhances the intensity of the secondary flow. The effects of the nonuniform heat flux distribution and the spacing between the rectangular channels on the variation of Nusselt number in the entrance region are presented for different values of Rayleigh number. At a value of Ra = 500,000, Nusselt number is more than 300 percent above the constant property prediction. (Author)

A81-18771 **Physical and geophysical aspects of solar energy.** V. Silvestrini (Napoli, Università, Naples, Italy). In: Geophysical aspects of the energy problem. Amsterdam and New York, Elsevier Scientific Publishing Co., 1980, p. 202-259. 13 refs.

The physical and geophysical grounds of natural radiative cooling are discussed, showing experimental performances of selective devices and the application of solar energy for water and room heating. Climate as a design parameter is extensively discussed, and methods of elaboration of climatic data are presented. Methods for large-scale control of ambient conditions are discussed. (Author)

A81-18797 **Aluminum-natural oxide-P type silicon /MIS/ solar cells.** E. Badura and W. Zdanowicz (Polish Academy of Sciences, Institute for Physics of Solid State, Zabrze, Poland). *Solar Energy Materials,* vol. 4, Dec. 1980, p. 81-87. 10 refs.

MIS (metal-interfacial region-semiconductor) solar cells are attractive because of their relatively high conversion efficiency. Their performance, however, is strongly affected by device preparation. Two methods are described for preparing Al - natural SiO - p-type Si cells which exhibit high photovoltaic values. The first, involving a 'nonsintered oxide' process, entails etching the active silicon surfaces in HF acid and exposing them to air at room temperature for 48 hours. The second method differs from the first only in that it requires the additional step of sintering the oxidized surfaces in a vacuum at about 500 C. In both cases, a semitransparent Al film is then applied to the oxide, after which an Al grid electrode and 70-nm SiOx antireflection coatings are deposited on the device. Measured against both the nonsintered cell and the Schottky barrier cell, the sintered assembly shows the highest open-circuit voltage (0.46-0.492), the highest fill factor (0.66-0.73), and the most efficient dark parameters. R.S.

A81-18798 **A study of two binary eutectic aluminum alloys as selective absorbers for solar photothermal conversion.** V. Chang and P. Bolsaitis (Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela). *Solar Energy Materials,* vol. 4, Dec. 1980, p. 89-100. 12 refs.

The fine microstructure found in two eutectic aluminum alloys, Al-6% Ni and Al-33% Cu, is used to study their probable applications as textured selective surfaces. A solar calorimeter has been used to determine the bulk absorptivity and emissivity of sample surfaces. For the studied samples the figure of merit for bulk absorptivity/emissivity is 2.08 for the Al-Cu alloy and 1.38 for the Al-Ni alloy. It is found that solidification rate and etching time are the two important parameters controlling the optical properties, i.e. the bulk absorptivity/emissivity ratio of the surface. (Author)

02 SOLAR ENERGY

A81-18799 **Investigation of metal oxide/cuprous oxide heterojunction solar cells.** J. Herion, E. A. Niekisch, and G. Scharl (Kernforschungsanlage Jülich GmbH, Institut für Grenzflächenforschung und Vakuumphysik, Jülich, West Germany). *Solar Energy Materials,* vol. 4, Dec. 1980, p. 101-112. 16 refs.

ZnO/Cu2O heterojunction solar cells can be prepared by means of RF sputter deposition of In-doped ZnO layers on Cu2O. The temperature at which ZnO is deposited is found to be of crucial importance for the photovoltaic performance of the cells. Maxima of the open-circuit voltage, the short-circuit current, and the dark resistance are observed for deposition temperatures between 230 and 240 C. Auger sputter profiles show an oxygen depletion zone at the ZnO/Cu2O interface which can be attributed to a very thin copper layer. The oxygen depletion and, correspondingly, the copper enrichment are apparently correlated with the photovoltaic effects. A relatively small copper enrichment has also been observed in CuO/Cu2O cells. However, the nature of copper enrichment seems to be different in both types of cells. (Author)

A81-18806 **The technological and economic development of photovoltaics.** D. Costello (Solar Energy Research Institute, Golden, Colo.) and P. Rappaport. In: Annual review of energy. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1980, p. 335-356. 52 refs.

The present status of photovoltaic technologies is reviewed with emphasis on their potential role in energy supply. The materials and concepts currently under research are organized into three sections: silicon technology, concentrators, and thin films. Special consideration is given to the evolution and status of the photovoltaic industry, photovoltaic markets, and the role of the public sector in photovoltaics. V.L.

A81-19548 **Scanning light-spot analysis of the carrier collection in liquid-junction solar energy converters.** T. E. Furtak, D. C. Canfield, and B. A. Parkinson (Iowa State University of Science and Technology, Ames, Iowa). *Journal of Applied Physics,* vol. 51, Nov. 1980, p. 6018-6021. 14 refs. Research supported by the Solar Energy Research Institute; Contract No. W-7405-eng-82.

A scanning laser-spot system has been developed for the in situ evaluation of carrier collection in liquid-junction solar cells. The system was applied to the identification of topological features and the correlation of these features to the carrier collection efficiency on several materials presently being considered as solar energy converters in the liquid-junction cell configuration. (Author)

A81-19557 **Two-stage tilting solar concentrators.** D. R. Mills (New South Wales, University, Kensington, Australia). *Solar Energy,* vol. 25, no. 6, 1980, p. 505-509. 10 refs. Research supported by the National Energy Research, Development and Demonstration Program.

An inclined two-stage nonfocusing concentrator is presented which may be used to obtain maximal solar energy concentration without diurnal tracking. The design is based on that of a two-stage nonrefractive thermal concentrator for a tubular absorber which uses a nearly ideal extreme asymmetrical concentrator as a second stage receiver and attains about 98% of the theoretical maximum concentration (about 9X). Modifications to the system for the construction of a practical photovoltaic concentrator include the use of a prism concentrator as the secondary concentrator, resulting in a possible concentration factor of 12. The cost of electricity from such a system, which does not require a large mirror, is estimated at $1.96/peak W, and $0.50/peak W if low temperature heat is extracted, which is presently competitive with conventional sources of energy and expected to improve as the prices of photovoltaics drop. A.L.W.

A81-19558 **The effect of air flow rate in collector-storage walls.** D. M. Utzinger, S. A. Klein, and J. W. Mitchell (Wisconsin, University, Madison, Wis.). *Solar Energy,* vol. 25, no. 6, 1980, p. 511-519. 8 refs. Contract No. E(11-1)-2588.

A one-dimensional thermal circuit network model of the collector-storage wall is developed based on the energy balances of the collector-storage wall and the building. This one-dimensional model is compared with a two-dimensional model to determine the effects of nonuniform heat flow through the wall. The results show that a one-dimensional model, which assumes that the air temperature varies exponentially in the flow direction, gives excellent agreement compared with the two-dimensional model. The one-dimensional model is used to determine the effects of air flow rate and gap heat transfer coefficient on the auxiliary heating energy consumption. It is found that auxiliary heating requirements are not significantly affected by air flow in the gap. (Author)

A81-19559 **Minimizing convective heat losses in flat plate solar collectors.** A. Malhotra, H. P. Garg, and U. Rani (Indian Institute of Technology, New Delhi, India). *Solar Energy,* vol. 25, no. 6, 1980, p. 521-526. 11 refs.

Based on available correlations, relations are found for the local maxima and minima in heat transfer as the gap spacing is varied in flat plate solar collectors. A criterion is proposed for evaluating the use of alternate mediums in the enclosed space. It is shown that the use of heavy gases such as argon can result in a 34% reduction in heat losses. Nusselt number correlations of a single gap are extended to a two-cover system. It is found that by using two covers there is an overall savings of more than 50% in convection losses. It is also found that heat transfer rates in the laminar and turbulent regions are relatively insensitive to the internal spacing of the covers but reduce on changing from the mid-way position in the initial regime. A new type of two-cover system is proposed in which the upper space is partially evacuated and it is shown that heat losses can be reduced by 85% on a one-tenth reduction of pressure. (Author)

A81-19560 **The efficacy of solar conversion in a polar environment.** R. E. Grojean (Northeastern University, Boston, Mass.), J. A. Sousa, and M. C. Henry (U.S. Army, Natick Research and Development Command, Natick, Mass.). *Solar Energy,* vol. 25, no. 6, 1980, p. 537-542. 8 refs.

A simple optical model of the polar environment is proposed. The unique properties of this polar model are shown to give equal significance to direct and scattered solar radiation. The influence of this model on the design of solar collectors for the arctic environment are discussed. The results of this analysis are applied to several basic geometric shapes with regard to their use as arctic shelters. (Author)

A81-19561 **Hail resistance of solar collectors with tempered glass covers.** G. O. G. Lof and R. R. French (Colorado State University, Fort Collins, Colo.). *Solar Energy,* vol. 25, no. 6, 1980, p. 555-561.

The resistance of solar collectors glazed with 3 mm of tempered glass to hailstones of up to 10 cm in diameter and 0.5 kg in weight which fell on Fort Collins, Colorado is discussed. Of the ten solar heating systems directly in the hailpath with tempered glass covers, seven were undamaged, two lost one collector panel each, and a 700-panel collector had seven broken covers, amounting to a total breakage of nine panels out of 956, approximately 1%. In addition, one system with nontempered glass covers suffered two glass punctures in a 26-panel collector. It is concluded that the risk of hail damage to commercial solar collectors glazed with 3-mm tempered glass is negligibly small, and greatly exceeded by the risk of hail damage to the roofs of buildings and automobiles or to fiberglass-reinforced polyester sheets used as collector glazings. A.L.W.

N81-10222# Joint Publications Research Service, Arlington, Va.

DESALINATION OF WATER WITH SOLAR POWER

B. Agricola and V. Cena *In its* West Europe Rept.: Sci. and Technol., No. 13 (JPRS-75031) 30 Jan. 1980 p 32-44 Transl. into ENGLISH from Fonti di Energia Alternative (Rome), no. 2, Mar. - Apr. 1979 p 22-27

Avail: NTIS HC A03/MF A01

A critical analysis of the state of the art of solar desalinization is presented. The technical and economic viability of the process is assessed and the predictable evolution of certain parameters of interest is evaluated. The developmental lines of research objectives that are attainable in the short and medium terms from the standpoint of their industrial realization are also discussed. T.C.T.

N81-10500# Joint Publications Research Service, Arlington, Va.
WORLD'S FIRST SOLAR POWER STATION IN CATANIA

Taddeo Canca *In its* West Europe Rept.: Sci. and Technol., No. 14 (JPRS-75070) 5 Feb. 1980 p 20-22 Transl. into ENGLISH from Unita (Milan), 3 Dec. 1979 p 7
Avail: NTIS HC A04/MF A01

By the end of 1980, the world's first solar electric power station the first thousand kilowatts of electric power provided by the Sun into the Italian National Electric Power Agency network. Installation of the 182 solar mirrors and costs of the power to be provided are discussed. A.R.H.

N81-10518*# Security State Bank, Starkville, Miss.
SOLAR HEATING SYSTEM AT SECURITY STATE BANK, STARKVILLE, MISSISSIPPI Final Report
Aug. 1980 95 p Sponsored by NASA. Marshall Space Flight Center
(Contract EM-78-F-01-5198)
(NASA-CR-161550) Avail: NTIS HC A05/MF A01 CSCL 10B

The 312 square feet of Solaron flat plate air collectors provide for 788 square feet of space heating, an estimated 55 percent of the heating load. Solar heated air is distributed to the 96 cubic foot steel cylinder, which contains two inch diameter rocks. An air handler unit moves the air over the collector and into the steel cylinder. Four motorized dampers and two gravity dampers are also part of the system. A Solaron controller which has sensors located at the collectors, rock storage, and at the return air, automatically controls the system. Auxiliary heating energy is provided by electric resistance duct heaters. Author

N81-10519*# Days Inn of America, Inc., Atlanta, Ga.
SOLAR HOT WATER SYSTEM INSTALLED AT DAY'S LODGE, ATLANTA, GEORGIA Final Report
Sep. 1980 23 p Sponsored by NASA. Marshall Space Flight Center
(Grant EG-77-G-01-1632)
(NASA-CR-161559) Avail: NTIS HC A02/MF A01 CSCL 10A

The solar energy hot water system installed in the Days Inns of America, Inc., Atlanta, Georgia is described. This system provides for 81 percent of the total hot water demand. There are two separate systems, each serving one building of the lodge (total of 65 suites). The entire system contains only potable city water. The 1024 square feet of Grumman Sunstream Model 332 liquid flat plate collectors and the outside piping drain whenever the collector plates approach freezing or when power is interrupted. Solar heated water from the two above ground cement lined steel tanks (1000 gallon tank) is drawn into the electric Domestic Hot Water (DHW) tanks as hot water is drawn. Electric resistance units in the DHW tanks top off the solar heated water, if needed, to reach thermostat setting. T.M.

N81-10520*# Shoney's South, Inc., Memphis, Tenn.
SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT SHONEY'S RESTAURANT, NORTH LITTLE ROCK, ARKANSAS Final Contractor Report
Aug. 1980 123 p
(Contract EM-78-F-01-5188)
(NASA-CR-161557) Avail: NTIS HC A06/MF A01 CSCL 10A

A solar heating system designed to supply a major portion of the space and water heating requirements for a restaurant is described. The restaurant has a floor space of approximately 4,650 square feet and requires approximate 1500 gallons of hot water daily. The solar energy system consists of 1,428 square feet of Chamberlain flat plate liquid collector subsystem, and a 1500 gallon storage subsystem circulating hot water producing 321 x 10 to the 6th power Btu/Yr (specified) building heating and hot water heating. R.C.T.

N81-10521*# Days Inn of America, Inc., Atlanta, Ga.
SOLAR HOT WATER SYSTEM INSTALLED AT DAY'S INN MOTEL, DALLAS, TEXAS (VALLEY VIEW) Final Contractor Report
Sep. 1980 47 p
(Contract EG-77-G-01-1632)
(NASA-CR-161570) Avail: NTIS HC A03/MF A01 CSCL 10A

The solar system was designed to provide 65 percent of the total domestic hot water (DHW) demand. A liquid (water) flat plate collector (1,000 square feet) system automatically drains into the 1,000 gallon steel storage tank when the solar pump is not running. Heat is transferred from the DHW tanks through a shell and tube heat exchanger. A circulating pump between the DHW tanks and heat exchanger enables solar heated water to help make up standby losses. All pumps are controlled by differential temperature controllers. L.F.M.

N81-10522*# Days Inn of America, Inc., Atlanta, Ga.
SOLAR HOT WATER SYSTEM INSTALLED AT DAY'S INN MOTEL, SAVANNAH, GEORGIA Final Contractor Report
Sep. 1980 44 p
(Contract EG-77-G-01-1632)
(NASA-CR-161561) Avail: NTIS HC A03/MF A01 CSCL 10A

The Solar System was designed to provide 50 percent of the total Domestic Hot Water (DHW) demand. Liquid Flat Plate Collectors (900 square feet) are used for the collector subsystem. The collector subsystem is closed loop, using 50 percent Ethylene Glycol solution antifreeze for freeze protection. The 1,000 gallon fiber glass storage tank contains two heat exchangers. One of the heat exchangers heats the storage tank with the collector solar energy. The other heat exchanger preheats the cold supply water as it passes through on the way to the Domestic Hot Water (DHW) tank heaters. Electrical energy supplements the solar energy for the DHW. The Collector Mounting System utilizes guy wires to structurally tie the collector array to the building. L.F.M.

N81-10523*# Days Inn of America, Inc., Atlanta, Ga.
SOLAR HOT WATER SYSTEM INSTALLED AT DAYS INN MOTEL, JACKSONVILLE, FLORIDA Final Contractor Report
Sep. 1980 32 p
(Contract EG-77-G-01-1632)
(NASA-CR-161560) Avail: NTIS HC A03/MF A01 CSCL 10A

The solar system was designed to provide 65 percent of the hot water demand. Water in the liquid flat plate collector (900 square feet) system automatically drains into the 1000 gallon lined and vented steel storage tank when the pump is not running. Heat is transferred from storage to Domestic Hot Water (DHW) tanks through a tube and shell heat exchanger. A circulating pump between the DHW tanks and heat exchanger enables solar heated water to help make up DHW standby losses. All pumps are controlled by differential temperature. L.F.M.

N81-10524*# Days Inn of America, Inc., Atlanta, Ga.
SOLAR HOT WATER SYSTEM INSTALLED AT DAYS INN MOTEL, DALLAS, TEXAS (FORREST LANE) Final Report
Sep. 1980 47 p Sponsored by NASA. Marshall Space Flight Center
(Grant EG-77-G-01-1632)
(NASA-CR-161569) Avail: NTIS HC A03/MF A01 CSCL 10A

The solar system was designed to provide 65 percent of the total Domestic Hot Water (DHW) demand. The liquid flat plate (water) collector (1,000 square feet) system automatically drains into the 1,000 gallon steel storage tank located in the mechanical room when the pump is not running. Heat is transferred from the storage tank to DHW tanks through a tube and shell heat exchanger. A circulating pump between the DHW tanks and the heat exchanger enables solar heated water to help make DHW tank standby losses. All pumps are controlled by differential temperature. Author

N81-10532# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
RELIABILITY ENGINEERING IN SOLAR ENERGY. WORKSHOP PROCEEDINGS
Gordon Gross Mar. 1980 46 p refs Workshop held in Denver, 30-31 May 1979
(Contract DE-AC02-77CH-00178)
(SERI/TP-334-489) Avail: NTIS HC A03/MF A01

A workshop to reveal the scope of reliability related activities in solar energy conversion projects and in nonsolar segments of industry is described. Two reliability programs, one in heating and cooling and one in photovoltaics, are explicated. General suggestions are presented for the establishment of a unified program for reliability, durability, maintainability, and safety in present and future solar projects. DOE

N81-10533# Atlas Corp., Santa Cruz, Calif.
MONITORING THE PERFORMANCE OF SOLAR HEATED AND COOLED BUILDINGS. VOLUME 2: MEASURING INSTRUMENTS: SELECTION, CALIBRATION, AND INSTALLATION Final Report
P. R. Armstrong, T. L. Freeman, F. deWinter, and H. Grunes Nov. 1979 221 p refs Sponsored by Electrical Power Research Inst. 2 Vol.
(EPRI-ER-1239-Vol-2) Avail: NTIS HC A10/MF A01

Measurements needed to assess the thermal performance of solar heated or cooled buildings are discussed. Transducers most appropriate for monitoring are discussed in detail. These include, for temperature: semiconductor sensors, thermistors, and thermopiles; for flow: positive displacement and propeller meters with pulse train outputs and heated sensor probes; and for insolation: thermopile and photovoltaic pyranometers. The measurements of concern in passive buildings: heat flux, temperature time trajectories and mean radiant temperature; and the measurements generally needed to compute thermal capacitance rates in air systems: pressure and humidity; are also discussed. Calibration, installation, and signal interfacing considerations are reviewed. Special techniques for measuring fluid flows and enthalpy rates associated with fluid flows (using Btu meters) are described and some new designs proposed. Also presented are a transducer selection procedure, an analysis of sampling error and error propagation, and a review of grounding and shielding practice. DOE

N81-10535# Rockwell International Corp., Thousand Oaks, Calif. Electronics Research Center.
DEVELOPMENT OF POLYCRYSTAL GaAs SOLAR CELLS Quarterly Technical Progress Report, 15 Jan. - 30 Apr. 1979
D. L. Miller, Marshall J. Cohen, J. S. Harris, Jr., Joseph Ballantyne (Cornell Univ., N.Y.), Alfred Hoyte (Howard Univ.), and Elias Stefanakos (North Carolina A and T State Univ.) May 1979 46 p refs
(Contract EG-77-C-01-4042)
(DSE-4042-T3; QTPR-1) Avail: NTIS HC A03/MF A01

Progress is reported on a study of junction formation in large grain polycrystal GaAs. Characterization of the electronic properties of polycrystal GaAs grown by MBE on low cost foreign substrates; optimizing the structure of AlGaAs-GaAs heterojunction Schottky barrier solar cells; and a variety of grain boundary measurements are presented including Scanning Light Microscopy, Deep Level Transient Spectroscopy, SIMS and temperature dependent resistivity. DOE

N81-10536# Solar Environmental Engineering Co., Inc., Fort Collins, Colo.
SOLAR INDEX PREDICTION METHODOLOGY FOR EARLY DELIVERY
Loren J. Lantz 1980 13 p
(Contract DE-AC02-77ET-20090)
(DOE/ET-20090/7) Avail: NTIS HC A02/MF A01

Since the beginning of the Solar Index project in 1978, one of the primary objectives was to deliver the Indices in midafternoon local standard time. This was desirable because it would make it possible to have the numbers broadcast in the early evening news. A short description of the current project is presented and then a summary of the work that led to the early delivery of the Solar Index is given. DOE

N81-10537# Solar Environmental Engineering Co., Inc., Fort Collins, Colo.
ALTERNATIVE SOLAR INDICES
Loren J. Lantz 1 Jul. 1980 15 p
(Contract DE-AC02-77ET-20090)
(DOE/ET-20090/6) Avail: NTIS HC A02/MF A01

Possible alternative Solar Indices which could either be a perturbation from the currently defined Solar Index or possible indices based on current technologies for other media markets are discussed. An overview is given of the current project, including the logic that was utilized in defining its current structure and then alternative indices and definitions are presented and finally, recommendations are made for adopting alternative indices. DOE

N81-10538# Solar Environmental Engineering Co., Inc., Fort Collins, Colo.
SOLAR INDEX GENERATION AND DELIVERY
Loren J. Lantz 1980 19 p
(Contract DE-AC02-77ET-20090)
(DOE/ET-20090/8) Avail: NTIS HC A02/MF A01

The Solar Index, more completely defined as the Service Hot Water Solar Index, was conceptualized during the spring of 1978 with direction from a US Government interoffice agency committee which was headed by the Department of Energy. The purpose was to enhance public awareness of solar energy usability. Basically, the Solar Index represents the percentage of energy that solar would provide in order to heat an 80 gallon service hot water load for a given location and day. The Index is computed by utilizing SOLCOST, a computer program which in addition to solar service hot water systems, has be ability to estimate thermal performance of space heating, cooling, and heat pump systems. It also supplies economic analyses for these solar energy systems. The Index is generated daily for most large metropolitan locations in the country. The definition of the Index, how the project came to be, what it is at the present time, and a plan for the future are presented. DOE

N81-10539# Midwest Research Inst., Golden, Colo.
DEVELOPMENT OF POLYCRYSTAL GaAs SOLAR CELLS Quarterly Technical Progress Report, 1 May - 31 Jul. 1979
D. L. Miller, M. J. Cohen, J. S. Harris, Jr., Joseph Ballantyne, Alfred Hoyte, and Elias Stefanakos Sep. 1979 74 p ref Prepared in cooperation with Rockwell International Electronics Research Center, Thousand Oaks, Calif., Cornell Univ., Howard Univ., North Carolina Agricultural and Technical State Univ.
(Contract EG-77-C-01-4042)
(DSE-4042-T7; QTPR-2) Avail: NTIS HC A04/MF A01

Investigation of grain boundaries in GaAs, growth of small grained GaAs, and solar cell fabrication on the small grained material continued. Some highlights were the fabrication of MS cells of small grained GaAs grown on Mo, the fabrication of MIS cells using spin on oxides, and the determination of interface state density at a high resistance grain boundary. Initial measurements show that series resistance and shunt leakage seriously degrade the performance of cells made from small grain polycrystal MBE GaAs, leading to efficiencies less than 1 percent. DOE

N81-10541# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
CADMIUM SULFIDE/COPPER SULFIDE HETEROJUNCTION CELL RESEARCH Progress Report, 1 Sep. - 30 Nov. 1979

W. W. Anderson and A. D. Jonath Feb. 1980 38 p refs
(Contracts EG-77-C-01-4042)
(DSE-8033-1/3; LMSC-D-682102) Avail: NTIS HC A03/MF A01

Several all sputter deposited Cu2S/CdS cells were prepared with J sub SC approximately 3 mA/sq cm under simulated AM1 illumination. The best AM1 conversion efficiency obtained is 0.6%. This is shown to be typical of sputtered CdS in Cu2S/CdS cells investigated. The sputtered Cu2S appears to be satisfactory for solar cell applications. Presented evidence indicates that the poor conversion efficiency is due to a low-junction electric field intensity on the CdS side of the heterojunction. A multilayer CdS structure was developed which may allow the tailoring of the junction electric field intensity to a selected high value to obtain high-junction collection efficiency. Other areas of cell development advances included: (1) determination of effect of Cu cones in Cu2S on Cu2S/CdS cell performance; (2) solution of CdS pinhole problem; and (3) open circuit voltage improvement by heat treatment. DOE

N81-10542# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DESIGN OF SOLAR CELLS FOR USE IN PHOTOVOLTAIC/ THERMAL COLLECTORS
C. H. Cox, III 16 Nov. 1980 7 p refs Presented at the ASME Winter Ann. Meeting, Chicago, 16-21 Nov. 1980
(Contract De-AC02-76ET-20279)
(DOE/ET-20279/79; CONF-801102-19) Avail: NTIS HC A02/MF A01

A promising design development for combined photovoltaic/ thermal (PV/T) collectors is one in which the photovoltaic cell is both the conversion device for electrical energy and the absorber of thermal energy. To accomplish this, the PV cell design is modified to use the approximately 25 percent of the air mass 1 spectrum at lambda greater than 1.1 micrometers that is currently rejected by the cell. The parameters investigated are: cell back metallization, back surface field, texture etching and anti-reflective coating. A model indicating the increase in absorptance as a function of these parameters is presented, together with the results of experimental measurements. Discussion closes with the presentation of a PV/T collector design that incorporates the improved cells, has 10 percent greater thermal output than current PV/T collectors, and exhibits no degradation in electrical output. DOE

N81-10550# PFR Engineering Systems, Inc., Marina Del Rey, Calif.
SOLAR CENTRAL RECEIVER REFORMER SYSTEM FOR AMMONIA PLANTS Final Technical Report
Jul. 1980 449 p refs
(Contract DE-AC03-79SF-10735)
(DOE/SF-10735/1) Avail: NTIS HC A19/MF A01

Details of the conceptual design, economic analysis, and development plan for a solar central receiver system for retrofitting the Valley Nitrogen Producers, Inc., El Centro, California 600 ST/SD Ammonia Plant are presented. The retrofit system consists of a solar central receiver reformer (SCRR) operating in parallel with the existing fossil fired reformer. Steam and hydrocarbon react in the catalyst filled tubes of the inner cavity receiver to form a hydrogen rich mixture which is the syngas feed for the ammonia production. The SCRR system displaces natural gas presently used in the fossil reformer combustion chamber. The solar reformer retrofit system characteristics and its interface with the existing plant are simple, incorporating state of the art components with proven technology. A northfield composed of one thousand forty second generation heliostats provides solar energy to the receiver which is positioned on top of a 90 meter high steel tower. The overall economics of this system can provide over 20% discount cash flow rate of return with proper investment and market conditions. DOE

N81-10551# PFR Engineering Systems, Inc., Marina Del Rey, Calif.
SOLAR CENTRAL RECEIVER REFORMER SYSTEM FOR AMMONIA PLANTS Final Report
Jul. 1980 65 p refs
(Contract DE-AC03-79SF-10735)
(DOE/SF-10735/1-Summ) Avail: NTIS HC A04/MF A01

An overview of a study to retrofit the Valley Nitrogen Producers, Inc., El Centro, California 600 ST/SD Ammonia Plant with Solar Central Receiver Technology is presented. The retrofit system consists of a solar central receiver reformer (SCRR) operating in parallel with the existing fossil fired reformer. Steam and hydrocarbon react in the catalyst filled tubes of the inner cavity receiver to form a hydrogen rich mixture which is the syngas feed for the ammonia production. The SCRR system will displace natural gas presently used in the fossil reformer combustion chamber. DOE

N81-10555# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
NOVEL CONCEPTS IN ELECTROCHEMICAL SOLAR CELLS Quarterly Progress Report, 15 Aug. - 15 Oct. 1979
J. DuBow, R. Job, Rajeshwar Krishnan, and Bob Gale 1979 36 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-8802-9-T2; QPR-2) Avail: NTIS HC A03/MF A01

It is considered that the short term stability of n-GaAs PEC's in a ferrocene based, ambient temperature molten salt electrolyte is reasonably good. However, longer term evaluation is required to determine the extent and significance of corrosion, stability, etc. Design parameters for PEC's of any kind have not been quantitatively delineated and present consideration will be given to models for PEC solar cells and limitations caused by ion transport in the electrolyte. The MoSe2 and MoS2 electrodes appear to have substrate reproducibility and transport limitations that make them unsuitable candidates for efficient PEC's at this time. Similarly, the lack of availability of high quality CuInSe2 and CuInS2 substrates limits the quantitative experimental evaluation of their utility for PEC applications. Attenuation is focused on CdSe/CdTe mixtures and CdS as electrodes as well as Si and GaAs in molten salt and polyelectrolyte solutions. The system for solar cell evaluation and network analysis of substrates and cells was mode operational. Preliminary work on economic and theoretical modelling was begun. DOE

N81-10557# Swedlow, Inc., Garden Grove, Calif.
DEVELOPMENT OF A 10X LENS CONCENTRATOR Status Report, 1 Apr. 1978 - 31 Mar. 1980
David Holdridge DOE May 1979 35 p
(Contract EM-78-C-04-4197)
(ALO-4197-T2) Avail: NTIS HC A03/MF A01

Many linear and circular lens designs were tested to verify both predicted and field test results. Analyzer test results confirm existing data on energy distribution, but yield lower lens efficiencies than expected. Approximately 15 to 20% of the energy exiting the lens is not being detected at the focal plane. It is thought that the chopped beam leaving the lens centerline and the periphery is resulting in a phase shift problem with the detector. Tests are in progress to determine and cure the test problems. Nearly all performance predictions for the three candidate lens designs were completed. These designs include: plano convex lenses; bi-convex lenses; and convex-concave lenses. DOE

N81-10558# Sperry Univac, St. Paul, Minn.
SOLAR COLLECTOR STUDIES FOR SOLAR HEATING AND COOLING APPLICATIONS Final Report
J. H. Anderson (Sunsource Systems Co.), S. O. Jensen, and J. E. Kovacic Jan. 1980 72 p refs
(Contract EM-78-C-04-5355)
(ALO-5355-T2) Avail: NTIS HC A04/MF A01

A summary of the literature, especially patent teachings pertaining to black fluid solar collectors is given. Laboratory tests to determine the suspension stability of various carbon types in water/Propylene glycol are reported. The suspensions were aged at 160 F for 3600 hours and at -15 F for 1100 hours. It is suggested that the suspending agent interacts with electrical charges on the carbon particles to prevent agglomeration. The liquid was tested for its operating characteristics with several collector design variables using glass tubes as the containment system. The collectors were installed in a house previously operated on a black liquid system, and observed for a six month period with the weather ranging from -12 F to 94 F with no major problems occurring with either the liquid or the collectors. DOE

N81-10842# Honeywell, Inc., Minneapolis, Minn. Technology Strategy Center.
SURVEY MIRRORS AND LENSES AND THEIR REQUIRED SURFACE ACCURACY, VOLUME 1 Final Report, 15 Sep. 1978 - 1 Dec. 1979
Jan. 1980 115 p refs
(Contract EM-78-C-04-5348; DE-AC04-78CS-05348)
(DOE/CS-35348/T1-Vol-1) Avail: NTIS HC A06/MF A01

An investigation of the optical performance of a variety of concentrating solar collectors is reported. The accuracy of reflective or refractive surfaces required to achieve specified performance goals and the effect of environmental exposure on the performance concentrators are addressed. To assess the importance of surface accuracy on optical performance, 11 tracking and nontracking concentrator designs were selected for detailed evaluation. Mathematical models were developed for each design and incorporated into a Monte Carlo ray trace computer program to carry out detailed calculations. Results for the 11 concentrators are presented in graphic form. A survey data base was established on the effect of environmental exposure on the optical degradation of mirrors and lenses. Information on environmental and maintenance effects was found to be insufficient to permit specific recommendations for operating and maintenance procedures. DOE

N81-10843# Honeywell, Inc., Minneapolis, Minn. Technology Strategy Center.
SURVEY MIRRORS AND LENSES AND THEIR REQUIRED ACCURACY. VOLUME 2: CONCENTRATOR OPTICAL PERFORMANCE SOFTWARE (COPS) USERS MANUAL Final Report, 15 Sep. 1978 - 1 Dec. 1979
Jan. 1980 223 p
(Contract EM-78-C-04-5348; DE-AC04-78CS-05348)
(DOE/CS-3548/T1-Vol-2) Avail: NTIS HC A10/MF A01

The mathematical modeling of 11 different concentrating collectors is documented and instructions are given for use of the computer code. The 11 concentrators modeled are: faceted mirror concentration; fixed mirror, two axis, tracking receiver; parabolic trough collector; linear Fresnel; incremental reflector; inflated cylindrical concentrator; CPC involute reflector with evacuated receiver; CPC parabolic/involute reflector; V trough collectors, imaging collapsing concentrator; and parabolic dish collector. DOE

N81-11108# Battelle Columbus Labs., Ohio.
COMPENDIUM OF INFORMATION ON IDENTIFICATION AND TESTING OF MATERIALS FOR PLASTIC SOLAR THERMAL COLLECTORS
V. D. McGinniss, F. A. Sliemers, D. K. Landstrom, and S. G. Talbert 31 Jul. 1980 389 p refs
(Contract DE-AC84-79CS-30171)
(DOE/CS-30171/1) Avail: NTIS HC A17/MF A01

Topics covered include: (1) rate of aging of polymeric materials; (2) environmental factors affecting performance; (3) evaluation and prediction of service life; (4) measurement of physical and chemical properties; (5) discussion of evaluation techniques and specific instrumentation; (6) degradation reactions and mechanisms; (7) weathering of specific polymeric materials; and (8) exposure testing methodology. Major emphasis was placed on defining the current state of the art in plastics degradation and on identifying information that can be utilized in applying appropriate and effective aging tests for use in projecting service life of plastic solar thermal collectors. DOE

N81-11172# Ionics, Inc., Watertown, Mass.
SOLAR POWERED ELECTRODIALYSIS. PART 1: DESIGN OF A SOLAR POWERED ELECTRODIALYSIS SYSTEM FOR DESALTING REMOTE, BRACKISH WATER SOURCES Final Report
Dec. 1979 172 p
(Contract DI-14-34-0001-8576)
(PB80-203805; W80-06001) Avail: NTIS HC A08/MF A01 CSCL 07D

Alternative design of a solar powered electrodialysis system were evaluated for a desalting application that is typical of the brackish water sources in the southwestern United States. The designs were evaluated relative to total water costs for an average water production of 4,000 gallons per day where the solar isolation averages 24 million joules per square meter per day (10 hours of collection) and the feed water contains 2,200 parts per million of dissolved solids. GRA

N81-11192# Giner, Inc., Waltham, Mass.
STUDY OF ALUMINUM CORROSION IN ALUMINUM SOLAR HEAT COLLECTORS USING AQUEOUS GLYCOL SOLUTION FOR HEAT TRANSFER Semiannual Technical Progress Report, 30 Jul. 1979 - 31 Jan. 1980
D. Wong, F. H. Cocks, and J. Giner Feb. 1980 24 p refs
(Contract DE-AC04-79CS-31072)
(DOE/CS-31072/T1) Avail: NTIS HC A02/MF A01

The study of the effects of glycol aging at elevated temperatures is presented. Glycols are known to be susceptible to thermal decomposition producing new product species which may be aggressive to aluminum. In addition, the possible breakdown of corrosion inhibitors due to long term exposure to high temperature were also investigated. Both uninhibited and inhibited ethylene (as well as propylene) glycols were aged at temperatures up to 190 C for over 2000 h continuously. Aliquot samples of each glycol solution tested in this program were taken at 1000 and 2000 h of exposure for chemical analysis and pH measurement. Based on the data obtained so far, solution pH was found to decrease steadily with exposure time. The critical pitting potential of 1100 series aluminum in a 50 vol % aqueous ethylene glycol solution is reported as functions of both temperature and chloride ion concentration. This information is essential in the cathodic protection of pitting corrosion of aluminum. DOE

N81-11206# Battelle Columbus Labs., Ohio.
CORROSION PROBLEMS WITH AQUEOUS COOLANTS, Final Report
R. B. Diegle, J. A. Beavers, and J. E. Clifford 11 Apr. 1980 224 p refs
(Contract DE-AC04-79CS-10510)
(DOE/CS-10510/T11) Avail: NTIS HC A10/MF A01

The results of a one year program to characterize corrosion of solar collector alloys in aqueous heat transfer media are summarized. The program involved a literature review and a laboratory investigation of corrosion in uninhibited solutions. It consisted of three separate tasks, as follows: review of the state of the art of solar collector corrosion processes: study of corrosion in multimetallic systems; and determination of interaction between different waters and chemical antifreeze additives. A comprehensive review of published literature concerning corrosion under solar collector operating conditions was undertaken. The corrosion behavior of candidate alloys was determined. The degradation rates of glycol based heat transfer media were measured and the effects of degradation on the corrosion behavior of metallic collector materials were evaluated. DOE

N81-11221# Midwest Research Inst., Golden, Colo. Materials Research Branch.
POLYMERS IN SOLAR TECHNOLOGIES: AN R AND D STRATEGY
William F. Carroll (Jet Propulsion Lab.) and Paul Schissel Jul. 1980 37 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-334-601) Avail: NTIS HC A03/MF A01

A five year program consisting of 20 tasks categorized into six major problem areas are presented. These are: response to combined stresses, photochemistry permeability adhesion; surface properties; mechanical properties; and development of polymers. A budget required for each task is estimated and summarized for each problem area. The potential future impact of polymers on the economics of solar technologies is shown to justify the proposed expenditures. DOE

N81-11450*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Materials Engineering.
IDENTIFICATION AND ANALYSIS OF FACTORS AFFECTING THERMAL SHOCK RESISTANCE OF CERAMIC MATERIALS IN SOLAR RECEIVERS Final Report
D. P. H. Hasselman, J. P. Singh, and K. Satyamurthy 15 Jul. 1980 150 p refs
(Contracts NAS7-100; JPL-955629)
(NASA-CR-163727; JPL-9950430) Avail: NTIS HC A07/MF A01 CSCL 10A

An analysis was conducted of the possible modes of thermal stress failure of brittle ceramics for potential use in point-focussing solar receivers. The pertinent materials properties which control thermal stress resistance were identified for conditions of steady-state and transient heat flow, convective and radiative heat transfer, thermal buckling and thermal fatigue as well as catastrophic crack propagation. Selection rules for materials with optimum thermal stress resistance for a particular thermal environment were identified. Recommendations for materials for particular components were made. The general requirements for a thermal shock testing program quantitatively meaningful for point-focussing solar receivers were outlined. Recommendations for follow-on theoretical analyses were made. Author

N81-11452*# Kulicke and Sofa Industries, Inc., Horsham, Pa.
AUTOMATED SOLAR MODULE ASSEMBLY LINE Final Report
Max Bycer Aug. 1980 105 p refs Prepared for JPL
(Contract JPL-955287)
(NASA-CR-163726; DOE/JPL-955287-80/6; JPL-9950-438) Avail: NTIS HC A06/MF A01 CSCL 10A

The solar module assembly machine which Kulicke and Soffa delivered under this contract is a cell tabbing and stringing machine, and capable of handling a variety of cells and assembling strings up to 4 feet long which then can be placed into a module array up to 2 feet by 4 feet in a series of parallel arrangement, and in a straight or interdigitated array format. The machine cycle is 5 seconds per solar cell. This machine is primarily adapted to 3 inch diameter round cells with two tabs between cells. Pulsed heat is used as the bond technique for solar cell interconnects. The solar module assembly machine unloads solar cells from a cassette, automatically orients them, applies flux and solders interconnect ribbons onto the cells. It then inverts the tabbed cells, connects them into cell strings, and delivers them into a module array format using a track mounted vacuum lance, from which they are taken to test and cleaning benches prior to final encapsulation into finished solar modules. Throughout the machine the solar cell is handled very carefully, and any contact with the collector side of the cell is avoided or minimized. Author

N81-11454*# Spire Corp., Bedford, Mass.
DESIGN, FABRICATION, TEST QUALIFICATION AND PRICE ANALYSIS OF THIRD GENERATION DESIGN SOLAR CELL MODULES Final Design Report
Michael J. Nowlan Sep. 1980 104 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955405)
(NASA-CR-163708; JPL-9950-420; DOE/JPL-955405-80/1) Avail: NTIS HC A06/MF A01 CSCL 10A

A JPL qualified, high efficiency block 4 solar module with a power density of 125 W/sq m at 28 C was developed and manufactured. The module design is described as well as experiments conducted during the development phase of the program. The rationale for each major component choice is given and the quality assurance plan is outlined. Data on cell and module fabrication and on the performance and yield of the modules are presented. Testing, both to determine module characteristics and to establish JPL qualifications are discussed. The results of the SAMIS cost analysis are included. A.R.H.

N81-11456*# ECON, Inc., Princeton, N. J.
SATELLITE POWER SYSTEM SALVAGE AND DISPOSAL ALTERNATIVES Final Report
Nov. 1980 91 p refs
(Contract NAS8-33783)
(NASA-CR-3349; ECON-80-148-1) Avail: NTIS HC A05/MF A01 CSCL 10A

A wide range of salvage options for the SPS satellite, ranging from use in and beyond geosynchronous orbit to use in low Earth orbit in return and use on Earth are presented. The satellite can be used intact to provide power for various purposes, it can be cannibalized or it can be melted down to supply materials for space or ground based products. The use of SPS beyond its nominal lifetime provides value that can be deducted from the SPS capital investment cost. The present value of the salvage value of the SPS satellites, referenced to the system initial operation data, is on the order of five to ten percent of its on-orbit capital cost. (Given a 30 year satellite lifetime and a four percent discount rate, the theoretical maximum salvage value is 30.8 percent of the capital cost.) The SPS demonstration satellite is available some 30 years earlier than the first full scale SPS satellite and has a salvage value on the order of 80 percent of its on-orbit capital cost. In the event that it becomes desirable to dispose of either the demonstration of full scale SPS satellite, a number of disposal options is presented for which intact disposal costs are less than one percent of capital costs. T.M.

N81-11459*# Rice Univ., Houston, Tex.
ELECTROSTATIC PROTECTION OF THE SOLAR POWER SATELLITE AND RECTENNA. PART 1: PROTECTION OF THE SOLAR POWER SATELLITE Final Report
Washington NASA Nov. 1980 36 p refs
(Contract NAS8-33023)
(NASA-CR-3344; M-308) Avail: NTIS HC A03/MF A01 CSCL 10A

Several features of the interactions of the Solar Power Satellite (SPS) with its space environment are examined theoretically. The voltages produced at various surfaces due to space plasmas and the plasma leakage currents through the kapton and sapphire solar cell blankets are calculated. At geosynchronous orbit, this parasitic power loss is only 0.7%, and is easily compensated by oversizing. At low Earth orbit, the power loss is potentially much larger (3%), and anomalous arcing is expected for the EOTV high voltage negative surfaces. Preliminary results of a three dimensional self consistent plasma and electric field computer program are presented, confirming the validity of the predictions made from the one dimensional models. Lastly, magnetic shielding of the satellite is considered to reduce the power drain and to protect the solar cells from energetic electron and plasma ion bombardment. It is concluded that minor modifications can allow the SPS to operate safely and efficiently in its space environment. Subsequent design changes will substantially alter the basic conclusions. L.F.M.

N81-11460# RCA Labs., Princeton, N. J.
LOW COST EPITAXIAL TECHNIQUES FOR SOLAR CELL FABRICATION Quarterly Technical Progress Report, 25 Mar. - 24 Jun. 1980
R. V. DAiello and P. H. Robinson Jul. 1980 34 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-0-8274-3; QTPR-3) Avail: NTIS HC A03/MF A01

The practical aspects of making epitaxial solar cells were emphasized by exploring the growth and fabrication of large area cells. A significant achievement was the attainment of efficiencies close to 10% with epitaxial cells of 10.8 cu cm area grown on the lowest grade silicon substrate under study. For larger areas 23.1 cu cm an efficiency of 7.0% was obtained. The use of low cost surface preparation techniques was successfully demonstrated for both epitaxial growth and the resultant solar cell properties. Some requirements on the subsequent application of AR coatings are pointed out. Work on the use of silane as an alternate gaseous silicon source was extended by exploring growth on upgraded metallurgical grade silicon substrates. The results show equivalent performance for cell structures grown in silane at 1000 C with those grown using dichlorosilane at 1100 to 1150 C. DOE

N81-11465# Aerospace Corp., Los Angeles, Calif. Energy and Resources Div.
SUMMARY OF SYSTEM DESIGNS FOR PHOTOVOLTAIC EXPERIMENTS AND RECOMMENDATIONS FOR FUTURE ACTIVITIES
R. B. Fling and B. Siegel Jul. 1980 56 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-7069) Avail: NTIS HC A04/MF A01

The designs covered a wide range of applications, including office buildings, industrial plants, airports, schools, amusement parks, utility substations, institutional facilities, and remote stand alone loads. The concentrator types included parabolic troughs, linear Fresnel, circular Fresnel, and cassegrain designs with geometric concentration ratios ranging from 20 to 400. One project selected gallium arsenide as a cell material and all but one of the remaining designs used single crystal silicon cells. Nine of the projects were selected for construction and evaluation. DOE

N81-11466# Spire Corp., Bedford, Mass.
AMORPHOUS SILICON SOLAR CELLS BY HYDROGEN IMPLANTATIONS Quarterly Report, 1 Jul. - 30 Sep. 1979
A. R. Kirkpatrick and A. A. Melas Jan. 1980 27 p refs
(Contract DE-AC03-79ET-23042)
(SAN-3042-3; QR-3) Avail: NTIS HC A03/MF A01

A large number of implantation matrices were evaluated and material investigations initiated. The usefulness of ion implantation in the amorphization and hydrogenation of devices was established. Indeed both of these processes can controllably and reproducibly be carried out. The amorphized material shows superior visible light absorption behavior compared to crystalline silicon. Hydrogenation with subsequent furnace annealing produces higher open circuit voltage, in selected devices, than the polycrystalline material. The use of infrared spectroscopy established the presence and type of silicon hydrogen bonding. DOE

N81-11467# Varian Associates, Palo Alto, Calif., Solid State Lab.
NEAR-TERM IMPLEMENTATION OF PRODUCTION COST REDUCTION FOR PHOTOVOLTAIC CONCENTRATOR ARRAY
Bruce R. Cairns Jul. 1980 78 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-7066) Avail: NTIS HC A05/MF A01

Progress on the development of a standardized process for fabricating GaAs/AlGaAs concentrator solar cells at a lower cost is reported. High quality GaAs ingots weighing 1.0 to 1.5 Kgm and 2.0 to 2.5 in. diameter were routinely grown. A high throughput liquid phase epitaxial reactor was completed and considerable process development work was performed to characterize growth parameters. Larger area organometallic growth of thin AlGaAs layers led to improved cell efficiencies for this material. An improved cell metallization structure and process was developed to give reliable low contact resistance, stable at temperatures of 400 C and above. The silicon nitride AR coating was also improved. Package development to obtain a packaged cell suitable for easy installation in an array is discussed. Completely packaged cells from liquid and organometallic epitaxial material gave efficiencies in the 18 to 20 percent range at 440 suns concentration. DOE

N81-11468# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
DEVELOPMENT OF HIGH EFFICIENCY SOLAR CELLS Final Technical Report, 23 Jan. 1978 - 2 Jan. 1979
D. L. Miller, Marshall J. Cohen, J. S. Harris, Jr., Joseph Loferski (Brown Univ.), Joseph Ballantyne (Cornell Univ.), Tarak Bhar (Howard Univ.), and Elias Stefanakos (North Carolina Agricultural and Technical State Univ.) Apr. 1979 184 p refs
(Contract ET-78-C-03-1712; EG-77-C-03-1712)
(SAN-1712-T1) Avail: NTIS HC A09/MF A01

Emphasis was on developing new polycrystal growth techniques, developing new analytical techniques to study grain boundaries, and fundamental studies of the physical mechanisms by which grain boundaries limit solar cell performance. Molecular beam epitaxy proved to be a very attractive technique for fundamental studies of both grain boundaries and unique device structures. Several high spatial resolution analytical techniques were developed and are providing information on the electrical properties of grain boundaries. Auger potential profiling provided the first experimental verification of the Fermi level pinning at a grain boundary. Cathodoconductivity, photovoltage, and photocurrent measurements with a scanning laser microscope provided data on minority carrier transport near grain boundaries. Transient capacitance and deep level transient spectroscopy measurements are yielding data on carrier lifetime, trap levels, and densities at grain boundaries. DOE

N81-11469# Hanford Engineering Development Lab., Richland, Wash.
CURRENT SOLAR CELL MEASUREMENT METHODS REVIEW AND EVALUATION
D. R. Green, T. E. Michaels, L. C. Olsen, and L. S. Price May 1980 159 p refs
(Contracts DE-AC14-76FF-02170; EY-77-C-01-8146; EY-76-C-14-2170)
(HEDL-TC-1548) Avail: NTIS HC A08/MF A01

Selected measurement methods commonly applied to solar cells are studied. Basic theoretical models are emphasized, and methods for determining important parameters are outlined. Methods are reviewed for measurement of resistivity, Hall effect, Seebeck effect, dark current voltage characteristics, illuminated current voltage characteristics, and spectral photoresponse. State of the art in each area is reviewed. DOE

N81-11481# Battelle Columbus Labs., Ohio.
DEVELOPMENT OF ELECTROCHEMICAL PHOTOVOLTAIC CELLS Technical Progress Report, 1 Nov. 1979 - 31 Jan. 1980
H. J. Byker, R. E. Schwerzel, V. E. Wood, A. E. Austin, and E. W. Brooman 7 Mar. 1980 23 p refs
(Contract EG-77-C-01-4042)
(DSE-4042-T24; TPR-3) Avail: NTIS HC A02/MF A01

The development of stable, efficient, electrochemical photovoltaic cells based on silicon and gallium arsenide in nonaqueous electrolyte systems was investigated. The effect of surface condition of silicon electrodes on electrochemical and physical characteristics was studied. An electrode-supporting electrolyte interaction in acetonitrile was identified which leads to etching of the surface. Improved performance can result, which has practical significance. Gallium arsenide electrodes were electrochemically characterized in cells containing propylene carbonate with a ferrocene/ferricenium redox additive. Degradation of the ferricenium salt under illumination was investigated. Other redox couples studied did not give promising results. Long term stability experiments were deferred while a better understanding of electrode behavior is being obtained. DOE

N81-11484# Sandia Labs., Albuquerque, N. Mex. Guidance and Control Div.
DEVELOPMENT OF A MICROPROCESSOR-BASED SUN-TRACKING SYSTEM FOR SOLAR COLLECTORS
Stewart M. Kohler and Jeffrey L. Wilcoxen Apr. 1980 23 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-2163) Avail: NTIS HC A02/MF A01

The development of a prototype Sun-tracking system and the tests performed on it on an east-west trough solar collector array are described. The system includes a controller built around an RCA1802 microprocessor, a digital shaft encoder, and a heat flux sensor. The heat flux sensor consists of a fine resistance wire wrapped around the receiver tube. The wire is used to correct errors in calculated tracking angles arising from reflector imperfections and misalignments. DOE

N81-11485# Sandia Labs., Albuquerque, N. Mex. Component and Subsystem Development Div.
FLUID TEMPERATURE CONTROL FOR PARABOLIC TROUGH SOLAR COLLECTORS

Rudolph Schindwolf Jun. 1980 35 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-2006) Avail: NTIS HC A03/MF A01

Computer simulation studies of temperature control techniques for the heat transfer fluid in parabolic trough solar collector fields are discussed. In particular, the temperature control requirements associated with thermal electric power generation or cogeneration systems are addressed. Computer models representing the fluid temperature dynamics of the collectors and interconnecting piping were developed and integrated with dynamic models of control elements to obtain a simulation of a closed loop control system. A specific control configuration was chosen consisting of a flow control valve and one or more temperature sensors to control the flow in each row of collectors. Various control algorithms were evaluated for stability and static errors, and time responses to startup transients and to partial and full collector cloud shadowing transients were obtained. The results indicate that the temperature control requirements can be satisfied using readily available components. DOE

N81-11487# Los Alamos Scientific Lab., N. Mex. Solar Energy Group.
RESEARCH AND DEVELOPMENT TO SUPPORT COMMERCIALIZATION IN SOLAR PONDS
Kenneth A. Meyer 1980 8 p Presented at the Nonconvecting Solar Pond Workshop, Washington, D.C., 30-31 Jul. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2123; CONF-800757-1) Avail: NTIS HC A02/MF A01

An indepth analytical, numerical, and experimental program leading to the understanding of solar pond hydrodynamics is presented. The practical problems of water clarity, heat extraction, maintenance, and thermal loses are quantified. The need for a coordinated research and development program with the necessary long term continuity to accomplish these goals is emphasized. DOE

N81-11488# Martin Marietta Corp., Denver, Colo.
SOLAR CENTRAL RECEIVER HYBRID POWER SYSTEM, PHASE 1. VOLUME 2: CONCEPTUAL DESIGN Final Technical Report, Oct. 1978 - Aug. 1979
Sep. 1979 511 p refs
(Contract ET-78-C-03-2234)
(DOE/ET-21038/1-Vol-2) Avail: NTIS HC A22/MF A01

A hybrid power system design that produces minimum cost electric power, minimizes the capital investment and operating cost, permits capacity displacement, and achieves utility acceptance for market penetration is proposed. The concept combines the alternate central receiver power system design and a high temperature salt primary heat transfer fluid and thermal storage media system with a fossil fired nonsolar energy source. Twenty-two utilities were selected within nine regions of the country. Both written and verbal correspondence was used to assess solar hybrid power plants with respect to the utilities' future requirements and plans. DOE

N81-11489# Institute of Gas Technology, Chicago, Ill.
ELECTROCHEMICAL PHOTOVOLTAIC CELLS Quarterly Technical Progress Report, 15 Oct. 1979 - 15 Jan. 1980
Peter C. P. Ang, Robert J. Remick, and Anthony F. Sammells Mar. 1980 39 p refs
(Contract EG-77-C-01-4042)
(DSE-4042-T26) Avail: NTIS HC A03/MF A01

Liquid junction devices based upon the semiconductors MoSe2, GaAs, and CdSe were evaluated. Lifetime testing of MoSe2 and MoS2 materials in acidic halogen electrolytes at constant current densities of 5 mA/sq cm showed excellent stability. For MoSe2 single crystals in the electrolyte 1M HBr + 1M Br2 short circuit currents of 63 mA/sq cm were achieved with a power conversion efficiency of 6.7% for 200 mW/sq cm xenon light illumination. Transient potentiostatic measurements made on MoSe2 in this electrolyte indicated little diffusion control, with exchange currents being of the order of 1 to 10 mA/sq cm. Good photoresponse of MoS2 has been observed in 1M HBr + 1M Br2. The performance of the natural crystal is comparable to the performance of a single crystal MoS2 in this electrolyte. CdSe thermally evaporated onto porous titanium gave efficiencies of about 4% with 100 mW/sq cm xenon illumination. Experimental work was initiated on the dye sensitization of Fe2O3 and TiO2 materials. Of the twelve dyes evaluated, little enhancement of the photoresponse of these materials was noted. DOE

N81-11490# Midwest Research Inst., Golden, Colo. Solar Thermal Engineering Development Branch.
PRELIMINARY OPERATIONAL RESULTS OF THE LOW TEMPERATURE SOLAR INDUSTRIAL PROCESS HEAT FIELD TESTS
Charles F. Kutscher and Roger L. Davenport Jun. 1980 40 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-632-385) Avail: NTIS HC A03/MF A01

Six solar industrial process heat field tests have been in operation for a year or more, three are hot water systems and three are hot air systems. All are low temperature projects (process heat at temperatures below 212 F). Performance results gathered by each contractor's data acquisition system are presented and project costs and problems encountered are summarized. Flat plate, evaluated tube, and line focus collectors are all represented with collector array areas ranging from 2500 to 21,000 sq ft. Collector array efficiencies ranged form 12% to 36% with net system efficiencies from 8% to 33%. Low efficiencies are atrributable in some cases to high thermal losses and, for the two projects using air collectors, are due in part to high parasitic power consumptions. Problems included industrial effluents on collectors, glazing and absorber surface failures, excessive thermal losses, freezing and overheating, control problems, and data acquisition system failure. With design and data acquisition costs excluded, costs of the projects ranged from $25/sq ft to $87/sq ft and $499/(MBtu/yr) to $1537/(MBtu/yr). DOE

N81-11494# Products Research and Chemical Corp., Glendale, Calif.
DEVELOPMENT OF 400 F SEALANTS FOR FLAT PLATE SOLAR COLLECTOR CONSTRUCTION AND INSTALLATION Final Report, 1 Oct. 1978 - 30 Sep. 1979
Lester Morris and R. J. Schubert Mar. 1980 71 p
(Contract DE-AC04-78CS-35303)
(DOE/CS-35303/T1) Avail: NTIS HC A04/MF A01

Twenty candidate sealants representing ten different polymer types were evaluated as potential solar collector sealants. Polymer types tested included epichlorohydrin rubber, EPDM rubber, silicone, polysulfide, acrylate rubber, and a fluoroelastomer. Initial screening of sealants consisted of measuring high temperature stability and adhesion retention. Several sealant compositions exhibited satisfactory performance in these tests and were selected for further evaluation. These materials were based on an EPDM rubber, a Viton fluoroelastomer, and silicone polymers. Further testing of these candidate materials included determination of adhesion retention under uv/water/heat conditions, fogging temperature, low temperature flexibility, and physical properties. Four silicone-based materials appeared to be suitable candidates for sealing solar collectors. DOE

N81-11497# Toledo Univ., Ohio. College of Engineering.
PERFORMANCE IMPROVEMENT OF A SOLAR HEATING SYSTEM UTILIZING OFF-PEAK ELECTRIC AUXILIARY
Adel H. Eltimsahy Jun. 1980 101 p refs
(Contract DE-FG02-79R5-10140)
(DOE/R5-10140/T1) Avail: NTIS HC A06/MF A01

The design and construction of a heat pump system suitable for incorporating in a space solar heating system utilizing off-peak storage from the electric utility are described. The performance of the system was evaluated. The refrigerating capacity, heating capacity and compressor horsepower for a heat pump system using a piston type compressor were determined. The heat pump design was matched with the existing University of Toledo solar house heating system. The refrigerant is Freon-12 working between a condensing temperature of up to 172 F and evaporator temperature between 0 F and 75 F. The heat pump was then installed. Performance indices for the heat pump and the heating system in general are defined and generated by the on-line computer monitoring system for the 1979/80 heating season operation. DOE

N81-11499# Pennsylvania State Univ., University Park. Dept. of Architectural Engineering.
EVALUATION OF THE SOLAR BUILDING, ALBUQUERQUE, NEW MEXICO Final Report, Apr. 1974 - Sep. 1978
Stanley F. Gilman Dec. 1979 76 p refs
(Contract EY-76-S-02-2704)
(COO-2704-22) Avail: NTIS HC A05/MF A01

During portions of the 1974-1975 and 1975-1976 winter heating seasons, a field evaluation was made of a solar-assisted heat pump heating system in a small commercial office building in Albuquerque, N.M. The system was comprised of one main water-to-water heat pump and five small water-to-air heat pumps. The liquid-type solar collector array had an area equivalent to about 10% of the building floor area. Other than the ethylene glycol/water solution circulated through the solar collector array, water was used in all parts of the system, including three thermal energy storage tanks. The work done on this project over the period of the contract is summarized and pertinent information concerning the building, the solar-assisted heat pump system, data acquisition aspects, results, and conclusions are included. DOE

N81-11509# Poly Solar, Inc., Garland, Tex.
THIN-FILM POLYCRYSTALLINE SILICON SOLAR CELLS Technical Progress Report, 15 Apr. - 15 Jul. 1980
Jul. 1980 30 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-9192-1-Ti; TPR-1) Avail: NTIS HC A03/MF A01

Efforts during the past quarter were directed to the purification of metallurgical silicon, the preparation of substrates, and the fabrication and characterization of solar cells. The partial purification of metallurgical silicon by extraction with aqua regia was investigated in detail, and the resulting silicon was analyzed by the atomic absorption technique. The unidirectional solidification of aqua regia-extracted metallurgical silicon on graphite was used for the preparation of substrates, and the impurity distribution in the substrate was also determined. Large area (greater than 30 sq cm) solar cells were prepared from aqua regia-extracted metallurgical silicon substrates by the thermal reduction of trichlorosilane containing appropriate dopants. Chemically deposited tin-dioxide films were used as antireflection coatings. Solar cells with AM1 efficiencies of about 8.5% were obtained. DOE

N81-11510# Westinghouse Research and Development Center, Pittsburgh, Pa. Materials Chemistry Dept.
LOW-COST SUBSTRATES FOR POLYCRYSTALLINE SILICON SOLAR CELLS BY ELECTRODEPOSITION PROCESSES Quarterly Progress Report, 1 Jan. - 31 Mar. 1980
W. R. Gass, I. E. Kanter, and R. E. Witkowski Jun. 1980 43 p refs
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/PR-8119-2-T2; QPR-2) Avail: NTIS HC A03/MF A01

Studies had begun to evaluate the technical feasibility for producing thin film polycrystalline silicon sheet by molten salt electrolytic plating techniques. Purified metallurgical grade silicon and silica will be investigated as inexpensive feedstocks for the electrodeposition process. Acid leaching was shown to reduce the concentration of major photovoltaic performance affecting impurities by a factor of 10 or more. Large (10 to 50 micrometers) silicon crystals have been successfully electroplated onto 1 cm x 1 cm substrate sheets. DOE

N81-11511# RCA Labs., Princeton, N. J.
THIN-FILM POLYCRYSTALLINE SILICON SOLAR CELLS Technical Progress Quarterly Report, 25 Mar. - 24 Jun. 1980
B. W. Funghnan, J. Blanc, W. Phillips, and D. Redfield Aug. 1980 54 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contract DE-AC02-77CH-00178)
(SERI/PR-0-8276-3; TPQR-3) Avail: NTIS HC A04/MF A01

Thirty-four new solar cells were fabricated on Wacker Sislo substrates and the AM-1 parameters were measured. A detailed comparison was made between the measurement of minority carrier diffusion length by the OE method and the penetrating light laser scan grain boundary photoresponse linewidth method. The laser scan method has more experimental uncertainty and agrees within 10 to 50% with the QE method. It allows determination of L over a large area. Atomic hydrogen passivation studies continued on Wacker material by three techniques. A method of determining surface recombination velocity, s, from laser scan data was developed. No change in s in completed solar cells after H-plasma treatment was observed within experimental error. H-passivation of bare silicon cars as measured by the new laser scan photoconductivity technique showed very large effects. DOE

N81-11512# Los Alamos Scientific Lab., N. Mex.
DEVELOPMENT OF AN EXPERIMENTAL TEST APPARATUS FOR NATURAL CONVECTION SOLAR COLLECTORS
W. Scott Morris 1980 6 p Presented at 5th Natl. Passive Solar Conf. Amherst, Mass., 19-26 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-2329) Avail: NTIS HC A02/MF A01

An experimental test apparatus to obtain a broad experimental data base on natural convection solar collectors is described. As construction of the apparatus was completed in late February 1980, and shakedown testing was conducted during late winter, a brief evaluation of system performance and preliminary test results are presented. DOE

N81-11516# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.
ECONOMIC EVALUATION OF THE ANNUAL CYCLE ENERGY SYSTEM (ACES), VOLUME 3, APPENDICES Final Report
Jun. 1980 406 p refs
(Contract W-7405-eng-26)
(ORNL/Sub-7470/1-V3) Avail: NTIS HC A18/MF A01

Seven appendices related to ACES, the first three of which are concerned with computer programs are presented. The appendices are entitled: ACESIM: Residential Program Listing; Typical inputs and outputs OF ACESIM; CACESS: Commercial Building Program Listing; Typical Weather Year Selection Requirements; Building Characteristics; List of AJOR Variables Used in the Computer Programs; and Bibliography. DOE

N81-11527# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SOLAR REPOWERING/INDUSTRIAL RETROFIT SYSTEMS STUDY: GULF MT. TAYLOR URANIUM MILL SOLAR RETROFIT, EXECUTIVE SUMMARY Final Technical Report
Jun. 1980 26 p refs Prepared in part by Gulf Research and Development Co., Pittsburgh and Houston Univ., Tex.
(Contract DE-AC03-79SF-10608)
(DOE/SF-10608-Exec-Summ; MDC-G8656ES) Avail: NTIS HC A03/MF A01

A nine month study to develop a site specific conceptual design for solar industrial retrofit of the Gulf Mt. Taylor Uranium Mill is described. This has resulted in preparation of a System Requirements Specification, conduct of trade studies leading to selection of a system concept, and conceptual design, performance, cost estimating and economic analysis of the selected concept. A baseline system with no storage and an alternative system with extended storage were evaluated. The baseline system with no storage was selected, because it provides the best overall opportunity for fuel displacement, operating experience in industrial application and successful demonstration in the near term for both DOE and the user. DOE

N81-11528# Acurex Corp., Mountain View, Calif. Alternate Energy Div.

FURTHER DEVELOPMENT OF A LOW COST SOLAR PANEL Final Report, 28 Sep. 1979 - 31 May 1980
T. Muller, R. Torok, D. Erskine, and R. Short Jul. 1980 81 p refs
(Contract DE-AC04-79AL-12032)
(ALO-2032-2) Avail: NTIS HC A05/MF A01

A full-scale prototype panel section, with emphasis on the unglazed configuration was fabricated and tested. Design refinement, fabrication of full-scale prototypes by hand and semiautomated equipment, subscale and full-scale structural testing, outdoor performance tests, and an assessment of manufacturing requirements and production costs are included. The Low Cost Solar Panel, the project approach, and the more significant accomplishments of this contract are described in detail. DOE

N81-11529# Middlebury Coll., Vt.
MODE VALIDATION AND SENSITIVITY ANALYSIS OF SOLAR COLLECTOR LOOPS Final Technical Report
30 Jul. 1980 18 p
(Contract DE-AC03-80CS-30218)
(DOE/CS-30218/1; SAN-30218-1) Avail: NTIS HC A02/MF A01

The experimental solar collector systems at Middlebury College were modified to permit short time resolution studies of solar collector loop performance. A variety of experiments were performed to measure the following system properties: collector efficiency, collector response to step changes in insolation, collector response to the introduction of cold inlet water; and pump cycling as a function of control sensor location and set points. Data from these experiments was supplied to the solar group at Drexel for validation of their analytical collector loop model. DOE

N81-11534# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SOLAR REPOWERING/INDUSTRIAL RETROFIT SYSTEMS STUDY: GULF MT. TAYLOR URANIUM MILL SOLAR RETROFIT Final Technical Report
Jun. 1980 281 p refs Prepared in cooperation with Gulf Research and Development Co., Pittsburgh and Houston Univ., Tex.
(Contract DE-AC03-79SF-10608)
(DOE/SF/10608-1; MDC-G8656) Avail: NTIS HC A13/MF A01

The efforts in a nine month study to develop a site specific conceptual design for solar tower focus collector industrial retrofit of the Gulf Mt. Taylor Uranium Mill are described. Details of the conceptual design, subsystem characteristics, economic analysis, and development plan are presented. DOE

N81-11537# Battelle Columbus Labs., Ohio.
REVIEW OF STATE-OF-THE-ART OF SOLAR COLLECTOR CORROSION PROCESSES. TASK 1 OF SOLAR COLLECTOR STUDIES FOR SOLAR HEATING AND COOLING APPLICATIONS Final Technical Progress Report
J. E. Clifford and R. B. Diegle 11 Apr. 1980 183 p refs
(Contract DE-AC04-79CS-10510)
(DOE/CS-10510/T12) Avail: NTIS HC A09/MF A01

The state of the art of solar collector corrosion processes is reviewed, and Task 1 of a current research program on use of aqueous heat transfer fluids for solar heating and cooling is summarized. The review of available published literature indicated that lack of quantitative information exists relative to collector corrosion at the present time, partucularly for the higher temperature applications of solar heating and cooling compared to domestic water heating. Solar collector systems are reviewed from the corrosion/service life viewpoint, with emphasis on various applications, collector design, heat transfer fluids, and freeze protection methods. Available information (mostly qualitative) on collector corrosion technology is reviewed to indicate potential corrosion problem areas and corrosion prevention practices. DOE

N81-11541# Los Alamos Scientific Lab., N. Mex.
ATTACHED SUNSPACE HEATING PERFORMANCE ESTIMATES
Robert W. Jones and Robert D. McFarland 1980 6 p refs Presented at the 5th Natl. Passive Solar Conf., Amherst, Mass., 19-26 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2236; CONF-801016-3) Avail: NTIS HC A02/MF A01

Heating performance in terms of an annual solar savings fraction (SSF) was estimated for attached-sunspace (or attached-greenhouse) types of passively solar; heated buildings. The estimation method is computer simulation method using sunspace model in the framework of PASOLE, a passive solar energy simulation program. Certain reference designs were used to provide a first estimate of performance for various locations. The primary emphasis of the present paper is to report estimates of the variations in performance as a result of variations of certain design parameters from their reference values. Design parameters varied include thermal storage volume, thermocirculation vent areas, sunspace-to-living-space well thermal resistance, sunspace infiltration rate, extent of lightweight sunspace objects, glazing tilt, and other sunspace geometry variations. DOE

N81-11546# American Planning Association, Chicago, Ill.
SITE PLANNING FOR SOLAR ACCESS: A GUIDEBOOK FOR RESIDENTIAL DEVELOPERS AND SITE PLANNERS
Duncan Erley and Martin Jaffe Sep. 1979 156 p refs Prepared in cooperation with Living Systems, Winters, Calif.
(Contract EX-76-A-29-1020)
(HUD-PDR-481) Avail: NTIS HC A08/MF A01

A guide for developers, site planners, and builders which assists in the design of residential developments for solar access was compiled. Data included in an evaluation of site selection and analysis are the Sun's positions, latitude and topography, atmospheric conditions, existing shading and shading by natural and man made objects, energy conservation, and site assessment criteria. Criteria reviewed for preliminary site planning include solar access objectives, local regulations, site planning criteria, procedures and an analysis checklist. The relationship of building and site design building orientation and solar access, and techniques for analyzing solar access are considered. Design strategies to protect solar access include road layout, lot design, open space planning, and siting strategies for single family detached, low rise multifamily, and high rise housing. Other considerations for building orientation include trees, landscaping, and vegetation utilization. Two examples of solar site planning and building orientation are provided. DOE

N81-11547# Ames Lab., Iowa.
OPERATIONAL EXPERIENCES FROM THE FEDERAL SOLAR HEATING AND COOLING DEMONSTRATIONS
Paul H. Sidles 1980 9 p Presented at the 2d Ann. Iowa Solar Operational Results Conf., Des Moines, 19-20 Jun. 1980
(Contract W-7405-eng-82)
(IS-M-286; CONF-8006115-2) Avail: NTIS HC A02/MF A01

The functional and economic feasibility of solar heating and cooling buildings is discussed. The establishment of a viable solar industry to achieve a substantial reduction in the use of fossil fuel through the widespread use of solar heating and cooling was investigated. Performance data are currently published monthly for each instrumented site in the national solar heating and cooling demonstration program. As these reports accumulate they provide an ongoing basis for evaluating the performance of solar systems and can be utilized for illustration of many of these lessons learned from operational experience. The general status of the demonstration program and experience gained are discussed. DOE

N81-11549# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION FOR DESIGN CONSTRUCTION ASSOCIATION SINGLE FAMILY DWELLING, BIG FORK, MONTANA
4 Apr. 1980 62 p
(Contract DE-AB01-76CS-31020)
(SOLAR/1029-80/50) Avail: NTIS HC A04/MF A01

A solar energy system was installed in a 2100 sq ft house located in Big Fork, Montana. The system is designed to provide solar energy for heating and domestic hot water. Solar energy is collected by flat plate collectors with a gross area of 792 square feet. The collector banks are mounted on the roof of the house and face due south at an angle of 45 deg to the horizontal optimizing solar energy collection. Solar energy is transferred from the collector array to a 1500 gallon storage tank. Water is used as the heat collection, transfer and storage medium. Freeze protection is provided by use of a drain down system. Space heating demands are met by circulating hot water from storage through baseboard units in the distribution system of the house. Auxiliary space heating is provided by an electrical heating element in the boiler. Similarly, an electrical heating element in the DHW tank provides energy for water heating. The dwelling was fully instrumented for performance evaluation since October 1977 and the data is integrated into the National Solar Data Network. DOE

N81-11551# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SNOW-COVERING EFFECTS ON THE POWER OUTPUT OF SOLAR PHOTOVOLTAIC ARRAYS
Bronwyn L. Brench Dec. 1979 29 p refs
(Contract DE-AC02-76ET-20279)
(COO-4094-61) Avail: NTIS HC A03/MF A01

In general, snow covering a photovoltaic panel causes negligible energy loss when the snow is light and melts easily; however, a more serious loss can occur when the snow is heavy and does not quickly melt or shed. In order to examine the effects of snow cover on the output energy available from photovoltaic modules, a small scale snow shedding experiment was conducted during winter at the Natural Bridges National Monument in Utah. This site was chosen since it was the planned location for a 100 kWp flat plate photovoltaic power system. Daily array power output and weather measurements were recorded by a data logger, and time lapse photographs were taken of the array. The analysis of these data and conclusions concerning the dependence of power loss on type of snow, weather conditions, and panel angle are discussed. DOE

N81-11553# Bickle/CM, Inc., Albuquerque, N. Mex.
PERFORMANCE DATA FOR PASSIVE SYSTEMS: THE RALPH WILLIAMSON HOUSE
Jun. 1980 34 p
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-0924-5) Avail: NTIS HC A03/MF A01

This house uses direct gains on the massive floor and walls. In addition to a large expanse of south facing windows is a large clerestory. The environment, building, passive solar system, data acquisition system, and thermal performance are described. DOE

N81-11554# Bickle/CM, Inc., Albuquerque, N. Mex.
PERFORMANCE DATA FOR PASSIVE SYSTEMS: THE LOS ALAMOS SCIENTIFIC LABORATORY TEST ROOMS
Jun. 1980 23 p
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-0924-2) Avail: NTIS HC A02/MF A01

Direct gain and Trombe wall test cells were constructed for use in assessing the performance of such systems and to provide data for the validation of a computer model. The environment, building, passive solar system, and data acquisition system are described for each cell. Graphs and tables of weather and validation variables are included. DOE

N81-11555# Bickle/CM, Inc., Albuquerque, N. Mex.
PERFORMANCE DATA FOR PASSIVE SYSTEMS: THE BRUCE HUNN HOUSE
Jun. 1980 38 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-0924-6) Avail: NTIS HC A03/MF A01

A 1955 sq ft house which uses a Trombe wall for space heating as well as direct gain is discussed. A rock bed storage box which is actively charged has not operated satisfactorily. The house, the envrionment, the solar system, and the data acquisition system are described. Annual and hourly test data for the house are presented. DOE

N81-11564# Franklin Research Center, Philadelphia, Pa.
PERFORMANCE DATA FROM THE RESIDENTIAL SOLAR DEMONSTRATION PROGRAM Interim Report
1980 116 p Sponsored in part by DOE
(PB80-206642; HUD-0001492) Avail: NTIS HC A06/MF A01 CSCL 05K

Information from three performance-related data bases covering some of the solar homes built under the Residential Solar Demonstration Program was surveyed and analyzed in order to identify the design and installation factors that help a solar energy system perform to its maximum potential. Data from instrumentation show that only 2 of the 17 active space heating systems have performed up to predictions, but 3 of the 5 domestic hot water systems performed better than predicted. Data from utility bills comparing solar and regular houses show that over two-thirds of the solar houses used less total gas or electric energy than comparative houses in the same locales, but on a case-by-case basis, the comparison of the utility bills is highly variable. Information from troubleshooting reports shows that through all of the first three cycles, collectors remain the equipment for which the most problems were reported. GRA

N81-12150# Societe Nationale Industrielle Aerospatiale, Cannes (France). Div. Systemes Balistiques et Spatiaux.
DEVELOPMENT OF A FOLD-OUT RIGID SOLAR ARRAY FOR THREE AXIS-STABILIZED GEOSYNCHRONOUS SATELLITES
Gerard Barkats Paris 1980 14 p refs
(SNIAS-801-440-101) Avail: NTIS HC A02/MF A01

This array was developed for point-to-point spacecraft communication purposes. The various components (panel, yoke, and wings), structures and special materials used are described together with the tilting and stowing mechanisms. The panel cell network is made up of four identical interchangeable subpanels. The masses of the different components are itemized. The functional behavior of the equipment is presented together with the results of the test program carried out. The end of life performance of the array is approximately 25 W/kg (with currently mass produced solar cells). Author (ESA)

N81-12153# Royal Aircraft Establishment, Farnborough (England).
SOLAR POWER SATELLITES. A REVIEW OF THE SPACE TRANSPORTATION OPTIONS
D. G. Fearn London HMSO Mar. 1980 194 p refs
(RAE-TR-80034; RAE-Space-577; BR74953) Avail: NTIS HC A09/MF A01

The options available for lifting both heavy payloads and personnel to low Earth orbit, and from there to geostationary orbit are reviewed. It is concluded that conventional launcher technology using liquid hydrogen/liquid oxygen engines should be adequate for the former task. The latter can best be accomplished using electric propulsion with ion thrusters being the most suitable devices, owing to their high efficiency and advanced state of development. Environmental effects of such a transportation system are considered and it is concluded that they should be acceptable. Author (ESA)

N81-12215# Giner, Inc., Waltham, Mass.
STUDY OF ALUMINUM CORROSION IN ALUMINUM SOLAR HEAT COLLECTORS USING AQUEOUS GLYCOL SOLUTION FOR HEAT TRANSFER Annual Technical Progress Report, 30 Jul. 1979 - 31 Jul. 1980
David Wong and Franklin H. Cocks Aug. 1980 42 p refs
(Contract DE-AC04-79CS-31072)
(DOE/CS-3107/T2) Avail: NTIS HC A03/MF A01

The effects of glycol aging at elevated temperatures over long periods of time were studied and the zinc powder protective technique was optimized. Glycol are known to gradually decompose into organic acids at high temperatures. These product species may be aggressive to aluminum in the long run. Corrosion inhibitors breakdown due to continuous exposure to high temperatures. As for the zinc powder protective technique, efforts were made to determine the optimal conditions under which aluminum solar collector panels can be protected most effectively and economically. Both uninhibited and inhibited ethylene as well as propyleneglycols were aged at three different temperatures (100, 140, and 190 C) for 6000 hours continuously. Aliquot samples were taken at 1000 hour intervals for pH measurement and chemical analysis. Results showed that in most cases solution pH dropped sharply during the first 1000 hours of exposure and gradually decreased at a slower pace as the aging process progressed. DOE

N81-12243# Sandia Labs., Albuquerque, N. Mex.
DEVELOPMENT AND TESTING OF POLYMER REFLECTORS
R. A. Assink 1980 9 p refs Presented at Line-Focus Solar Thermal Energy Technol. Development Conf., Albuquerque, N. Mex., 9 Sep. 1980
(Contract DE-AC04-76DA-00789)
(SAND-80-1483C; CONF-800955-1) Avail: NTIS HC A02/MF A01

Metallized polymer sheets and films offer the potential of providing a low cost, light weight and easily installed solar reflector surface. Metallized polymers presently available, however, suffer from three disadvantages: (1) low initial reflectance; (2) uv degradation; and (3) surface abrasion. The solar reflectance properties of commercially available aluminized polymers are typically 0.06 to 0.10 reflectance units (1.00 reflectance units = 100 percent reflectance) lower than the solar reflectance properties of high quality silvered glasses. This difference results from the inherently lower solar reflectance of aluminum as compared to the solar reflectance of silver. Efforts to deposit and protect silver on a polymer surface have not been successful. Recent studies, however, indicate that uv degradation may not be a serious problem for acrylic materials. Abrasion of the polymer surface by wind blown sand or contact cleaning methods can cause a substantial reduction in the specularity of the reflector. DOE

N81-12401# Sandia Labs., Albuquerque, N. Mex.
PORTABLE INSTRUMENTATION FOR SOLAR ABSORPTANCE AND EMITTANCE MEASUREMENTS
R. B. Pettit and A. R. Mahoney 1980 20 p refs Presented at Line-Focus Solar Thermal Energy Technol. Development Conf., Albuquerque, N. Mex., 9 Sep. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-1541C; CONF-800955-3) Avail: NTIS HC A02/MF A01

Two portable instruments, one designed for solar absorptance and the other for emittance measurements, were evaluated. A solar spectrum reflectometer was used for solar absorptance measurements while a model AE emissometer was used to measure the emittance for an 80 C blackbody. Both instruments are manufactured by Devices and Services Co., Dallas, TX. The solar spectrum reflectometer uses four different detector/filter combinations to match an air mass two solar spectral distribution. The solar absorptance values measured for a variety of solar coatings were determined to an accuracy of +-0.02 absorptance units. For second surface solar mirrors, the instrument underestimates the hemispherical solar reflectance when the reflecting surface is more than 0.2 mm away from the measurement port. The emissometer consists of a heated measurement head and separate display unit. The accuracy of this instrument is better than +-0.03 emittance units for black chrome solar coatings and better than +-0.06 emittance units for all coatings studied. DOE

N81-12542* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLAR CELL SYSTEM HAVING ALTERNATING CURRENT OUTPUT Patent
John C. Evans, Jr., inventor (to NASA) Issued 12 Aug. 1980 6 p Filed 10 Aug. 1979 Continuation-in-part of abandoned US Patent Appl. SN-915050, filed 9 Jun. 1978
(NASA-Case-LEW-12806-2; US-Patent-4,217,633; US-Patent-Appl-SN-065676; US-Patent-Class-363-27; US-Patent-Class-136-249; US-Patent-Class-136-291; US-Patent-Class-363-60; US-Patent-Class-363-147; US-Patent-Appl-SN-915050) Avail: US Patent and Trademark Office CSCL 10A

A monolithic multijunction solar cell was modified by fabricating an integrated circuit inverter on the back of the cell to produce a device capable of generating an alternating current output. In another embodiment, integrated curcuit power conditioning electronics was incorporated in a module containing a solar cell power supply.
Official Gazette of the U.S. Patent and Trademark Office

N81-12544*# Dayton Univ., Ohio.
SOLAR HEATING AND COOLING SYSTEM INSTALLED AT COLUMBUS, OHIO Final Report
Sep. 1980 173 p Sponsored by NASA. Marshall Space Flight Center Prepared in cooperation with Columbus Technical Inst., Ohio
(Contract EG-77-A-01-4090)
(NASA-CR-161589) Avail: NTIS HC A08/MF A01 CSCL 10A

The Solar Energy System was installed as a part of a new construction of a college building. The building will house classrooms and laboratories, administrative offices and three lecture halls. The Solar Energy System consists of 4,096 square feet (128 panels) Owens/Illinois Evacuated Glass Tube Collector Subsystem, and a 5,000 gallon steel tank below ground storage system. Hot water is circulated between the collectors and storage tank, passing through a water/lithium bromide absorption chiller to cool the building. L.F.M.

N81-12545*# Dayton Univ., Ohio.
SOLAR HEATING SYSTEM INSTALLED AT TROY, OHIO Final Report, Jul. 1976 - Nov. 1979
Sep. 1980 221 p Sponsored in part by NASA, Daytona Association of Plumbing Contractor, City of Troy, Concord Township, Troy Foundation
(Contract EX-76-C-01-2375)
(NASA-CR-161588) Avail: NTIS HC A10/MF A01 CSCL 10A

The completed system was composed of three basic subsystems: the collector system consisting of 3,264 square feet of Owens Illinois evacuated glass tube collectors; the storage system which included a 5,000 gallon insulated steel tank; and the distribution and control system which included piping, pumping and heat transfer components as well as the solemoid activated valves and control logic for the efficient and safe operation of the entire system. This solar heating system was installed in an existing facility and was, therefore, a retrofit system. Extracts from the site files, specifications, drawings, installation, operation and maintenance instructions are included. Author

N81-12547*# BDM Corp., McLean, Va.
POINT FOCUSING THERMAL AND ELECTRIC APPLICATIONS PROJECT. VOLUME 1: EXECUTIVE SUMMARY
Karen E. Landis, ed. 1979 97 p refs Workshop for Potential Military and Civil Users of Small Solar Thermal Elec. Power Technol., McLean, Va., 11-14 Sep. 1979 Sponsored in part by DOE Prepared for JPL
(Contract JPL-955354)
(NASA-CR-163803) Avail: NTIS HC A05/MF A01 CSCL 10A

Background and objectives used for the Workshop for Potential Military and Civil Users for Small Solar Thermal Electric Power Technologies are discussed. A summary of the results and conclusions developed at the workshop regarding small solar thermal electric power technologies is included. S.F.

N81-12548*# BDM Corp., McLean, Va.
POINT FOCUSING THERMAL AND ELECTRIC APPLICATIONS PROJECT. VOLUME 2: WORKSHOP PROCEEDINGS
Karen E. Landis, ed. 1979 241 p refs Workshop for Potential Military and Civil Users of Small Solar Thermal Elec. Power Technol., McLean, Va., 11-14 Sep. 1979 Sponsored in part by DOE Prepared for JPL Original contains color illustrations
(Contract JPL-955354)

(NASA-CR-163804) Avail: NTIS HC A11/MF A01 CSCL 10A

Point focus distributed receiver solar thermal technology for the production of electric power and of industrial process heat is discussed. Thermal power systems are described. Emphasis is on the development of cost effective systems which will accelerate the commercialization and industrialization of plants, using parabolic dish collectors. The characteristics of PFDR systems and the cost targets for major subsystems hardware are identified. Markets for this technology and their size are identified, and expected levelized bus bar energy costs as a function of yearly production level are presented. The present status of the technology development effort is discussed. S.F.

N81-12553*# Optical Coating Lab., Inc., City of Industry, Calif. Photoelectronics Div.

DEVELOPMENT OF HIGH EFFICIENCY (14 PERCENT) SOLAR CELL ARRAY MODULE Final Report, Nov. 1979 - Jun. 1980

P. A. Iles, S. Khemthong, S. Olah, W. J. Sampson, and K. S. Ling Jun. 1980 61 p refs Sponsored in part by DOE

(Contract JPL-955217)

(NASA-CR-163808; DOE/JPL-955217-80/5; JPL-9950-445) Avail: NTIS HC A04/MF A01 CSCL 10A

Most effort was concentrated on development of procedures to provide large area (3 in. diameter) high efficiency (16.5 percent AM1, 28 C) P+NN+ solar cells. Intensive tests with 3 in. slices gave consistently lower efficiency (13.5 percent). The problems were identified as incomplete formation of and optimum back surface field (BSF), and interaction of the BSF process and the shallow P+ junction. The problem was shown not to be caused by reduced quality of silicon near the edges of the larger slices. Author

N81-12554*# Applied Solar Energy Corp., City of Industry, Calif.

THIRD GENERATION DESIGN SOLAR CELL MODULE LSA TASK 5, LARGE SCALE PRODUCTION Final Report

Aug. 1980 43 p refs Sponsored in part by DOE

(Contract JPL-955409)

(NASA-CR-163809; DOE/JPL-955409-80/1; JPL-9950-444) Avail: NTIS HC A03/MF A01 CSCL 10A

A total of twelve (12) preproduction modules were constructed, tested, and delivered. A concept to the frame assembly was designed and proven to be quite reliable. This frame design, as well as the rest of the assembly, was designed with future high volume production and the use of automated equipment in mind. Author

N81-12558*# Rice Univ., Houston, Tex.

SOLAR POWER SATELLITE OFFSHORE RECTENNA STUDY Final Report

Nov. 1980 252 p refs Prepared in cooperation with Brown and Root Development, Inc. and Arthur D. Little, Inc.

(Contract NAS8-33023)

(NASA-CR-3348) Avail: NTIS HC A12/MF A01 CSCL 10A

It was found that an offshore rectenna is feasible and cost competitive with land rectennas but that the type of rectenna which is suitable for offshore use is quite different from that specified in the present reference system. The result is a nonground plane design which minimizes the weight and greatly reduces the number of costly support towers. This preferred design is an antenna array consisting of individually encapsulated dipoles with reflectors supported on feed wires. Such a 5 GW rectenna could be built at a 50 m water depth site to withstand hurricane and icing conditions for a one time cost of 5.7 billion dollars. Subsequent units would be about 1/3 less expensive. The east coast site chosen for this study represents an extreme case of severe environmental conditions. More benign and more shallow water sites would result in lower costs. Secondary uses such as mariculture appear practical with only minor impact on the rectenna design. The potential advantages of an offshore rectenna, such as no land requirements, removal of microwave radiation from populated areas and minimal impact on the local geopolitics argue strongly that further investigation of the offshore rectenna should be vigorously pursued. Author

N81-12564*# Little (Arthur D.), Inc., Cambridge, Mass.

GaAlAs/GaAs SOLAR CELL PROCESS STUDY Final Report

David W. Almgren and Katinka I. Csigi Washington NASA Dec. 1980 160 p refs

(Contract NAS1-15516)

(NASA-CR-3361; ADL-82340) Avail: NTIS HC A08/MF A01 CSCL 10A

Available information on liquid phase, vapor phase (including chemical vapor deposition) and molecular beam epitaxy growth procedures that could be used to fabricate single crystal, heteroface, (AlGa) As/GaAs solar cells, for space applications is summarized. A comparison of the basic cost elements of the epitaxy growth processes shows that the current infinite melt LPE process has the lower cost per cell for an annual production rate of 10,000 cells. The metal organic chemical vapor deposition (MO-CVD) process has the potential for low cost production of solar cells but there is currently a significant uncertainty in process yield, i.e., the fraction of active material in the input gas stream that ends up in the cell. Additional work is needed to optimize and document the process parameters for the MO-CVD process. Author

N81-12574# Midwest Research Inst., Golden, Colo.

INVESTIGATION OF SIMPLE DAILY SOLAR RADIATION MODELS SUITABLE FOR USE IN THE DESIGN OF SOLAR HEATING SYSTEMS

S. Sillman Aug. 1980 50 p refs

(SERI/RR-721-675) Avail: NTIS HC A03/MF A01

Solar heating system simulations typically require hourly weather data and the use of a main line computer. A simpler alternative is to use daily steps with a model for daily solar collection. The accuracy of sinusoidal radiation models for use in solar heating simulation is investigated. Accuracy of daily radiation models is assessed in two ways: by a theoretical comparison with hourly weather data, and by analysis of results of daily simulation. Results indicate that a daily radiation model can be designed with errors of less than 2 percent. DOE

N81-12575# Midwest Research Inst., Golden, Colo.

SYSTEMS ANALYSIS OF THERMAL STORAGE

R. J. Copeland Aug. 1980 6 p refs Presented at 5th Ann. Thermal Storage Meeting, McLean, Va., 10 Oct. 1980

(Contract DE-AC02-77CH-00178)

(SERI/TP-631-841; CONF-801055-1) Avail: NTIS HC A02/MF A01

Analyses were conducted on thermal storage concepts for solar thermal applications. These studies include both estimates of the obtainable costs of thermal storage concepts and their worth to a user (i.e., value). Based on obtainable costs and performance, promising thermal storage concepts are being identified. A preliminary screening was completed and a more indepth study was initiated. Value studies are being conducted to establish cost goals. A ranking of storage concepts based on value in solar thermal electric plants was conducted for both diurnal and long duration applications. Ground mounted thermal storage concepts for a parabolic dish/Stirling system are also being evaluated. DOE

N81-12576# Midwest Research Inst., Golden, Colo.

ANNUAL-CYCLE THERMAL ENERGY STORAGE FOR A COMMUNITY SOLAR SYSTEM: DETAILS OF A SENSITIVITY ANALYSIS

F. Baylin, R. Monte, and S. Sillman Jul. 1980 88 p refs

(Contract DE-AC02-77CH-00178)

(SERI/TR-721-575) Avail: NTIS HC A05/MF A01

Results and conclusions of a simulation and sensitivity analysis of community sized, annual cycle thermal energy storage (ACTES) solar energy systems. A total of 440 systems were sized for 10 locations in the United States. Three different building types and four different community sizes were modeled. All designs used each of two collector types at each of two different tilt angles. Two linear relationships were derived which simplify system sizing. The average ambient temperature is used to determine average yearly collector efficiency. This parameter combined with estimates of space/DHW loads, storage/distribution losses, and total yearly insolation per square meter allows estimation of collector area. Storage size can be estimated from the winter net load which is based on space and DHW loads, storage and distribution losses, and collector solar heat gain for the winter months. DOE

N81-12577# Acurex Corp., Mountain View, Calif. Alternate Energy Div.
DEVELOPMENT OF A LOW-COST SOLAR PANEL USING LAMINATED POLYMER FILMS Final Report, 15 Sep. 1977 - 15 Nov. 1978
E. V. Nelson, G. J. Adams, W. Elkins, and A. H. McLeod Mar. 1980 116 p refs
(Contract EG-77-C-04-4121)
(ALO-4121-2) Avail: NTIS HC A06/MF A01

The Low Cost Solar Panel development program demonstrate the fabrication of an inexpensive single glazed, nonconcentrating solar collector. With fabrication of a prototype version of the LCSP, the following key conclusions are reached: (1) the LCSP can provide cost effective thermal energy in the near term due to low collector cost, low shipping and installation costs, and high performance; (2) the LCSP concept can be rapidly commercialized since the required manufacturing technology already exists, and the capital cost for equipment would be relatively low; and (3) the LCSP concept is technically feasible; however, additional engineering and manufacturing development are required to reach the point of commercialization. S.F.

N81-12581# Purdue Univ., Fort Wayne, Ind. Dept. of Chemistry.
SOLAR CELL UTILIZING PHOTOCHEMICAL GENERATION OF ELECTRICITY Final Research Report
Kenneth L. Stevenson 1979 15 p refs
(Grant DE-FG02-79R5-10114)
(DOE/R5-10114/1) Avail: NTIS HC A02/MF A01

The performance and parameter optimization of iodine photogalvanic cells were studied. The effects of solute and solvent, solvent concentration, electrode resistance and material, wavelength dependence, distance between electrodes, and temperature on cell performance were examined experimentally. Results are presented and discussed. DOE

N81-12583# National Homes Corp., Lafayette, Ind.
PRELIMINARY DESIGNS: PASSIVE SOLAR MANUFACTURED HOUSING Technical Status Report
12 May 1980 52 p
(Contract DE-FC02-80CS-30377)
(DOE/CS-30377/1) Avail: NTIS HC A04/MF A01

The criteria established to guide the development of the preliminary designs are listed. Three preliminary designs incorporating direct gain and/or sunspace are presented. Costs, drawings, and supporting calculations are included. DOE

N81-12585# Ueland and Junker, Architects and Planners, Philadelphia, Pa.
SOLAR ATRIUM: A HYBRID SOLAR HEATING AND COOLING SYSTEM Technical Progress Report, 19 Dec. 1979 - 19 Mar. 1980
Mark Ueland 19 Jun. 1980 7 p
(Contract DE-FG02-77CS-34135; Grant EG-77-G-04-4135)
(DOE/EG-34135/10; TPR-10) Avail: NTIS HC A02/MF A01

The atrium is designed to be constructed of materials and equipment that are economical and readily available. Cost effectiveness of installation and operation is a primary design objective. The solar atrium is a further development of efforts begun in the 1930's and 1940's to design houses that would obtain a major portion of their heating from the Sun. The early solar house experiments proved the benefits of large glazed areas for trapping solar energy. However, they were not equipped to collect and store surplus solar energy, nor were they equipped to control heat losses through glass areas at night or during cloudy days. The solar atrium incorporates the large glass areas of the earlier houses and adds facilities for heat storage and control of heat losses through glass. Progress and plans are outlined. DOE

N81-12586# Bickle/CM, Inc., Albuquerque, N. Mex.
PERFORMANCE DATA FOR PASSIVE SYSTEMS. THE NATIONAL CENTER FOR APPROPRIATE TECHNOLOGY TEST ROOMS
Jun. 1980 34 p Prepared in cooperation with the National Center for Appropriate Technology, Butte, Mont.
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-0924-3) Avail: NTIS HC A03/MF A01

Direct gain and Trombe wall test cells were constructed to assess the performance of such systems and provide data for the validation of a computer model. The environmental, building, passive solar system, data acquisition system, and system thermal performance are described. DOE

N81-12596# American National Standards Inst., New York.
SOLAR STANDARDS COORDINATED BY THE STEERING COMMITTEE ON SOLAR ENERGY STANDARDS DEVELOPMENT CONTENTS Status Report
18 Aug. 1980 33 p
(Contract DE-AC01-79CS-30118)
(DOE/CS-30118/T3; SCSE-SR-3) Avail: NTIS HC A03/MF A01

Solar standards are listed for each of the standards writing organizations associated with the Steering Committee. A complete list of approved standards under development, and standards under revision is provided. DOE

N81-12598# Black and Veatch Consulting Engineers, Kansas City, Mo.
SOLAR REPOWERING FOR ELECTRIC GENERATION. NORTHEASTERN STATION UNIT 1, PUBLIC SERVICE COMPANY OF OKLAHOMA
15 Jul. 1980 251 p Prepared in cooperation with the Public Service Co. of Oklahoma and Babcock and Wilcox Co., Lynchburg, Va.
(Contract DE-AC03-79SF-10738)
(DOE/SF-10738/1-3) Avail: NTIS HC A12/MF A01

This plant was selected because it is representative of candidate plants for repowering and for solar fossil hybrid operation; it is located in a moderate insolation region, utilizes an efficient reheat cycle with steam conditions characteristic of modern power plants, and has sufficient land for repowering. NES-1 has a subcritical, single reheat turbine generator and a gas fired steam generator. The basic repowering configuration was established through a series of trade studies and the criterion that proven technology be used. The system selected has a water/steam receiver which supplies superheated steam to the turbine at a design point flow rate sufficient to displace 20 percent of the unit's fossil fuel consumption. DOE

N81-12601# RCA Labs., Princeton, N. J.
PHOTOVOLTAIC MECHANISMS IN POLYCRYSTALLINE THIN-FILM SILICON SOLAR CELLS Quarterly Report, 1 Feb. - 30 Apr. 1980
David Redfield May 1980 21 p refs
(Contract DE-AC01-79ET-23108)
(DOE/ET-23108/4; QR-3) Avail: NTIS HC A02/MF A01

In the area of heavy doping effects there are two significant recent developments. One concerns JO the saturation current density of shallow p-n junctions in which essentially all minority carriers generated are collected by the junction (e.g., solar cells with good blue response). It is shown that for such cases JO is proportional to the junction depth. The second result concerns the role of Auger recombination in n-type bases of solar cells. It is shown that, as in p-type bases, the reduction in I/sub sc/ caused by heavy doping is explained by Auger recombination that becomes apparent at densities of 10 to the 18th power per cubic cm Increased work in the modeling of electrical properties of grain boundaries appears to have opened a new path to understanding a number of observations of these properties. On the basis of several types of measurements–and the reports of others in the field, it is shown that a quasi surface model for the electrical properties describes the boundaries much better than does the crystallographic misorientation model. DOE

N81-12603# Poly Solar, Inc., Garland, Tex.
LOW COST THIN FILM POLYCRYSTALLINE SILICON SOLAR CELLS Final Report, 15 Mar. 1979 - 31 Jul. 1980
Jul. 1980 48 p refs
(Contract DE-AC03-79ET-23048)
(DOE/ET-23048/T1) Avail: NTIS HC A03/MF A01

The objective was to advance the thin film silicon solar cell technology with a view toward achieving photovoltaic conversion efficiencies greater than 10% at a cost of $100 to $300/kWe. The purification of metallurgical silicon by acid extraction and phosphorus oxide treatment was studied in detail. The minimum iron concentration obtainable was about 500 ppMa by the acid extraction technique and was about 200 ppMa by the gettering technique. A standard procedure was developed for the acid extraction of metallurgical silicon, however, considerable difficulties were encountered in the large scale gettering process. Metallurgical silicon substrates were prepared from the unidirectional solidification of the melt on graphite by the stationary and moving coil techniques. Many large area solar cells were prepared from acid extracted metallurgical silicon substrates by depositing the active region using the trichlorosilane process. The best cells have AM1 efficiencies of about 7.7%, and their photovoltaic properties were characterized. DOE

N81-12605# ROM-AIRE Solar Corp., Avon Lake, Ohio.
LOW COST, BARE PLATE SOLAR AIR COLLECTOR Semiannual Progress Report
1980 15 p ref
(Contract DE-FG02-79RE-10143)
(DOE/R5-10143/1) Avail: NTIS HC A02/MF A01

A low cost, bare plate solar collector designed to preheat ambient air with solar energy is discussed. Two prototype solar collector test systems were designed, fabricated and assembled. Each system was instrumented to provide instantaneous and average thermal performance data by means of a computerized data logger system. Preliminary test data were obtained for both prototype systems. Ambient air was preheated between 3 F and 10 F with the systems achieving a thermal performance of between 15 percent and 30 percent efficiency. DOE

N81-12606# Ames Design Collaborative, Iowa.
EXPERIMENTAL AND THEORETICAL STUDY OF THERMAL PERFORMANCE OF A HYBRID SOLAR SYSTEM AT LIVING HISTORY FARMS Final Report, 19 Sep. 1977 - 31 Aug. 1980
John R. Hull 1980 28 p refs
(Contract DE-FG04-77CS-34136)
(DOE/CS-34136/1) Avail: NTIS HC A03/MF A01

The development and study of the salt gradient solar pond and hybrid solar house at the Farm of Today and Tomorrow at Living Histor Farms are described. The backgroun of the project is given and includes conceptualization to present status. The construction history is summarized. The instrumentation and experimental results from the solar pond are discussed, as well as conclusions in regard to solar pond operation and gradient zone stability. The solar pond operated for over a year and supplied interesting experimental observations about stability of the salt gradient. DOE

N81-12607# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
INTERDIGITATED BACK CONTACT SOLAR CELLS Annual Report
M. S. Lundstrom and R. J. Schwartz Aug. 1980 144 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-7104) Avail: NTIS HC A07/MF A01

The interdigitated back contact solar cell (IBC cell) was shown to possess a number of advantages for silicon solar cells, which operate at high concentration. A detailed discussion of the factors which need to be considered in the analysis of semiconducting devices which utilize heavily doped regions such as those which are found in solar cells in both the emitter and in the back surface field regions is given. This discussion covers the questions of: how to handle degeneracy, how to compute carrier concentrations in the absence of knowledge of the details of the band structure under heavily doped conditions, and how to reconcile the usual interpretation of heavy doping as a rigid shift of the bands with the band tailing and impurity level conduction models. It also discusses the reasons for the observed discrepancies between various experimental measurements of bandgap narrowing. DOE

N81-12608# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SOLAR TOTAL ENERGY MODULARITY STUDY Final Report
Aug. 1980 203 p refs Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(SAND-80-7060) Avail: NTIS HC A10/MF A01

The results of a 26 month study which included the survey of industrial sites to obtain site specific energy demand data and other information pertinent to designing solar total energy systems for the sites are presented. Solar systems, using single axis tracking parabolic trough solar collectors were designed for each of the sites to the depth necessary to verify feasibility and identify major system components. Cost and performance estimates for each of the systems were estimated and used to predict internal rate of return over a range of collector cost and performance. Parametric system and component performance data are presented along with solar insolation data for all the Sol-Met data stations which allows the rapid assessment of solar system feasibility for future potential industrial users. DOE

N81-12609# Battelle Pacific Northwest Labs., Richland, Wash.
HELIOSTAT MIRROR SURVEY AND ANALYSIS
M. A. Lind, C. Q. Buckwalter, J. L. Daniel, J. S. Hartman, M. T. Thomas, and L. R. Pederson Sep. 1979 185 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3194) Avail: NTIS HC A09/MF A01

Field experience in existing systems showed that the performance of the reflective surface varies greatly with time and is influenced to a large extent by the construction details of the mirror module. Degradation of the reflective layer was seen that ranged from nonobservable to severe. The exact mechanisms involved in the degradation process are not well understood from either the phenomenological or microanalytical points of view and are thus subject to much debate. The work recently performed in three general areas that are key to understanding and ultimately controlling the degradation phenomena is summarized. These areas are: a survey of the present commercial mirroring industry, the microanalytical examination of numerous degraded and nondegraded mirrors, and an investigation of several novel techniques that might be used to extend the life of heliostat mirrors. DOE

N81-12610# Applied Solar Energy Corp., City of Industry, Calif.
AUTOMATED LINEAR CONCENTRATOR CELL MODULE ASSEMBLY
S. Khemthong, K. S. Ling, S. Olah, and W. J. Sampson Aug. 1980 37 p
(Contract DE-AC04-76DP-00789)
(SAND-80-7103) Avail: NTIS HC A03/MF A01

The objectives of this program were to reduce the cost of linear photovoltaic concentrator cell modules by reducing the cost of interconnection, encapsulation, and module assembly; to design and fabricate equipment for semi-automation; and to fabricate and deliver five (5) prototype modules of approximately four (4) feet in length utilizing semi-automated equipment. All of these objectives were accomplished. The procedure and equipment are described. DOE

N81-12622# Argonne National Lab., Ill.
ARGONNE SOLAR ENERGY PROGRAM. SUMMARY OF SOLAR PROGRAM ACTIVITIES Annual Report, fiscal year 1979

Jun. 1980 83 p refs
(Contract W-31-109-eng-38)
(ANL-80-80) Avail: NTIS HC A05/MF A01

Various applications of solar energy were examined. Particular emphasis was given to: solar energy collection; heating and cooling; thermal energy storage; ocean thermal energy conversion; photovoltaics; biomass conversion; satellite power systems; and solar liquid metal magnetohydrodynamic power systems. R.C.T.

N81-12623# Sandia Labs., Albuquerque, N. Mex.
BLACK CHROME SOLAR SELECTIVE COATING
R. B. Pettit and R. R. Sowell 1980 13 p refs Presented at Line-Focus Solar Thermal Energy Technol. Development Conf., Albuquerque, N. Mex., 9 Sep. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-1480C; CONF-800955-2) Avail: NTIS HC A02/MF A01

Electrodeposited black chrome solar selective coatings frequently experienced thermal stability problems when heated to temperatures above 250 C (480 F) in air. By reducing the trivalent chromium concentration in the standard black chrome plating bath, coatings on nickel substrates are obtained which are stable for thousands of hours at 350 C (660 F) and for hundreds of hours at 400 C (750 F). These results were obtained consistently on a laboratory scale, but difficulty in reproducing the results was encountered in a production environment. A current study of the effects of known plating variables in the optical properties and thermal stability of coatings is aimed at establishing an acceptable range for each plating parameter. A preliminary process specification for electroplating mild steel substrates with a stable black chrome coating is presented. DOE

N81-12624# Los Alamos Scientific Lab., N. Mex.
PASSIVE SOLAR DESIGN CALCULATIONS WITH THE DOE-2 COMPUTER PROGRAM
J. F. Kerrisk, J. E. Moore, N. M. Schnurr, and B. D. Hunn 1980 6 p refs Presented at the 5th Natl. Passive Solar Conf., Amherst, Mass., 19-26 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2340; CONF-801016-6) Avail: NTIS HC A02/MF A01

The DOE-2 computer program was modified to improve modeling of passive solar buildings by the addition of the custom weighting factor method. The thermal load and air temperature calculation procedure in DOE-2 are described. Assumption inherent in the use of American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) precalculated and the custom weighting factors are discussed. Calculated results from DOE-2 are compared with measured heat extraction rates and air temperatures for four buildings. These comparisons indicate that DOE-2 can accurately model direct gain passive buildings and can treat night ventilative cooling and water walls in an approximate manner. DOE

N81-12631# European Space Agency, Paris (France).
CONTRIBUTION TO THE STUDY OF THE INTERNAL MECHANICS OF A SPACE PHOTOVOLTAIC GENERATOR [CONTRIBUTION A L'ETUDE DE LA MECANIQUE INTERNE D'UN GENERATEUR PHOTOVOLTAIQUE SPATIAL]
D. C. Richard (ESTEC, Noordwijk, Netherlands) and W. R. Burke, ed. Jan. 1980 64 p refs In FRENCH
(ESA-STR-205; ISSN-0379-4067) Avail: NTIS HC A04/MF A01; ESA, Paris FF 55

A review of the mechanical characteristics and testing procedures of photovoltaic generator assemblies is presented related to the design of solar generators for space applications. Included are properties of materials, analytical study of a half-cell, welding points study, interconnector study and electrical wiring. The impact of theoretical results on manufacturing procedures is discussed. Author (ESA)

N81-12638# National Technical Information Service, Springfield, Va.
FLAT PLATE SOLAR COLLECTOR DESIGN AND PERFORMANCE. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - 1980
Audrey S. Hundemann Sep. 1980 261 p Supersedes NTIS/PS-70/0929; NTIS/PS-78/0841
(PB80-814122; NTIS/PS-79/0929; NTIS/PS-78/0841) Avail: NTIS HC $30.00/MF $30.00

Citations on the design, thermal performance, and optimization of air and liquid type flat plate collectors are covered. Topic areas include heat loss and heat transfer, effect of orientation, corrosion protection, optical coatings, enhancement of performance through the use of planar reflectors, and the effect of honeycomb layers on collector performance. A few studies pertain to grooved, corrugated, or V-trough collectors. Methods of measuring the performance of flat plate collectors and computer optimization studies are included. GRA

N81-12639# National Technical Information Service, Springfield, Va.
FLAT PLATE SOLAR COLLECTOR DESIGN AND PERFORMANCE. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Jul. 1980
Audrey S. Hundemann Sep. 1980 165 p Supersedes NTIS/PS-79/0928; NTIS/PS-78/0840
(PB80-814130; NTIS/PS-79/0928; NTIS/PS-78/0840) Avail: NTIS HC $30.00/MF $30.00 CSCL 10A

Federally funded research on the design and thermal efficiency of air and liquid type flat plate collectors is discussed. Topic areas cover convection characteristics, methods to reduce heat loss, optical coatings, and corrosion control. Emphasis of the bibliography is on basic research studies. This updated bibliography contains 196 citations, 36 of which are new entries to the previous edition. GRA

N81-12642# National Technical Information Service, Springfield, Va.
SOLAR ENERGY CONCENTRATOR DESIGN AND OPERATION. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Jul. 1980
Audrey S. Hundemann Sep. 1980 330 p Supersedes NTIS/PS-79/0927; NTIS/PS-78/0839
(PB80-813934; NTIS/PS-79/0927; NTIS/PS-78/0839) Avail: NTIS HC $30.00/MF $30.00 CSCL 10A

Worldwide research on the design and operation of various types of solar energy concentrators is discussed. Topic areas cover thermal and optical performance of Fresnel lenses, compound parabolic concentrators, fixed mirror concentrators, and planar reflector enhancement of flat plate collector systems. A few abstracts deal with V-trough concentrators and methods to calculate performance of concentrators. A separate Published Search on heliostat systems is available. GRA

N81-12643# Insights West, Inc., Los Angeles, Calif.
SOLAR-AUGMENTED APPLICATIONS IN INDUSTRY
John H. Williams, Steven C. Whitney, and Heather Ball Feb. 1980 124 p refs
(GSRI Proj. 5011-343-0105)
(PB80-205313; GRI-78/0036) Avail: NTIS HC A06/MF A01 CSCL 10A

Through 200 field interviews, the process needs of a wide variety of industries were examined and matched to existing solar hardware. Through a screening process using available annual insolation's relationship to process thermal needs, a ranking of the most likely candidates for early entry application of solar was then developed. The institutional aspects of solar's use by industry were examined, as were generic solar collector performance variables. Significant feedback was obtained relative to the attitudes of industrial plane executive concerning solar. GRA

N81-12874# Chicago Univ., Ill. Enrico Fermi Inst.
FUNDAMENTALS AND TECHNIQUES OF NONIMAGING OPTICS FOR SOLAR ENERGY CONCENTRATION Technical Progress Report
Roland Winston and Joseph J. OGallaher 15 Sep. 1980 50 p refs
(Contract DE-AC02-80ER-10575)
(DOE/ER-10575/1) Avail: NTIS HC A03/MF A01

Recent progress in basic research into the theoretical understanding of nonimaging optical systems and their application to the design of practical solar concentration was reviewed. Work was done to extend the previously developed geometrical vector flux formalism with the goal of applying it to the analysis of nonideal concentrators. Both phase space and vector flux representation for traditional concentrators were generated. Understanding of the thermodynamically derived relationship between concentration and cavity effects led to the design of new lossless and low loss concentrators for absorbers with gaps. Quantitative measurements of the response of real collector systems and the distribution of diffuse insolation shows that in most cases performance exceeds predictions in solar applications. These developments led to improved nonimaging solar concentrator designs and applications. DOE

N81-13112# EIC, Inc., Newton, Mass.
NONAQUEOUS ELECTROCHEMICAL PHOTOVOLTAIC CELLS BASED ON N-GaAs AND N-Si
Margaret E. Langmuir, Ronald H. Micheels, and R. David Rauh 1980 10 p refs Presented at the 3rd Intern. Conf. on Photochem. Conversion and Storage of Solar Energy, Boulder Colo., 3-8 Aug. 1980
(Contract N00014-79-C-0700)
(AD-A091382; TR-1) Avail: NTIS HC A02/MF A01 CSCL 07/4

The photoelectrochemical properties of n-GaAs and n-Si are compared in nonaqueous electrolytes. Si is the more sensitive material to surface treatment, and is more prone to anodic passivation. Surface adsorption of Ru or basic heterocyclic polymers greatly improves photocurrent yields for both materials, possibly due to a complexation of surface states. GRA

N81-13144 Purdue Univ., Lafayette, Ind.
SOLAR CONVERSION AND ENERGY STORAGE BY THE CHLOROPHYLL A DIHYDRATE PHOTOCATALYTIC DECOMPOSITION OF WATER AND REDUCTION OF CARBON DIOXIDE Ph.D. Thesis
Daniel Ray Fruge 1980 203 p
Avail: Univ. Microfilms Order No. 8027280

The photoconversion and storage of visible light energy based on the cell reactions of water photolysis by crystalline chlorophyll a dihydrate is described. The role of water on the photochemical activity of chlorophyll a is examined by a study of a photogalvanic cell consisting of a Pt/Chl a photocathode and a Chl a-free anode. The production of H(+) and OH(-) ions in the water oxidation and reduction half reactions is established by acid base titration. The observed photogalvanic current is decomposed into two contributions attributable to the markedly different rates of hydrogen evolution from elementary photochemical reactions initiating at the Chl a-H2O and Pt-Chl a interfaces. The dependence of the photocurrent on sample equilibration with water is examined relative to the enhancement of the diffusion coefficient for electron hole pair migration in (chla.2H2O)(n) on impregnation of the chlorophyll film by excess water. It is shown that (Chl a.2H2O)(n) catalyzes water photolysis on illumination by red light and that this capability is greatly enhanced by platinization of the chlorophyll. Dissert. Abstr.

N81-13169# General Electric Co., Philadelphia, Pa. Space Systems Organization.
MATERIALS AND PROCESS SCREENING APPLIED TO A REINFORCED PLASTIC PARABOLIC TROUGH CONCENTRATOR MODULE
Ronald Hodge, ed. and John M. Hogan Aug. 1980 77 p refs Sponsored by DOE
(SAND-80-7003) Avail: NTIS HC A05/MF A01

Existing parabolic trough solar collectors are basically sheet metal designs utilizing aluminum or steel as the major structural materials. The relatively high labor content associated with these sheet metal designs generated an interest in investigating the cost effectiveness of using reinforced plastics as a major structural material for trough solar collectors. This interest is bolstered by a growing desire on the part of industry to identify new material process combinations which save weight, use less energy, and require less capital equipment and assembly costs. The use of reinforced plastics as the basic material for a line focus parabolic trough concentrator module is reinforced. This module constitutes a basic building block with which longer trough rows can be built. The basic part analysis includes the quantification of key material and part function relationships. Candidate materials and processes are reviewed and, the costs associated with the most attractive combinations defined. Author

N81-13171# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center and Avionics Div.
SOLAR-SELECTIVE PAINT COATING DEVELOPMENT Final Report, 5 Jun. 1978 - 4 Dec. 1979
W. D. McKelvey, P. B. Zimmer, and R. J. H. Lin Dec. 1979 83 p refs
(Contract DE-AC04-78CS-34287)
(DOE/CS-34287/T1) Avail: NTIS HC A05/MF A01

Formulations and process conditions for thickness-sensitive paint coatings were defined. Pigments were evaluated, but none were found which can be used as a substitute for Ferro's F-6331. It was discovered that significant improvement in abrasion resistance was achieved by decreasing the pigment volume concentration without adversely affecting optical properties. Coating thermal stability, weathering and humidity resistance, and effects of pigment agglomeration size on coating optical performance were studied. It was evident that the selective paint coating is a viable alternative to selective black chrome and promises significant cost reduction. Additional developmental work is needed to bring the technology into the real world of production. Author

N81-13459 Clark Univ., Worcester, Mass.
RESIDENTIAL SOLAR ENERGY USE: A COMPARATIVE ASSESSMENT OF SOLAR CONSUMERS AND THE SOLAR RESEARCH COMMUNITY Ph.D. Thesis
Stephen Weld Sawyer 1980 269 p
Avail: Univ. Microfilms Order No. 8027967

An accurate and sensitive evaluation of the barriers and incentives to the use of solar energy systems is presented. This was achieved by determining how they are assessed by present solar consumers and by comparing these assessments to those of the solar research community. The consumers' motivations, attitudes, and economic and technical assessments were also determined and compared to the scientists' perceptions of these topics. In addition, the two populations' perspectives of the barriers, incentives and other issues related to the widespread adoption of solar systems were ascertained. The survey results are augmented by the public policy implications of the research findings. Dissert. Abstr.

N81-13461*# La Quinta Motor Inns, Inc., San Antonio, Tex.
SOLAR HOT WATER SYSTEM INSTALLED AT MOBILE, ALABAMA Final Report
Oct. 1980 28 p refs Sponsored by NASA
(Grant DOE-77-G-01-1623)
(NASA-CR-161587) Avail: NTIS HC A03/MF A01 CSCL 10A

The system consists of six rows of ten collectors and three rows of eleven collectors (1990 square feet) mounted on the roof. Griswald flow control valves were installed to regulate the flow to each row. Two Heliotrope electronic thermometers with a combined capability of measuring the temperatures of 22 different locations were installed for monitoring purposes. Author

N81-13462*# Spectrolab, Inc., Sylmar, Calif.
INVESTIGATION OF PROPOSED PROCESS SEQUENCE FOR THE ARRAY AUTOMATED ASSEMBLY TASK, PHASES 1 AND 2 Final Report, 1 Oct. 1977 - 30 Jun. 1980
Nick Mardesich, Alec Garcia, and Kim Eskenas Aug. 1980 484 p refs Sponsored in part by DOE Prepared for JPL

(Contract JPL-954853)
(NASA-CR-163813; JPL-954853-80/10; JPL-9950-441) Avail: NTIS HC A21/MF A01 CSCL 01A

Progress was made on the process sequence for module fabrication. A shift from bonding with a conformal coating to laminating with ethylene vinyl acetate and a glass superstrate is recommended for further module fabrication. The processes that were retained for the selected process sequence, spin-on diffusion, print and fire aluminum p+ back, clean, print and fire silver front contact and apply tin pad to aluminum back, were evaluated for their cost contribution. A.R.H.

N81-13473# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EXPERIMENTAL STUDY OF THE THERMAL PERFORMANCE PARAMETERS OF A LIQUID HEATING FLAT PLATE SOLAR COLLECTOR M.S. Thesis
Charles Dana Woodrum Sep. 1980 122 p refs
(AD-A091085; AFIT/GAE/AA/805-3) Avail: NTIS HC A06/MF A01 CSCL 10/1

From the results of this investigaiton the following conclusions are drawn: (1) the use of turbulators greatly enhanced the internal heat transfer coefficient, but unfortunately, made little difference in the overall performance; (2) the use of turbulators improved flow uniformity by increasing the pressure drop in the tubes; (3) the diameter of the headers should be larger to help ensure flow uniformity. This is especially true for low flowrate conditions such as those tested; (4) the bond conductance for the clamped fin was competitive with soldering since little gain in performance is realized after a value of 20 B/hr-ft-F is achieved; (5) the bond conductance of the woven fin configuration was unacceptable; and (6) Kalwall material was essentially opaque to far infrared radiation. GRA

N81-13476# Sandia Labs., Albuquerque, N. Mex.
PROTECTIVE COATINGS AND SEALANTS FOR SOLAR APPLICATIONS
K. B. Wischmann and N. H. Gonzales Sep. 1980 46 p refs
Sponsored by DOE
(SAND-80-0808) Avail: NTIS HC A03/MF A01

An aging study was completed which evaluated a number of polymeric materials for potential use as (1) protective coatings for back surfaces of mirrors and (2) solar heliostat edge seals. These investigations were conducted in an artificial weathering chamber that accelerated thermal cycling. The primary mirror failure mode was observed to be silver corrosion resulting from moisture exposure. To increase mirror longevity in current heliostat designs, intimate bonding at all the composite interfaces is essential to minimize moisture pathways to the silvered surface. If any voids or delaminations are present, mirror degradation will eventually occur. Delaminations can also occur as the result of mechanical stresses brought about by mismatches in the various materials coefficients of thermal expansion. If good bonding cannot be achieved or mechanical stresses avoided, then improved moisture barriers must be designed to assure mirror longevity. Author

N81-13477 FAFCO, Inc., Menlo Park, Calif.
COAXIAL EXTRUSION CONVERSION CONCEPT FOR POLYMERIC FLAT PLATE SOLAR COLLECTORS Final Technical Report, 30 Sep. 1978 - 31 Dec. 1979
Richard O. Rhodes, Nicholas J. Chapman, Kwang C. Chao, and Kenneth F. Sorenson Jan. 1980 221 p refs
(Contracts DE-AC03-78CS-32241; EM-78-C-03-3341)
(DOE/CS-32241/1) HC A10/MF A01

Materials and processes for fundamental improvements in flat plate solar collector cost and performance were investigated. The feasibility of a cost effective, glazed solar collector, with low labor input, utilizing a coaxial extrusion of compatible polymeric materials was studied. All considered materials for the desired application was evaluated. In addition, there was a trial extrusion of the leading candidate glazing and absorber materials, which resulted in successfully performing a coaxial extrusion of one cell. At the time the study was conducted, there were no materials available that met the necessary requirements for the specified utilization. It was recommended that, if potentially compatible materials become available, further investigation into the suitability of those materials be researched. DOE

N81-13478# Arizona State Univ., Tempe. Dept. of Mechanical Engineering.
SIMULATION AND SIMPLIFIED DESIGN STUDIES OF PHOTOVOLTAIC SYSTEMS
D. L. Evans, W. A. Facinelli, and L. P. Koehler 1980 180 p refs
(SAND-80-7013) Avail: NTIS HC A09/MF A01

Results of simulations of photovoltaic systems with electrical storage are described. Studies of the sensitivity of system performance, in terms of the fraction of the electrical load supplied by the solar energy system, to variables such as array size, battery size, location, time of year, and load shape are reported. An accurate simplified method for predicting array output of man power photovoltaic systems is presented. A second simplified method which estimates the overall performance of man power systems is developed. Finally, a preliminary technique for predicting clumped voltage system performance is discussed. Author

N81-13479# Spectrolab, Inc., Sylmar, Calif.
NEAR-TERM IMPLEMENTATION OF PRODUCTION COST REDUCTIONS FOR PHOTOVOLTAIC CONCENTRATOR ARRAYS
Ivan Lawrence Aug. 1980 37 p Sponsored by DOE
(SAND-80-7071) Avail: NTIS HC A03/MF A01

A process sequence for the fabrication of concentrator solar cells from raw silicon wafers is described. The innovation utilized in this process sequence consists of fabricating thick film conductive ink front contacts by utilizing solid photoresist as a mask. This approach overcomes the relatively poor line width resolution (approximately 5 mils) characteristic of conventional screen printing technology, while retaining the cost advantages of this technique. In this way, the premium performance characteristics of evaporated metal front contacts are combined with the low cost and high production capabilities of thick film materials and techniques. Author

N81-13482# Telic Corp., Santa Monica, Calif.
CADMIUM SULFIDE/COPPER SULFIDE HETEROJUNCTION CELL RESEARCH Final Report, 26 Feb. 1979 - 15 Jul. 1980
John A. Thornton and David G. Cornog 30 Jun. 1980 70 p refs
(Contract DE-AC02-77CH-00178)
(SERI/TR-8033-2-T1) Avail: NTIS HC A04/MF A01

Extensive modifications were made to the multi-source deposition apparatus. These include the installation of a larger vacuum chamber on the existing system. The new chamber provides improved inter-source shielding, an improved substrate mounting and heating system, and a vacuum interlock for introducing substrates. CdS resistivity control by both In doping and off-stoichiometric deposition was investigated. Indium doping was achieved both by diffusion from a pre-deposited In layer and by using In doped sputtering targets. Resistivities were found to be critically dependent on the H2S injection rate, apparently because of compensation by Cd vacancies. The Cu/sub x/S deposition process was found to be sensitive to the period of cathode operation prior to coating deposition, probably because of the conditioning of cathode and shield surfaces. DOE

N81-13483# General Electric Co., Schenectady, N. Y. Dept. of Energy Systems Programs.
ELECTRIC POWER GENERATING SUBSYSTEM STUDY FOR ADVANCED WATER/STEAM RECEIVERS Final Technical Report
G. Oganowski and D. J. Muller Apr. 1980 176 p Sponsored by DOE
(SAND-80-8180) Avail: NTIS HC A09/MF A01

The performance and economics of a range of 1985 vintage Rankine power conversion cycles for advanced water/steam solar plant application were evaluated. Sufficient information is provided for the selection of the optimum power conversion cycle when integrated with other advanced water/steam solar plant systems being developed. L.F.M.

N81-13486# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
OPEN WORKSHOP ON SOLAR TECHNOLOGIES: PROCEEDINGS
Jul. 1980 231 p Workshop held in Washington, D.C., 23-24 Oct. 1979
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/CP-741-683; CONF-7910187) Avail: NTIS HC A11/MF A01

The deliberations, conclusions, and recommendations of six panels asked to provide advice to the Department of Energy on the subject of solar energy are detailed. Introductory speeches by seven experts, excerpts from the succeeding two half days of discussion, the final reports for the panel chairpersons, and subsequent discussion and questioning are included. Approximately 125 findings and recommendations were developed by the six panels covering a wide variety of topics. Major recurring themes were recommendations for increased funding, federal program improvement, conservation, outreach programs small business funding, and solar training programs. DOE

N81-13489# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLAR PHOTOVOLTAIC SYSTEMS FOR RESIDENCES IN THE NORTHEAST
M. C. Russell 1980 5 p refs Presented at the 5th Natl. Passive Solar Conf., Amherst, Mass., 19 Oct. 1980
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/100; CONF-801016-2) Avail: NTIS HC A02/MF A01

The first phase of a program to develop residential solar photovoltaic (PV) systems involves the design, construction and testing of four prototype systems at the Northeast Residential Experiment Station. The systems employ roof mounted photovoltaic arrays of 500 to 800 square feet which provide solar generated electricity sufficient to cut in half the electrical demand of an energy efficient, passive solar residence. Construction of these systems is expected to be completed by December 1980, and will be followed by a one year test period. DOE

N81-13491# Battelle Pacific Northwest Labs., Richland, Wash.
ASSESSMENT OF SOLAR OPTIONS FOR SMALL POWER SYSTEMS APPLICATIONS. VOLUME 3: ANALYSIS OF CONCEPTS
W. W. Laity, D. T. Aase, W. J. Apley, S. P. Bird, M. K. Drost, B. A. Garrett-Price, and T. A. Williams Sep. 1980 136 p refs
(Contract DE-AC06-76RL-01830)
(PNL-4000-Vol-3) Avail: NTIS HC A07/MF A01

A comparative analysis of solar thermal conversion concepts that are potentially suitable for development as small electric power systems is given. Seven generic types of collectors, together with associated subsystems for electric power generation, were considered. The collectors are classified into three categories: (1) two axis tracking (with compound curvature reflecting surfaces; (2) one axis tracking (with single curvature reflecting surfaces; and (3) nontracking (with low concentration reflecting surfaces). All seven collectors were analyzed in conceptual system configurations with Rankine-cycle engines. In addition, two of the collectors were analyzed with Brayton-cycle engines, and the latter of the two also was analyzed with Stirling-cycle engines. The SOLSTEP computer code used to determine each configuration's system cost and performance is described. DOE

N81-13492# Battelle Pacific Northwest Labs., Richland, Wash.
ASSESSMENT OF SOLAR OPTIONS FOR SMALL POWER SYSTEMS APPLICATIONS. VOLUME 4: COMPARATIVE RANKING OF CONCEPTS
J. W. Currie and M. Jannol Jul. 1980 70 p refs
(Contract DE-AC06-76RL-01830)
(PNL-4000-Vol-4) Avail: NTIS HC A04/MF A01

Seven generic type of collectors, together with associated subsystems for electric power generation, were considered. The collectors can be classified into three categories: two axis tracking (with compound curvature reflecting surfaces); one axis tracking (with single curvature reflecting surfaces; and nontracking (with low concentration reflecting surfaces). All seven collectors were analyzed in conceptual system configuration with Rankine cycle engines. In addition, two of the collectors (the Point Focus Central Receiver and the Point Focus Distributed Receiver) were analyzed with Brayton cycle engines, and the latter of the two also was analyzed with Stirling cycle engines. With these engine options, 10 systems were formulated for analysis. Descriptions of the methodology used with, and concept ranks obtained from, potential users and R and D fund allocations are included. DOE

N81-13493# Battelle Pacific Northwest Labs., Richland, Wash.
ASSESSMENT OF SOLAR OPTIONS FOR SMALL POWER SYSTEMS APPLICATIONS. VOLUME 5: SOLSTEP. A COMPUTER MODEL FOR SOLAR PLANT SYSTEM SIMULATIONS
S. P. Bird Sep. 1980 95 p refs
(Contract DE-AC06-76RL-01830)
(PNL-4000-Vol-5) Avail: NTIS HC A05/MF A01

The thermodynamic performance is analyzed on a time step basis using actual recorded meteorological and insolation data for specific geographic locations. The flexibility of the model enables the user to analyze both central and distributed generation concepts using either thermal or electric storage systems. The thermodynamic and economic analyses view the plant in a macroscopic manner as a combination of component subsystems. In the thermodynamic simulation, concentrator optical performance is modeled as a function of solar position; other aspects of collector performance can optionally be treated as functions of ambient air temperature, wind speed, and component power level. The power conversion model accounts for the effects of ambient air temperature, partial load operation, auxiliary power demands, and plant standby and startup energy requirements. The code was designed in a modular fashion to provide efficient evaluation of the collector system, total plant, and system economics. DOE

N81-13496# Varian Associates, Palo Alto, Calif.
MATERIALS FOR HIGH EFFICIENCY MONOLITHIC MULTIGAP CONCENTRATOR SOLAR CELLS Quarterly Report, 1 Jan. - 31 Mar. 1980
1980 25 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-8081-1-T1; QR-4) Avail: NTIS HC A02/MF A01

Technologies are directed towards the development of a two gap, monolithic, lattice matched concentrator cell with 28% or higher AM 2 conversion efficiency at 500 to 1000 suns. The work is subdivided into the five major tasks: (1) develop and demonstrate the technology for a grading layer of GaInAs/GaAs and low bandgap cells in AlGaInAs/GaInAs/GaAs; (2) develop and demonstrate intercell tunnel junction contacts in the higher bandgap AlGaInAs alloys; (3) develop and demonstrate technology for a higher bandgap concentrator cell in AlGaInAs alloys; (4) demonstrate a complete two gap monolithic concentrator cell with Am2 efficiency of 28% or more; and (5) investigate the potential of AlInAsSb alloys grown on InAs substrates. Progress is reported. DOE

N81-13500# Arizona State Univ., Tempe. School of Engineering.
TERRESTRIAL PHOTOVOLTAIC POWER SYSTEMS WITH SUNLIGHT CONCENTRATION Annual Progress Report, 1979
C. E. Backus and B. D. Wood Jun. 1980 155 p refs
(Contract DE-AC04-76DP-00789)
(ERC-R-80025) Avail: NTIS HC A08/MF A01

A computer model was developed to predict solar cell performance under nonuniform temperature operation and experiments were performed on commercially available concentrator solar cells to validate model predictions. The magnitude of temperature nonuniformities caused by voids in the solar cell solder bond increases as the cell thickness decreases and intensity increases. Computer algorithms were developed to evaluate the performance characteristics of combined photovoltaic thermal (PV-T) solar collectors. This work emphasizes flat plate PV-T collectors but attention was also given to a detailed model for concentrating collectors. As expected, the extended fin geometries induce a greater degree of air turbulence and thus improves the fluid thermal conductance for a given mass flow rate. DOE

N81-13506# EIC, Inc., Newton, Mass.
CORROSION PROTECTION OF SOLAR-COLLECTOR HEAT EXCHANGERS WITH ELECTROCHEMICALLY DEPOSITED FILMS Final Report, 15 May 1978 - 15 Nov. 1979
V. R. Koch May 1980 67 p refs
(COO-4297-3) Avail: NTIS HC A04/MF A01

The electrochemical deposition of thin, adherent polymer films on the interior of heat-exchanger tubes by application of a current in the presence of a suitable organic monomer is described. Polyphenylene oxide (PPO) films were anodically deposited onto Cu and Fe coupons from methanolic media. However, defects in these films afforded poor corrosion protection. In an attempt to circumvent this problem, suitably functionalized PPO films were cross-linked via Schiff base formation in a subsequent chemical step. While these chemically modified PPO films were demonstrably more resistant to ethylene glycol H2O media at elevated temperatures, they were eventually undetermined by the thermal transfer fluid. Cinnamaldehyde, a styrene-type monomre, was successfully electrodeposited onto Al coupons. This process involved a constant, albeit unreferenced potential technique in which the Al was made the negative electrode. DOE

N81-13509# Bechtel National, Inc., San Francisco, Calif. Research and Engineering Div.
WIND DESIGN OF FLAT PANEL PHOTOVOLTAIC ARRAY STRUCTURES Final Report
Jun. 1980 174 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-7057) Avail: NTIS HC A08/MF A01

Feasible low cost structures for solar photovoltaic central power plants were studied. Wind load magnitudes for these arrays significantly influence structural costs. Wind load prediction is hampered by the lack of specific information for these unique structures. A wind-tunnel test program gave wind force coefficients for single or large-field photovoltaic arrays and the resulting design criteria are reported. DOE

N81-13510# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ANALYTICAL PREDICTIONS OF LIQUID AND AIR PHOTOVOLTAIC/THERMAL FLAT PLATE COLLECTOR PERFORMANCE
P. Raghuraman and S. D. Hendrie 1980 8 p refs Presented at the ASME Winter Ann. Meeting, Chicago, 16-21 Nov. 1980
(Contract DE-AC02-76ET-20279)
(COO-4049-89; CONF-801102-23) Avail: NTIS HC A02/MF A01

The analyses account for the temperature differences between the primary insolation absorber (the photovoltaic cells) and the secondary absorber (a thermal absorber flat plate). The results of the analyses are compared with test measurements, and therefore, design recommendations are made to maximize the total energy extracted from the collections. DOE

N81-13514# Midwest Research Inst., Golden, Colo. Solar Thermal Research Branch.
SOLAR ENERGY STORAGE PROGRAM: FY79 Annual Report
Charles E. Wyman, Robert J. Copeland, John D. Wright, and Frank Baylin May 1980 12 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/PR-631-636) Avail: NTIS HC A02/MF A01

A ranking methodology was developed for selection of thermal energy storage technologies for solar thermal applications. The ranking is based on cost and performance data. Thermal storage value data based on costs of alternative energy systems were generated for electric power plants and will be used for cost goals as a preliminary thermal storage screening tool. A survey was completed of thermal energy storage technologies, projects, and economics. An analysis was made of latent heat storage for solar heating based on previous system simulations. The only major advantage shown for latent heat storage is a reduced storage volume and not the improved solar system performance frequently postulated. Therefore, latent heat storage must be competitively priced with sensible heat options. Direct contact latent heat storage offers satisfactory low cost potential and could be used for a wide range of temperatures. DOE

N81-13516# Midwest Research Inst., Golden, Colo. Building Systems Development Branch.
SYSTEMS ANALYSIS TECHNIQUES FOR ANNUAL CYCLE THERMAL ENERGY STORAGE SOLAR SYSTEMS
F. Baylin Jul. 1980 34 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/RR-721-676) Avail: NTIS HC A03/MF A01

Community-scale annual cycle thermal energy storage solar systems are options for building heat and cooling. A variety of approaches are feasible in modeling ACTES solar systems. The key parameter in such efforts, average collector efficiency, is examined, followed by several approaches for simple and effective modeling. Methods are also examined for modeling building loads for structures based on both conventional and passive architectural designs. Two simulation models for sizing solar heating systems with annual storage are presented. Validation is presented by comparison with the results of a study of seasonal storage systems based on SOLANSIM, an hour-by-hour simulation. These models are presently used to examine the economic trade-off between collector field area and storage capacity. Programs directed toward developing other system components such as improved tanks and solar ponds or design tools for ACTES solar systems are examined. DOE

N81-13518# Sandia Labs., Albuquerque, N. Mex. Electronic and Transport Phenomena in Solids Div.
SINGLE CELL HIGH CONCENTRATION SOLAR TEST FACILITY
B. E. Gene Hammons Sep. 1980 34 p ref
(Contract DE-AC04-76DP-00789)
(SAND-80-1737) Avail: NTIS HC A03/MF A01

The facility uses a 71 cm diameter Fresnel lens as the concentrator. The lens and solar cell (with appropriate cooling fixtures) are mounted on a 2 axis tracking pedestal which is positioned by a sun seeking tracking device. The intensity of the incoming solar insolation is measured by a normal incidence pyrheliometer attached to this same tracking pedestal. Cell cooling is accomplished by the liquid impingement technique, and temperatures are held constant by a variable flow rate cooling loop using a 50/50 mixture of glycol/water as the coolant. Safety interlocks prevent the operator from being exposed to the high intensity solar radiation. Data acquisition and the associated instrumentation are controlled by a desk top computer. The computer also provides the user with a variety of cell parameters and methods of viewing the test results. Author

N81-13519# Sandia Labs., Albuquerque, N. Mex.
DEPARTMENT OF ENERGY LARGE SOLAR CENTRAL POWER SYSTEMS SEMIANNUAL REVIEW
Jun. 1980 348 p Review held in Albuquerque, N. Mex., 19-20 Mar. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-8505) Avail: NTIS HC A15/MF A01

An overview of recent developments in the area of solar technology is presented. Specific topics discussed include cogeneration, central receiver systems, solar retrofitting, heliostats, and solar thermal power systems. J.M.S.

N81-13521# Sandia Labs., Livermore, Calif. Heliostat Development Div.
STATUS AND RECOMMENDED FUTURE OF PLASTIC-ENCLOSED HELIOSTAT DEVELOPMENT
C. L. Mavis Oct. 1980 56 p refs Sponsored by DOE
(SAND-80-8032) Avail: NTIS HC A04/MF A01

Tests shows that biaxially oriented Kynar film has excellent weathering properties as an enclosure material and is practical to manufacture commercially. Reflectors using Kynar or weatherized polyester also appear to be feasible. The projected low cost of properly designed plastic enclosed heliostats indicates that further development effort should be continued. Both Boeing's one piece enclosure and reflectors need to be fabricated and set up at several desert locations to verify the designs and obtain weathering data under actual use conditions. Author

N81-13524# Sandia Labs., Albuquerque, N. Mex.
STEADY-STATE WIND LOADING ON PARABOLIC-TROUGH SOLAR COLLECTORS
Duane E. Randall, Donald D. McBride, and Roger E. Tate Aug. 1980 20 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-2134) Avail: NTIS HC A02/MF A01

Two wind tunnel force and moment tests were conducted on parabolic-trough solar collector configurations. The two tests were conducted in different flow field environments, one a uniform flow infinite airstream, the second a simulated atmospheric boundary layer flow with the models simulating a ground mounted installation. The force and moment characteristics of both isolated single module troughs and of trough modules within array configurations were defined over both operational and stow attitudes. The influence of various geometric design parameters for collector modules and arrays were established. Data indicate that forces and moments increase with mounting height and with trough aspects ratio. Collector modules interior to large arrays experience wind force reductions as high as 50 to 65%, while appropriate fences or berms surrounding the arrays can provide exterior modules with protection of this order. DOE

N81-13525# Sandia Labs., Albuquerque, N. Mex. Solar Energy Projects Dept.
FREQUENCY RESPONSE ANALYSIS OF FLUID CONTROL SYSTEMS FOR PARABOLIC TROUGH SOLAR COLLECTORS
Rudolph Schindwolf 1980 27 p refs Presented at the ASME Winter Ann. Meeting, Chicago, 16 Nov. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-0385C; CONF-801102-5) Avail: NTIS HC A03/MF A01

A linearized steady state frequency response is derived for parabolic trough collectors and for connecting piping, which can be used in standard gain phase analyses to evaluate system stability and closed loop frequency response. The frequency response characteristics of a typical collector string and piping are used in a gain phase analysis to get some insight into the effect on system stability of various system parameters such as controller gain, sensor and controller time constants, and sensor location. DOE

N81-13526# RCA Labs., Princeton, N. J. Display and Energy Systems Research Lab.
AMORPHOUS THIN FILMS FOR SOLAR-CELL APPLICATIONS
D. E. Carlson, R. S. Crandall, J. Dresner, B. Goldstein, J. J. Hanak, J. I. Pankove, H. E. Schade, D. L. Staebler, H. A. Weakliem, and R. Williams Jun. 1980 76 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-0-8254-3) Avail: NTIS HC A05/MF A01

A research program on hydrogenated amorphous silicon (a-Si:H) and the a-Si:H solar cell is described. Theoretical modeling, deposition and doping studies, experimental methods for the characterization of a-Si:H, formation of solar cell structures, theoretical and experimental evaluation of solar cell parameters, and an investigation of stacked junction cells are discussed. DOE

N81-13528# PRC Energy Analysis Co., McLean, Va.
SOLAR PHOTOVOLTAIC APPLICATIONS SEMINAR: DESIGN, INSTALLATION AND OPERATION OF SMALL, STAND-ALONE PHOTOVOLTAIC POWER SYSTEMS
Jul. 1980 351 p refs
(Contract DE-AC01-77CS-32522)
(DOE/CS-32522/T1) Avail: NTIS HC A16/MF A01

An introduction to photoconductivity, semiconductors, and solar photovoltaic cells is included along with a demonstration of specific applications and application identification. Small solar cell power system design engineering is discussed. Solar PV power system applications involve classical direct electrical energy conversion and electric power system analysis and synthesis. Presentations and examples involve a variety of disciplines including structural analysis, electric power and load analysis, reliability, sizing and optimization; and, installation, operation and maintenance. Four specific system designs are demonstrated: water pumping; domestic uses; navigational and aircraft aids; and telecommunications. All of the applications discussed are for small power requirement (under 2 kilowatts), stand alone systems to be used in remote locations. DOE

N81-13533# Martin Marietta Corp., Denver, Colo.
SOLAR CENTRAL RECEIVER HYBRID POWER SYSTEM, PHASE 1. VOLUME 1: EXECUTIVE SUMMARY Final Technical Report, Oct. 1978 - Aug. 1979
Sep. 1979 34 p ref
(Contract ET-78-C-03-2234)
(DOE/ET-21038/1-Vol-1) Avail: NTIS HC A03/MF A01

The analysis shows that in the 1990 time frame, hybrid and solar standalone power systems based on molten salt technology are competitive with peaking, intermediate and baseload conventional power technology. The hybrid plant consists of solar and nonsolar portions of the plant that operate in parallel. For the solar portion of the plant, molten salt is heated in cavity receivers and delivered to salt storage tanks. The hot salt is used to generate steam for the turbine in salt heat exchangers. For the nonsolar portion of the plant, molten salt is heated in a fossil fired salt heater and delivered to the salt storage tanks. The large quantities of storage and associated heliostats result in large plant capacity factors (0.75) from the solar portion of the plant, minimize the busbar energy costs, permit nonsolar subsystems less than the plant rating and minimize the amount of fossil fuel burned. An executive summary of the selection of the preferred system configuration, conceptual design, assessment of the commercial plant, and development plan is presented. DOE

N81-13534# Lockheed Missiles and Space Co., Palo Alto, Calif. Palo Alto Research Lab.
CADMIUM SULFIDE/COPPER SULFIDE HETEROJUNCTION CELL RESEARCH Final Report, 26 Feb. 1979 - 31 May 1980
W. W. Anderson and A. D. Jonath Jun. 1980 68 p refs
(Contract DE-AC02-77CH-0017)
(LMSC-D766341) Avail: NTIS HC A04/MF A01

Several all sputter deposited Cu2S/CdS cells were prepared with J/sub SC/ = 3 mA/sq cm under simulated AM 1 illumination. The best AM 1 conversion efficiency obtained is 0.6 percent. This is typical of sputtered CdS in Cu2S/CdS cells investigated. The sputtered Cu2S appears to be satisfactory for solar cell applications. Present evidence indicates that the poor conversion efficiency is due to a low junction electric field intensity on the CdS side of the heterojunction. A multilayered CdS structure was developed which may allow the tailoring of the junction electric field intensity to a selected high value to obtain high junction collection efficiency. Hybrid process cells consisting of sputter deposited CdS with conventional dry processed Cu2S were also prepared. The best of these cells exhibited a short circuit current density of 6.9 mA/sq cm and a conversion efficiency of 1.18 percent. DOE

N81-13535# General Electric Co., Schenectady, N. Y. Energy Systems Program Dept.
ALTERNATE CENTRAL RECEIVER POWER SYSTEM

PROGRAM, PHASE 2 **Midterm Technical Report**
Jul. 1980 101 p refs
(Contract DE-AC03-79SF-10535)
(DOE/SF-10535/1-3) Avail: NTIS HC A06/MF A01

A technique/procedure for the furnace brazing of thin walled tubular Incoloy 800 absorber panels for sodium cooled solar central receiver plants is described. This development included selection of a brazing filler metal type, form and application procedure determination of a joint design that would result in good brazibility and mechanical properties, and the selection of an appropriate panel brazing procedure, atmosphere control, orientation and fixturing method in a brazing furnace. Over 100 test specimens were fabricated and brazed. DOE

N81-14156*# European Space Research and Technology Center, Noordwijk (Netherlands).

OUTGASSING TESTS ON IRAS SOLAR PANEL SAMPLES

G. Premat, A. Zwaal, and N. H. Pennings (Fokker Space Div., Schiphol, Netherlands) *In* NASA. Johnson Space Center The 11th Space Simulation Conf. 1980 p 227-242

Avail: NTIS HC A19/MF A01 CSCL 10A

Several outgassing tests were carried out on representative solar panel samples in order to determine the extent of contamination that could be expected from this source. The materials for the construction of the solar panels were selected as a result of contamination obtained in micro volatile condensable materials tests. R.C.T.

N81-14393*# Kaw Valley State Bank and Trust Co., Topeka, Kans.

SOLAR HEATING, COOLING, AND DOMESTIC HOT WATER SYSTEM INSTALLED AT KAW VALLEY STATE BANK AND TRUST COMPANY, TOPEKA, KANSAS Final Report

Nov. 1980 184 p Sponsored by NASA
(Contract EG-77-A-01-4030)
(NASA-CR-161595) Avail: NTIS HC A09/MF A01 CSCL 10B

The building has approximately 5600 square feet of conditioned space. Solar energy was used for space heating, space cooling, and preheating domestic hot water (DHW). The solar energy system had an array of evacuated tube-type collectors with an area of 1068 square feet. A 50/50 solution of ethylene glycol and water was the transfer medium that delivered solar energy to a tube-in-shell heat exchanger that in turn delivered solar heated water to a 1100 gallon pressurized hot water storage tank. When solar energy was insufficient to satisfy the space heating and/or cooling demand, a natural gas-fired boiler provided auxiliary energy to the fan coil loops and/or the absorption chillers. Extracts from the site files, specification references, drawings, and installation, operation and maintenance instructions are presented. Author

N81-14394*# Columbia Gas Corp., Ohio.

SOLAR HEATING, COOLING AND DOMESTIC HOT WATER SYSTEM INSTALLED AT COLUMBIA GAS SYSTEM SERVICE CORPORATION, COLUMBUS, OHIO Final Report

Nov. 1980 123 p Sponsored by NASA
(Contract EG-77-A-01-4089)
(NASA-CR-161603; AH-45376) Avail: NTIS HC A06/MF A01 CSCL 10B

The solar energy system installed in the building has 2,978 sq ft of single axis tracking, concentrating collectors and provides solar energy for space heating, space cooling and domestic hot water. A 1,200,000 Btu/hour water tube gas boiler provides hot water for space heating. Space cooling is provided by a 100 ton hot water fired absorption chiller. Domestic hot water heating is provided by a 50 gallon natural gas domestic storage water heater. Extracts from the site files, specification references, drawings, installation, operation and maintenance instructions are included. A.R.H.

N81-14395*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CONTROL AND DYNAMICS STUDY FOR THE SATELLITE POWER SYSTEM. VOLUME 1: MPTS/SPS COLLECTOR DYNAMIC ANALYSIS AND SURFACE DEFORMATION

S. J. Wang 1 Sep. 1980 113 p refs Prepared for JPL
(Contract NAS7-100)
(NASA-CR-163826; JPL-Pub-80-77-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 10A

The basic dynamic properties and performance characteristics of the microwave power transmission satellite antenna were analyzed in an effort to develop criteria, requirements, and constraints for the control and structure design. The vibrational properties, the surface deformation, and the corresponding scan loss under the influence of disturbances are considered. A.R.H.

N81-14400# AEG-Telefunken, Wedel (West Germany). Fachbereich Raumfahrt, Neue Technologien.

DESIGN AND FABRICATION OF TERRESTRIAL PHOTOVOLTAIC SOLAR GENERATORS FOR FIELD TESTING IN REGIONS OF INTENSIVE INSOLATION Final Report

Hans-Dieter Wegmann Bonn Bundesministerium fuer Forschung und Technologie Oct. 1979 36 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-34; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 7,15

Two types of solar generators developed: encapsulation of interconnected 5 x 5 cm silicon solar cells in glass or in glass the evaluation of the net energy production. It was found that the energy amortization period for insulation improvement (ca. 2 months), for heat pump systems (5-14 months) and for solar systems (16-23 months) are much shorter than the anticipated life expectancy of the systems. From the point of view of energy economy it follows that even with accelerated market introduction there is no restriction for the market introduction rate. T.M.

N81-14407# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Div.

DEVELOPMENT AND PREPARATION OF INDUSTRIAL SCALE MANUFACTURING PROCESSES FOR A MODULAR SOLAR-ASSISTED HOUSE-HEATING-SYSTEM, PHASE 2B Final Report

Ruediger Elchlepp Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 60 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-85; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 12,60

Thermodynamic measurements were performed with solar experimental systems which were integrated into solar experimental houses at Hohenkirchen and Otterfing. All essential qualitative and quantitative test results up to the end of 1977 are summarized. Discussion of test results and conclusions are included. T.M.

N81-14409# Mound Lab., Miamisburg, Ohio.

SALT-GRADIENT SOLAR PONDS: DESIGN, CONSTRUCTION AND POWER PRODUCTION

Layton J. Wittenberg 1980 19 p refs Presented at the Intern. Symp. on Solar Energy Util., London, Ontario, 10-24 Aug 1980
(Contract DE-AC04-76DP-00053)
(MLM-2770(OP); CONF-800871-1) Avail. NTIS HC A02/MF A01

Salt gradient solar ponds are combined solar energy collectors and thermal storage systems. The ponds are made nonconvective by the formation of a density gradient composed of salt solutions whose concentrations increase with depth. The depth of the various layers of the pond determine the efficiency and thermal storage capacity of the system. The construction of the largest such pond in the US, 2000 sq m was completed for approximately $35/sq m. The pond is estimated to produce 1015 GJ/y of low temperature heat at a cost of $8.95/GJ, when the installation costs are amortized over, 15/y. Construction changes are suggested to improve the reliability of the system. DOE

N81-14410# Sandia Labs., Albuquerque, N. Mex. Fluid Mechanics and Heat Transfer Div.
ANNULAR SOLAR RECEIVER THERMAL CHARACTERISTICS
Arthur C. Ratzel and Carl E. Sisson Oct. 1980 80 p refs Sponsored by DOE
(SAND-79-1010) Avail: NTIS HC A05/MF A01

Results from thermal studies performed for an annular solar receiver assembly to be used with the 2 m, 90 deg parabolic collector trough are presented. The receiver configuration modeled consists of a 2.54 cm o.d. steel tube with a black chrome selective surface and an enclosing concentric Pyrex glass envelope. Previous thermal work conducted on the parabolic cylindrical collector design established the geometry and solar noon absorbed flux distribution used. One and two dimensional thermal models were developed to provide receiver assembly temperatures, heat losses, and working fluid energy extraction data with the Therminol-66 (T-66) bulk temperature maintained at 315 C. Parameters varied in the work include wind velocity, ambient air temperature, annulus gas pressure, and T-66 flow condition (Reynolds number). Heat loss and energy extraction results are tabulated and temperature distributions from two dimensional thermal modeling are graphically presented. Author

N81-14411# Sandia Labs., Albuquerque, N. Mex. Component and Subsystem Development Div.
DEVELOPMENT OF SHEET MOLDING COMPOUND SOLAR COLLECTORS WITH MOLDED-IN SILVERED GLASS REFLECTIVE SURFACES
Roscoe L. Champion and Ronald E. Allred 1980 42 p refs Sponsored by DOE
(SAND-80-0702C; CONF-800686-1) Avail: NTIS HC A03/MF A01

The feasibility of molding glass mirrors into SMC structural trough panels was investigated. Results indicate that the sagged and annealed glass panels will not survive the pressure and temperature conditions (600-700 psi, 300 F) encountered in SMC molding. However, the chemically strengthened glass mirrors were elastically formed to the parabolic contour and were successfully molded as an integral part of the structure. The 4 x 2 ft parabolic panels consisted of a front sheet of silvered glass molded with a back face sheet of SMC plus peripheral ribs and internal ribs for structural stiffness. Ribs were successfully molded with no 'sink' evident on the reflective surface of the glass. The environmental capability of these panels appears to be excellent based on their response to accelerated thermal cycling tests. DOE

N81-14412# Sandia Labs., Albuquerque, N. Mex. Thermophysical Properties Div.
SOLAR MIRROR MATERIALS: THEIR PROPERTIES AND USES IN SOLAR CONCENTRATING COLLECTORS
R. B. Pettit and E. P. Roth Jun. 1980 43 p refs Submitted for publication Sponsored by DOD
(SAND-79-2190) Avail: NTIS HC A03/MF A01

Solar mirror materials are used in a variety of solar collectors. Applications range from augmented flat plate collectors to high concentration tracking parabolic dish concentrators. The advantage in using solar mirrors is either to increase the system efficiency (e.g., by reducing thermal losses) or to reduce the system cost where relatively expensive receiver materials are utilized (e.g., photovoltaic cells). In most applications, the total mirror surface area deployed is large; thus the mirrors must be manufactured at a low cost. Because of the variety of solar applications, the optical requirements of solar mirrors vary greatly. All applications are sensitive to the solar averaged reflectance properties, which should be as close to unity as possible. The requirements on the distribution of the reflected sunlight (defined as specularity) span a range from very diffuse to highly specular, depending upon the application. Optical characterization of solar mirrors should be consistent with the intended application. S.F.

N81-14414# Sandia Labs., Albuquerque, N. Mex. System Analysis Div.
SOLAR CENTRAL RECEIVER IN PERSPECTIVE
Theodore A. Dellin 1980 10 p ref Sponsored by DOE
(SAND-79-2154C; CONF-800604-35) Avail: NTIS HC A02/MF A01

The variation in the energy costs of solar control receiver systems as a function of power level, receiver geometry, heliostat size, and heliostat canting option are presented. The results were obtained using a new version of the DELSOL computer model. A broad minimum in the cost of thermal energy at the base of the tower is observed in systems with power levels from 10 MWt to net 1000 MWt. In addition, this power range can be served by a single heliostat design. Author

N81-14415# Sandia Labs., Albuquerque, N. Mex.
THE EFFECT OF SOILING ON SOLAR MIRRORS AND TECHNIQUES USED TO MAINTAIN HIGH REFLECTIVITY
E. P. Roth and R. B. Pettit Jun. 1980 52 p refs Submitted for publication
(Contract DE-AC04-76DP-00789)
(SAND-79-2422; DR-1609) Avail: NTIS HC A04/MF A01

Specular reflectance losses as great as 25 percent was observed for mirrors exposed for only a few weeks. The effect of the deposited particles is to reduce the reflected energy by both absorbing and scattering light. The degree to which the particles reduce the collection of reflected energy depends on their composition, number and size distribution. An additional factor is the optics of the collection system. The angular acceptance aperture of the system, defined as the angle subtended by the receiver at the concentrator surface, determines the relative importance of the scattering due to dust accumulation. A field study was initiated simulating some of the operational configurations of solar mirrors. T.M.

N81-14416# Westinghouse Research Labs., Pittsburgh, Pa.
REGIONAL CONCEPTUAL DESIGN AND ANALYSIS STUDIES FOR RESIDENTIAL PHOTOVOLTAIC SYSTEMS, VOLUME 2 Final Report
P. F. Pittman, E. F. Federmann, M. Brodzik, W. J. McAllister, R. W. Stoeltzing, S. Nearhoof, and P. R. Rittelmann May 1980 269 p refs Prepared for Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(SAND-78-7040/2) Avail: NTIS HC A12/MF A01

Solar residential photovoltaic energy systems suitable for incorporation into single family residences were studied. The country was subdivided into ten regions, and the three best systems for each region were determined from the many possible system configurations, based on assumed subsystem costs and performance. Cost projections based on high volume production indicate that solar total energy systems would be viable. If a sufficiently comprehensive government program is forthcoming, they can be economically advantageous in some areas within 10 years and almost everywhere in the country by 2000. The three best system configurations found indepenent of the specific sites are those with combined electrical/thermal modules, electrical-only modules with a heat pump, and possibly separate side-by-side electrical and thermal arrays. Order of preference is determined by the site/structure characteristics. Author

N81-14418# Martin Marietta Corp., Denver, Colo.
SOLAR CENTRAL RECEIVER HYBRID POWER SYSTEM, PHASE 1. VOLUME 3: APPENDICES Final Technical Report, Oct. 1978 - Aug. 1979
Sep. 1979 253 p
(Contract ET-78-C-03-2234)
(DOE/ET-21038/1-Vol-3) Avail: NTIS HC A12/MF A01

Parametric salt piping data, sample heat exchanger calculations, and salt/materials compatibility evaluations are presented. Data lists that include the heliostat field coordinates, the STEAEC program input data, the hybrid receiver design drawings and models, and the piping stress analysis are also presented. T.M.

N81-14420# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Labs.
THIN FILM POLYCRYSTALLINE SILICON SOLAR CELLS Final Report, 1 Jan. - 31 Dec. 1979
Amal K. Ghosh, Tom Feng, and H. Paul Maruska 1979 108 p refs
(Contract DE-AC03-79ET-23047)
(DOE/ET-23047/4) Avail: NTIS HC A06/MF A01

A theory of the electrical and photovoltaic properties of polycrystalline silicon is presented. It is shown that grain boundary states play a dominant role is determining these properties of silicon. Since the grain boundary area is proportional to the grain size, it is possible to relate these properties to grain sizes. Results show that improvements in device performance can be achieved either by increasing the grain size or passivating the grain boundary states to reduce the number of recombination centers. Details of the fabrication procedures for making silicon solar cells are included. L.F.M.

N81-14428# Department of Energy, Washington, D. C.
SOLAR ENERGY: PROGRAM SUMMARY DOCUMENT Fiscal Year, 1981
Aug. 1980 376 p refs
(DOE/CS-0050) Avail: NTIS HC A17/MF A01

Solar programs and the eight solar technologies are discussed, including biomass energy systems, photovoltaic energy systems, wind energy conversion systems, solar thermal power, ocean systems, agricultural and industrial process heat, active solar heating and cooling, passive and hybrid solar heating and cooling. S.F.

N81-14429# Midwest Research Inst., Golden, Colo.
SOLAR THERMAL POWER SYSTEMS Annual Technical Progress Report, FY 1979
1980 194 p refs Sponsored by DOE
(DOE/CS-04042/1) Avail: NTIS HC A09/MF A01

Technical and cost readiness of mid and high temperature solar concentrating collector systems are examined. Topics covered include: 1) small power subsystems and component development; 2) small power systems and applications; 3) large power subsystems and component development; 4) large power system and applications; 5) advanced sybsystems; 6) advanced components; 7) material technology; and 8) supporting programs. S.F.

N81-14437# Texas Univ. at Arlington.
SOLAR PHOTOVOLTAIC/THERMAL RESIDENTIAL EXPERIMENT, PHASE 1 Final Report
Ghazi Darkazalli 1 Jul. 1980 54 p refs Prepared in cooperation with Lincoln Lab., MIT, Lexington
(Contract DE-AG02-76ET-20279)
(DOE/ET-20279/103) Avail: NTIS HC A04/MF A01

Month by month energy transfer data between an occupied residence and its energy supply systems are presented. Energy transfer data are divided into different categories depending on how the energy is consumed. Energy transfers between some system components are also categorized. These components include a flat-plate thermal collector array, a flat-plate photovoltaic array, a dc to ac inverter, thermal storage tanks, and a series heat pump. System operations included directing surplus electrical energy (generated by the photovoltaic array) into the local utility grid. The heat pump used off-peak utility power to chill water during the cooling season. Author

N81-14438# Southern Methodist Univ., Dallas, Tex.
THIN FILM CADMIUM TELLURIDE SOLAR CELLS Final Technical Report, 1 Jul. 1979 - 31 Aug. 1980
Ting L. Chu Aug. 1980 52 p refs
(Contract DE-AC04-79ET-23009)
(DOE/ET-23009/T10) Avail: NTIS HC A04/MF A01

Efforts were directed to the construction of apparatus for the chemical vapor deposition of cadmium telluride films, the selection and preparation of substrates, the deposition and characterization of cadmium telluride films, and the fabrication and characterization of solar cells. Cadmium telluride films were deposited on a number of substrates by the direct combination of cadmium and tellurium on the substrate surface at 500 C or higher, at rates of up to 0.6 micrometer/min. The structural, crystallographic, and electrical properties of cadmium telluride films deposited over a wide range of conditions were evaluated. A series of doping experiments were carried out using iodine and indium as the n-type dopant, and phosphorus, arsenic, and antimony as the p-type dopant. The In/W/graphite substrates were used for the deposition of n-type films with an ohmic interface. However, no suitable substrates were found to form an ohmic interface with p-type films. Solar cells prepared from these films exhibit relatively good short circuit current density, up to 15 mA/sq cm, but their conversion efficiencies are severely limited by the high series resistance of the devices. E.D.K.

N81-14440# RCA Labs., Princeton, N. J.
PHOTOVOLTAIC MECHANISMS IN POLYCRYSTALLINE THIN-FILMS SILICON SOLAR CELLS Quarterly Report, 1 May - 31 Jul. 1980
David Redfield Aug. 1980 20 p refs Sponsored in part by DOE
(DOE/ET-23108/5; QR-4) Avail: NTIS HC A02/MF A01

While seeking to optimize the dopent concentrations and profiles of diffused Si solar cells, it was found that 1000 C is a poor diffusion temperature and 875 C is much better. Attempts to passivate the front surface of cells by 100 percent of grown SiO2 indicate that this oxide is inadequate to reduce the surface recombination velocity. Exposure to atomic hydrogen worsened the blue response of such a cell. Indications exist that good blue performance may still be obtainable with somewhat deeper junctions than normally used. On grain boundaries (GR) in Si, the activating effect of heat treatment on the harmful effects of GB was verified. A slightly modified version of the liquid crystal technique for observation of the active GB correlates well with the light spot scan technique. Author

N81-14442# RCA Labs., Princeton, N. J.
PHOTOVOLTAIC MECHANISMS IN POLYCRYSTALLINE THIN-FILM SILICON SOLAR CELLS Summary Report, 31 May 1979 - 31 Jan. 1980
David Redfield Feb. 1980 36 p refs
(Contract DE-AC01-79ET-23108)
(DOE/ET-23108/3) Avail: NTIS HC A03/MF A01

Fundamental limitations on the performance of Si solar cells were shown to be quite different from those that were conventionally invoked. Particularly for heavy-doping effects, the usual models were shown to be invalid and a new method was devised for calculating the reverse saturation current of a heavily doped device in which nearly all minority carriers reach the junction (viz., good blue-response). Calculations by the new method show: increased doping above 10 to the 18th power per cu cm does not improve the open-circuit voltage as has been thought, and previous estimates of bandgap narrowing in diffused cells are much too high because of the neglect of Auger recombination effects. Also of importance are the effects of doping gradients and their relation to the properties of the front surface of a diffused-junction cell. These experiments led to a new, simple method of separating the internal optoelectronic properties of a solar cell (or optical detector) from the reflectance properties of the front surface. This method thus provides a direct means of evaluating the effectiveness of antireflection coatings on such devices. Author

N81-14444# Mobil Tyco Solar Energy Corp., Waltham, Mass.
A 25 kW SOLAR PHOTOVOLTAIC FLAT PANEL POWER SUPPLY FOR AN ELECTRODIALYSIS WATER DESALINATION UNIT IN NEW MEXICO Final Report, 1 Oct. 1978 - 31 May 1979
J. R. Wood and J. L. Crutcher Jun. 1980 100 p refs
(Contract DE-AC04-78ET-23061)
(DOE/ET-23061/1) Avail: NTIS HC A05/MF A01

The stand-alone system consists of a flat panel array employing silicon ribbon solar cells, used in conjunction with a lead-acid battery bank. Electrodialysis is an energy-conservative process for the desalination of water, in which ions are transferred from one solution through a membrane into another solution by imposition of a direct electrical current. The system design is intended to be prototypical of part of the drinking water supply for a remote village. The specific task of this system is to aid in the restoration of an aquifer following a uranium leaching operation. Author

N81-14445# Eagle-Picher Industries, Inc., Miami, Okla. Specialty Materials Div.
BORON ARSENIDE THIN FILM SOLAR CELL DEVELOPMENT Final Report
Jack L. Boone and Thomas P. VanDoren Sep. 1980 137 p refs
(Contract DE-AC04-79ET-23011)
(DOE/ET-23011/1) Avail: NTIS HC A07/MF A01

Pyrolytic decomposition of diborane and arsine was used in attempts to grow polycrystalline BAs films. This method produced only amorphous films for deposition temperatures below 920 C and polycrystalline boron subarsenide ($B_{12}As_2$) films for deposition temperatures above this value. The amorphous films were determined to have a significant arsenic content but the actual stoichiometry was not obtained. The films were adherent on single crystal sapphire (0001), (111) silicon, (0001) SiC, and polycrystalline SiC but were found not to be adherent to substrates of fused quartz, tungsten, and molybdenum. It was also found that all films deposited above 650 C were p-type while those deposited below 600 C were usually n-type. Polycrystalline BAs and $B_{12}As_2$ was produced by reaction of the elements in a closed tube. Reflectance data on the amorphous films indicate a probable additional optical transition between 3.0 and 3.5 eV. Measurements of a capacitor structure using a polycrystalline BAs pressed pellet gave an index of refraction of 1.9 at 15 KHz. Infrared studies show a possible significant amount of boron hydrogen bonding along with evidence indicating carbon hydrogen bonding. Author

N81-14446# Southern Methodist Univ., Dallas, Tex.
THIN FILM CADMIUM TELLURIDE SOLAR CELLS Final Technical Report, 1 Jul. 1979 - 31 Aug. 1980
Ting L. Chu Jul. 1980 54 p refs
(Contract DE-AC04-79ET-23009)
(DOE/ET-23009/T11) Avail: NTIS HC A04/MF A01

The construction of apparatus for the chemical vapor deposition of cadmium telluride films, the selection and preparation of substrates, the deposition and characterization of cadmium telluride films, and the fabrication and characterization of solar cells are described. Cadmium telluride films were deposited on a number of substrates by the direct combination of cadmium and tellurium on the substrate surface at 500 C or higher at rates of up to 0.6 micrometers per min. The structural, crystallographic, and electrical properties of cadmium telluride films deposited over a wide range of conditions were evaluated. A series of doping experiments were carried out using iodine and indium as the n type dopant, and phosphorus, arsenic, and antimony as the p type dopant. In/W/graphite substrates were used for the deposition of n type films with an ohmic interface. Solar cells prepared from these films exhibit relatively good short circuit current density but their conversion efficiencies are severely limited by the high series resistance of the devices. Author

N81-14450# Mitre Corp., McLean, Va.
SUMMARY OF SOLAR ENERGY TECHNOLOGY CHARACTERIZATIONS Characterization Reports, 1978 - 1979
Sep. 1980 190 p refs Sponsored by DOE Prepared in cooperation with Argonne National Lab., Oak Ridge National Lab., Los Alamos Scientific Lab., and California Univ., Lawrence Berkeley Lab.
(DOE/EV-0099) Avail: NTIS HC A09/MF A01

The design, operating, energy, environmental, and economic characteristics of 38 model solar systems used in the Technology Assessment of Solar Energy Systems Project are summarized. The generic systems designs utilized were based on systems studies and mission analyses performed by the DOE National Laboratories and the MITRE Corporation. Their purpose was to formulate materials and engineering cost data and performance data of solar equipment once mass produced. Author

N81-14451# Los Alamos Scientific Lab., N. Mex.
DECENTRALIZED SOLAR PHOTOVOLTAIC ENERGY SYSTEMS
Milton C. Krupka Sep. 1980 111 p refs Sponsored in part by DOE
(DOE/EV-0101) Avail: NTIS HC A06/MF A01

Emphasis was placed upon the selection and use of a model residential photovoltaic system to develop and quantify the necessary data. The model consists of a reference home located in Phoenix, AZ utilizing a unique solar cell array roof shingle combination. Silicon solar cells, rated at 13.5 percent efficiency at 28 C and 100 mW/sq cm insolation are used to generate 10 kW (peak). An all electric home is considered with lead acid battery storage, dc ac inversion and utility backup. The reference home is compared to others in regions of different insolation. It is suggested that solar cell materials production and fabrication may have the major environmental impact when comparing all facets of photovoltaic system usage. Fabrication of the various types of solar cell systems involves the need, handling, and transportation of many toxic and hazardous chemicals with attendant health and safety impacts. Increases in production of such materials as lead, antimony, sulfuric acid, copper, plastics, cadmium and gallium will be required should large scale usage of photovoltaic systems be implemented. Author

N81-14452# Los Alamos Scientific Lab., N. Mex.
THE CHARACTERIZATION AND ASSESSMENT OF SELECTED SOLAR THERMAL ENERGY SYSTEMS FOR RESIDENTIAL AND PROCESS HEAT APPLICATIONS
Jack C. Hyde Sep. 1980 54 p refs Sponsored in part by DOE
(DOE/EV-0102) Avail: NTIS HC A04/MF A01

Results of studies of seven solar thermal energy applications are presented. Five of these are residential applications: space heating--active liquid, space heating--active air, domestic hot water--active, space heating--passive, and space heating and cooling--active liquid. Denver, Colorado, was selected as a representative location for each of the above applications. The remaining two applications produce industrial process heat: a flat plate collector system producing 50 C - 100 C hot water for a commercial laundry in Indianapolis, Indiana; and a concentrating collector system that could produce 100 C - 300 C process heat adequate to the needs of a pulp mill in Madison, Wisconsin. Author

N81-14458# California State Coll., Bakersfield.
THE DESIGN CONSTRUCTION AND TESTING OF A LIQUID-HEATING FLAT-PLATE SOLAR COLLECTOR
Robert Edward Tuttle Feb. 1980 25 p refs Sponsored by DOE
(DOE/CS-34223/T1) Avail: NTIS HC A02/MF A01

A liquid heating, flat plate solar collector, easy to build and capable of space and water heating, was designed, constructed and tested. S.F.

N81-14459# Environmental Research Inst. of Michigan, Ann Arbor.
DEMONSTRATION OF AN ADVANCED SOLAR GARDEN WITH A WATER CEILING Final Technical Progress Report, 1 Jul. 1979 - 30 Jun. 1980
R. Maes, Catherine Riseng, G. Thomas, and M. Mandeville Sep. 1980 77 p refs
(Grant DE-FG02-79R5-10122)
(DOE/R5-10122/2) Avail: NTIS HC A05/MF A01

Experimental procedures for evaluating the water ceiling as an integral part of an ongoing garden agricultural experiment are discussed and the results presented. The water ceiling proved useful in providing extra thermal capacity to the solar garden. It provides heat at night after the water was warmed during the day, and retards overheating in the daytime by absorbing infrared energy into the water. In growing nonflowering plants such as lettuce and Chinese cabbage, the water ceiling showed no noticeable degradation in yield or maturation rate. In flowering

plants such as tomatoes, the reduced light levels delayed yields by a couple of weeks but the total yield was only slightly diminished. In geographic areas where there is less cloud cover than in Michigan, the water ceiling could be more effective.
Author

N81-14461# Battelle Columbus Labs., Ohio.
SOLAR ENERGY EMPLOYMENT AND REQUIREMENTS, 1978 - 1985. SUMMARY AND HIGHLIGHTS
Girard W. Levy and Jennifer Field Apr. 1980 210 p refs
(Contract EG-77-G-01-6037)
(DOE/TIC-1154) Avail: NTIS HC A10/MF A01
The characterization of establishments engaged in solar energy work and the number and occupational distribution of persons working in solar energy activities in 1978 are described. Future solar manpower requirements through 1983 are projected. Included were all types of solar energy technologies and applications (space heating and cooling, water heating, industrial process heat, thermal power, ocean thermal conversion, photovoltaic conversion, wind conversion and biomass conversion), and all phases of work (research and development, manufacturing, marketing and distribution, and installation and maintenance).
L.F.M.

N81-14465# ROM-AIRE Solar Corp., Avon Lake, Ohio.
LOW COST BARE-PLATE SOLAR AIR COLLECTOR
William L. Maag, Carl J. Wenzler, Frank E. Rom, and David R. VanArsdale Sep. 1980 68 p refs
(Grant DE-FG02-79R5-10143)
(DOE/R5-10143/T1) Avail: NTIS HC A04/MF A01
A low cost, bare plate solar collector for preheating ambient air was developed. This type of solar heating system would be applicable for preheating ventilation air for public buildings or other commercial and industrial ventilation requirements. Two prototype collectors were designed, fabricated and installed into an instrumented test system. Tests were conducted for a period of five months. Results of the tests showed consistent operating efficiencies of 60 percent or greater with air preheat temperature uses up to 20 degrees for one of the prototypes. The economic analyses indicated that this type of solar system was economically viable. For the materials of construction and the type of fabrication and installation perceived, costs for the bare plate solar collector are attainable. Applications for preheating ventilation air for schools were evaluated and judged to be economically viable.
S.F.

N81-14470# Systems Control, Inc., Palo Alto, Calif.
SATELLITE POWER SYSTEM: UTILITY IMPACT STUDY Final Report
J. G. Bohn, J. W. Patmore, and H. W. Zaininger Sep. 1980 70 p refs Sponsored by Electric Power Research Inst.
(EPRI-AP-1548; TPS-79-752) Avail: NTIS HC A04/MF A01
The reference system design would utilize 60 satellites in geosynchronous orbits. Each satellite would collect solar energy and convert it to electricity by means of a 55 sq km array of photovoltaic cells. This dc electricity would then be converted to microwave and transmitted to a 130 sq km receiving antenna on the ground, where it would be reconverted to dc and then ac electricity before being fed into the conventional utility power system. Each satellite would deliver approximately 5 GW of power at the utility interface. It is estimated that each 5 GW satellite and ground receiving antenna plus associated equipment would cost $10 to 20 billion (1977 dollars), with the entire 60 satellite system costing $600 billion to 1.2 trillion. This amounts to $2000 to 4000 per kW. Although there are serious technical problems to be solved befor the SPS would be feasible, the cost of the system may be the greatest obstacle to its implementation.
DOE

N81-14483# Midwest Research Inst., Golden, Colo.
QUALITY-ASSURANCE NEEDS AND GOALS IN SOLAR ENERGY CONVERSION
Gordon E. Gross Jul. 1980 9 p refs Presented at the 7th Ann. Natl. Energy Div. Conf., Houston, Tex., 29 Sep. 1980
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042).
(SERI/TP-641-773; CONF-800927-2) Avail: NTIS HC A02/MF A01
A discussion of the status of quality assurance activities in solar energy conversion technologies and of the needs for further efforts in this area is presented. The importance of reliability and quality assurance activities to various end users is briefly discussed. Some details of such activities in wind, active heating and cooling, and photovoltaic technologies are given. Suggestions for an inegrated reliability, quality assurance program are presented and their importance to the growth of solar energy application is discussed.
DOE

N81-14487# California Univ., Livermore.
SIX KILOWATT, RESIDENTIAL PHOTOVOLTAIC POWER SYSTEMS STUDY: DESIGN, PERFORMANCE, ECONOMICS, MARKET POTENTIAL
Larry D. Partain 4 Aug. 1980 58 p refs
(Contract W-7405-eng-48)
(UCID-18776) Avail: NTIS HC A04/MF A01
A cost and performance analysis is presented for a solar cell electric system that can provide 70% of the electric power to a home in a California-like climate. Both a battery storage and no-storage configuration with a six kilowatt, peak power, solar array were considered, including batteries, for a 15 kWh per day average energy use that equals that of an average household in Northern California. For the promising, no-storage home system the uncertainties in important parameter values are too large to allow definitive assessment until better characterizations have been made. The political and policy decisions that can have a strong influence were assessed and quantified. The effects of tax credits, utility buyback, and proper home construction were considered. Potential markets in the hundreds of millions of dollars per year range that involve on the order of one million peak kilowatts of solar cells per year were estimated.
DOE

N81-14489# Aerospace Corp., El Segundo, Calif.
SOLAR THERMAL POWER SYSTEMS Summary Report, Apr. 1973 - Nov. 1979
Leon R. Bush Jun. 1980 153 p refs Sponsored in part by NSF and ERDA
(Contracts DE-A101-79ET-21036; F04701-79-C-0080)
(DOE/CS-21036/01) Avail: NTIS HC A08/MF A01
Potential solar energy users and other interested organizations are provided a summary of solar thermal power methodology, assumptions, and major findings. Extensive references are provided to permit pursuit of detailed technical results and determine the content and availability of computer programs and data bases that were generated.
L.F.M.

N81-14491*# Alabama Univ. in Huntsville. Environmental and Energy Center.
SPS ENERGY CONVERSION POWER MANAGEMENT WORKSHOP Final Report
Jun. 1980 98 p Workshop held in Huntsville, Ala., 5-7 Feb. 1980
(Contracts NAS8-33132; DE-AS01-78CS-34218)
(NASA-CR-163840; DOE/CS-34218/T1) Avail: NTIS HC A05/MF A01 CSCL 10A
Energy technology concerning photovoltaic conversion, solar thermal conversion systems, and electrical power distribution processing is discussed. The manufacturing processes involving solar cells and solar array production are summarized. Resource issues concerning gallium arsenides and silicon alternatives are reported. Collector structures for solar construction are described and estimates in their service life, failure rates, and capabilities are presented. Theories of advanced thermal power cycles are summarized. Power distribution system configurations and processing components are presented.
T.M.

N81-14492# Battelle Columbus Labs., Ohio.
DEVELOPMENT OF A LOW-COST BLACK-LIQUID SOLAR COLLECTOR, PHASE 2 Semiannual Report, 1 Mar. - 31 Aug. 1980

D. K. Landstrom, S. G. Talbert, and V. D. McGinniss 30 Sep. 1980 15 p refs
(Contract DE-AC04-79CS-30171)
(DOE/CS-30171/2A; SAR-2) Avail: NTIS HC A02/MF A01

Research efforts were directed toward (1) evaluating the long-term durability of various plastic materials and solar collector designs, (2) obtaining sufficient outdoor performance data to design a full-scale demonstration of a black-liquid solar collector for a commercial application, (3) working closely with a company willing to commericalize black liquid plastic collectors, and (4) incorporating improved black liquids with the identified plastic collector designs. Besides conducting indoor weathering tests of various plastic materials, two outdoor automated test facilities were operated. Author

N81-14494# National Technical Information Service, Springfield, Va.
SOLAR PONDS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Jul. 1980
Audrey S. Hundemann Aug. 1980 54 p Supersedes NTIS/PS-79/0924 and NTIS/PS-78/0836 Updates NTIS/PS-77/0458
(PB80-814460; NTIS/PS-79/0924; NTIS/PS-78/0836) Copyright. Avail: NTIS HC$30.00/MF$30.00 CSCL 10A

Federally funded research on the design, performance, and use of solar ponds is discussed on these. Topic areas cover the use of solar ponds in industrial process heat production, roof ponds for passive solar buildings, and solar ponds use in the production of biomass for renewable fuels. GRA

N81-15460*# La Quinta Motor Inns, Inc., San Antonio, Tex. Development Div.
SOLAR DOMESTIC HOT WATER SYSTEM INSTALLED AT TEXAS CITY, TEXAS Final Technical Report
Dec. 1980 29 p Sponsored in part by NASA
(Contract EG-77-G-01-1670)
(NASA-CR-161605) Avail: NTIS HC A03/MF A01 CSCL 10A

This is the final technical report of the solar energy system located at LaQuinta Motor Inn, Texas City, Texas. The system was designed to supply 63 percent of the total hot water load for a new 98 unit motor inn. The solar energy system consists of a 2100 square feet Raypack liquid flat plate collector subsystem and a 2500 gallon storage subsystem circulating hot water producing 3.67 x 10 to the 8th power Btu/year. Abstracts from the site files, specification references, drawings, installation, operation, and maintenance instructions are included. E.D.K.

N81-15463*# Lincoln Lab., Mass. Inst. of Tech., Lexington.
GaAs SHALLOW-HOMOJUNCTION SOLAR CELLS Final Report
John C. Fan 30 Jun. 1980 29 p refs
(NASA Order C-30969-D)
(NASA-CR-165167) Avail: NTIS HC A03/MF A01 CSCL 10A

With the objective of demonstrating the feasibility of fabricating 2 x 2 cm efficient, shallow homojunction GaAs solar cells for space applications, this program addresses the basic problems of material preparation and device fabrication. Significant progress was made and conversion efficiencies close to 16 percent at AMO were obtained on 2 x 2 cm cells. Measurements and computer analyses on the n(+)/p/p(+) shallow homojunction cells indicate that such cell configuration should be very resistant to 1 MeV electron irradiation. E.D.K.

N81-15469# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION: SIR GALAHAD, VIRGINIA BEACH, VIRGINIA Seasonal Report, Nov. 1979 - Apr. 1980
Michael Raymond 1980 87 p refs
(Contract DE-AC01-79CS-30027)
(SOLAR/1028-80/14) Avail: NTIS HC A05/MF A01

The system supplied 76 percent of the space heating and 76 percent of the domestic hot water required for a house during the heating season of November through April. The overall performance of the solar system was, compared to an f-Chart simulation, equal to expectations during this season. The fraction of collected solar energy that was used was 50 percent, which was nearly the same as the f-Chart prediction of 49 percent. The f-Chart prediction and the actual energy used were far smaller than the design solar contribution. This was because the loads were so much smaller than the design loads. T.M.

N81-15470# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
VACUUM DEPOSITED POLYCRYSTALLINE SILICON FILMS FOR SOLAR CELL APPLICATIONS Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1980
Charles Feldman, Charles H. Arrington, III, Norman A. Blum, and Frank G. Satkiewicz Aug. 1980 50 p refs Sponsored by Solar Energy Research Inst.
(SERI/PR-8278-1-T3; QTPR-3) Avail: NTIS HC A03/MF A01

Polycrystalline p type silicon films were vacuum deposited onto TiB2 coated alumina and sapphire substrates. Epitaxial layers were also formed on single crystal silicon substrates. Junctions in the layers were created by both gaseous diffusion in a tube furnace and by vacuum deposition. All vacuum deposited solar cells were fabricated for the fist time. Efficiencies approaching those in the diffused junction devices were achieved. The n layers were deposited on the previously deposited p layer/TiB2/ceramic sandwiches by vacuum deposition of silicon in a phosphine (PH3) atmosphere. Photovoltaic data in diffused junction samples, including efficiency and spectral response measurements, indicate that crystallite size may no longer be the limiting factor in achieving high efficiency; rather, performance is now being limited by the presence of impurities in the vacuum deposition silicon base region. E.D.K.

N81-15471# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
VACUUM DEPOSITED POLYCRYSTALLINE SILICON FILMS FOR SOLAR CELL APPLICATIONS, VOLUME 2 Quarterly Technical Progress Report, 1 Jan. - 31 Mar. 1980
Charles Feldman, Charles H. Arrington, III, Norman A. Blum, and Frank G. Satkiewicz May 1980 55 p refs Prepared for Midwest Research Inst., Golden, Colo. 3 Vol.
(Contract ET-78-A-03-2208)
(SERI/PR-8278-1-T2; QTPR-2) Avail: NTIS HC A04/MF A01

A careful study of a specially formed thin silicon layer on TiB2 coated sapphire revealed that the interaction layer of TiSi2 is composed of larger grains. Processing steps were developed which lead closer to the goal of fabricating polycrystalline silicon photovoltaic devices completely by vacuum deposition. Both n-type and p-type silicon were deposited. Deposition masks were made for depositing the n regions upon the p-layers. The TiB2 bottom electrode fabrication was achieved in a single vacuum chamber. Reaction constants and activation energy for TiB2 layer formation were determined to be less than those reported for bulk material. Major sources of undesirable impurities were identified and removed from the vacuum chambers. T.M.

N81-15474# Solar Power Corp., Woburn, Mass.
A 194 KILOWATT SOLAR PHOTOVOLTAIC FLAT PANEL POWER SYSTEM FOR THE COMBINED BEVERLY HIGH SCHOOL/C. H. PATTEN VOCATIONAL HIGH SCHOOL, BEVERLY, MASSACHUSETTS Final Technical Report, 1 Oct. 1978 - 31 Mar. 1979
R. R. Addiss, Jr. and P. A. Lawson Jun. 1980 202 p
(Contract DE-AC04-78ET-23064)
(DOE/ET-23064/1) Avail: NTIS HC A10/MF A01

The design and performance of a photovoltaic power system is discussed. The 194 kW system consists of the photovoltaic array, the inverter/control subsystem, the building and utility interface, and the monitoring subsystem. The photovoltaic array consists of 56 separate subarrays of 112 photovoltaic modules each, deployed in rows on the southerly facing slope north of the school building. The wiring scheme permits individual modules to be disconnected without a radical change in subarray output current. Power is transmitted at 4160 V from the inverters and a step up transformer to the main 4160 V utility feed line in the school. Separate metering measures power bought and sold. At the optimum tilt angle of 40 deg. the array provides 232 MWH of AC energy annually, or 17 percent of the school load. The immediate impact is an $8000 saving in the annual utility bill. Levelized busbar energy costs are reduced from $2/kWH to $1/kWH when site specific parameters are used in the analysis instead of the JPL specified nominal values. A fault detection and isolation scheme which can find a single modulus failure is incorporated into the monitoring subsystem. M.G.

N81-15476# Globe-Union, Inc., Milwaukee, Wis.
COMMERCIALIZATION OF A THICK FILM SOLAR CELL Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1980
G. D. McDonald 30 Jun. 1980 28 p ref
(Contract EG-77-C-01-4042)
(SERI/PR-8104-2-T1; QTPR-3) Avail: NTIS HC A03/MF A01

Samples of screen printed cadmium sulfide were supplied to the Institute of Energy Conversion of the University of Delaware for the application of copper sulfide via the evaporated cuprous chloride technique. Results of this activity are not available at this time. Problems were encountered in reproducing the previously obtained low resistivity cadmium sulfide films. The probable cause of this problem is in the atmosphere control for the furnace. The furnace was extensively modified. When completed the modifications will permit greater control over the atmosphere, flow rate, and composition. A trial solar cell was prepared. While its short circuit current and open circuit voltage are low, present procedures for applying the cuprous chloride appear adequate. An attempt was made to apply the cuprous sulfide layer via a screen printed, fired-on copper electrode. The resultant copper electrode lacked adhesion to the cadmium sulfide layer. Author

N81-15484# Total Energy Applications and Management, Inc., Tucson, Ariz.
SOLAR PRODUCTION OF INTERMEDIATE TEMPERATURE PROCESS HEAT. PHASE 1 DESIGN Final Report
1 Aug. 1980 280 p
(Contract DE-FC03-79CS-30311)
(DOE/CS-30311/T1) Avail: NTIS HC A13/MF A01

The system consists of 42,420 sq ft of parabolic trough, single axis tracking, concentrating solar collectors. The collectors are oriented in a North-South configuration and track East-West. A heat transfer fluid (Gulf Synfluid 4cs) is circulated in a closed loop fashion through the solar collectors and a series of heat exchangers. The inlet and outlet fluid temperatures for the collectors are 370 F and 450 F respectively. These temperatures are constantly maintained via a variable flow rate through the collectors (the flow rate varies in direct proportion to the level of insolation). Superheated steam is the final product of the solar energy system. Final steam quality at the steam generator is 420 F and 165 Psia. Author

N81-15485# Aerospace Corp., El Segundo, Calif. Energy and Resource Div.
INTEGRATION OF PHOTOVOLTAIC UNITS INTO ELECTRIC UTILITY GRIDS: EXPERIMENT INFORMATION REQUIREMENTS AND SELECTED ISSUES
Ted Davey, Richard Rountree, William Dickter, and Leon Bush Sep. 1980 56 p refs
(Contract DE-AT03-79ET-30351)
(ATR-80(7694-21)-1) Avail: NTIS HC A04/MF A01

A number of investigations have led to the recognition of technical, economic, and institutional issues relating to the interface between solar electric technologies and electric utility systems. These issues derive from three attributes of solar electric power concepts, including (1) the variability and unpredictability of the solar resources, (2) the dispersed nature of those resources which suggest the deployment of small dispersed power units, and (3) a high initial capital cost coupled with relatively low operating costs. It is imperative that these integration issues be pursued in parallel with the development of each technology if the nation's electric utility systems are to effectively utilize these technologies in the near to intermediate term. An identification of utility information requirements, a review of planned experiments, and a preliminary determination of additional experimental needs and opportunities are presented. E.D.K.

N81-15486# Varian Associates, Palo Alto, Calif.
MATERIALS FOR HIGH EFFICIENCY MONOLITHIC MULTIGAP CONCENTRATOR SOLAR CELLS Quarterly Report, 1 Apr. - 30 Jun. 1980
C.B. III Cooper 1980 21 p ref
(Contract DE-AC02-77CH-00178; SER XP-9-8081-1)
(SERI/PR-8081-1-T2; QR-5) Avail: NTIS HC A02/MF A01

The work performed is subdivided into five major tasks: develop and demonstrate the technology for a grading layer of GaInAs/GaAs and low-bandgap cells in AlGaInAs/GaInAs/GaAs; develop and demonstrate inter-cell tunnel junction contacts in the higher bandgap AlGaInAs alloys; develop and demonstrate technology for a higher bandgap concentrator cell in AlGaInAs alloys; demonstrate a complete two-gap monolithic concentrator cell with AM2 efficiency of 28% or more; and investigate the potential of AlInAsSB alloys grown on InAs substrates. Progress is reported. DOE

N81-15487# Midwest Research Inst., Golden, Colo.
SOLAR COLLECTOR SYSTEMS ANALYSIS USING INFRARED SCANNING TECHNIQUES
Anthony Eden Aug. 1980 21 p refs Presented at the Conf. of Thermal Infrared Sensing Appl. to Energy Conserv. in Building Envelopes (Thermo sense 3), Minneapolis, 2-5 Sep. 1980
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-351-54-Rev; CONF-800958-1-Rev) Avail: NTIS HC A02/MF A01

The results of this extensive study, covering many sites and types of collectors, illustrate the capabilities of IR analysis as an analysis tool and operation and maintenance procedure when applied to large arrays. Infrared analysis of most collector systems showed temperature distributions that indicated balanced flow patterns with both the thermographs and the hand held unit. In three significant cases, blocked or broken collector arrays, which previously had gone undetected, were discovered. Using this analysis, validation studies of large computer codes can examine collector arrays for flow patterns of blockages that could cause disagreement between actual and predicted performance. Initial operation and balancing of large systems can be accomplished without complicated sensor systems not needed for normal operations. Maintenance personnel can quickly check their systems without climbing onto the roof and without complicated sensor systems. DOE

N81-15488# Rockwell International Corp., Thousand Oaks, Calif.
ELECTROCHEMICAL PHOTOVOLTAIC CELLS STABILIZATION AND OPTIMIZATION OF II-VI SEMICONDUCTORS Technical Progress Report, 15 Apr. - 30 Jun. 1980
R. Noufi, Dennis Tench, and Les Warren 20 Jul. 1980 23 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-9276-T1; ERC41066.7TPR; TPR-1) Avail: NTIS HC A02/MF A01

The basis for designing a practical electrochemical solar cell based on the II-VI compound semiconductors is explored. Emphasis is on developing new electrolyte redox systems and electrode surface modifications which will stabilize the II-VI compounds against photodissolution without seriously degrading the long term solar response. The bulk electrode material properties are also optimized to provide the maximum solar conversion efficiency and greatest inherent electrode stability. The principal limiting factor is apparently specific adsorption of hexacyanoferrate species on the electrode surface which occurs at higher redox couple concentrations and slows the overall charge transfer process. Ion pairing also occurs, resulting in a low mass transport rate (smaller diffusion coefficients and increased solution viscosity), and enhances the degree of specific adsorption. DOE

N81-15490# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Labs.
THIN FILM POLYCRYSTALLINE SILICON SOLAR CELLS
A. K. Ghosh, T. Feng, D. J. Eustace, and H. P. Maruska 1980 33 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-9077-1-T1) Avail: NTIS HC A03/MF A01

Efficiency of heterostructure solar cells was increased from 13 to 13.7 percent for single crystal and from 10.3 to 11.2 percent for polysilicon. For polysilicon the improvements can be attributed to reductions in grid area coverage and in reflection losses and for single crystal to a combination of reduction in grid area coverage and increase in fill factor. The heterostructure cells in both cases were ITO/n Si solar cells. Degradation in SnO2/n Si solar cells can be greatly reduced to negligible proportions by proper encapsulation. The cells used in stability tests have an average initial efficiency of 11 percent which reduces to a value of about 10.5 percent after 6 months of exposure to sunlight and ambient conditions. This small degradation occurs within the first month, and the efficiency remains constant subsequently. The effects of grain size on the Hall measurements in polysilicon were analyzed and interpreted, with some modifications, using a model proposed by Bube. T.M.

N81-15494# Boeing Aerospace Co., Seattle, Wash.
CADMIUM SULFIDE/COPPER SELENIDE CELL RESEARCH, COPPER SELENIDE-BASED THIN FILM SOLAR CELLS Quarterly Technical Progress Report, 1 Jun. - 1 Sep. 1980
S. P. Sauve, Reid A. Mickelsen, John M. Stewart, and Wes S. Chen 1980 20 p refs
(SERI/PR-9216-1-T1; QTPR-1) Avail: NTIS HC A02/MF A01

The use of Cu2-xSe to produce low cost, high efficiency photovoltaic solar cells is investigated. The goal is to: (1) develop a polycrystalline thin film photovoltaic device capable of 10 percent conversion efficiency; (2) demonstrate feasibility of large scale production at a cost of approximately $0.30/watt. The Cu2-xSe films are produced by coevaporation of Cu and Se from separate, individually controlled vapor sources onto heated glass substrates. The quartz crystal microbalances are used to separately monitor the Cu and Se deposition rates. Cadmium sulfide-copper selenide must be deposited on low temperature substrates or significant deterioration of cell performance occurs. This is most likely due to diffusion of Cu into the CdS film. In addition, texturing of the CdS film by etching in HCL is an important step. S.F.

N81-15499# Sandia Labs., Albuquerque, N. Mex. Experimental Systems Operations Div.
MIDTEMPERATURE SOLAR SYSTEM TEST FACILITY PROGRAM
John Otts Aug. 1980 71 p refs
(SAND-80-1681) Avail: NTIS HC A04/MF A01

Approximately thirty programs are presented. The objectives of each program are described, the current status is noted, and future plans are outlined. Test data/results are not included, but references and test engineers names are listed for each project. T.M.

N81-15501# Combustion Engineering, Inc., Windsor, Conn. Power Systems Group.
CONCEPTUAL DESIGN OF AN ADVANCED WATER/STEAM CENTRAL SOLAR RECEIVER, VOLUME 1 Final Report
F. T. Matthews, H. M. Payne, B. O. Jones, T. K. Snyder, and M. J. Davidson Jun. 1980 408 p refs Sponsored by DOE Prepared for Sandia Labs., Livermore, Calif.
(SAND-79-8176) Avail: NTIS HC A18/MF A01

A drum type boiler with forced circulation evaporator using rifled tubing can be designed for the high heat flux of a North field collector without the problems associated with departure of nuclear boiling. Existing boiler technology and materials can be used to design an advanced water/steam receiver. Rifled tubing was shown by test data to provide protection to evaporator panels at peak heat flux levels 30 percent greater than the design point of these receivers. Estimated budgetary type costs of these receivers vary from $10 per pound of steam for the large receiver to $13 per pound of steam for the smaller units. Fatigue life was conservatively calculated to be 30,000 full strain range cycles. This is adequate for the diurnal cycling, plus some cloud over a 30 year period. It is possible that the allowable creep fatigue cycles may be increased to 40,000 - 50,000 by an inelastic stress analysis. This analysis was recommended for future work and is required to resolve the cyclic lifetime of these receivers. Additional analysis is also needed to resolve receiver and plant control systems. E.D.K.

N81-15502# Mobil Tyco Solar Energy Corp., Waltham, Mass.
ION IMPLANTED AND LASER PROCESSED SOLAR CELLS MADE FROM EFG RIBBON
L. A. Ladd, K. V. Ravi, and J. Naragan 1980 9 p refs Prepared in cooperation with Oak Ridge National Lab., Tenn.
(Contract W-7405-eng-26)
(CONF-800544-2) Avail: NTIS HC A02/MF A01

Samples were phosphorus ion implanted, laser processed using either a pulse larger area ruby laser or a scanned YAG laser with a second harmonic generator, and then processed into solar cells. Many of the samples had high reverse leakage and it was determined that this was due to too high a laser processing power. This effect was determined to be more severe for the scanned YAG laser, and is thought to be due to point effects. Cells were made from EFG ribbon with a low laser energy density which had efficiencies of up to 10 percent at AMI demonstrating the feasibility of this approach. High efficiencies should be attainable by optimizing the laser processing parameters. T.M.

N81-15503# Hanford Engineering Development Lab., Richland, Wash.
ELECTRO-THERMAL INFRARED SCANNING METHOD FOR POLYCRYSTALLINE SOLAR CELLS
D. R. Green, L. C. Olsen, and D. L. Barton Jul. 1980 31 p
(Contracts DE-AC14-76ET-02170; EY-76-C-14-2170; EG-77-C-01-8146)
(HEDL-TC-1599) Avail: NTIS HC A03/MF A01

Single crystal Al/Si as well as polycrystalline Al/Si and Cu/Cu2O thin film Schottky barrier cells were included in this work. Laser scans in which cell short circuit output was mapped as a function of light spot position were performed for comparison with the electrothermal infrared results. Some basic mechanisms involved in the electrothermal results were proposed. Experimental results are presented and some of the proposed relationships between basic cell parameters and electrothermal scan results are discussed. Although the work was conducted mainly with Schottky diodes, the electrothermal method can also be applied to N-P and P-N photovoltaic cells. The results strongly suggest that infrared scanning of solar cells could be very useful for helping characterize basic photovoltaic mechanisms. In particular, prospects for applying this measurement appear very good in the case of polycrystalline solar cells. T.M.

N81-15506# Farallones Inst., Berkeley, Calif. Solar Group
THE FARALLONES INSTITUTE SOLAR DATA PACKAGE AND PERFORMANCE ANALYSIS
Peter Calthorpe 30 Jan. 1980 134 p
(Contract DE-AP02-79CS-30240; Grant EM-78-G-01-5229)
(DSE-5229-T1) Avail: NTIS HC A07/MF A01

Passive solar test units, small cabins of 285 sq ft each, were constructed to study, on a comparative basis, different generic forms of passive solar space heating systems. The cabins were built using the standard wood framing construction methods most commonly used in California in order to demonstrate the applicability of these systems to accepted building practice. The cabins have integrated solar systems which use the building itself, to a greater or lesser degree, as collector and storage container. The performance of these four cabins was analzyed and information about their individual subsystems as well as the full systems' comparative strengths and weaknesses is provided. Author

N81-15517# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.
INTEGRATION OF PHOTOVOLTAIC UNITS INTO ELECTRIC UTILITY GRIDS: EXPERIMENT INFORMATION REQUIREMENTS AND SELECTED ISSUES
Ted Davey, Richard Rountree, William Dickter, and Leon Bush Sep. 1980 190 p refs
(Contract DE-AT03-79ET-30351)
(ATR-80(7694-21)-1) Avail: NTIS HC A09/MF A01
These issues derive from three attributes of solar electric power concepts, including the variability and unpredictability of the solar resources, the dispersed nature of those resources which suggest the deployment of small dispersed power units, and a high initial capital cost coupled with relatively low operating costs. It is imperative that these integration issues be pursued in parallel with the development of each technology, if the nation's electric utility systems are to effectively utilize these technologies in the near intermediate term. The impacts of onsite photovoltaic units on load duration curves and optimal generation mixes were considered. The impacts of onsite photovoltaic units on utility production costs, with and without dedicated storage and with and without sellback, were analyzed. Current utility rate structure experiments, rationales, policies, practices, and plans were reviewed. T.M.

N81-15518# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION: LOUDOUN COUNTY SCHOOL, LEESBURG, VIRGINIA Seasonal Report, Jul. 1979 - Jun. 1980
David Missal Jun. 1980 84 p refs
(Contract DE-AC01-79CS-30027)
(SOLAR/2016-80/14) Avail: NTIS HC A05/MF A01
The solar energy system at the Loudoun County School was functioned very well throughout the year (July 1979 to June 1980). The actual system contribution was about the same as the design contribution. This is exceptional considering the actual load was 40 percent of the design load. Storage efficiency for the year, at 85 percent, was also very good. The collector control system operated as designed throughout the year. The solar system performance and lack of malfunctions shows a well thought out design and high quality of construction. E.D.K.

N81-15519# Monsanto Research Corp., Dayton, Ohio.
SUPERIOR HEAT TRANSFER FLUIDS FOR SOLAR HEATING AND COOLING APPLICATIONS Final Report, 21 Aug. 1978 - 31 Dec. 1979
Leo Parts, David R. Miller, James W. Leffingwell, and Quentin E. Thompson Sep. 1980 210 p refs
(Contracts DE-AC04-78CS-45356; EM-78-C-04-5356)
(ALO-45356-2; MRC-DA-953) Avail: NTIS HC A10/MF A01
The major objective of this program was the identification of superior, currently available organic heat transfer fluids for solar collector applications. Organic fluids used in the form of aqueous solutions were also to be identified. The required design and handling properties of the fluids were determined through a survey in which 115 designers and manufacturers of solar collectors and collection systems participated. A state of the art survey of commercially available organic heat transfer fluids provided information on fifty fluids. These were grouped into nine classes. This report contains information on limiting, design, and handling properties of these fluids. The limiting properties affix the use temperature ranges of the fluids. The design properties include the following thermo-physical data: densities, vapor pressures, viscosities, and coefficients of thermal expansion. The handling properties include: compatibility and incompatibility with construction materials, chemical sensitivity, ignitability, physiological effects, and biodegradability characteristics. Author

N81-15529# Institute of Gas Technology, Chicago, Ill.
ELECTROCHEMICAL PHOTOVOLTAIC CELLS Quarterly Technical Progress Report, 15 Apr. - 31 Jul. 1980
Peter G. P. Ang and Anthony F. Sammella Sep. 1980 18 p
(Contract EG-77-C-01-4042; Grant SERI XG-0-9175-1)
(SERI/PR-9175-1-T1) Avail: NTIS HC A02/MF A01
Liquid junction photoelectrochemical cells can be used either for the direct conversion of solar energy to electricity or to generate stored chemical species available for later electrochemical discharge. Experimental approaches are identified for electrochemical photovoltaic cells that not only show promise of high power conversion efficiencies but also have the potential to achieve long life and the capacity for energy storage. The work is organized as follows: (1) selection of high efficiency semiconductor photoelectrode electrolyte systems; (2) development of long life electrochemical photovoltaic cells; (3) all solid state electrochemical photovoltaic cell with in situ storage; and (4) demonstration of laboratory size photoelectrochemical cell with redox storage. This program is directed toward identifying a suitable match between the proposed semiconductor and the redox species present in aqueous, nonaqueous, and solid electrolytes for achieving the necessary performance and semiconductor stability requirements. Emphasis is on aqueous electrolyte based systems where fast kinetics are favored. E.D.K.

N81-15530# Harvard Univ., Cambridge, Mass. Dept. of Landscape Architecture.
IMPLICATIONS OF SOLAR ENERGY ALTERNATIVES FOR COMMUNITY DESIGN
A. Steinitz Jun. 1980 228 p refs
(Contract W-7405-eng-26)
(ORNL/Sub-7830-1) Avail: NTIS HC A11/MF A01
How a policy of solar-based energy independence will influence the design of a new community of approximately 4500 housing units and other uses was explored. Three large sites outside Tucson (a cooling problem), Atlanta (a humidity problem), and Boston (a heating problem) were selected. Each is typical of its region. A single program was assumed and designed for. Each site had two teams, one following a compact approach and one following a more dispersed approach. Each was free to choose the most approprite mix of (solar) technology and scale, and was free to integrate energy and community in the design as it saw fit. These choice and integration issues are key areas where our experience may be of interest to those involved in community design and solar energy. Author

N81-15532# Battelle Pacific Northwest Labs., Richland, Wash.
THE EVALUATION OF SOLAR MIRROR FIGURE BY MOIRE CONTOURING
J. W. Griffin and M. A. Lind Jun. 1980 85 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3286) Avail: NTIS HC A05/MF A01
The theoretical and experimental considerations necessary to fully implement moire topography on mirror surfaces are reported in detail. A procedure to de-specularize the mirror is demonstrated which conserves the surface morphology without damaging the reflective surface. The moire fringe patterns observed for the actual mirror facets are compared with theoretical contours generated for representative dish facets using a computer simulation algorithm. A method for evaluating the figure error of the real facet is presented in which the error parameter takes the form of an average absolute deviation of the surface slope from theoretical. Author

N81-15538# RCA Labs., Princeton, N. J. Energy Systems Lab.
THIN-FILM POLYCRYSTALLINE SILICON SOLAR CELLS Quarterly Technical Progress Report, 25 Sep. - 24 Dec. 1979
B. W. Faughnan, J. Blanc, W. Phillips, and D. Redfield Jan. 1980 39 p refs
(Contract EG-77-C-01-4042)
(SERI/PR-0-8276-1; PRRL-80-CR-5; QTPR-1) Avail: NTIS HC A03/MF A01
The laser scanner was improved in resolution and convenience of operation. Experiments include: deep level spectroscopy, where a sample is being fabricated with a grain boundary parallel to the surface; liquid crystal technique for measuring grain boundaries, by improving the electrical contacts to the sample; and electron channeling patterns, by examining grains which were previously laser scanned. Hydrogenation experiments on phospho-

rus diffused Wacker Silso solar cells yielded negative results even when grain boundary activity was monitored by the sensitive laser scanning method. Phosphorus diffusion down grain boundaries were observed by bevel and stain experiments on a variety of diffused and implanted junctions in the temperature range of 750 to 950 C. Diffusion spike lengths vary from 1/3 to 1 1/2 times the junction depth, and between 25 to 75 percent of the grain boundaries show these spikes. Laser scanning experiments show that grain boundaries with diffusion spikes are not electrically active. T.M.

N81-15539# RCA Labs., Princeton, N. J.
LOW-COST EPITAXIAL TECHNIQUES FOR SOLAR-CELL FABRICATION Quarterly Technical Progress Report, 25 Dec. 1979 - 24 Mar. 1980
R. V. DAiello and P. H. Robinson Apr. 1980 25 p refs
Sponsored by Solar Energy Research Inst.
(SERI/PR-0-8274-2; QTPR-2) Avail: NTIS HC A02/MF A01

The material characterization and epitaxial of solar cell structures on three grades of a candidate low cost upgraded metallurgical grade silicon substrate are discussed. Enough epitaxial solar cells to characterize the baseline performance of cells on these three substrate grades were fabricated and tested. With a 15 micrometer thick epitaxial structure grown on the purest form of UMG substrate, an average cell AM-1 efficiency of 12.5 percent was obtained. Similar structures grown on the less pure multicrystalline substrates grades result in efficiencies of 9 to 10.3 percent. A way of slicing these substrates which exposes larger grain areas and results in higher cell efficiencies is described. The application of slow cooling and gettering to the growth of thicker (greater than or equal to 50 micrometers) epitaxial solar cell structures was ineffective. The use of alternate silicon gas sources was explored by using silane for the growth of cell structures. Author

N81-15543# Pacific Northwest Lab., Richland, Wash.
PREDICTIONS OF CONVECTIVE LOSSES FROM A SOLAR CAVITY RECEIVER
L. L. Eyler Dec. 1979 24 p refs
(Contract EY-76-C-06-1830)
(PNL-SA-8070; CONF-800804-35) Avail: NTIS HC A02/MF A01

Convective losses arising from buoyancy driven flow were calculated for a two dimensional model simulating a solar cavity receiver. The TEMPEST code, capable of fully three dimensional coupled thermal-hydraulic transient calculations, was used for the simulation. Predicted velocity and temperature results for a 2.59 m deep by 2.88 m high rectangular cavity with an aperture opening of 1.72 m were used to determine convective losses for prescribed interior wall temperatures and cavity orientation. Velocity vector and temperature isotherm plots were used to analyze flow characteristics. Author

N81-15544# Pacific Northwest Lab., Richland, Wash.
ASSESSMENT OF SOLAR OPTIONS FOR SMALL POWER SYSTEMS APPLICATIONS. VOLUME 4: COMPARATIVE RANKING OF CONCEPTS
J. W. Currie and M. Jannol Jul. 1980 70 p refs
(Contract DE-AC06-76RL-01830)
(PNL-4000-Vol-4) Avail: NTIS HC A04/MF A01

Ranking methodology selection and refinement are described. A questionnaire was developed and its importance weights and preference functions were determined. The concept scores and rankings were analyzed for sensitivity and general accuracy. The principal solar thermal conversion concepts that were ranked were those that have the potential for achieving commercial success as small electric power systems in the 1 to 10 MWe range. T.M.

N81-15545# Pacific Northwest Lab., Richland, Wash.
ASSESSMENT OF SOLAR OPTIONS FOR SMALL POWER SYSTEMS APPLICATIONS. VOLUME 2: IDENTIFICATION AND CHARACTERIZATION OF CONCEPTS FOR ANALYSIS
W. W. Laity, D. T. Aase, W. J. Apley, S. P. Bird, M. K. Drost, and T. A. Williams Jun. 1980 300 p refs
(Contract DE-AC06-76RL-01830)
(PNL-4000-Vol-2) Avail: NTIS HC A13/MF A01

An independent, objective assessment is provided of the principal solar thermal conversion concepts that have the potential for achieving commercial success as small electric power systems in the 1 to 10 MWe range. Seven generic types of collectors, together with associated subsystems for electric power generation, were considered in this study. The collectors are classified into three categories: (1) two axis tracking (with compound curvature reflecting surfaces); (2) one axis tracking (with single curvature reflecting surfaces); and (3) nontracking (with low concentration reflecting surfaces). E.D.K.

N81-15550# Science Applications, Inc., McLean, Va.
COMPARISON OF SOLAR HEAT PUMP SYSTEMS TO CONVENTIONAL METHODS FOR RESIDENTIAL HEATING, COOLING, AND WATER HEATING. VOLUME 1: EXECUTIVE SUMMARY
P. J. Hughes and J. H. Morehouse Apr. 1980 35 p refs
Prepared for Midwest Research Inst., Golden, Colo. 3 Vol.
(Contracts EG-77-C-01-4042; DE-FC04-78CS-34261)
(SERI/TR-98150-2-Vol-1) Avail: NTIS HC A03/MF A01

Since the purpose of space conditioning equipment is to provide thermal comfort, models were formulated to force this requirement on all systems. The thermal performance maps (fraction of the load met with free energy versus collector area) presented include the effects of the comfort requirement and of parasitic energy consumption for blower and pump operation. Economic comparisons were made after sizing collectors and storage for the combined solar heat pump systems in a manner which was sensitive to climate as well as to the thermal and economic characteristics of each particular system. This, combined with life cycle cost analysis, allows collector cost goals to be established which, if met, will allow combined solar heat pump systems to compete with conventional alternatives. T.M.

N81-15552# Sri Venkateswara Univ., Tirupati (India). Engineering Sciences Lab.
LOW-COST PROCESS FOR P-N JUNCTIONS-TYPE SOLAR CELL Quarterly Technical Progress Report, 1 Mar. - 30 May 1980
John B. Mooney, Robert H. Lamoreaux, and Clayton W. Bates (Stanford Univ.) Jun. 1980 38 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contract EG-77-C-01-4042; SRI Proj. 8833)
(SERI/PR-8104-4-T1; QTPR-3) Avail: NTIS HC A03/MF A01

Films of CuInSe2 were deposited by spray pyrolysis. The preparation of single-phase stoichiometric films is less probable than the analogous CuInS2, owing to the relative ease of dissociation of H2Se. Examination of films by optical absorption verifies these predictions. A heterojunction of glass/SnO2(Sb)/n-CdS/p-CdS/p-CuInSe2Au configuration exhibited photovoltaic effect with low efficiency but without the cracking that resulted with the CuInS2 devices. Two sintered n-CdS/p-CdTe devices exhibited photovoltaic effect with low efficiency. The resistivity of the CdS films was reduced. S.F.

N81-15555# Spire Corp., Bedford, Mass.
AMORPHOUS SILICON SOLAR CELLS BY HYDROGEN IMPLANTATION Final Report, 1 Jan. 1979 - 31 Aug. 1980
A. R. Kirkpatrick and A. A. Melas Aug. 1980 49 p Sponsored by DOE
(SAN-3042-4; FR-10084) Avail: NTIS HC A03/MF A01

Possible approaches to utilizing implantation in the preparation of materials adequate for amorphous silicon solar cells were investigated. Concurrent investigations to develop an approach to employing implantation effectively in the total fabrication of amorphous silicon solar cells were performed. Some amorphous silicon cell devices were fabricated but detailed knowledge of the material and structural characteristics needed in a practical cell remain to be adequately identified. L.F.M.

N81-15556# Midwest Research Inst., Golden, Colo.
DETERMINING THE OPTICAL QUALITY OF FOCUSING COLLECTORS WITHOUT LASER RAY TRACING

P. Bendt, H. W. Gaul, and A. Rabl Feb. 1980 23 p refs
(Contract EG-77-C-01-4042)
(SERI/TR-333-359) Avail: NTIS HC A02/MF A01

An alternative to the laser ray trace technique for evaluating the optical quality of focusing solar collectors is described. The method does not require any equipment beyond that which is used for measuring collector efficiency; it could therefore become part of routine collector testing. The total optical errors resulting from imperfect specularity and from inaccuracies in reflector position or slope are characterized by an angular standard deviation sigma (optical), the rms deviation of the reflected rays from the design direction. The method is based on the fact that the off-axis performance of a concentrator depends on sigma (optical). An angular scan is performed; i.e., the collector output is measured as a function of misalignment angle over the entire range of angles for which there is measurable output. This test should be carried out on a very clear day, with the receiver close to ambient temperature. The parameter sigma (optical) is then determined by a least squares fit between the measured and the calculated angular scan. E.D.K.

N81-15557# Solar Turbines International, San Diego, Calif. Research Lab.
ADVANCED SOLAR RECEIVERS HIGH TEMPERATURE STEAM LOOP EXPERIMENTS Final Report
A. H. Campbell and H. L. Teague (Georgia Inst. of Technol., Atlanta) Jul. 1980 135 p refs
(Contract EG-77-C-01-4042)
(SERI/TR-98323-1) Avail: NTIS HC A07/MF A01

A high temperature steam loop experiment was built to examine the critical design problems associated with a solar cavity receiver/steam generator combination with central receiver application. The test loop consists of a once through monotube steam generator mounted in a downward facing cavity receiver with external circulation and condensing systems. The thermal input to the receiver with external circulation and condensing systems. The thermal input to the receiver is approximately 15 kilowatts which reduces the size of the hardware to a point where fabrication costs are not excessive yet where the test data obtained are totally meaningful and relevant to the design of much larger systems. A once-through steam generator design was chosen for this type of advanced system and holds promise for solar thermal energy conversion purposes because of its relative system simplicity, low cost potential, light weight, and inherent safety. Test results confirm that the generation of high temperature/high pressure steam in the regions of 1500 psia and 1500 F is feasible and the lower heat rates and subsequent smaller heliostat fields tend to make these high operating conditions more attractive from an economic standpoint. Author

N81-15561# Johnson Controls, Inc., Milwaukee, Wis.
COMMERCIALIZATION OF THICK FILM SOLAR CELL Final Technical Report
1980 67 p refs Prepared for Midwest Research Inst.
(SERI/TR-8104-2-T2) Avail: NTIS HC A04/MF A01

Films of cadmium sulfide and cadmium telluride were produced by screen printing and sintering. Cadmium sulfide films ten microns thick had a resistivity in the 10 ohm cm range. A technique was developed for forming a cadmium telluride layer on top of a cadmium sulfide layer. Process control and device preparation are areas requiring further study. T.M.

N81-15562# Midwest Research Inst., Golden, Colo.
SOLAR PONDS FOR DISTRICT HEATING AND ELECTRICITY GENERATION
Cecile Leboeuf, John Kowalik, Michael Edesess, and T. S. Jayadev Jul. 1980 7 p refs Presented at the AIAA Intersoc. Energy Conversion Eng. Conf., Seattle, 18-22 Aug. 1980
(Contract EG-77-C-01-4042)
(SERI/TP-733-759; CONF-800806-31) Avail: NTIS HC A02/MF A01

This paper considers system requirements, performance, and costs for the application of solar ponds to district heating and to electricity generation. It focuses on the optimal sizing and configuration of the solar ponds themselves, but other system features are also investigated and discussed. Performance and costs range widely, depending upon location and component costs, particularly upon salt costs for the salt gradient pond. Distribution cost for district heating is also an important parameter that can vary widely. Both salt gradient and saltless ponds are considered. Author

N81-15563# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
COMPARATIVE RANKING OF 0.1-10 MW SUB E SOLAR THERMAL ELECTRIC POWER SYSTEMS. VOLUME 2: SUPPORTING DATA Final Report
John P. Thornton, Kenneth C. Brown, Joseph G. Finegold, James B. Greshem, F. Ann Herlewich, and Thomas A. Kriz Jul. 1980 174 p refs
(Contract EG-77-C-01-4042)
(SERI/TR-351-461-Vol-2) Avail: NTIS HC A08/MF A01

The technical, economic, and institutional feasibility of providing remote load centers, small communities, rural areas, and industrial users with supplementary energy sources was examined. Ten systems that have an available backup power source such as a grid of diesel generator were modeled for industrial or small community use. Data on performance, cost, and ranking methodology is presented. T.M.

N81-15566# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
LINE-FOCUS SUN TRACKERS
Randy Gee May 1980 6 p refs Presented at the AS/ISES 1980 Ann. Meeting, Phoenix, 2-6 Jun. 1980
(Contract EG-77-C-01-4042)
(SERI/TP-632-645; CONF-800604-31) Avail: NTIS HC A02/MF A01

Sun trackers have been a troublesome component for line focus concentrating collector systems. The problems have included poor accuracy, component failures, false locks on clouds, and restricted tracker operating ranges. In response to these tracking difficulties, a variety of improved sun trackers was developed. A testing program is underway at SERI to determine the tracking accuracy of this new generation of sun trackers. This paper defines the three major types of trackers, describes some recent sun tracker developments, and outlines the testing that is underway. Author

N81-15570# International Institute for Applied Systems Analysis, Laxenburg (Austria). Programm Energiesysteme.
SYSTEM STUDY ON THE POSSIBILITIES OF INTENSIFIED USE OF SOLAR ENERGY IN THE FEDERAL REPUBLIC OF GERMANY (FRG) Final Report
Charles R. Bell, Fredy Jaeger, and Wolfgang Korzen Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 156 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-100; ISSN-0340-7608) Avail: NTIS HC A08/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 32.80

The state of the art of solar energy conversion technologies is analyzed in terms of technology assessment to identify possibilities of intensified use of solar options. It is deemed essential to identify and evaluate the criteria for large-scale application of solar technology, in particular the probable time phase in which it might be competitive and/or necessary to minimize the impact of the anticipated shortages of conventional energy sources. Four options for solar energy conversion were selected as being of specific interest: (1) low temperature system for space and water heating; (2) medium temperature systems for process heat; (3) high-temperature solar-thermal system; and (4) photovoltaic systems for electricity production. Energy storage alternatives were evaluated in connection with each of the concepts, to formulate economic viability of their future use. Performance and cost assessments of the contemporary developments were made to provide basis for projections, scenarios and market penetration criteria. Capital and energy payback estimates were made to develop visibility of the long-term potential of solar options. Low temperature systems offer the earliest potential, if further improvements and cost reduction are achieved. J.M.S.

N81-15574# National Bureau of Standards, Washington, D.C. National Engineering Lab.
DIMENSIONAL CONSIDERATIONS IN SOLAR INSTALLATIONS Final Report
Hans J. Milton Sep. 1980 155 p Sponsored by DOE
(PB81-106312; NBSIR-80-2116) Avail: NTIS HC A08/MF A01 CSCL 10A

The interim report contains a study of dimensional considerations in solar installations using nonintegrated flat plate collectors. Special attention is given to sizes of collectors and their constituent materials, to dimensions that effect the collector array, and to sizes for thermal storage tanks. GRA

N81-15575# National Bureau of Standards, Washington, D.C. National Engineering Lab.
TESTING FLAT-PLATE WATER HEATING SOLAR COLLECTORS IN ACCORDANCE WITH THE BSE AND ASHRAE PROCEDURES Final Report
John P. Jenkins and James E. Hill Aug. 1980 82 p refs
Sponsored in part by DOE
(PB81-104770; NBSIR-80-2087) Avail: NTIS HC A05/MF A01 CSCL 10A

All five collectors tested were modular, flat plate, and water heating and included single and double glazed designs with and without selectively coated absorbers. In both procedures, collector efficiency curves were determined. T.M.

N81-15644# Department of Energy, Washington, D. C.
VALIDATION OF THE GUIDELINES FOR PORTABLE METEOROLOGICAL INSTRUMENTATION PACKAGE. REPORT TASK 4: DEVELOPMENT OF AN ISOLATION HANDBOOK AND INSTRUMENTATION PACKAGE Interim Report
Oct. 1980 126 p refs
(DOE/ER-0083) Avail: NTIS HC A07/MF A01

Guidelines for a solar energy related portable meteorological instrument package were developed and carried out and preliminarily demonstrated and validated. An international comparison of resultant devices was conducted. The Swiss Mobile Solar Radiation System, using German meteorological standards, is discussed. S.F.

N81-15865 Arizona Univ., Tucson.
THE HIGH TEMPERATURE BEHAVIOR OF THIN METAL FILMS Ph.D. Thesis
Richard Raymond Zito 1980 237 p
Avail: Univ. Microfilms Order No. 8100300

The reliable merits of thin films materials useful in solar energy technology was evaluated. In particular, the surface morphological changes of Al, Cu, Ag, Au, Cr, Ni, Mo, Pt, Rh, and W thin films were examined as a function of temperature for 1 hr anneals. Tests were run in both air and under laboratory vacuum conditions with substrates of uniform composition and cleanliness. In one case the effect of annealing specimens in He and H2 was evaluated. Morphological changes under investigation included pinhole formation, agglomeration, cracking, peeling, oxidation, recrystallization, and the interdiffusion of atoms across surfaces in multilayer selective surfaces. Mathematical tools were developed to enable the prediction of temperatures at which film failure occurs. These predictions agree well with experiment. The relationship between the various film defects and their evolution from film deposition point defects to complete breakup (agglomeration) at high temperatures has been uncovered. In most cases, materials of exceptional purity were used.
Dissert. Abstr.

03
HYDROGEN

Includes hydrogen production, storage, and distribution.

A81-11751 **Hydrogen - Its technology and implications. Volume 4 - Utilization of hydrogen.** Edited by K. E. Cox and K. D. Williamson, Jr. (California, University, Los Alamos, N. Mex.). Boca Raton, Fla., CRC Press, Inc., 1979. 252 p. $59.95.

This compilation focused on hydrogen fueled surface transportation, hydrogen-fueled aircraft, domestic uses of hydrogen, industrial applications, and safety in the handling of H. The volume includes numerous references on H properties, materials of construction for its containment, and the design of H equipment; physical properties of H and its compounds are tabulated. A.T.

A81-11752 **Hydrogen-fueled surface transportation.** W. D. van Vorst (California, University, Los Angeles, Calif.) and R. L. Woolley (Billings Energy Corp.; Brigham Young University, Provo, Utah). In: Hydrogen: Its technology and implications. Volume 4. Boca Raton, Fla., CRC Press, Inc., 1979, p. 3-76. 65 refs.

A review of hydrogen fueled surface transportation is presented. H offers emissions free of unburned hydrocarbons, CO, CO2, sulfur oxides, and reduced amounts of nitrogen oxides when it is combusted with air. The history of the H engine is given along with the description of engine cycles including the air standard Otto cycle, Diesel cycle, and a comparison of fuel properties. The requirements of hydrogen engines such as preignition and flashback and their NO(x) emissions are discussed; hydrogen storage, heat exchange with hydrides, and the refueling of a hydrogen vehicle are described. Finally, prototype hydrogen vehicles using liquid H, fuel cells, and metal hydrides are presented. A.T.

A81-11753 **Hydrogen-fueled aircraft.** G. D. Brewer (Lockheed-California Co., Burbank, Calif.). In: Hydrogen: Its technology and implications. Volume 4. Boca Raton, Fla., CRC Press, Inc., 1979, p. 79-148. 27 refs.

A review is presented of applications of hydrogen in aircraft and aerospace. The costs of LH2 as fuel in commercial transport aircraft are outweighed by the low energy requirements of LH2 powered vehicles in performing long range missions; a H powered SST can save more than 25% of fuel at speeds of Mach 2.7. The NASA flight research program and the CL-400 aircraft project are described along with turbojet engine development and hypersonic aircraft studies. Transport aircraft designs including supersonic transport fuels system, engine characteristics, environmental factors, and aircraft performance are discussed. A.T.

A81-11754 **Domestic uses of hydrogen.** J. Pangborn and M. I. Scott (Institute of Gas Technology, Chicago, Ill.). In: Hydrogen: Its technology and implications. Volume 4. Boca Raton, Fla., CRC Press, Inc., 1979, p. 151-188. 27 refs.

A review is presented of domestic hydrogen uses utilizing the existing natural gas distribution system, the compatibility of H in the system, conversion of appliances to H use, and the development of catalytic devices. H compatibility in distribution is discussed in terms of volumetric laminar and turbulent flow, odorants and illuminants, and metallurgical effects. Residential use patterns including space and water heating, cooking, and clothes drying are analyzed; the applications in domestic appliances such as atmospheric burners and emissions, ignition, and construction materials are considered. A.T.

A81-11755 **Industrial applications of hydrogen.** D. Cooperberg (Lummus Co., Process Planning Dept., Bloomfield, N.J.). In: Hydrogen: Its technology and implications. Volume 4. Boca Raton, Fla., CRC Press, Inc., 1979, p. 191-200.

Industrial applications of hydrogen in the production of ammonia, petroleum refining, petrochemicals, and methanol are reviewed. The NH3 production from H and N, and petroleum processes including hydrotreating, hydrocracking and hydrodealkylation are discussed. The future uses will include direct reduction of metal ores, coal conversion and gasification for synthetic natural gas production, and liquefaction of coal; the role of H in oil shale liquefaction, tar sands upgrading, cryogenic applications, and manufacture of ethylene glycol are considered. A.T.

A81-11756 **Safety.** F. J. Edeskuty (California, University, Los Alamos, N. Mex.). In: Hydrogen: Its technology and implications. Volume 4. Boca Raton, Fla., CRC Press, Inc., 1979, p. 203-219. 27 refs. ERDA-sponsored research.

A review is presented of safety considerations in hydrogen operation, design of equipment, operator training, and codes and regulations. Properties of hydrogen including its flammability, detonation range, flame emissivity, and heat of vaporization are discussed; hazards of combustion within closed spaces and the weakening of structural equipment by H embrittlement are described. Avoidance of hazards by purging air prior to operation, ventilation of the surrounding areas, and avoidance of leakage are illustrated; regulatory codes must consider the thermal contraction of materials of construction which contain LH and the maximum flow rates for safe operation. A.T.

A81-11757 **Economics of hydrogen.** J. Hord (National Bureau of Standards, Institute for Basic Standards, Boulder, Colo.) and W. R. Parrish. In: Hydrogen: Its technology and implications. Volume 5 - Implications of hydrogen energy. Boca Raton, Fla., CRC Press, Inc., 1979, p. 3-48. 68 refs.

Economics of hydrogen utilization are examined on the basis of return on investment, discounted cash flow rate of return, and the utility financing method. Costs of H production, compressing, liquefying, and solidifying are analyzed along with the transmission charges of gas pipelines, highway and barge transportation, liquid conveying, and moving of metal hydrides by highway and railway. The underground, aboveground, and liquid H storage are considered; examples are given of H-system cost analysis including solar-hydrogen systems and airport H2-fuel supply equipment. A.T.

A81-13275 **Hydrogen and oxygen from water. IV - Control of an effusional separator during a solar intensity transient.** R. B. Diver and E. A. Fletcher (Minnesota, University, Minneapolis, Minn.). *Energy* (UK), vol. 5, Dec. 1980, p. 1261-1263. 7 refs. Contract No. DE-AC02-79ER-10450.

An example performance map of an archetypal reactor for producing hydrogen and oxygen from water in a one-step thermochemical process is presented. It is shown that readjustment of the device in response to a change in incident solar intensity may be achieved without changing the reactor temperature, Knudsen number, or feed rate, by simply changing the downstream pressure, with very little effect on the thermal efficiency. (Author)

A81-14075 # **On the utilization of hydrogen as a fuel for gas turbine. I - On the utilization of low temperature exergy of liquid hydrogen.** Y. Tsujikawa and T. Sawada (Osaka Prefecture, University, Sakai, Japan). *JSME, Bulletin,* vol. 23, Sept. 1980, p. 1506-1513. 5 refs.

In order to utilize the low temperature exergy of the liquid hydrogen, the characteristic of a gas turbine cycle employing a precooler and an auxiliary hydrogen turbine is discussed. The thermal efficiency and specific output of this cycle are superior to those of the simple cycle gas turbine which has the same components' efficiencies. The low temperature exergy is converted to work by decreasing the compressor input and hydrogen turbine output added. The merit of improvements in specific output of this cycle is about 20 percent of that of the simple cycle. The pressure loss coefficient of the precooler is very critical to the merit of improvements of the thermal efficiency. The critical value is about 5 percent. The thermal efficiency and the specific output are increased with an increasing ambient temperature, thus the performance degradation of the simple cycle gas turbine at high ambient temperature can be improved by introducing a precooling system. (Author)

A81-14448 **Photocatalytic production of hydrogen from water and Texas lignite by use of a platinized titania catalyst.** S. Sato and J. M. White (Texas, University, Austin, Tex.). *I & EC - Industrial and Engineering Chemistry, Product Research and Development,* vol. 19, Dec. 1980, p. 542-544. 13 refs. Navy-supported research.

By using a physical mixture of powdered Texas lignite and platinized titania in the presence of water vapor and ultraviolet light, it is shown that a catalytic reaction occurs at 23 C to form hydrogen and carbon dioxide. These results are contrasted with a recent electrochemical conversion process. (Author)

A81-15030 **Laser-induced photoelectrochemistry - Time-resolved coulostatic-flash studies of photooxidation at n-TiO_2 electrodes.** S. P. Perone, J. Rosenthal, J. N. Ziemer (Purdue University, West Lafayette, Ind.), J. H. Richardson, and S. B. Deutscher (California, University, Livermore, Calif.). *(Electrochemical Society, Meeting, Los Angeles, Calif., Oct. 14-19, 1979.) Electrochemical Society, Journal,* vol. 127, Dec. 1980, p. 2580-2588. 35 refs. Contracts No. W-7405-eng-48; No. EG-77-5-02-4263.

Time-resolved measurements of photopotential transients were made in the submicrosecond time domain using coulostatic-flash irradiation of semiconductor/liquid-junction cells with a pulsed laser source. In 1.0M electrolyte, 12 nsec rise times were measured with n-TiO_2 electrodes; the dependences of transient photopotentials on the initial potential, pulsed laser intensity, and type of electrolyte were investigated. Possible contributions to the transient behavior include electron-hole recombination, photoinduced charge transfer at the solution interface, and a transient expansion of the space-charge layer due to rapid photoinduced charge injection. A.T.

A81-15103 # **Storage of solar energy as hydrogen.** M. V. C. Sastri (Indian Institute of Technology, Madras, India). *Regional Journal of Energy, Heat and Mass Transfer,* vol. 1, July 1979, p. 201-222. 35 refs.

Solar energy, when used in conjunction with water to produce hydrogen, forms an inexhaustible source of transportable primary energy. Hydrogen is, thus, a potential means of storing solar energy. The spectral characteristics of solar radiation and the energetics and different techniques of water-decomposition employing solar energy are discussed. These include: electrolysis, thermal and thermochemical decomposition, photochemical, photoelectrochemical and some novel hybrid techniques. (Author)

A81-15109 # **Photoproduction of hydrogen - A potential system of solar energy bioconversion.** V. S. R. Das (Hyderabad, University, Hyderabad, India). *Regional Journal of Energy, Heat and Mass Transfer,* vol. 1, Oct.-Nov. 1979, p. 291-301. 51 refs.

The photoproduction of hydrogen from water utilizing the photosynthetic capacity of green plants is discussed as a possible means of solar energy conversion. Advantages of the biological production of H_2 over various physical and chemical processes are pointed out, and the system used for the production of hydrogen by biological agents, which comprises the photosynthetic electron transport chain, ferredoxin and hydrogenase, is examined in detail. The various types of biological hydrogen production systems in bacteria, algae, symbiotic systems and isolated chloroplast-ferredoxin-hydrogenase systems are reviewed. The limitations and the scope for further improvement of the promising symbiotic Azolli-Anabena azollae and chloroplast-ferredoxin-hydrogenase are discussed, and it is concluded that future research should concern itself with the identification of the environmental conditions that would maximize solar energy conversion efficiency, the elimination of the oxygen inhibition of biological hydrogen production, and the definition of the metabolic state for the maximal production of hydrogen. A.L.W.

A81-16116 # **The application of semiconductors in the production of hydrogen from water using solar energy (Utilizarea semiconductorilor in producerea de hidrogen din apa folosind energia solara).** R. M. Candea (Institutul de Tehnologie Izotopica si Moleculara, Cluj, Rumania). *Studii si Cercetari de Fizica,* vol. 32, no. 9, 1980, p. 1003-1022. 58 refs. In Rumanian.

The solar-hydrogen energy conversion technique is reviewed: solar optical energy is converted into the chemical energy of H_2 and O_2 molecules using photoactive semiconductor electrodes in a photoelectrochemical cell. Attention is given to the basic principles, current problems, and advantages relating to the use of photoelectrochemical cells as energy conversion devices. The present state of research is briefly reviewed. B.J.

A81-17543 **Hydrogen power: An introduction to hydrogen energy and its applications.** L. O. Williams (Aerospace Corp., Germantown, Md.). Oxford, Pergamon Press, 1980. 168 p. 130 refs. $10.00.

Current technology for the production, application and handling of hydrogen is discussed in relation to its potential as a medium for the storage, transport and utilization of energy. The chemical and physical properties of hydrogen are examined, and current uses of hydrogen in the petrochemical, fertilizer, edible oil, plastics, metallurgical and rocket propellant industries as well as in scientific instruments and balloons are surveyed. Methods of hydrogen production in the laboratory, and from hydrocarbons, coal, and water by electrolysis, thermal and solar processes are then treated, and hydrogen transport and storage are discussed. Finally, the potential of hydrogen as an energy carrier and as a transportation fuel is assessed, and the safety and environmental aspects of hydrogen use are considered. A.L.W.

A81-17841 # **An experimental study on kerosene-hydrogen hybrid combustion in a gas turbine combustor.** H. Hiroyasu, M. Arai, T. Kadota (Hiroshima, University, Hiroshima, Japan), and J. Yoso (Japanese National Railways, Tokyo, Japan). *JSME, Bulletin,* vol. 23, Oct. 1980, p. 1655-1662. 7 refs.

Kerosene-hydrogen hybrid combustion was studied in a swirler type combustor. Kerosene was atomized by an air blast atomizer, and gaseous hydrogen was supplied to a kerosene spray through an annular slit in the atomizer. Blow out limit of the flame shifts to the lean side of the air-fuel mixture in the hybrid combustion, which results in a slight decrease in NOx emission and a decrease in soot emission. When the hybrid ratio is under 10%, the flame stability is improved by hybrid combustion; increasing the hybrid ratio from 10 to 50% produces an increased combustion efficiency and reductions of soot and NOx. (Author)

A81-18567 **Calculation of the energy change involved in chemical reactions occurring irreversibly.** A. J. Appleby (Energy Power Research Institute, Palo Alto, Calif.) and J. O. Bockris (Texas A & M University, College Station, Tex.). *International Journal of Hydrogen Energy,* vol. 6, no. 1, 1981, p. 1-7. 7 refs.

A81-18568 **Hydrogen recovery and purification using the solid polymer electrolyte electrolysis cell.** J. M. Sedlak, J. F. Austin, and A. B. LaConti (General Electric Co., Wilmington, Mass.). *International Journal of Hydrogen Energy,* vol. 6, no. 1, 1981, p. 45-51. 6 refs.

A81-18569 **The market potential for electrolytic hydrogen.** E. Fein (Futures Group, Glastonbury, Conn.). *International Journal of Hydrogen Energy,* vol. 6, no. 1, 1981, p. 53-65. 5 refs. Research supported by the Electric Power Research Institute.

By the year 2000, the potential market for advanced technology electrolytic hydrogen among specialty users is projected to be about half of what the merchant hydrogen market would be in the absence of electrolytic hydrogen. This potential market, representing an annual demand of about 16 billion SCF of hydrogen (approx. 200 MW of installed electrolyzer capacity), will develop from market penetrations of electrolyzers assumed to begin in the early 1980s. (Author)

A81-18570 Availability of large quantities of low-deuterium hydrogen, and possible uses. S. K. Fellows, H. P. Rothbaum, M. K. Stewart, and J. P. Widdowson (Department of Scientific and Industrial Research, Lower Hutt, New Zealand). *International Journal of Hydrogen Energy*, vol. 6, no. 1, 1981, p. 67-71. 10 refs.

Hydrogen produced electrolytically is isotopically light (depleted in deuterium) relative to the water in the electrolysis cell. Samples of the hydrogen by-product from two caustic soda/chlorine plants in New Zealand have been collected; one plant uses diaphragm cells and the other mercury cells. The hydrogen from one plant has been burnt to produce light water. These samples, commercial compressed hydrogen and Antarctic snow-melt (previously recommended as a source of light water) are approx. 80, 50 and 35%, respectively, depleted in deuterium, relative to standard mean ocean water. The water produced by burning hydrogen from the caustic/chlorine plants, could be available in tonnage quantities anywhere in the industrialized world. Work with this water has failed to confirm previous claims of accelerated germination of seeds and subsequent growth of plants, when using light water. (Author)

A81-18795 The photoelectrochemical response of the lanthanides of chromium, rhodium, vanadium and gold on a titanium base. V. Guruswamy, P. Keillor, G. L. Campbell, and J. O. Bockris (Texas A & M University, College Station, Tex.). *Solar Energy Materials*, vol. 4, Dec. 1980, p. 11-30. 19 refs. Research supported by the Texas A & M University.

A number of active photo-anodes, involving lanthanum-containing compounds with chromium oxides and similar perovskitic transition metal oxides - namely, compounds involving gold, nickel, rhodium and vanadium - on a titanium base, have been studied. The electrodes were made by heating a paste of lanthanum oxide, La2O3, with the individual oxides of Cr2O3, Au2O3, Rh2O3, V2O3, on a titanium base. The anodic photocurrents observed were found to be 2-6 times higher than those obtained with a TiO2 single crystal for the same intensity of the solar spectrum. The LaCrO3-TiO2 electrode, coupled with GaP, was found to have an efficiency (overall solar spectrum) of about 2% for hydrogen evolution. This is one order of magnitude better than for the previously examined photo-fuel cell, TiO2-GaP, and somewhat better than that for the average of the efficiencies of the values observed in natural photosynthesis. The absolute efficiency for the biased cells of LaCrO3, LaAuO3, LaRhO3 and LaVaO3 varies between 5-8% for the solar spectrum, as compared with about 1.5% for TiO2. (Author)

N81-10502# Joint Publications Research Service, Arlington, Va.
USE OF HYDROGEN TO STORE, TRANSMIT POWER c44
Paolo Boccanera, Andrea Moriconi, and Antonio Naviglio *In its* West Europe Rept.: Sci. and Technol., No. 14 (JPRS-75070) 5 Feb. 1980 p 35-51 refs Transl. into ENGLISH from Fonti di Energia Alternative (Rome), no. 2, Mar. - Apr. 1979 p 14-21

Avail: NTIS HC A04/MF A01

A mode of using hydrogen specifically as an energy storage component is discussed. A system is described in which electrical energy taken from the power distribution network during low-demand periods is used to produce H2 by electrolysis. The hydrogen energy potential produced is stored by absorption of the gas in iron-titanium hydrid beds, from which it is recovered (during energy peak demand periods) in the form of electrical energy through hydrogen-fueled fuel cells, that is, electric cells that use as a fuel the hydrogen previously absorbed by the FeTi hydride and subsequently dissociated from it through simple heating. The thermal energy developed during the formation of the metallic hydride and that which must be supplied to release hydrogen are respectively removed and transferred by a thermal-carrier liquid circulating in pipes inside the vessels containing the hydride. A.R.H.

N81-12275# Los Alamos Scientific Lab., N. Mex.
THERMOCHEMICAL CYCLES: A NEW METHOD OF PRODUCING HYDROGEN
K. E. Cox Aug. 1980 4 p refs
(Contract W-7405-eng-36)
(LASL-80-26) Avail: NTIS HC A02/MF A01

The concept of using hydrogen as a universal fuel is considered. Various aspects of hydrogen production are described with particular emphasis on hydrogen production from water. The effects of catalysts, organic solvents, complexing agents, and molten salts are examined and their contribution to the basic understanding of the thermochemical cycles of hydrogen production are evaluated. R.C.T.

N81-13200# Institute of Gas Technology, Chicago, Ill.
THERMOCHEMICAL HYDROGEN PRODUCTION Annual Report, 1979
Stephen E. Foh, James D. Schreiber, Jon B. Pangborn, and Thomas P. Whaley May 1980 193 p refs
(Contract GRI-5014-323-0017)
(PB80-210776; GRI-80/0039) Avail: NTIS HC A09/MF A01 CSCL 21D

Chemical cycle development for water splitting to produce hydrogen and oxygen advanced through research on sequences of thermochemical and electrochemical reactions. One of the reaction sequences or cycles is based on copper oxide and sulfate chemistry, a similar one uses zinc chemistry, and one is a solar energy cycle that uses cadmium chemistry. The most promising copper cycle was demonstrated in the laboratory with recycled materials, and the zinc sulfate cycle was improved in energy efficiency through a procedure that decreases thermal separation requirements. The electrochemical step of the cadmium cycle achieved efficient operation at low voltage potentials. GRA

N81-14103* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATOMIC HYDROGEN STORAGE METHOD AND APPARATUS Patent
John A. Woollam, inventor (to NASA) Issued 21 Oct. 1980 4 p Filed 6 Feb. 1979 Supersedes N79-18455 (17-09, p 1157) Division of US Patent Appl. SN-837794, filed 29 Sep. 1977, US Patent-4,193, 827, which is a division of US Patent Appl. SN-676432, filed 13 Apr. 1976, US Patent-4, 077, 788
(NASA-Case-LEW-12081-3; US-Patent-4,229,196; US-Patent-4,193,827; US-Patent-4,077,788; US-Patent-Appl-SN-009887; US-Patent-Appl-SN-837794; US-Patent-Appl-SN-676432; US-Patent-Class-62-40; US-Patent-Class-62-47; US-Patent-Class-62-18; US-Patent-Class-62-12; US-Patent-Class-55-2; US-Patent-Class-423-648R; US-Patent-Class-156-344; US-Patent-Class-149-1; US-Patent-Class-44-7R) Avail: US Patent and Trademark Office CSCL 21D

Atomic hydrogen, for use as a fuel or as an explosive, is stored in the presence of a strong magnetic field in exfoliated layered compounds such as molybdenum disulfide or an elemental layer material such as graphite. The compounds maintained at liquid helium temperatures and the atomic hydrogen is collected on the surfaces of the layered compound which are exposed during delamination (exfoliation). The strong magnetic field and the low temperature combine to prevent the atoms of hydrogen from recombining to form molecules.
Official Gazette of the U.S. Patent and Trademark Office

N81-14430# Engelhard Minerals and Chemicals Corp., Edison, N. J. Research and Development Dept.
CATALYST AND PROCESS DEVELOPMENT FOR HYDROGEN PREPARATION FROM FUTURE FUEL CELL FEEDSTOCKS Quarterly Report, 1 Apr. - 30 Jun. 1980
R. M. Yarrington, I. R. Feins, and H. S. Hwang Jul. 1980 32 p
(Contract DE-AC03-79ET-15383)
(DOE/ET-15383-22) Avail: NTIS HC A03/MF A01

Four types of tests were run on the small scale catalyst screening unit. The operating line for coke-free operations was found to be approximately between 0.41 to 0.44 O2/C level.

Screening at lower 02/C levels lead to problems with plugging. Increased severity for screening steam reforming catalysts was obtained by doubling the space velocity. Tests were run to determine the gas composition from the catalytic partial oxidation (CPO) section and to evaluate two CPO catalysts. Catalysts were aged for about 20 hours using a propane, steam, and air mixture before testing with No. 2 oil for another five hours. This latter test was used to study Pt/Rh catalysts made with various supports. Differences were readily determined for Pt/Rh supported on alpha alumina and Pt/Rh supported on stabilized alumina. Several samples must be evaluated by this method before aging runs are made in the larger unit. After leaching alumina from a used Pt/Rh catalyst, the XRD pattern showed the presence of a Pt-Rh alloy in the metal residue. Experiments were run to show that the alloy was formed in the reactor during testing and not during catalyst preparation. A larger version of the ATR reactor was designed and major components are on order. Author

N81-14477# Brookhaven National Lab., Upton, N. Y.
AMMONIA AS A HYDROGEN ENERGY-STORAGE MEDIUM
G. Strickland Aug. 1980 8 p refs Presented at 5th Ann. Thermal Storage Meeting, McLean, Va., 10 Oct. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28293; CONF-801055-2) Avail: NTIS HC A02/MF A01

Liquid hydrogen methanol, and ammonia are compared as hydrogen energy storage media on the basis of reforming the MeOH to produce H2 and dissociating (cracking) the NH3 to release H2. The factors in this storage concept are discussed. In terms of energy input for media manufacture from natural gas hydrogen energy content of the medium, and energy cost, NH3 has a wide advantage and comes the closest to matching gasoline. The tasks required in developing a safe and practical hydrogen energy storage system based on the storage and cracking of NH3 are listed. DOE

N81-15126# TRW Defense and Space Systems Group, Redondo Beach, Calif. Chemistry and Chemical Engineering Lab.
CATALYTIC CONVERSION OF COAL ENERGY TO HYDROGEN Final Report
J. A. Starkovich Mar. 1980 84 p refs
(Contract ET-78-C-01-2855)
(FE-2855-T1) Avail: NTIS HC A05/MF A01

The potential of generating hydrogen by means of alkali catalyzed coal char steam reactions was assessed. Particular emphasis was placed on determining the nature of catalyst fuel communication during gasification, the processes involved in catalyst deactivation, and the chemical mechanism of catalysis. The kinetics of fixed bed conversion reactions were measured and the effects of several reaction parameters on the kinetics evaluated. A major step was taken in describing alkali catalyst behavior in catalytic char gasification. In the second part of the experimental studies, the performance of alkali catalysts in fluidized char gasification reactions was investigated. Information gained from these studies was used to develop and support a conceptual catalytic process design. DOE

N81-15549# California Univ., Livermore. Lawrence Livermore Lab.
THE TANDEM MIRROR REACTOR AS A SYNTHETIC FUEL PRODUCER
Richard W. Werner 1980 10 p refs Presented at 4th ANS Topical Meeting on the Technol. of Controlled Nucl. Fusion, King of Prussia, Pa., 14-17 Oct. 1980
(Contract W-7405-eng-48)
(UCRL-83536; CONF-801011-17) Avail: NTIS HC A02/MF A01

The role of nuclear controlled fusion in the future production of synthetic fuels is discussed. It is pointed out that fuels for transportation, industrial, residential, and commercial uses are greatly needed as well as fuels for the production of electricity. Emphasis is given to fusion reactors based on tandem mirror physics coupled to thermochemical processes for the production of hydrogen. L.F.M.

N81-15842# Brookhaven National Lab., Upton, N. Y.
HYFIRE: A TOKAMAK, HIGH-TEMPERATURE ELETROLYSIS SYSTEM
O. W. Lazareth, J. A. Fillo, J. R. Powell, M. Steinberg, R. Benenati, V-D. Dang, F. L. Horn, S-Y. Hsieh, H. Issacs, H. Makowitz et al 1980 4 p refs Presented at 4th ANS Topical Meeting on the Technol. of Controlled Nucl. Fusion, King of Prussia, Pa., 14-17 Oct. 1980 Sponsored by DOE
(BNL-28441; CONF-801011-41) Avail: NTIS HC A02/MF A01

The conceptual design of a commercial nuclear power system which uses high temperature electrolysis to produce synthetic fuels is described. The HYFIRE system includes a Tokamak fusion power reactor supplying electrical and thermal energy to an array of electrolytes. The electrolytes produce hydrogen which can be used either directly as a fuel or in the production of hydrocarbons. The HYFIRE design is based on STARFIRE which uses the dueterium tritium lithium fuel cycle. The STARFIRE plasma shape and characteristics are assumed, but a different blanket design is envisioned. A.R.H.

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FUELS AND OTHER SOURCES OF ENERGY

Includes fossil fuels, nuclear fuels, geothermal and ocean thermal energy, tidal energy, and wind energy.

A81-10624 Gasohol - Analysis and biomass alternatives. *Energy,* vol. 5, Fall 1980, p. 18-20.

The economics of fermentation ethanol as a near-term alternative to liquid hydrocarbon fuels are analyzed and alternatives to grain-fermented ethanol are examined. Based on estimates of raw material and production costs and energy consumption, it is shown that net production costs for alcohol fuel from corn amount to $2.14/gallon, with no significant net consumption or gain in energy. It is also pointed out that the use of grain for alcohol production will influence quantities available for livestock production and export, and that land available for grain production is limited. Consideration is then given to the economic potential of using cellulosic biomass from agricultural and forest residues in the production of ethanol fuels and coal gasification for methanol production, and it is pointed out that these alternatives offer economic, energy and oil-savings advantages over ethanol production from grains. A.L.W.

A81-10625 Geothermal energy - Ready for use. J. T. Miskell. *Energy,* vol. 5, Fall 1980, p. 27, 28.

The use of geothermal energy in the United States for heating applications is discussed. The three major forms of geothermal energy, hydrothermal, pertrothermal and geopressured, are briefly reviewed, with attention given to the types of energy available from each. Federally supported projects demonstrating the use of geothermal hot water to heat homes in Boise, Idaho, and hot dry rocks in Fenton Hill, New Mexico to produce electricity are presented. Data available from existing geothermal energy applications are presented which show that geothermal is cost competitive with conventional energy sources using existing technology, and government economic incentives to the producers and users of geothermal energy are indicated. Finally, advanced equipment currently under development for the generation of electricity from geothermal resources at reduced costs is presented. A.L.W.

A81-10771 A proposed large-scale wind energy program for California. M. Ginosar (California Energy Commission, Sacramento, Calif.). *Energy Sources,* vol. 5, no. 2, 1980, p. 141-169. 20 refs.

Large wind-electric systems are proposed to provide about 10 percent (30 billion kWh/year) of California's electricity by the year 2000. The electrical power would be generated by approximately 3,300 three-megawatt wind-electric conversion systems (WECS) situated on 100 utility-owned, wind-electric farms. Emphasis is given to cost estimates and finance of the program's commercial operation which includes wind-resource development, prototype installation and testing, and prototype development of multimegawatt WECS, proposing an overall cost of 105 million dollars for the six-year program. A.C.W.

A81-10796 Potential air quality impacts of large-scale geothermal energy development in the Imperial Valley. D. L. Ermak, R. A. Nyholm, and P. H. Gudiksen (California, University, Livermore, Calif.). *Atmospheric Environment,* vol. 14, no. 11, 1980, p. 1321-1330. 20 refs.

The potential impact on air quality of large-scale (3000 MW) geothermal development in Imperial Valley, California is assessed, based on the predictions of numerical atmospheric transport models. Emission rates derived from analyses of the composition of geothermal fluids in the region and meteorological data taken at six locations in the valley over a one-year period were used as input to the models. Hydrogen sulfide is the emission of major concern. The calculations predict that at the 3000-MW level (with no abatement), the California 1-h standard for H2S (42 microgram/cu m) would be violated at least 1% of the time over an area of approximately 1500 sq km (about one-third of the valley area). The calculations indicate that an H2S emission rate below 0.8 g per sec per 100-MW unit is needed to avoid violations of the standard beyond a distance of 1 km from the source. Emissions of ammonia, carbon dioxide, mercury, and radon are not expected to produce significant ground level concentrations, nor is the atmospheric conversion of hydrogen sulfide to sulfur dioxide expected to result in significant SO2 levels. (Author)

A81-11048 On the possibilities of thermal energy conversion in lakes. F. M. Boyce (Department of the Environment, National Water Research Institute, Burlington, Ontario, Canada). *Atmosphere - Ocean,* vol. 18, no. 3, 1980, p. 195-206. 10 refs.

The paper discusses the possibility of extracting electrical energy from the thermal energy stored in stratified lakes. Three situations are examined, an open lake or pond acting as a solar collector, a combination of waste heat and solar energy, and selective withdrawal of warm and cold streams from a stratified hydroelectric reservoir. Approximate calculations of the energy returns are made for typical conditions. The returns are limited by environmental factors as well as a short operating season. By using the deep stratified Great Lakes (Superior, Huron, Michigan, and Ontario) as solar collectors, a few thousand megawatts of electrical power could be produced in the Great Lakes Basin during the summer months. This power could be produced on a year-round basis by a single large nuclear generating station. (Author)

A81-11544 * Chemicals from biomass - The U.S. prospects for the turn of the century. M. N. Sarbolouki and J. Moacanin (California Institute of Technology, Jet Propulsion Laboratory, Energy and Materials Research Section, Pasadena, Calif.). *Solar Energy,* vol. 25, no. 4, 1980, p. 303-315. 27 refs. Contract No. NAS7-100.

Historically, chemicals from biomass have been and are expected to be economical in three major areas: byproducts, specialty items and polymers. Assessments of producing major chemicals from biomass in a processing plant based on the available conversion techniques indicate that they are not economically attractive, with the possible exception of conversion to ammonia and ethanol. The deterrents are the heavy capital investments, dependability of raw material supply and transportation costs for large plants, lack of operation experience, inadaptability of market variations, and competition from petroleum and coal. More importantly, it is also shown that even if chemicals from biomass were economical today, the resultant savings in petroleum would be far less than those achieved through other options available for the utilization of biomass as fuel and structural material. Thus, it is concluded that near-term research and development must be toward improved conversion processes, recovery of valuable products from waste streams at existing plants, more efficient use of biomass of energy and more efficient production of superior material products. (Author)

A81-11561 The UK wave energy resource. A. J. B. Winter (Atomic Energy Research Establishment, Energy Technology Support Unit, Harwell, Oxon, England). *Nature,* vol. 287, Oct. 30, 1980, p. 826-829. 7 refs.

Previous estimates of wave energy around the United Kingdom have been made by extrapolating measurements from a few sites to the whole UK seaboard. Here directional wave spectra are used from a numerical wave model developed by the Meteorological Office to make estimates which are verified where possible by observation. It is concluded that around 30 GW of power is available for capture by wave energy converters: when estimates of converter spacing and efficiency are considered an average of about 7 GW of electrical power could be supplied. This resource estimate is smaller than previous ones, though consistent with them when factors such as the directional properties of waves and the likelihood that converters will be sited near coasts are included. (Author)

A81-11612 * **Advanced fuel system technology for utilizing broadened property aircraft fuels.** G. M. Reck (NASA, Lewis Research Center, Cleveland, Ohio). In: International Council of the Aeronautical Sciences, Congress, 12th, Munich, West Germany, October 12-17, 1980, Proceedings. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 129-143. 28 refs.

Factors which will determine the future supply and cost of aviation turbine fuels are discussed. The most significant fuel properties of volatility, fluidity, composition, and thermal stability are discussed along with the boiling ranges of gasoline, naphtha jet fuels, kerosene, and diesel oil. Tests were made to simulate the low temperature of an aircraft fuel tank to determine fuel tank temperatures for a 9100-km flight with and without fuel heating; the effect of N content in oil-shale derived fuels on the Jet Fuel Thermal Oxidation Tester breakpoint temperature was measured. Finally, compatibility of non-metallic gaskets, sealants, and coatings with increased aromatic content jet fuels was examined. A.T.

A81-11737 **Note on the use of the inverse Gaussian distribution for wind energy applications.** W. E. Bardsley (Otago, University, Dunedin, New Zealand). *Journal of Applied Meteorology,* vol. 19, Sept. 1980, p. 1126-1130. 7 refs. Research supported by the New Zealand Energy Research and Development Committee.

The inverse Gaussian distribution is suggested as an alternative to the three-parameter Weibull distribution for the description of wind speed data with low frequencies of low speeds. A comparison of the two distributions indicates a region of strong similarity, corresponding reasonably well to three-parameter Weibull distributions which have been fitted to wind data. Maximum likelihood estimation of the inverse Gaussian parameters is much simpler than the iterative technique required for the three-parameter Weibull distribution. In addition, the inverse Gaussian distribution features the mean wind speed as a parameter, a desirable property for wind energy investigations. A summation-reproductive property of the distribution permits estimation of the mean wind energy flux from a sequence of speed averages. (Author)

A81-11796 **Is there a new future for coal (Hat die Steinkohle eine neue Zukunft).** D. R. Lenhartz (Saarbergwerke AG, Saarbrücken, West Germany). *(Deutsches Atomforum, Bonn, West Germany, June 26, 1980.) Energiewirtschaftliche Tagesfragen,* vol. 30, Oct. 1980, p. 749-754. In German.

The West German energy situation is reviewed from the standpoint of decreasing the dependence on oil imports. A discussion of the potentialities of nuclear power, coal, and secondary energy sources shows that, in the long run, electric power requirements may be met to a great extent by nuclear power plants, whereas most of the other power requirements will have to depend on coal. The fortunate position of Germany, where both raw material and well proven processing installations are available, is noted. The need for coal rich countries to help the less fortunate ones, in particular the third-world countries, is emphasized. V.P.

A81-11975 **Raw materials and energy from coal gasification - The Ruhrchemie/Ruhrkohle Texaco coal gasification demonstration facility (Rohstoffe und Energie durch Kohlevergasung - Die Ruhrchemie/Ruhrkohle-Demonstrationsanlage zur Texaco-Kohlevergasung).** B. Cornils, J. Hibbel, P. Ruprecht (Ruhrchemie AG, Oberhausen-Holten, West Germany), J. Langhoff, and R. Dürrfeld (Ruhrkohle Öl und Gas GmbH, Bottrop, West Germany). *Brennstoff-Wärme-Kraft,* vol. 32, Oct. 1980, p. 468-471. In German. Bundesministerium für Forschung und Technologie Contract No. ET-1217-Z.

Starting with January 1978 the Texaco coal gasification system has produced 52 million cu m synthetic gas, of the composition 54% CO, 34% H, 11% CO_2, 0.3% H_2S/COS, 0.6% N_2, and less than 0.1% CH_4, from 30,000 tons of coal. The principle and specifications of the Texaco second-generation method, involving high temperatures, high pressures, and the use of powdered coal of any quality in the form of a suspension, are examined in the present paper. V.P.

A81-12738 **Controlling the synfuel process.** J. Fagenbaum. *IEEE Spectrum,* vol. 17, Nov. 1980, p. 31-36.

The three main problem areas for instrumentation used in coal gasification and liquefaction systems are measurement of the density and velocity of the process streams (known as mixed-phase mass-flow monitoring); on-line analysis of the molecular composition of process streams; and measurement of temperatures in combustion and reactor vessels. Intrusive flow meters are ill suited because of the corrosion problem. The present paper deals with the development of nonintrusive flowmeters of the electromagnetic, thermal, sonic, and ultrasonic type, the development of capacitive transducers for velocity and density measurements, the use of neutron-induced gamma-ray spectrometry in on-line analysis to obtain the effective density of each constituent, and the use of acoustic techniques (time domain reflectometry) in temperature measurements. V.P.

A81-12915 **TiO_2 on and around a deactivated hydrodesulphurization catalyst.** L. E. Makovsky, S. S. Pollack, and F. R. Brown (U.S. Department of Energy, Pittsburgh Energy Technology Center, Pittsburgh, Pa.). *Nature,* vol. 288, Nov. 13, 1980, p. 154, 155. 12 refs.

The nature of the titanium found to accumulate around a deactivated catalyst used for the promotion of the liquefaction and desulphurization of coal is investigated. Examination of the titanium deposits found on and around spent Co-Mo on alumina catalysts used in a fixed-bed reactor reveals most of the deposit to be composed of the anatase form of TiO_2, with smaller amounts of calcite, gypsum and quartz. X-ray diffraction linewidth measurements indicate a crystallite size for the anatase material in the deposit in the range 190-260 A, with a c axis of 9.460 A, which is slightly less than that measured for pure anatase. Possible origins of the anatase material by the oxidation of organically bound coal titanium during liquefaction or the presence of 200-A anatase crystallites in the original coal are discussed. A.L.W.

A81-13200 **Fiftieth anniversary of oxygen gasification (50 Jahre Sauerstoffvergasung).** W. Flesch. *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie,* vol. 33, Oct. 1980, p. 467-475. 10 refs. In German.

The easy technological control of gasification temperatures in turbulent layers has greatly contributed to the introduction of coal gasification with oxygen on an industrial scale. In the present paper, the current status of large-scale fixed-bed, fluidized-bed, and entrained-bed gasification is reviewed. It is shown how the individual drawbacks of each of these technologies can be eliminated by combining the technologies. V.P.

A81-13380 **Progress in biomass conversion. Volume 1.** Edited by K. V. Sarkanen and D. A. Tillman (Washington, University, Seattle, Wash.). New York, Academic Press, Inc., 1979. 270 p. $19.50.

The volume focuses on biomass sources including wood and wood residues, agricultural materials, municipal refuse, paper, plywood, and food. Papers are presented on wood fuel use in the forest products industry, economic values of wood residues as fuel, pyrolysis of wood residues with a vertical bed reactor, methanol from wood, survey of the U.S. and European practices for energy recovery from municipal waste, and the silvicultural energy farm in perspective. A.T.

A81-13381 **Wood fuel use in the forest products industry.** R. L. Jamison (Weyerhauser Co., Div. of Energy Management, Tacoma, Wash.). In: Progress in biomass conversion. Volume 1. New York, Academic Press, Inc., 1979, p. 27-52. 8 refs.

A review is presented of the forest industry perspectives on use of wood fuels. These fuels have a modest heat content, are renewable, and have a low tendency to pollution. Wood fuels are now available in limited quantities, so that the forest products industry obtains 45% of its energy (1.2 quads) requirements from wood. Technologies for combustion and cogeneration can convert wood fuels into useful energy; these methods are costlier and less efficient than comparable oil and gas fired equipment, requiring low cost fuel to be economic. To expand wood fuel use, it will be necessary to provide financial and tax incentives to wood utilization facilities; it will also be necessary to increase supply by restocking forests, improving their management, and continuing R & D in genetics and silviculture. A.T.

A81-13382 ***Methanol from wood - A critical assessment.*** R. M. Rowell (U.S. Department of Agriculture, Forest Products Laboratory, Madison, Wis.) and A. E. Hokanson (Raphael Katzen Associates, Cincinnati, Ohio). In: Progress in biomass conversion. Volume 1. New York, Academic Press, Inc., 1979, p. 117-144. 20 refs.

A review of economics and technology of producing methanol from wood is presented. It is technically feasible but economically unprofitable to produce methanol from wood residues since it costs $0.77/gal to produce, while the selling price is only $0.44. A possible source of syngas for manufacture of methanol would be refinery light-gas streams; another potential source comes from coal in the U.S., particularly for a methanol plant located near a mining operation. No methanol has yet been produced from the gasification of wood; a study of methanol-from-wood process has used a Moore-Canada gasifier system, but the Union Carbide Purox method is designed to gasify municipal waste. The wood residues from methanol production may be utilized for producing pulp; the total energy input for a 50 million gpy methanol unit utilizing 1500 otpd will be 1125 million BTU/hr, with the product of the 427 million BTU/hr heating value. A.T.

A81-13383 **A survey of U.S. and European practices for recovering energy from municipal waste.** J. G. Abert and H. Alter (National Center for Resource Recovery, Inc., Washington, D.C.). In: Progress in biomass conversion. Volume 1. New York, Academic Press, Inc., 1979, p. 145-213. 99 refs.

Methods of waste recovery in U.S. and Europe are reviewed with emphasis on environmental effects. The location of waste-to-energy steam generating incinerators is discussed, noting that 80% of U.S. residential discards consisting of newsprint and plastic materials are combustible. The mass burning of waste with heat recovery in firebox-boiler units is discussed along with burning of refuse-derived fuel used as the total fuel, supplemental fuel, and for cofiring in utility and industrial boilers. Environmental considerations including ash and gas pollution, control regulations, air emission standards, and stoker firing with coal are examined. Finally, corrosion of equipment subjected to burned waste gases is described, concluding with economic assessment of energy recovery based on capital and operating costs, revenue from byproducts, and tipping fees. A.T.

A81-13384 **The silvicultural energy farm in perspective.** J.-F. Henry. In: Progress in biomass conversion. Volume 1. New York, Academic Press, Inc., 1979, p. 215-255. 94 refs.

Silviculture energy farming is an attractive method for increasing the wood-fuel/fiber production to satisfy greater demand for these products. Current information indicates that short rotation intensively managed hardwood plantations can achieve high sustained yields required to produce fuel at costs competitive with other energy sources. The intensive management of evergreen farms, and their weed control, irrigation, and fertilization are discussed along with the species selection for biomass production (growing sycamore and Populus hybrids for energy farming). Economics of silvicultural biomass farms is analyzed on the basis of land acquisition, crop management, and harvesting; energy balance for wood production on an energy farm is computed taking into account supervision, irrigation, and fertilizer costs. A.T.

A81-13752 **Eastern geothermal resources - Should we pursue them.** J. E. Tillman (Johns Hopkins University, Laurel, Md.). *Science,* vol. 210, Nov. 7, 1980, p. 595-600.

Geothermal resources in the 37 states east of the Rockies are assessed. The types of viable resources are examined, along with their geographic and geologic distributions, ease of exploitation, and most realistic applications. Problems in the private development of the geothermal resources are discussed, and possible government development programs are considered. F.G.M.

A81-13832 **Biomass from marine macroscopic plants.** W. J. North (California Institute of Technology, Pasadena, Calif.). *Solar Energy,* vol. 25, no. 5, 1980, p. 387-395. 22 refs. Navy-NSF-supported research; Contract No. E(04-3)-1275; Grant No. NOAA-04-5-158-13.

The article deals with the problem of marine biomass production. Farming of various seaweeds and especially of giant kelp is discussed, noting that because of high salt and water content, bacterial digestive techniques seem favored for purposes of fuel production. Active research fields are examined, including biological and engineering studies of biomass production system, as well as investigations of fuel conversion processes and economics of the proposed systems. Results of economic studies by three organizations using different fundamental assumptions differ only by a factor of about four. S.S.

A81-13833 **An overview of bio-energy projects in the United States.** P. F. Bente, Jr. (Bio-Energy Council, Washington, D.C.). *Solar Energy,* vol. 25, no. 5, 1980, p. 397-400.

The direct use of wood for energy is discussed, and attention is given to special techniques for burning or gasifying woody biomass. Various alcohol routes to energy are also considered. The environmental impact of biomass energy is briefly discussed. B.J.

A81-13872 **Offshore wind data.** D. J. Moore (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 199-207. 6 refs.

The use of wind power as a major source of energy for the United Kingdom would involve the construction of thousands of large aerogenerators off-shore. The economic appraisal and optimum siting of such a large network requires reliable knowledge of the off-shore wind field in three dimensions. This paper examines the features of the off-shore wind field which are important from the point of view of assessing its potential for power generation. Attention is given to such features as variation of wind velocity with height, effect of instrument exposure, effect of distance from the coast, pressure patterns, free stream wind, topographical effects, diurnal variation, annual variation, extreme winds, turbulence, and the effect of arrays. B.J.

A81-13873 ***Wind speed measurement for wind turbine testing.*** D. W. Bridson (Exeter, University, Exeter, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 208-217.

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The characteristics of wind velocity and its measurement are discussed taking into account wind direction, wind speed, and meteorological pressure. The turbine parameters including the rotor diameter, aerodynamics, and response rate, accuracy, and cost of wind speed instrumentation are described; currently available equipment such as anemometers, pitot tubes, and laser interferometers are considered. Field measurements using pitot/static tubes which achieve a flat directional response of minimum 45 deg in azimuth and pitch and a hot wire anemometer in which the fragile wire is embedded in resin are reported. A.T.

A81-13874 Wind tunnel modelling as a prospecting tool for wind energy site selection - A field assessment. D. Lindley (Taylor Woodrow Construction, Ltd., Southall, Middx., England), R. N. Meroney (Colorado State University, Fort Collins, Colo.), J. Pearse, and A. J. Bowen (Canterbury, University, Christchurch, New Zealand). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 218-229; Discussion, p. 229. 21 refs. Contracts No. EG-77-S-06-1043; No. EY-76-S-06-2438.

An attempt has been made to evaluate the accuracy of a wind tunnel investigation of a complex terrain model. Both terraced and contoured models of the Rakaia River Gorge region of New Zealand were prepared to an undistorted geometric scale of 1:5000. The contoured model was examined for three separate surface roughness conditions. On two spring days, selected for strong adiabatic down valley wind flow, three teams of investigators surveyed up to 27 sites on either side and within the river gorge. Measurements consisted of wind speed and direction at a 10 m height. The laboratory simulation results were compared with the available field data by means of statistical correlation and scatter diagrams. The model and field results have been used to assess the value of laboratory experiments as part of a strategy to develop and demonstrate efficient and economical techniques for identifying favourable wind energy conversion sites. (Author)

A81-14227 # Use of alternate feedstocks in the SGFM process. S. R. Beck, M. J. Wang, and J. A. Hightower (Texas Tech University, Lubbock, Tex.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 12-21. 7 refs.

The Synthesis Gas From Manure (SGFM) process was designed to convert cattle feedlot manure to ammonia synthesis gas. Current work is aimed at using any biomass feedstock to produce either medium-Btu gas of chemical feedstocks. This paper presents a comparison of the gasification of oak sawdust, corn stover, mesquite and cotton gin trash in the SGFM pilot plant. (Author)

A81-14233 # Economics of ethanol production from agricultural residues. O. C. Sitton, G. L. Foutch, N. L. Book, and J. L. Gaddy (Missouri-Rolla, University, Rolla, Mo.). In: Energy alternatives: An assessment; Proceedings of the Sixth annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 362-370. 8 refs.

A laboratory investigation of producing ethanol from cornstalks by H_2SO_4 hydrolysis indicated that yields of 0.031 gal. per pound of agricultural residue could be produced. The cornstalks were converted to glucose and xylose which were fermented to ethanol with yeast. The process economics are projected to be profitable at the current ethanol price of \$1.41/gal., but are unacceptable at the current gasoline price of \$1.00/gal.; the economics can be improved by larger plant sizes or lower cornstalk prices to make it attractive as a fuel additive at the gasoline price of \$1.25/gal. A.T.

A81-14444 # Methane production from agricultural residues - A short review. Y.-R. Chen, V. H. Varel, and A. G. Hashimoto (Science and Education Administration, Roman L. Hruska Meat Animal Research Center, Clay Center, Neb.). *(American Chemical Society, Symposium on Chemicals from Cellulosic Materials, Houston, Tex., Mar. 23-28, 1980.) I & EC - Industrial and Engineering Chemistry, Product Research and Development,* vol. 19, Dec. 1980, p. 471-477. 59 refs.

This paper summarizes the methanogenesis process, the environmental requirement, kinetics, energy requirements, and methane production cost of methane fermentation systems. Available data of biodegradability of the residue and kinetic equations can be used to predict the methane production under different operating conditions. The optimum condition for fermenting beef cattle residue is operating at a thermophilic temperature (55 C) with an influent concentration of 80 g of VS/L. This produces yields of 3.96 L of CH_4/L fermenter-day at 5 days retention time. It is apparent that the anaerobic fermentation process is technically feasible. However, only at plant sizes larger than 300 Mg TS/day will the anerobic fermentation system produce methane gas comparable to the current natural gas price. If the effluent can be used as a feed supplement for livestock, the anaerobic fermentation system for livestock residue will be economically feasible at a plant size between 3 and 6 Mg TS/day. This corresponds to beef cattle feedlots between 1000 and 2000 head. (Author)

A81-15106 # Fermentation parameters needed to improve biogas production. P. G. Anglo (National Institute of Science and Technology, Manila, Philippines). *Regional Journal of Energy, Heat and Mass Transfer,* vol. 1, Oct.-Nov. 1979, p. 251-264. 8 refs.

Swine waste has been reported to be a good source of organic substances for microbial growth and activities. Biogas, composed mainly of methane and carbon dioxide is one of the products of its fermentation under anaerobic condition. Gas production is enhanced with the use of methane starters. Under optimum conditions inoculum size, pretreatment dilution, pH, agitation, light intensity and addition of actizyme, maximum gas production can be obtained after 30 days of anaerobic fermentation. (Author)

A81-15107 # Energy for internal combustion engines from wastes and biomass. K. V. Gopalakrishnan and B. S. Murthy (Indian Institute of Technology, Madras, India). *Regional Journal of Energy, Heat and Mass Transfer,* vol. 1, Oct.-Nov. 1979, p. 265-279. 13 refs.

Processes for the production of liquid and gaseous fuels from biomass and wastes are reviewed, including methane production from municipal wastes, energy crops, and animal dung by anaerobic digestion and production of alcohols from sugar cane, grain, municipal cellulosic wastes, and wood by fermentation, enzymatic hydrolysis, and hybrid processes. The suitability of these fuels for internal combustion engines is discussed. V.L.

A81-15108 # High productivity fermentation for ethanol production. P. L. Rogers (New South Wales, University, Sydney, Australia). *Regional Journal of Energy, Heat and Mass Transfer,* vol. 1, Oct.-Nov. 1979, p. 281-290. 18 refs.

The high-productivity fermentation of sugars, starches and cellulose into ethanol to serve as a supplement to liquid fuels is discussed. Processes involved in the pretreatment of raw materials, including the hydrolysis of starch and cellulose, are examined, and criteria for the selection of yeasts and bacteria for fermentation are considered. Developments in fermentor design resulting in improved operation and higher productivity by the use of cell recycle and continuous operation are reviewed, and the results of preliminary studies indicating the advantages of using the bacterium Zymomonas mobilis rather than yeasts are presented. It is also shown that considerable cost reductions may be achieved by the use of ethanol-tolerant organisms which can ferment to 12 vol %, as less steam is required for distillation. Estimates are presented of the costs of ethanol production from cassava, sugar beets and sugar cane in the Australian context, and it is concluded that the development of high-productivity continuous fermentation with cell recycle offers considerable potential for cost reductions in medium to large scale ethanol production. A.L.W.

A81-15110 # **Fuel farming.** J. A. Semana (Forest Products Research and Industries Development Commission, Laguna, Philippines). *(UNESCO, Workshop on Energy from Biomass and Wastes, University of Peradeniya, Peradeniya, Sri Lanka, Nov. 26-30, 1979.) Regional Journal of Energy, Heat and Mass Transfer,* vol. 1, Oct.-Nov. 1979, p. 313-347. 46 refs.

Plantations of fast-growing hardwoods, such as the Leucaena leucocephala giant strains which are leguminous, reproduce by coppicing and are hardy, could serve as renewable, self-perpetuating sources of energy. These energy plantations or fuel farms would produce fuelwood for household use, for the manufacture of charcoal for household and industrial purposes, and for the generation of electricity, either by direct combustion in wood-fire steam power plants or by conversion into producer gas which can be used by gas turbines or specially-designed producer gas-fueled engines to drive electric generators. The investment requirement for a plantation of giant Leucaena leucocephala fuelwood is estimated to be US$ 479 to US$ 552 per ha. The fuelwood price at the plantation would vary from US$ 8 to US$ 16 per bone-dry tonne at growth rates of 50 down to 16.4 bone-dry tonnes per ha per year and from US$ 11 to US$ 27 per bone dry tonne at hauling distances of 10 up to 50 km. If the fuelwood were used in wood-fired steam power plants, the cost of electricity generated would be from US$ 0.026 to US$ 0.074 per net kWh within the 10 to 50 km fuelwood hauling distances.

(Author)

A81-15111 # **The potentiality of water hyacinth for decentralised power generation in developing countries.** I. V. Gopalakrishnan and B. S. Murthy (Indian Institute of Technology, Madras, India). *Regional Journal of Energy, Heat and Mass Transfer,* vol. 1, Oct.-Nov., 1979, p. 349-357. 6 refs.

A81-15112 # **Scope and potential of methane generation from agriculture wastes with special reference to industrial tapioca wastes in Malaysia.** J. Kader (National University of Malaysia, Kuala Lumpur, Federation of Malaysia). *Regional Journal of Energy, Heat and Mass Transfer,* vol. 1, Oct.-Nov. 1979, p. 359-364. 17 refs.

A81-15113 # **Utilization of cellulosic waste for energy production.** V. Deshpande, C. Mishra, M. Rao, R. Seeta, M. C. Srinivasan, and V. Jagannathan (National Chemical Laboratory of India, Poona, India). *(UNESCO, Workshop on Energy from Biomass and Wastes, University of Peradeniya, Peradeniya, Sri Lanka, Nov. 26-30, 1979.) Regional Journal of Energy, Heat and Mass Transfer,* vol. 2, Jan. 1980, p. 23-29. 10 refs.

Bioconversion of cellulose for the production of food or alcohol is of importance for the utilization of a renewable and abundant resource. The hydrolysis of different cellulosic materials by the cellulolytic enzymes produced by Penicillium funiculosum was studied. Fifty to 70% saccharification was obtained from pretreated bagasse, cotton and wood. The effect of different pretreatments to make the cellulose more susceptible to enzyme breakdown was also studied. Alkali pretreatment was found to be effective for most of the substrates. The production of alcohol from the hydrolysates by yeast fermentation without isolation of glucose was studied.

(Author)

A81-15114 # **Anaerobic filter for biogas production.** S. Chavadej (Thailand Institute of Scientific and Technological Research, Bangkok, Thailand). *(UNESCO, Workshop on Energy from Biomass and Wastes, University of Peradeniya, Peradeniya, Sri Lanka, Nov. 26-30, 1979.) Regional Journal of Energy, Heat and Mass Transfer,* vol. 2, Jan. 1980, p. 31-44. 7 refs. Research supported by the National Research Council of Thailand.

A laboratory study evaluated the performance of an anaerobic filter in producing biogas from pig waste with 30,000 mg/l of COD. The filter packing was bamboo rings of 1 and 1/2 in. diameter, 1 in. long; the bamboo-bed filter operated satisfactorily in a wide COD loading range of 3.74-15.65 kg/cu m/d which corresponds to the hydraulic retention of 8.47 to 1.68 days. At the optimum loading of 7.299 kg COD/cu m/d, the largest gas rate of 0.212 cu m/kg of COD was produced. The required volume of the digester for 1.2 cu m/d of gas production would be only 1.5 cu m; in practical applications, consideration should be given to the gas collecting system and clogging problems.

A.T.

A81-15115 # **Integrated biogas systems.** M. Amaratunga (Peradeniya, University, Peradeniya, Sri Lanka). *(UNESCO, Workshop on Energy from Biomass and Wastes, University of Peradeniya, Peradeniya, Sri Lanka, Nov. 26-30, 1979.) Regional Journal of Energy, Heat and Mass Transfer,* vol. 2, Jan. 1980, p. 45-49.

Integrated biogas systems as alternatives to fossil fuels in Sri Lanka are considered from standpoints of population growth, land availability, and employment opportunities. Agricultural practices would be improved by use of chemical fertilizers, and health/nutrition problems be alleviated by using biogas systems. Fuel for cooking and rural industries will become more easily available; water weeds, such as water hyacinth and salvinia which pose a threat to waterways and rice paddy lands could be used for the production of biogas and fertilizers. A concept of an integrated biogas system comprising photosynthesis and anaerobic degradation processes to produce food and energy is presented.

A.T.

A81-15764 **Molybdenum blue applied to arsenic and phosphorus determinations in fluoride- and silica-rich geothermal waters.** R. E. Stauffer (Wisconsin, University, Madison, Wis.). *Environmental Science and Technology,* vol. 14, Dec. 1980, p. 1475-1481. 32 refs. U.S. Environmental Protection Agency Grant No. R-805281-01-0.

The use of the reduced molybdenum blue technique is evaluated for the determination of arsenic and phosphorus levels in geothermal waters with high concentrations of potentially interfering SiO2, F, Mo and Sb. Field-filtered samples of boiling hot waters from Yellowstone National Park were analyzed for soluble reactive phosphorus, total phosphorus, As(V) + soluble reactive phosphorus, As(III) + As (V) + soluble reactive phosphorus and total As and P by a spectrophotometric method using a mixed molybdate reagent and persulfate and iodate oxidation. Soluble phosphorus concentrations are found to be less than 2 micrograms/liter, three orders of magnitude less than previously reported estimates, and total arsenic concentrations, represented only by soluble arsenite and arsenate, are found to be in the range 1.5-3.0 mg/liter. It is concluded that the proposed molybdenum blue procedure is optimally suited to total As determinations in water of high Cl content, and that the previous estimates of soluble phosphorus content were in error due to high concentrations of As and possibly SiO2.

A.L.W.

A81-16250 **Alternative fuels - Chemical energy resources.** E. M. Goodger (Cranfield Institute of Technology, Cranfield, Beds., England). New York, Halsted Press, 1980. 254 p. 155 refs. $43.95.

Candidate alternative chemical fuels which may serve to bridge the predicted gap between conventional fuels and a long-term solution to the energy problems are examined. Following a survey of the availability and the properties and performance characteristics of conventional fuels intended for oxidation, a suggested classification of the alternative fuels of interest is presented, including alternative forms of conventional fuels, alternative applications of conventional fuels, simulated fuels, supplemental fuels, elemental synthesis fuels, substitute fuels (hydrogen, alcohol, nitrogen hydrides, nitrohydrocarbons, solid wastes, biofuels) and high-energy hydrides. Theoretical and likely practical combustion processes for these fuels are reviewed, and their reported laboratory and field performances are surveyed. The handling characteristics of these alternative fuels are then discussed, and techniques proposed for the future production of the most promising alternative fuels are considered, together with forecasts of possible fuel utilization patterns and costs.

A.L.W.

A81-16698 **The calculation of gasification from coal in a fixed bed reactor (Zur Berechnung von Entgasung und Vergasung von Kohle im Festbettreaktor).** B. Hörsgen and H. Köhne (Aachen, Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie,* vol. 33, Nov. 1980, p. 515-521. 13 refs. In German.

A one dimension, two phase model for the transfer of coal into gas through the Lurgi pressure gasification process is discussed. Calculations for drying, devolatilization, and gasification are presented along with energy and mass transport operations. The heterogeneous chemical reactions of carbon with hydrogen, water vapor, and carbon dioxide, and the homogeneous reaction between carbon monoxide and water vapor are described by kinetic equations, that take into account deviations from thermodynamic equilibrium as the driving potential of the chemical reaction. Data from different types of coal and different gas compositions were used to test the model. R.C.

A81-16700 **Catalytic liquefaction of coal with petroleum residues (Katalytische Verflüssigung von Kohle zusammen mit Erdölrückständen).** W. Kotowski, L. Jakubowski, and R. Gorski (Instytut Ciezkiej Syntezy Organicznej, Kozle, Poland). *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie,* vol. 33, Nov. 1980, p. 526-528. 12 refs. In German.

A process combining the desulfurization of fuel oil with coal liquefaction is presented. The unit operates at 90-110 bar, and 420-490 C, with a spatial velocity of 1.2-1.3 cu m/hr. It is designed with the possibility of producing benzene and increasing the heating oil supply. Emphasis is placed on using the smallest possible number of procedures to carry out the process. The relation between temperature change and the production of benzene, light oil, and gas is discussed. R.C.

A81-16725 ***Summary of 1979 geothermal drilling - Western United States.*** J. L. Smith, J. S. Matlick, and W. J. Ehni (Republic Geothermal, Inc., Santa Fe Springs, Calif.). *Geothermal Energy,* vol. 8, July 1980, p. 3-18.

Geothermal drilling activity during 1979 in California, Idaho, Nevada, New Mexico, Oregon and Utah is summarized. Of the 77 wells drilled to depths in excess of 2000 ft, 39 are noted to have been intended as development wells, two for direct utilization, and the remaining 36 as exploratory attempts, of which seven are now considered commercially productive. In addition, the extension of proven steam production at The Geysers field, with an increase in electric generating capacity, and the sale of the first electricity generated in the United States from a hot water reservoir are indicated. A.L.W.

A81-16947 # **Magnetohydrodynamic Couette flow and heat transfer in a rotating system.** V. Vidyanidhi, G. Krishnam Raju, and V. V. R. Rao (Andhra University, Waltair, India). *Defence Science Journal,* vol. 30, July 1980, p. 143-148. 8 refs.

The magnetohydrodynamic Couette flow and heat transfer in a rotating system has been studied, with particular attention being given to the influence of the loading factor K. In general, the open or short circuited methods depending on K = 1 or 0 are used to analyze generators, pumps and meters in flow problems and form the groundwork for the MHD generator analysis with the present study extending the work of Jana et al. (1977). A series of equations is presented showing that as K increases, both the rate of heat transfer and the critical Eckert number increase. B.R.K.

A81-17136 **A mathematical model of laminar axisymmetrical natural gas flames.** N. W. Heys, F. G. Roper, and P. J. Kayes (British Gas Corp., London, England). *Computers and Fluids,* vol. 9, Mar. 1981, p. 85-103. 21 refs.

A computational procedure for determining the velocities, temperatures and species concentrations in a laminar Bunsen type flame is presented. The boundary layer form of the Navier-Stokes equations with coupled chemistry are solved for a compressible, viscous and axisymmetric flow. An implicit finite difference method is used in the solutions. Velocities, temperatures and stable species concentrations are compared with experimental data. (Author)

A81-18226 **Oil fields of foredeeps as seen from space.** V. D. Skariatin (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-02.* 12 p.

Preliminary results of studying large oil- and gas-bearing regions and subregions by space images are given in this report. Newly revealed structural elements of the earth's crust are analyzed. An attempt is made to find the correlation between the location of lineaments and deposits of oil and gas, using data about the front foredeeps of the Alpine fold belt. (Author)

A81-18420 **Economic benefit derived from use of satellite information.** K. Tsuchiya, Y. Yamada, N. Ohono (National Space Development Agency of Japan, Tokyo, Japan), Y. Miki (Science and Technology Agency, Tokyo, Japan), H. Ochiai (Toba National Merchant Marine College, Toba, Japan), and A. Tani (Mitsubishi Research Institute, Japan). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-IAA-43.* 10 p. 6 refs.

An attempt is made to estimate the economic benefit derived from use of satellite information on a national scale. On the average it is estimated that 10% of conventional observation in research projects of various national organizations can be replaced with satellite observation. For example, 10-20% of total fuel consumption can be saved in the offshore fishing industry, while in the far sea fishing industry the amount of saving is estimated to be approximately 10%, provided information effective for searching the fishing field is supplied to fishermen in proper time. A fairly large amount of benefit can be obtained in exploration of natural resources, cereals yield prediction, and fisheries industries in general. (Author)

A81-18563 **Directions in synfuel development.** R. Whitaker. *EPRI Journal,* vol. 5, Nov. 1980, p. 21-25.

The paper covers the problems and interest of electric utilities in synthetic fuels as presented at a synthetic fuels conference held in San Francisco in October 1980. It was noted that liquid and gaseous forms of synthetic fuels will both be important in replacing fossil fuels at electric utilities and the role to be played by utilities in developing synthetic fuels was analyzed. It was pointed out that utilities can define synthetic fuel performance criteria through support in research and development. In addition, they can aid development through advance fuel purchase contracts and through equity participation in production facilities. Technological data, costs and consumption capacities as far as the 1990's were discussed. C.R.

A81-18730 # **A potential new energy source - Assessment of energy recovery from municipal solid waste.** E. T. Sherwin and A. R. Nollet (AENCO, Inc., New Castle, Del.). *American Society of Mechanical Engineers, Century 2 Plant Engineering and Maintenance Conference, San Francisco, Calif., Aug. 13-15, 1980, Paper 80-C2/PEM-2.* 11 p. 7 refs. Members, $1.50; nonmembers, $3.00. Research supported by the Cargill, Inc.

The state-of-the-art of recovering resources from the 135 million tons of household, industrial, and commercial wastes generated each year in the United States is discussed. Some of the hazards attendant upon the preliminary shredding of solid wastes at resource recovery plants are described with reference made to the impetus for resource recovery arising from legislation and to the difficulty in finding markets for refuse-derived fuel. Economic factors militating against resource recovery are enumerated, including the unviability of mass-burning systems to generate process or heating steam and/or electrical energy. It is also shown that the cost per ton of incoming waste has been underestimated and that the revenues to be derived from recovered resources have been overestimated. A new system in which separation, that is, classification, of incoming waste is the first step is proposed. This system would avoid the hazards of shredding and would make the recovery of resources less costly. It is shown that the cellulose contained in solid waste could be converted into ethanol. C.R.

A81-18735 # **Operational problems and solutions of gas turbine liquid fuel systems - A survey report.** H. Lukas (Encotech, Inc., Schenectady, N.Y.) and R. Duncan (Electric Power Research Institute, Fossil Fuel and Advanced Systems Div., Palo Alto, Calif.). *American Society of Mechanical Engineers, Joint Power Generation Conference, Phoenix, Ariz., Sept. 28-Oct. 2, 1980, Paper 80-JPGC/GT-3.* 5 p. 7 refs. Members, $1.50; nonmembers, $3.00.

The paper presents the results of a survey conducted among the owners of gas turbines burning residual fuel or crude oil to identify operating problems, cost, and general owner reaction to burning these fuels. The fuel system, including storage, handling, and treatment, is found to represent a major problem area. However, all respondents consider these fuels to be a realistic and economical alternative to higher priced premium fuels. V.L.

A81-18737 # **Refuse-derived fuels.** H. H. Krause (Battelle Columbus Laboratories, Columbus, Ohio). *American Society of Mechanical Engineers, Joint Power Generation Conference, Phoenix, Ariz., Sept. 28-Oct. 2, 1980, Paper 80-JPGC/Fu-2.* 9 p. 14 refs. Members, $1.50; nonmembers, $3.00.

The rationale for energy recovery from municipal refuse is discussed, and planning for future installations for this purpose is cited. The composition and energy content of bulk waste, shredded refuse, and pelletized material are compared. Potential problems encountered with refuse combustion in the areas of slagging, corrosion, and stack emissions are outlined. (Author)

A81-18766 **Thermodynamic aspects of geothermal energy.** J. Goguel (Bureau de Recherches Géologiques et Minières, Orléans, France). In: Geophysical aspects of the energy problem. Amsterdam and New York, Elsevier Scientific Publishing Co., 1980, p. 1-50.

The origin and the mechanisms by which the internal energy of the earth is produced are discussed in relation to the extraction of geothermal energy. It is shown that energy produced by gravitational differentiation and radioactivity within the earth is very small in comparison with that received from the sun, and is unevenly distributed in heat flow, volcanoes, earthquakes, geologic upheavals and continental drift. Sources of geothermal energy are then defined as locations where heat stored in rocks can be extracted by the circulation of water or steam, and means for extracting geothermal energy from natural hot springs of high-temperature aquifers are examined. The origin of high-energy geothermal fields is then discussed in terms of the cooling of deep-seated magmatic intrusions and ground-water convection, and it is shown that the decay time constant for conductive cooling of such intrusions requires that they be sought only in regions of very recent geological activity. The development and management of geothermal systems are then considered, and areas likely to contain high-energy sources are indicated. A.L.W.

A81-18767 **Geophysical methods in prospecting for geothermal resources.** G. V. Keller (Colorado School of Mines, Golden, Colo.). In: Geophysical aspects of the energy problem. Amsterdam and New York, Elsevier Scientific Publishing Co., 1980, p. 51-82. 21 refs.

Geophysical methods used for the discovery of geothermal resources lacking strong surface expressions such as volcanic activity, geysering and fumaroles are surveyed. Attention is given to methods involving the measurement of temperature gradients and heat flow, electrical resistivity, and self-potential voltages, the determination of the Curie point from magnetic data, and observations of various seismic phenomena, and it is pointed out that, in combination with the magnetotelluric method and the Curie point method, the Pn wave delay method appears promising for the reliable mapping of areas of high heat flow from the mantle. The application of these methods is illustrated by geothermal prospecting studies in the Black Rock Desert area of northwestern Nevada, with potential geothermal resources unrelated to modern volcanic or magmatic activity, and the Puna district of the island of Hawaii, where evidence of a magmatic heat source is abundant. A.L.W.

A81-18768 **Low enthalpy geothermal fields, with reference to geothermal energy in France.** J. Varet (Bureau de Recherches Géologiques et Minières, Orléans, France). In: Geophysical aspects of the energy problem. Amsterdam and New York, Elsevier Scientific Publishing Co., 1980, p. 100-133.

The classification and utilization of geothermal resources are discussed in relation to the low-temperature geothermal energy reserves and requirements of France. Criteria for distinguishing the types of geothermal fields according to geologic structure, salinity and temperature, which determines the eventual use of a geothermal source, are presented, and methods for determining the characteristics of a given site are indicated. Techniques for the exploitation of geothermal resources are then considered, with attention given to the calculation of the optimum distance between wells, drilling techniques and costs, geothermal plant design, and the solution of common problems encountered in geothermal wells. The power and temperature requirements of surface applications including domestic heating, agricultural uses and industrial uses are discussed, and the economics of low enthalpy energy are considered. Finally, five examples of the utilization of geothermal energy in France are presented, and the objectives of French geothermal energy policy are discussed. A.L.W.

A81-18769 **Man-made geothermal reservoirs.** A. C. Gringarten (Flopetrol, Melun, Seine-et-Marne, France). In: Geophysical aspects of the energy problem. Amsterdam and New York, Elsevier Scientific Publishing Co., 1980, p. 134-158. 15 refs.

Methods for extracting geothermal energy from hot dry rocks by the creation of artificial reservoirs within the rock are considered. Problems of containing and recovering water injected into rock with high permeability and of circulating and heating water injected into rock of low permeability are pointed out, and possible solutions involving water-flooding and reservoir management techniques on the one hand and crack initiation and propagation techniques on the other are indicated. Calculations are then presented of the amount of heat which could be recovered from an infinite series of parallel, equidistant, vertical fractures of uniform thickness, separated by blocks of homogeneous, isotropic impermeable rock, and a refined model of heat transfer is presented which takes into account variations in water flow distribution, fracture width and the effects of secondary cracking. A demonstration project for the extraction of heat from hot dry rocks is then presented which has shown that hot granite could be drilled and hydraulically fractured, and that fractures and boreholes could be connected, and it is pointed out that much work, particularly in the areas of theoretical heat production capacities, remains to be done before the concept can be brought to industrial scale. A.L.W.

A81-18770 **Technical, physical and economic problems in the development and use of petrogeothermal resources.** Iu. A. Diadkin (Leningradskii Gornyi Institut, Leningrad, USSR). In: Geophysical aspects of the energy problem. Amsterdam and New York, Elsevier Scientific Publishing Co., 1980, p. 159-201. 14 refs.

Technical, physical and economic aspects of the exploitation of the geothermal energy contained within dry hot rocks are considered. The technology of artificial geothermal systems which use a working fluid to extract heat from dry rocks for subsequent applications is examined, with attention given to approaches to extracting injected fluids and developing artificial reservoirs, including rock breakage by hydraulic fracturing, underground nuclear explosions, and thermodynamics, acoustic and explosive methods, and to possible subsurface energy transfer structures. Processes of heat and mass transfer are analyzed for porous reservoirs, fractured reservoirs, cavity reservoirs and geothermal wells, and the economics of geothermal circulation systems is considered, with the conclusion that geothermal energy can be developed not only in areas with high heat flow where reservoirs can be reached at shallow depths, but in regions underlain by thick sequences of sedimentary rock where there are potential users of even moderate quality thermal energy. The energy and economic potentials of petrogeothermal resources are then evaluated for the various regions of the USSR. A.L.W.

A81-18974 **Theoretical and practical considerations in forming uniform solid fuel layers inside 'vacuum' layered inertial confinement fusion targets.** D. L. Musinski, R. J. Simms (KMS Fusion, Inc., Ann Arbor, Mich.), and R. B. Jacobs (Robert B. Jacobs Associates, Inc., Boulder, Colo.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 376-381. 14 refs. Contract No. DE-AC08-78DP-40030.

The concept of 'vacuum' layer target design for inertial confinement fusion applications is defined, and a model is proposed which provides a way to evaluate the potential uniformity of a solid cryogenic fuel layer formed within the fuel container. It is shown that for the case of He and H2 exchange gases in the continuum regime of cooling, the fuel layer uniformity should be as good as current experimental results with simple targets. V.L.

A81-19061 **Fusion reactor technology impact of alternate fusion fuels.** C. C. Baker, R. Clemmer, K. Evans, Jr., J. Jung, D. Smith, L. Turner (Argonne National Laboratory, Argonne, Ill.), T. Blue, J. DeVeaux, D. Driemeyer (Illinois, University, Urbana, Ill.), and A. Bolon. In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 861-868. 6 refs. Research supported by the U.S. Department of Energy.

The initial results of a study carried out to assess some of the technology implications of non-D-T fusion fuel cycles are presented. The primary emphasis in this paper is on D-D, catalyzed-D and D-He-3 fuel cycles. Tokamaks and field-reversed mirrors have been selected as sample confinement concepts. The technology areas considered include first wall design considerations, shielding requirements, fuel cycle requirements and some safety and environmental considerations. Conclusions resulting from the study are also presented. (Author)

A81-19153 **Scoping of fusion-driven retorting of oil shale.** T. R. Galloway (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1543-1551. 31 refs. Contract No. W-7405-eng-48.

Research has been done on the application of fusion reactors for providing economic high temperature process heat for the production of shale oil in underground retorts. A process has been developed whereby fusion reactors supply a 600 C mixture of nitrogen, carbon dioxide, and water vapor to both surface and in situ retorts. The surface retorts are operated at high flows and yields using water for temperature control. It is found that fusion reactor-heated inert gases retort the oil from four 50 x 50 x 200-m in situ rubble beds at a rate of 40 m/d with a yield of 95% F.A., which provides a 20% return on investment for the syncrude selling at $20/bbl or 30% if sold at $30/bbl for heating oil. V.L.

A81-19154 **SYMECON - An economic evaluation code for fusion-fission symbiotic energy systems.** F. M. Heck, H. R. Howland, and M. E. Crotzer (Westinghouse Electric Corp., Fusion Power Systems Dept., Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1552-1556. 5 refs. Contract No. EG-77-C-02-4544.

A computer code, SYMECON, has been developed for analyzing the economics of symbiotic energy systems, wherein client fission reactors are supplied with fissile fuel produced by a fusion-hybrid reactor. Equilibrium fuel cycles and steady-state mass flow rates are assumed. The principal inputs include hybrid fissile fuel production, client reactor fuel cycle characteristics, capital and unit fuel cycle cost information, and assumed economic parameters. The principal output includes the megawatt capacity of clients supported by the hybrid, the price of the fuel purchased by the client, and the overall system busbar cost of electricity. The fusile fuel requirements (tritium, deuterium, lithium) for the hybrid are also calculated. (Author)

A81-19528 **Measurement of tracer elements in inertial fusion target fuel.** B. W. Weinstein and J. T. Weir (California, University, Livermore, Calif.). *Journal of Applied Physics,* vol. 51, Nov. 1980, p. 5604-5606. 5 refs. Contract No. W-7405-eng-48.

For some inertial confinement fusion experiments, a tracer impurity element is added to the deuterium-tritium fuel gas as an aid in diagnosing the implosion conditions. A general, nondestructive technique has been developed for measuring the initial tracer density in an individual fusion target. The technique takes advantage of the fact that beta emission from the tritium excites the tracer characteristic X-ray lines. Using an energy dispersive X-ray detector, the intensity ratio of a tracer X-ray line to the bremsstrahlung background is measured. The ratio is proportional to the tracer density and the inner radius of the target and is independent of other parameters. Argon tracer densities as low as 0.01 atm have been measured with an accuracy of + or - 15%. (Author)

A81-19556 **Measurement strategies for estimating long-term average wind speeds.** J. V. Ramsdell, S. Houston, and H. L. Wegley (Battelle Pacific Northwest Laboratories, Richland, Wash.). *Solar Energy,* vol. 25, no. 6, 1980, p. 495-503. 8 refs. Contract No. DE-AC06-76RL-01830.

The uncertainty and bias in estimates of long-term average wind speeds inherent in continuous and intermittent measurement strategies are examined by simulating the application of the strategies to 40 data sets. Continuous strategies have the smaller uncertainties for fixed duration measurement programs, but intermittent strategies make more efficient use of instruments and have smaller uncertainties for a fixed amount of instrument use. Continuous strategies tend to give biased estimates of the long-term annual mean speed unless an integral number of years' data is collected or the measurement program exceeds 3 yr in duration. Intermittent strategies with 3 or more month-long measurement periods/yr do not show any tendency toward bias. (Author)

A81-19649 **Solvent effects on the hydroliquefaction of Wyodak coal.** R. L. Miller and H. F. Silver (Wyoming, University, Laramie, Wyo.). *Energy Sources,* vol. 5, no. 3, 1980, p. 211-222. 14 refs. Contract No. EX-76-S-01-2367.

Results of an experimental study to measure the effect of coal-derived solvents on the noncatalytic hydroliquefaction of Wyodak coal have been correlated using a Watson type characterization factor (Kw). Solvents with Kw near 7.8 (K) exp 1/3 were the most effective in liquefying Wyodak coal. However, this specific conclusion should not be generalized to all coals. The results of this work suggest the solvent Kw can be a powerful parameter in monitoring solvent effectiveness during continuous operation of a coal-liquefaction plant. (Author)

A81-19650 **Carbide fuel cycles - A mixture of solar energy and coal.** K. R. Smith (Center for Cultural and Technical Interchange Between East and West - East-West Center, Honolulu, Hawaii). *Energy Sources,* vol. 5, no. 3, 1980, p. 223-246. 31 refs.

Metal carbides show some promise as fuels that can be manufactured from coal and solar energy. Calcium carbide, which produces acetylene gas upon reaction with water, could possibly be used as a vehicle fuel, although handling acetylene presents serious problems. Aluminum carbide produces methane, a more controllable gas, but has the disadvantage of releasing substantial heat during hydrolysis. However, in a system in which the heat of reaction is used to provide backup heat for a solar heating system and the methane is used for vehicle fuel, aluminum carbide may be the basis of an attractive fuel cycle. It seems to offer certain environmental advantages, although it poses other potential difficulties that would have to be investigated. Its costs are speculative but seem to lie within range of the economic value of the fuels to be replaced. (Author)

N81-10126 Oklahoma State Univ., Stillwater.
EQUILIBRIUM CONSTANTS FOR PHYSICAL SOLVENTS IN NATURAL GAS Ph.D. Thesis
Adeyinka Akibu Adeyiga 1980 103 p
Avail: Univ. Microfilms Order No. 8027156

A simple procedure for investigating the vaporization equilibrium ratios of carbon dioxide and hydrogen sulfide in physical solvents was developed. The procedure uses a single equilibrium cell and samples only the vapor phase for the determination of K values for the components and conditions of interest. The K values for carbon dioxide and hydrogen sulfide were determined in tetra ethylene-glycol-dimethyl-ether, tetra-methylene-sulfone and propylene carbonate at pressures up to 100 psia and temperatures from 50 to 150 F. The technique developed and the apparatus designed were found to be sound as illustrated by the consistency, reproducibility, and reliability of the data. Of the three physical solvents studied, tetra-ethylene-glycol-dimethyl-ether was found to be the most effective for both hydrogen sulfide and carbon dioxide removal from sour gas streams. Dissert. Abstr.

N81-10173# Oak Ridge National Lab., Tenn.
SCLEROGLUCAN BIOPOLYMER PRODUCTION, PROPERTIES AND ECONOMICS
A. L. Compere and W. L. Griffith 1980 7 p refs Presented at the 6th Intern. Ferment. Symp. and 5th Intern. Symp. on Yeasts, London and Ontario, Canada, 20 Jul. 1980
(Contract W-7405-eng-26)
(CONF-800739-1) Avail: NTIS HC A02/MF A01

Production and solution properties which may make scleroglucan polysaccharide economically advantageous for onsite production and use in tertiary oil recovery were investigated. Scleroglucan, which is similar in viscosity and shear thinning to xanthan, can be produced in a 3 day batch or 12 h continuous fermentation. Yield is nearly 50 percent based on input glucose. Gross biopolymer biomass separation may be effected using microscreening, a low energy process, followed by polish filtration. Polymer flux may be improved by hydrolysis with an endolaminarinase from Rhizopus arrhizius QM 1032. Simple feedstock requirements and low growth pH, together with the difficulty of resuspending dried polymer, may encourage field biopolymer fermentation and use of purified culture broth. DOE

N81-10177 Brigham Young Univ., Provo, Utah.
MIXING AND GASIFICATION OF PULVERIZED COAL Ph.D. Thesis
Frederick Douglas Skinner 1980 248 p
Avail: Univ. Microfilms Order No. 8025617

An entrained gasifier was developed to investigate the local details of pulverized coal gasification. A series of experiments were completed in which the operating characteristics of the reactor were determined at atmospheric pressure. Gas and particle samples were obtained from inside the reactor at various radial locations near the reactor exit with water quench probes. The effect of reactant mixture ratios on carbon conversion. H2/CO ratio, CO2/CO ratio and coal-gas heating value were deduced. A second series of experiments were conducted wherein radial gas and particle composition profiles were obtained at several axial locations within the reactor. The extents of particle reaction and elemental acoal component release were measured. A method was developed by which local concentrations of steam could be calculated. For the given flow conditions, gas mixing was complete at about 2/3 of the distance down the reactor, while the particles were not totally dispersed within the length of the reactor. Coal burnout near the reactor exit was about 57%. Dissert. Abstr.

N81-10180# Kansas Energy Office, Topeka.
COGENERATION OF ETHANOL FROM I.C. ENGINE POWER PLANTS
Randall Noon 1980 9 p refs
(NP-24437) Avail: NTIS HC A02/MF A01

Internal combustion engine power plants have significant and suitable waste heat for the production of ethanol. Such power plants are often located in conjunction with cattle and grain producing areas, two of the important ingredients for ethanol production. Cogeneration of ethanol from I.C. engines will afford significant production of ethanol without requiring more fuel than is currently used. A one megawatt peak electrical output rated I.C. engine could produce 250,000 gallons of anhydrous ethanol per year. DOE

N81-10181# Rockwell International Corp., Canoga Park, Calif. Environment and Energy Systems Div.
PARTIAL LIQUEFACTION OF COAL BY DIRECT HYDROGENERATION Quarterly Progress Report, Jul. - Sep. 1979
A. Y. Falk 1979 21 p
(Contract EX-76-C-01-2044)
(FE-2044-49) Avail: NTIS HC A02/MF A01

Seven additional reactor tests were made in the 1 TPH PDU; five of these were greater than 1 hour in duration. Twenty one tests were made with the PDU since the installation of the high pressure product recovery system. The carbon balances for the longer duration tests approach approximately 95 percent. Several operational and hardware problems were encountered and solved. Excessive char carryover into the liquid product recovery system was observed on several of the tests. By limiting the coal flow rates of less than 1500 lbm, char carryover is not a problem. The gas side main injector injection pressure drop was steadily increasing with continued use of the indicator. After approximately 60 tests, the injector had suffered some heat induced distortion which caused the increased pressure drop. Installation and checkout of the water cooled heat recovery quench unit was completed and testing is in progress. DOE

N81-10182# Rockwell International Corp., Canoga Park, Calif. Energy Systems Group.
DEUTERIUM TRACER METHOD FOR INVESTIGATING THE CHEMISTRY OF COAL LIQUEFACTION Quarterly Technical Progress Report, Oct. - Dec. 1979
R. P. Skowronski, J. J. Ratto, and L. A. Heredy Jan. 1980 40 p refs
(Contract DE-AC01-77ET-11418)
(FE-2781-5) Avail: NTIS HC A03/MF A01

The deuterium tracer method which provides information on where the hydrogen is incorporated into the coal structure during hydrogenation, is discussed. Emphasis is placed upon donor solvent coal hydrogenation. Tetralin or tetralin-d sub 12 in a protium, deuterium, or nitrogen atmosphere, was used to elucidate the roles of gas phase and solvent hydrogen. Experiments were conducted with (1) fully deuterated solvent and protium gas, (2) fully deuterated solvent and nitrogen, and (3) the all-protium form of the solvent with deuterium gas. Coal injection and rapid cooldown techniques were used to provide a well defined reaction time. The combined solid and liquid products were solvent fractionated into oil, asphaltene, preasphaltene, and residue portions. These fractions were analyzed to determine the amount of deuterium incorporated and the structural positions of the incorporation. Also, the elemental compositions of the fractions were determined. The gas phase products were analyzed for molar and isotopic compositions. DOE

N81-10183# Rockwell International Corp., Canoga Park, Calif. Energy Systems Group.
DEUTERIUM TRACER METHOD FOR INVESTIGATING THE CHEMISTRY OF COAL LIQUEFACTION Quarterly Technical Progress Report, Jan. - Mar. 1980
R. P. Skowronski, J. J. Ratto, I. B. Goldberg, and L. A. Heredy Apr. 1980 54 p refs
(Contract DE-AC01-77ET-11418)
(FE-2781-6) Avail: NTIS HC A04/MF A01

The deuterium tracer method is used to investigate donor solvent coal hydrogenation. Tetralin or tetralin-d sub 12 in a protium, deuterium, or nitrogen atmosphere was used to elucidate the roles of gas phase and solvent hydrogen in donor solvent coal hydrogenation. The coal products from these experiments show preferential deuterium incorporation in alpha-aliphatic and aromatic positions; the structural position least susceptible to deuterium incorporation is the beta-aliphatic position. On the basis of the results, it is clear that hydrogen from the gas phase is incorporated into the donor solvent. The results suggest that the alipha-alphatic radical of the tetralin may act to channel gas phase hydrogen into the coal during liquefaction. DOE

N81-10186# UOP, Inc., Des Plaines, Ill. Corporate Research Center.
UPGRADING OF COAL LIQUIDS: HYDROTREATING AND FLUID CATALYTIC CRACKING OF SRC-2 PROCESS DERIVED GAS OILS Interim Report
F. J. Riedl and A. J. deRosset Jul. 1980 88 p
(Contract DE-AC01-77ET-10131)
(FE-2566-39) Avail: NTIS HC A05/MF A01

Four different fluid catalytic cracking (FCC) feedstocks, ranging in hydrogen content from 8.66 to 10.59 wt percent were prepared by topping the raw SRC-II gas oil and hydrotreated SRC-II products to remove 400 F minus material. Rerunning the raw SRC-II feed to remove 5.2 wt percent of the bottoms removed most of the heptane insolubles and Conradon carbon precursor. Results of fluid caralytic cracking showed that feed hydrogen content is a dominant factor in conversion and yield structure. As the feed hydrogen content increased, both conversion and gasoline yield increaased, and carbon deposited decreased. In the range of conditions investigated, gasoline research octane numbers of 97.5 to 106.7 were obtained. The yields of 650 F minus distillates generated were as high as 93 vol percent. It is concluded that SRC-II gas oil, or other coal derived distillate of similar quality, can be processed into high quality gasoline by use of current hydrotreating and FCC technology. DOE

N81-10187# California Univ., Livermore. Lawrence Livermore Lab.
MOTOR FUELS AND SNG FROM COAL
H. Hiller 1980 26 p refs Transl. into ENGLISH from Erdoel-Erdgas Z., (West Germany) no. 96, 1980 p 76-80
(UCRL-Trans-11604) Avail: NTIS HC A03/MF A01

The classical coal-conversion processes for the production of motor fuels must be adapted to present economic and production conditions. Only the process sequence for Fischer-Tropsch synthesis plants has undergone continuous further development, stimulated by the existence of large industrial plants in this sector. Recently, methanol synthesis based on coal gasification and followed by gasoline synthesis has become possible on a large industrial scale. The economy of the various processes for converting coal to motor fuels and SNG is compared. It is observed that there are proven conversion processes which guarantee competitive supplies in view of the price trend in the crude-oil market. Immediate construction of such plants to reduce the dependence of West Germany on crude-oil supplies is advisable. DOE

N81-10188# Institute of Gas Technology, Chicago, Ill.
PREPARATION OF A COAL CONVERSION SYSTEMS TECHNICAL DATA BOOK
A. T. Talwalkar and W. W. Bodle (DOE) 1980 21 p refs Presented at the 88th Natl. Meeting, AICE Conf., Philadelphia, 8-12 Jun. 1980
(Contracts DE-AC01-76ET-10251; EX-76-C-01-2286)
(CONF-800610-9) Avail: NTIS HC A02/MF A01

The purpose of the Data Book is to compile, evaluate and correlate data in the fields of coal conversion and utilization (except for direct combustion) generated under various DOE projects or otherwise available. These prepared data are to be presented in forms useful to engineers and scientists engaged in developments within the emerging coal conversion and utilization industry. The Data Book is being prepared in a loose-leaf form that can be updated at regular intervals. This is not a research project but rather a critical review and evaluation of existing information, correlations, and design techniques as well as compilation of necessary data. This continuing project also brings into focus areas where needed technical data are lacking. In the preparation of this Data Book, IGT and DOE are making every effort to obtain inputs from potential users and to this end have the benefit of a volunteer industrial consultant group to review the Data Book program, progress, and priorities. DOE

N81-10192# Carnegie-Mellon Inst. of Research, Pittsburgh, Pa.
DESIGN AND SIMULATION OF A RECIRCULATING BED REACTOR FOR COAL HYDROGASIFICATION. PART 1: RECIRCULATING BED HYDROGASIFIER CONCEPTUAL DESIGN AND SIMULATION RESULTS Final Report
Thomas W. Bierl, Lawrence J. Bajdos, and Alan E. McCiver Mar. 1980 259 p refs
(Contracts DE-AS01-78ET-13336; ET-78-S-01-3031)
(FE-3031-5-Pt-1) Avail: NTIS HC A12/MF A01

A conceptual design of a recirculating bed hydrogasifier is presented. The reactor was designed to operate at 1800 F and 44 atm on hydrogen, and it would convert 63% of coal carbon. A mechanical design is presented which utilizes U-bend crossovers, a unique mechanism for controlling loop pressure balance and a dense phase coal injector for direct addition of agglomerating coals. DOE

N81-10193# Department of Energy, Bartlesville, Okla. Bartlesville Energy Technology Center.
LIQUID FOSSIL FUEL TECHNOLOGY Quarterly Technical Progress Report, Oct. - Dec. 1979
Apr. 1980 56 p refs
(DOE/BETC/QPR-79/4) Avail: NTIS HC A04/MF A01

Activities and progress are reported in: liquid fossil fuel cycle, extraction (enhanced recovery of oil and gas), processing (of petroleum and alternate fuels), utilization (transportation and energy conversion), and systems integration. Bartlesville Energy Technology Center publications and finances are listed in appendices. DOE

N81-10197# Exxon Research and Engineering Co., Florham Park, N.J.
EDS COAL LIQUEFACTION PROCESS DEVELOPMENT, PHASE 5 Monthly Technical Progress Report, 1 Jun. - 30 Jun. 1980
W. R. Epperly Jul. 1980 54 p Sponsored in part by Exxon Co., Electric Power Research Inst., Japan Coal Liquefaction Development Co., Phillips Petroleum Co., ARCO Coal Co. and Ruhrkohle AG.
(Contracts DE-FC01-77ET-10069; EF-77-A-01-2893)
(FE-2893-52) Avail: NTIS HC A04/MF A01

High pressure bottoms recycle operations were conducted on the 50 pounds/day Recycle Coal Liquefaction Unit with Texas lignite. Significant conversion, yield and unit operability advantages can be obtained with lignnite by operating in the bottoms recycle mode, as compared to coal only operation. The impact of high pressure bottoms recycle on the relative economics of various bottoms processing options was studied. Various methods of calculating the Required Initial Selling Price of coal liquids were examined. DOE

N81-10201# Rockwell International Corp., Palo Alto, Calif. Energy Systems Group
MOLTEN ALKALI METAL HYDROXIDE CATALYZED COAL LIQUEFACTION Final Report, Oct. 1978 - Sep. 1979

R. P. Skowronski and L. A. Heredy Mar. 1980 124 p refs
(Contracts DE-AC01-78ET-13377; ET-78-C-01-3048)
(FE-3048-4) Avail: NTIS HC A06/MF A01

With a 2/1 NaOH melt/coal ratio, conversions of greater than 80 percent and liquid yields of greater than 50 percent can be achieved under hydroliquefaction conditions using tetralin. It is shown that NaOH is a more effective catalyst than KOH and NaOH affords very good heteroatom removal, particularly with respect to sulfur and nitrogen. At 400 C, some improvement in liquefaction is noted compared with the reaction at 425 C. Contacting is very important. Preliminary experiments indicate impregnation of small amounts (2 wt %) of NaOH has some catalytic effect and improves conversion. Inconel 671 is a satisfactory material of construction for use with NaOH under hydroliquefaction conditions. Inconel 600, 617, 625, and 671 were tested as potential materials of construction for molten alkali metal hydroxide-catalyzed coal liquefaction. Coupons were tested in both the hydroxide-sulfide melt and in the vapor phase. The samples in the melt showed little evidence of corrosion, and the samples in the vapor phase showed even less. DOE

N81-10205# Office of Technology Assessment, Washington, D. C.
ALTERNATIVE ENERGY FUTURES. PART 1: BACKGROUND REPORTS. THE FUTURE OF LIQUEFIED NATURAL GAS IMPORTS
Mar. 1980 435 p refs
(PB80-203847) Avail: NTIS HC A19/MF A01 CSCL 21E

Future demand for gas, implications for liquefied natural gas policy; North American oil and gas resources and production potential are analyzed. Imported liquefied natural gas projects, supply and consumption are discussed. GRA

N81-10208# Petroleum Conservation Research Association, New Delhi (India).
USE OF ETHANOL FROM SUGAR MOLASSES AS A BLENDING COMPONENT IN GASOLINE
1979 20 p
(PB80-197874) Avail: NTIS HC A02/MF A01 CSCL 21E

The possibilities and the various issues involved in the use of ethyl alcohol from sugar molasses as a blend component in gasoline in India are analyzed. GRA

N81-10209# Economics, Statistics and Cooperatives Service, Washington, D. C. National Economics Div.
GASOHOL: PROSPECTS AND IMPLICATIONS
Ronald Meekhof, Mohinder Gill, and Wallace Tyner Jun. 1980 36 p refs
(PB80-202112; AER-458) Avail: NTIS HC A03/MF A01 CSCL 21D

Current and proposed legislation, current and near-term ethanol production capacity, the economics of ethanol production, and its impact on the balance of trade and the farm sector are examined. GRA

N81-10211# National Oceanic and Atmospheric Administration, Rockville, Md. Office of Ocean Engineering.
REMOTELY OPERATED VEHICLES, AN OVERVIEW
Joseph R. Vadus and R. Frank Busby Dec. 1979 24 p Prepared in cooperation with Busby (R. Frank) Associates, Arlington, Va.
(PB80-201353; NOAA-80052902; NOAA-TR-OOE-6) Avail: NTIS HC A02/MF A01 CSCL 13J

Four types of remotely operated vehicles are identified. The growth, application and utilization of the more than 180 vehicles constructed and under development is discussed. Current operational problems vary, but cable entanglement and system reliability are the dominant technical liabilities. Current development trends are aimed at specialized vehicles and equipment for support of offshore oil and gas exploration, development and production. The advent of low-cost, simplified ROV's has placed this technology in the hands of virtually any activity involved in utilization and investigation of the marine environment. Vehicles developed by worldwide organizations are identified. GRA

N81-10225# Joint Publications Research Service, Arlington, Va.
BIOGAS AS ENERGY SOURCE EXAMINED
Rudolf Wicha *In its* West Europe Rept.: Sci. and Technol., No. 3 (JPRS-74565) 14 Nov. 1979 p 9-11 Transl. into ENGLISH from Unser Umwelt (Vienna), no. 32, 1979 p 6-7

Avail: NTIS HC A05/MF A01

The generation of biogas from animal manure is discussed. The manure can be fermented in fermentation containers at a mesophile temperature of 35 C and an average duration of 30 days. The biogas formed is collected in a gas container, from whence it is conducted to the areas of utilization. The subsequent energy transformation can proceed by means of conventional gas burners for heat generation in hot water heating facilities or for electrical current generation in a gas motor generator aggregate. The long duration (approximately 30 days) until gas formation can be shortened by appropriate measures. A total of 70 percent of the biogas is methane; the carbon dioxide content depends on the temperature of the decomposition process and decreases in proportion to the temperature. The heating value lies at 24,700 kj (5,900 kcal/cum) and can be increased by rinsing out the carbon dioxide to approximately 37,680 kj (9,000 kcal/cum). Such biogas facilities become economically feasible with at least 20 GVE's (1 GVE = 500 kg of live weight). This amounts to 20 cows or 200 hogs or 3,500 hens. M.G.

N81-10226# Joint Publications Research Service, Arlington, Va.
IMPROVED USE, REUSE OF SPENT OIL PROPOSED
In its West Europe Rept.: Sci. and Technol., No. 3 (JPRS-74565) 14 Nov. 1979 p 12-15 Transl. into ENGLISH from Unsere Umwelt (Vienna), no. 32, 1979 p 23-24

Avail: NTIS HC A05/MF A01

The possibilities of reuse for several typical types of mineral oil waste are illustrated with particular reference to their economic feasibility. The utilization of spent oil as an energy source in enterprises with and without specifically designed spent oil burners is examined; environmental considerations are addressed. The refining of spent oil and its reuse as a lubricant are also considered. M.G.

N81-10433# Westinghouse Electric Corp., Tampa, Fla.
DEVELOPMENT OF AUTOMATED WELDING PROCESS FOR FIELD FABRICATION OF THICK WALLED PRESSURE VESSELS, FY 1980 Technical Progress Report, period ending 28 Mar. 1980
U. A. Schneider 1980 72 p
(Contract DE-AC01-78ET-13511)
(DOE/ET-13511/T2) Avail: NTIS HC A04/MF A01

Specifications of 2 1/4 chromium-1 molybdenum low alloy steel plate for a coal gasification project are discussed along with methods of welding and analyses of helium argon mixtures for welding. The tensile properties of welded joints are also examined. DOE

N81-10435# TRW Energy Systems Group, Morgantown, W. Va.
VALVE TECHNOLOGY DEVELOPMENT AT THE MORGANTOWN ENERGY TECHNOLOGY CENTER
Nov. 1979 87 p
(Contract DEAM21-78MC-08496)
(DOE/METC/SP-80/1) Avail: NTIS HC A05/MF A01

During development of second and third generation coal conversion and utilization processes, a recurrent problem was manifested - valve failures. The valve failures are typically caused by erosion, jamming, or other solids handling related problems. Redundant loops to allow on-stream valve maintenance and replacement, process redesign to locate valves in a less severe environment, use of sacrificial valves, and other means to try to eliminate valving were tried. Most of these techniques are expensive, inconvenient, and detrimental to the process. The proposed solution is to: define requirements for valve service that encompass the most promising coal conversion process; obtain input from valve users; survey the valve industry to determine the availability of valves to satisfy the requirements; test available valves to ensure their adequacy; and develop new valves for applications where existing valves are inadequate.

04 FUELS AND OTHER SOURCES OF ENERGY

N81-10442# Fiat Research Center, Turin (Italy).
POTENTIAL OF DIESEL ENGINES, FUELS AND LUBRICATION TECHNOLOGY *Final Report*
Giorgio Cornetti Mar. 1980 62 p refs
(Contract DOT-TSC-1424)
(PB80-197098; DOT-TSC-NHTSA-79-42; DOT-HS-805241) Avail: NTIS HC A04/MF A01 CSCL 21E

The chemical and physical properties of diesel fuel are reviewed along with their relationships to the fuel economy and emissions of diesel powered automobiles and light trucks. The fuels considered include both conventional and alternative diesel fuels. Additives are surveyed and their impacts on combustion and overall engine performance are discussed. The fuel economy potential of future lubricants is investigated, particularly: (1) upgraded mineral oils; (2) synthetic oils; and (3) colloidal suspension in mineral oils. GRA

N81-10491*# GeoSpectra Corp., Ann Arbor, Mich.
THE USE OF RADAR AND LANDSAT DATA FOR MINERAL AND PETROLEUM EXPLORATION IN THE LOS ANDES REGION, VENEZUELA
Robert K. Vincent *In* JPL Radar Geol: An Assessment Rept. of the Radar Geol. Workshop 1 Sep. 1980 p 367-384 refs
(For primary document see N81-10472 01-42)
Avail: NTIS HC A22/MF A01 CSCL 08G

A geological study of a 27,500 sq km area in the Los Andes region of northwestern Venezuela was performed which employed both X-band radar mosaics and computer processed Landsat images. The 3.12 cm wavelength radar data were collected with horizontal-horizontal polarization and 10 meter spatial resolution by an Aeroservices SAR system at an altitude of 12,000 meters. The radar images increased the number of observable suspected fractures by 27 percent over what could be mapped by LANDSAT alone, owing mostly to the cloud cover penetration capabilities of radar. The approximate eight fold greater spatial resolution of the radar images made possible the identification of shorter, narrower fractures than could be detected with LANDSAT data alone, resulting in the discovery of a low relief anticline that could not be observed in LANDSAT data. Exploration targets for petroleum, copper, and uranium were identified for further geophysical work. Author

N81-10506# California Univ., Livermore. Lawrence Livermore Lab.
RESERVOIR RESPONSE TO TIDAL AND BAROMETRIC EFFECTS
Jonathan M. Hanson 29 May 1980 5 p refs Presented at Geothermal Resources Council 1980 Ann. Meeting, Salt Lake City, 9-11 Sep. 1980 Submitted for publicaton
(Contract W-7405-eng-48)
(UCRL-84461; CONF-800920-13) Avail: NTIS HC A02/MF A01

Solid earth tidal strain and surface loading due to fluctuations in barometric pressure have the effect, although extremely minute, of dilating or contracting the effective pore volume in a porous reservoir. If a well intersects the formation, the change in pore pressure can be measured with sensitive pressure gauges. Mathematical models of the relevant fluid dynamics of the well-reservoir system were generated and tested against conventional well pumping results or core data at the Salton Sea Geothermal Field, California and at the Raft River, Geothermal Field, Idaho. Porosity-total compressibility product evaluation based on tidal strain response compares favorably with results based on conventional pumping techniques. Analysis of reservoir response to barometric loading using Auto Regressive Integrated Moving Average stochastic modeling appears also to have potential use for the evaluation of reservoir parameters. DOE

N81-10566# Office of Technology Assessment, Washington, D. C.
RECENT DEVELOPMENTS IN OCEAN THERMAL ENERGY
Apr. 1980 40 p refs
(PB80-201825; OTA/TM-003; LC-80-600074) Avail: NTIS HC A03/MF A01 CSCL 10B

The status of Ocean Thermal Energy Conversion (OTEC) technology developments as of April 1980 are reviewed. Major technical accomplishments and principal technical uncertainties that remain are discussed. GRA

N81-10654# Atmospheric Research and Technology, Inc., Sacramento, Calif.
WIND RESOURCE ASSESSMENT IN CALIFORNIA *Final Report*
Edwin X. Berry May 1980 77 p refs
(PB80-195167; CAEC-51; CAEC-500-80-024) Avail: NTIS HC A05/MF A01 CSCL 10A

A strategy for wind energy prospecting, a design for a wind prospecting instrument, and a method of analysis of wind energy data are provided. The formulation also produces an improved basis for the calculation of wind machine performance using only a few wind parameter measurements. GRA

N81-10830# Los Alamos Scientific Lab., N. Mex.
GENERAL-PURPOSE HEAT SOURCE PROJECT AND SPACE NUCLEAR SAFETY AND FUELS PROGRAM *Progress Report, Mar. 1980*
W. J. Maraman, comp. Jul. 1980 52 p
(Contract W-7405-eng-36)
(LA-8431-PR) Avail: NTIS HC A04/MF A01

The use of 238PuO2 in radioisotopic power systems is discussed. More specifically, the results from the graphite impact shell tests are discussed, along with fuel pellet development. DOE

N81-11171# EIC, Inc., Newton, Mass.
LOW TEMPERATURE THERMOCONVERSION OF BIOMASS TO USEFUL CHEMICALS BY LEWIS ACID CATALYSTS, PHASE 1 *Final Report, 1 Oct. 1979 - 31 Mar. 1980*
V. R. Koch and G. H. Schnaper Mar. 1980 28 p refs
(Grant NSF PFR-79-17513)
(PB80-200462; NSF/RA-800067) Avail: NTIS HC A03/MF A01 CSCL 07D

Lewis acids such as aluminum chloride (AlCl3) were used for thermoconversion of lignocellulosic materials (biomass) into useful organic materials. Temperatures used in the process were lower than those heretofore reported. A renewable domestic resource such as biomass provides an alternative source of industrially important organic materials. Use of a temperature range between those of liquefaction and biological fermentation insures product selectivity at reasonable reaction rates. Rice hulls and AlCl3 were heated in an argon filled reactor from ambient to 175 C. Reaction products collected from 120 C to 175 C consisted of CO, CO2, acetone, methylisobutyl ketone, and three unidentified carbohydrates. GRA

N81-11188# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
CORROSION OF HIGH Ni-Cr ALLOYS AND TYPE 304L STAINLESS STEEL IN HNO3-HF
R. S. Ondrejcin and B. D. McLaughlin Apr. 1980 46 p refs
(Contract DE-AC09-76SR-00001)
(DP-1550) Avail: NTIS HC A03/MF A01

Nineteen alloys were evaluated as possible materials of construction for steam heating coils, the dissolver vessel, and the off-gas system of proposed facilities to process thorium and uranium fuels. Commercially available alloys were found that are satisfactory for all applications. DOE

N81-11200# Lehigh Univ., Bethlehem, Pa.
FRACTURE MECHANICS AND SURFACE-CHEMISTRY STUDIES OF STEELS FOR COAL-GASIFICATION SYSTEMS *Final Technical Report, 17 Sep. 1976 - 31 Dec. 1979*
R. P. Wei and G. W. Simmons May 1980 73 p refs
(Contracts DE-AS01-76ET-10647; DE-AS05-76OR-10647)
(IFSM-80-104) Avail: NTIS HC A04/MF A01

Fracture mechanics and surface chemistry experiments on the kinetics of fatigue crack growth, and on the thermodynamics and kinetics of surface reactions carried out on a 2-1/4Cr-1Mo steel are discussed. The results indicate considerable enhancement of fatigue crack growth by hydrogen sulfide, hydrogen, and water vapor. The degree of enhancement is related to the reactivity of these gases with the steel. Furthermore, the results indicate that the apparent immunity of this steel to stress corrosion cracking does not imply the same immunity to corrosion fatigue. The enhanced segregation of sulfur to free surfaces during heating in hydrogen is found. The crack growth data are discussed in terms of the influences of temperature, gas pressure, and loading variables, and are interpreted in terms of gas transport and chemical reaction kinetics. Quantitative modeling of environment enhancement and inhibition of fatigue crack growth is considered. Preliminary studies of fatigue crack growth in mixtures of H2S and CO indicate that CO reduces the effectiveness of H2S in enhancing crack growth. DOE

N81-11227 Utah Univ., Salt Lake City.
CHARACTERIZATION OF COAL-DERIVED LIQUIDS RELATIONSHIPS TO CHEMICAL STRUCTURES IN COAL Ph.D. Thesis
Kwang Eun Chung 1980 164 p
Avail: Univ. Microfilms Order No. 8025596

The fundamental structural features of a high volatile bituminous coal were investigated by characterizing the liquid products derived from it. The structural features were described quantitatively in terms of heterogeneity, aromaticity, aromatic cluster size and polymeric nature. A scheme for characterization of coal-derived liquid (CDL) was developed based upon available information on coal and CDL. Three CDL's were prepared and characterized according to the scheme. The CDL's were produced in high conversion processes differing in the degree of depolymerization. The characterization of the three CDL's revealed (1) conservation of aromatic clusters during two liquefaction processes, (2) a definite distribution of aromatic clusters in the feed coal, and (3) some polymeric nature of the feed coal materials. Dissert. Abstr.

N81-11228*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
EXPERIMENTAL EVALUATION OF COMBUSTOR CONCEPTS FOR BURNING BROAD PROPERTY FUELS Final Report
J. M. Kasper, E. E. Ekstedt, W. J. Dodds, and M. W. Shayeson Sep. 1980 171 p refs
(Contract NAS2-21594)
(NASA-CR-159855; R80AEG514) Avail: NTIS HC A08/MF A01 CSCL 21I

A baseline CF6-50 combustor and three advanced combustor designs were evaluated to determine the effects of combustor design on operational characteristics using broad property fuels. Three fuels were used in each test: Jet A, a broad property 13% hydrogen fuel, and a 12% hydrogen fuel blend. Testing was performed in a sector rig at true cruise and simulated takeoff conditions for the CF6-50 engine cycle. The advanced combustors (all double annular, lean dome designs) generally exhibited lower metal temperatures, exhaust emissions, and carbon buildup than the baseline CF6-50 combustor. The sensitivities of emissions and metal temperatures to fuel hydrogen content were also generally lower for the advanced designs. The most promising advanced design used premixing tubes in the main stage. This design was chosen for additional testing in which fuel/air ratio, reference velocity, and fuel flow split were varied. Author

N81-11233# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
TOXICITY OF SYNTHETIC HIGH DENSITY AND CONVENTIONAL HYDROCARBON JET FUELS TO A SOIL BACTERIUM Technical Report, Sep. 1978 - Sep. 1979
Sheldon A. London and Charlie R. Mantel Aug. 1980 22 p refs
(AF Proj. 6302)
(AD-A089527; AFAMRL-TR-80-105) Avail: NTIS HC A02/MF A01 CSCL 06/20

The effects of selected high density and conventional jet fuels on the growth kinetics of a soil microorganism were determined. A culture of Enterobacter clocacae isolated from soil was exposed to various concentrations of each fuel in a mineral salts medium and bacterial growth was monitored turbidimetrically and by viable count techniques. Effects were indicated by observing changes in maximum bacterial growth, growth rate, lag time, and death rate. The majority of the fuels studied manifested their effects by decreasing the number of viable organisms during the stationary growth period. Stable emulsion formation resulted in erroneous turbidimetric determinations. The applicability of bacterial systems as indicators of toxicity of water insoluble jet propellants was discussed. GRA

N81-11235# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
INVESTIGATION OF FIRE-VULNERABILITY-REDUCTION EFFECTIVENESS OF FIRE-RESISTANT DIESEL FUEL IN ARMORED VEHICULAR FUEL TANKS Final Report, 25 Sep. 1979 - 30 Sep. 1980
B. R. Wright and W. D. Weatherford, Jr. 30 Sep. 1980 41 p refs
(Contract DAAK70-79-C-0215; DA Proj. 1L7-62733-AH-20)
(AD-A090129; AFLRL-130) Avail: NTIS HC A03/MF A01 CSCL 21/4

Laboratory flammability tests and bench-scale ballistic tests are described which have been used in the development of fire-resistant diesel fuel (FRF). These tests have indicated that FRF, at a bulk liquid temperature of 77 C, would be self extinguishing even if the flash point of its base fuel was less than 62 C. In order to confirm that this self-extinguishing property would prove effective in a realistic combat environment, arrangements were made for a series of tests to be conducted. These tests used 3.2 inch precision shaped charges fired through the armor and internally mounted fuel tanks of M48 battle tank and M113 armored personnel carrier hulks. AFLRL personnel participated in the planning and conducting of the tests, including all FRF blending. Results of the full-scale tests confirmed that residual burning can be eliminated by the use of FRF even though the mist fireball development is similar to that of neat fuel. Transient pressure effects are not affected by FRF, but sustained temperatures are drastically reduced by the FRF self-extinguishment. GRA

N81-11236# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
ENGINE TESTS USING HIGH-SULFUR DIESEL FUEL Final Report
E. A. Frame and R. B. Moon Sep. 1980 112 p refs
(Contract DAAK70-79-C-0215; DA Proj. 1L7-62733-AH-20)
(AD-A090142; AFLRL-129) Avail: NTIS HC A06/MF A01 CSCL 21/4

This report covers the engine test evaluation of an organo-zinc additive for its effectiveness in combating the deleterious effects of using high-sulfur diesel fuel in a two-cycle U.S. Army diesel engine. The report also covers the 6V-53T testing of a preservative engine oil which in previous testing had shown promise in controlling the effects of using high-sulfur fuel. GRA

N81-11237# Science Applications, Inc., McLean, Va.
TECHNICAL-ECONOMIC ASSESSMENT OF THE PRODUCTION OF METHANOL FROM BIOMASS: EXECUTIVE SUMMARY, VOLUME 1 Final Research Report
Edward I. Wan, John A. Simmons, Joseph D. Price, and Tien D. Nguyen 12 Jul. 1979 27 p 3 Vol.
(Contract ET-78-C-01-3002)
(DSE-3002-T1-Vol-1) Avail: NTIS HC A03/MF A01

The results are presented of a comprehensive systems study which assessed the engineering and economic feasibilities of the production of methanol from biomass utilizing existing technology. The three major components of the biomass to methanol system assessed are the availability of biomass feedstocks, the thermochemical conversion of biomass to methanol fuels, and the distribution and markets for methanol fuels. The results of this study show that methanol fuel can be produced from biomass using commercially available technology in the near term, and could be produced economically in significant quantities in the mid to late 1980's when advanced technology is available. DOE

N81-11239# Science Applications, Inc., McLean, Va.
TECHNICAL ECONOMIC ASSESSMENT OF THE PRODUC-

TION OF METHANOL FROM BIOMASS. CONVERSION PROCESS ANALYSIS, VOLUME 3 Final Research Report
Edward I. Wan, John A. Simmons, Joseph D. Price, and Tien D. Nguyen 12 Jul. 1979 353 p refs 3 Vol.
(DSE-3002-T1-Vol-3) Avail: NTIS HC A16/MF A01

Various thermochemical processes suitable for converting biomass to methanol are discussed. The results of the conversion process study are presented, delineating the technical and economic feasibilities of producing methanol fuel from biomass utilizing available technologies. DOE

N81-11240# Mueller Associates, Inc., Baltimore, Md.
SOLID FUEL APPLICATIONS TO TRANSPORTATION ENGINES
Richard L. Rentz and Roy A. Renner Jun. 1980 76 p refs
(Contract DE-AC05-79CS-56051)
(DOE/CS-56051/T2) Avail: NTIS HC A05/MF A01

The utilization of solid fuels as alternatives to liquid fuels for future transportation engines is reviewed. With respect to diesel engines, coal/oil mixtures are addressed because of the high interest in this specific application as a result of the large number of diesel engines currently in transportation use. Final assessments refer to solid fuels only for diesel engines. The technical assessments of solid fuels utilization for transportation engines is summarized. DOE

N81-11245# Los Alamos Scientific Lab., N. Mex.
METHANE HYDRATE AS AN ENERGY RESEARCH. A REVIEW WITH RECOMMENDED FUTURE RESEARCH
B. L. Barraclough Jun. 1980 33 p refs
(Contract W-7405-eng-36)
(LA-8368-MS) Avail: NTIS HC A03/MF A01

A review of current knowledge concerning the nature, evidence for natural occurrence, and resource potential of methane (natural gas) hydrate is presented. Soviet production technology is briefly surveyed, and an outline of research necessary for understanding, assessing, and exploiting unconventional energy resource is included. DOE

N81-11246# Brookhaven National Lab., Upton, N. Y.
FLASH HYDROPYROLSIS OF COAL Quarterly Report, 1 Jul. - 30 Sep. 1979
Meyer Steinberg, Peter Fallon, and Bharat L. Bhatt Dec. 1979 99 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51172; QR-10) Avail: NTIS HC A05/MF A01.

A parametric study of New Mexico sub-bituminous coal is discussed. This coal has been found to be considerably more reactive than the lignite previously studied, particularly at 500 psi where the gaseous yields were approximately twice that of the lignite (35% vs 17%) and liquids two to four times greater (10% vs 2.6 to 4.6%). The relationship between the yield of gaseous hydrocarbons from sub-bituminous coal at 900 C and the hydrogen partial pressure is not as linear as originally thought. At pressures below 1000 psi, there is an absolute increase of 3.75% per 100 psi increase in hydrogen partial pressure while above 1000 0 psi, the value is reduced to 2.2% per 100 psi. Neither the reduction in particle size to less than 50 microns nor the addition of Na2CO3 showed any significant change in yield obtained with the sub-bituminous coal at 900 C and 1000 psi. Data from experiments using North Dakota lignite are analyzed. DOE

N81-11247# Bituminous Coal Research, Inc., Monroeville, Pa.
TEST AND EVALUATE THE TRI-GAS LOW-BTU COAL GASIFICATION PROCESS Quarterly Report, Apr. - Jun. 1980
Jul. 1980 14 p
(Contract DE-AC01-78ET-10254)
(DOE/ET-10254/82; BRC-L-1115) Avail: NTIS HC A02/MF A01

Four tests were conducted in the TRI-GAS PEDU. Test no. 3S-55 was prematurely shut down because of failure of the steam boiler. Steady state operation was not achieved. Following repairs to the steam boiler, test no. 3S-56 was conducted. This test was also terminated prematurely, due to failure of the power controller for the steam boiler. Repairs were again made. In test no. 3S-57, bed temperatures in stages 2 and 3 were lower than required for gasification, although some reaction occurred at the top of the reactors where the temperatures exceeded 1600 F. The test was conducted somewhat prematurely due to plugging of the coal feed line. Test no. 3S-58, an integrated three stage test, was conducted in June. The heating value of the product gas was about 100 Btu per cu ft even though failure of the reactor heaters prevented the stage 2 temperature from exceeding 1550 F. DOE

N81-11248# Rockwell International Corp., Canoga Park, Calif. Environmental and Energy System Div.
ADVANCED DEVELOPMENT OF A SHORT-RESIDENCE-TIME HYDROGASIFIER Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1980
J. Friedman Jul. 1980 161 p refs
(Contract DE-AC01-78ET-10328)
(FE-3125-21) Avail: NTIS HC A08/MF A01

Efforts in the development of the Rockwell single-stage short-residence-time hydrogasifier for the gasification of coal and peat are reported. These involve test results, the design and construction of a 3/4-TPH coal feed rate integrated process development unit, materials and engineering studies for a commercial plant, process optimization, hydrogen production studies, utilization of chars, economic analysis and analytical evaluation of experiments with peat. DOE

N81-11250# Argonne National Lab., Ill. Materials Science Div.
MATERIALS TECHNOLOGY FOR COAL-CONVERSION PROCESSES Progress Report, Jan. - Mar. 1980
Jun. 1980 54 p refs
(Contract W-31-109-eng-38)
(ANL-80-46) Avail: NTIS HC A04/MF A01

Nondestructive testing, failure analysis, and studies of erosive wear, corrosion, and refractory degradation are discussed. Analysis of recent refractory slay interaction tests suggests that as the chromia content is increased from 10 to 32 percent the primary reaction product changes from calcium hexaluminate to spinel, significantly increasing the corrosion resistance of the refractory. Field reliability of the high temperature ultrasonic erosion scanner was demonstrated at both a coal liquefaction plant and a coal gasification plant. Continuous high temperature operation was demonstrated and an accuracy of ±0.025 mm seems achievable. Results of tests utilizing 10,000-h exposures suggest that corrosion rates of 0.6 mm/y can be expected. Failure analysis activities included studies of compressor diaphragms. Cracks were found in two of the three diaphragms. DOE

N81-11251# Battelle Columbus Labs., Ohio.
FUELS FROM BIOMASS SYSTEMS FOR ARID LAND ENVIRONMENTS
Edward S. Lipinsky, Steven Kresovich, J. R. Goodin, ed., and David K. Northington, ed. 1979 13 p refs
(Contract W-7405-eng-92)
(DOE/TIC-11247) Avail: NTIS HC A02/MF A01

Integrated fuels from biomass systems that might function in arid environments are discussed and illustrated. The emphasis is on principles and strategic guidelines for use by those initiating studies on arid land fuels from biomass. DOE

N81-11253# Bituminous Coal Research, Inc., Monroeville, Pa.
SURVEY OF COAL INDUSTRY PROGRAMS FOR UTILIZATION OF METHANE FROM COAL SEAMS Final Report, 31 Mar. - 31 Oct. 1979
David C. Uhrin, F. DuBreuil, and R. D. Saltsman 14 Feb. 1980 39 p refs
(Contract GRI-5010-380-0164)
(PB80-205305; GRI-79/0044; BCR-L-1068) Avail: NTIS HC A03/MF A01 CSCL 21D

The activity in the private sector of the United States regarding removal and utilization of coalbed methane was determined. An attempt was made to learn to what extent and for what purposes coalbed methane is currently being used, what experimental programs exist, and what programs are planned or proposed. Information was obtained primarily from interviews with coal industry personnel familiar with the subject of recovery of methane from coalbeds. GRA

N81-11353# California Univ., Berkeley.
RANDOM CHOICE METHOD FOR CALCULATING FLUID DISPLACEMENT IN A POROUS MEDIUM
N. Albright, C. Anderson, and P. Concus Jun. 1980 12 p refs Presented at 1st BAIL Conf., Dublin, 3 Jun. 1980
(Contract W-7405-eng-48)
(LBL-11086; CONF-800695-1) Avail: NTIS HC A02/MF A01

Multiphase fluid displacement in a porous medium gives rise naturally to the occurrence of steep fronts, for example between different fluids or between regions of differing chemical concentrations. Such fronts pose substantial difficulty for most numerical methods. However, the recently developed random choice numerical method was found capable of following effectively even perfectly sharp fronts. An application to the calculation of immiscible displacement in a petroleum reservoir is discussed, including the effects of capability pressure and gravity. Numerical results of current work for solving a model problem of two phase displacement in two dimensions indicate that the effects of the additional possible interactions of shock and expansion waves permitted by the inclusion of gravity can be handled efficiently within the framework of the random choice method. DOE

N81-11359# General Electric Co., Schenectady, N. Y. Power Generation and Propulsion Lab.
TWO-PHASE FLOW AND HEAT TRANSFER IN FLUIDIZED BEDS Final Report, 1 Aug. 1975 - 30 Jun. 1978
F. W. Staub, R. T. Woods, ed., G. S. Canada, and M. H. McLaughlin Jul. 1980 323 p refs
(EPRI Proj. 525-1)
(EPRI-CS-1456) Avail: NTIS HC A14/MF A01

Cold modeling studies of fluidized bed behavior related to coal combustion provide information required for the design and optimization of fluidized bed systems for power generation. Data for flow regime, bed expansion (void fraction), transverse thermal conductivity, and bare- and finned-tube heat transfer were obtained for beds of single and mixed particle sizes fluidized with air and refrigerant at room temperature. Five and ten row tube banks were tested. Generalized predictive models for the bed flow regimes, the bed expansion, the solids circulation rates, and the transfer to tube banks were developed and shown to be qualified by the data for both local and average bed quantities. DOE

N81-11377# Stanford Univ., Calif. Edward R. Ginzton Lab. of Physics.
REMOTE ATMOSPHERIC MEASUREMENTS OF CH-4 USING A LiNbO3 TUNABLE SOURCE Final Report, Oct. 1978 - Jun. 1979
Robert L. Byer and Martin Endemann Tyndall AFB, Fla. AF Engineering and Services Lab. Mar. 1980 27 p refs
(Grant EPA-R-805750-01; AF Proj. 1900)
(AD-A089993; AFESC/ESL-TR-80-11) Avail: NTIS HC A03/MF A01 CSCL 20/5

A laser transmitter tuned by means of a lithium niobate optical parametric oscillator was employed to demonstrate the capability for remote measurement of gaseous pollutants in the atmosphere. Measurements of methane were obtained continuously over an 18-hour period with a precision of better than 0.06 parts per million. The long path measurements of methane were in excellent agreement with a Bay Area Pollution Control District point monitoring station. Capabilities of the tunable laser transmitter to measure other molecules, as well as atmospheric temperature, are discussed. GRA

N81-11437*# Arkansas Univ., Fayetteville.
EVALUATION OF AIRCRAFT MICROWAVE DATA FOR LOCATING ZONES FOR WELL STIMULATION AND ENHANCED GAS RECOVERY Final Report
H. MacDonald, W. Waite, C. Elachi, R. Babcock, R. Konig, J. Gattis, M. Borengasser, and D. Tolman Jan. 1980 130 p refs
(Contract JPL-955048)
(NASA-CR-163710) Avail: NTIS HC A07/MF A01 CSCL 08G

Imaging radar was evaluated as an adjunct to conventional petroleum exploration techniques, especially linear mapping. Linear features were mapped from several remote sensor data sources including stereo photography, enhanced LANDSAT imagery, SLAR radar imagery, enhanced SAR radar imagery, and SAR radar/LANDSAT combinations. Linear feature maps were compared with surface joint data, subsurface and geophysical data, and gas production in the Arkansas part of the Arkoma basin. The best LANDSAT enhanced product for linear detection was found to be a winter scene, band 7, uniform distribution stretch. Of the individual SAR data products, the VH (cross polarized) SAR radar mosaic provides for detection of most linears; however, none of the SAR enhancements is significantly better than the others. Radar/LANDSAT merges may provide better linear detection than a single sensor mapping mode, but because of operator variability, the results are inconclusive. Radar/LANDSAT combinations appear promising as an optimum linear mapping technique, if the advantages and disadvantages of each remote sensor are considered. Author

N81-11445# Department of Energy, Washington, D. C. Energy Information Administration.
BITUMINOUS COAL AND LIGNITE PRODUCTION AND MINE OPERATIONS, 1978 Energy Data Report
Clyde Boykins Jun. 1980 90 p ref
(DOE/EIA-0118/78) Avail: NTIS HC A05/MF A01

In 1978 bituminous coal and lignite US production totaled 665.1 million tons, a decline of about 3.8 percent from the alltime high of 691.3 million tons in 1977. The drop in production in 1978 was largely the result of the coal miners' strike that began December 6, 1977 and continued until March 25, 1978. Production from underground mines in 1978 totaled 242.2 million tons, down 8.9 percent from 266.0 million tons the previous year. Production from surface mines decreased to 423.0 million tons, 0.6 percent below the 425.4 million tons reported in 1977. The average price of coal (F.O.B. mines) rose 9.8 percent to $21.78 per ton from $19.82 per ton in 1977. At underground mines the average price was $30.94 per ton, up 9.5 percent from $28.25 per ton the previous year. At surface mines it increased 13.5 percent to $16.53 per ton from $14.56 per ton in 1977. The average number of miners employed rose 9.4 percent to 242.295 from 221.428 in 1977. DOE

N81-11464# California Univ., Berkeley. Lawrence Berkeley Lab.
OCEAN THERMAL ENERGY CONVERSION PRELIMINARY DATA REPORT FOR THE FEBRUARY 1978 GOTEC-03 CRUISE TO THE GULF OF MEXICO, MOBILE SITE
Jun. 1980 34 p refs
(Contract W-7405-eng-48)
(LBL-9438) Avail: NTIS HC A03/MF A01

Preliminary physical, chemical, and biological data obtained on the GOTEC-03 cruise in February 27 to March 3, 1978 to the Mobile Site near 29 deg N, 88 deg W are presented in tabular and graphic form. The physical and chemical data consists of salinities and dissolved oxygens derived from water samples and temperatures from XBT's. The biological data includes biomass indicators (chlorophyll a, phaeophytin, and adenosine triphosphate), and zooplankton samples. DOE

N81-11474# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN UNITED STATES. GEOTHERMAL SPACE HEATING: PITTSVILLE MIDDLE/ELEMENTARY SCHOOL, PITTSVILLE, MARYLAND

Roy VonBriesen and Kwang Yu Jun. 1980 33 p
(Contracts EX-76-A-36-1008; DE-AI01-79ET-27025)
(JHU/APL-QM-80-101) Avail: NTIS HC A03/MF A01

A technical evaluation was made to determine whether geothermal energy obtained from a well could be used to space heat the new school building being constructed as well as the existing elementary wing of the Pittsville School. The first part deals with space heating the new school building only; the second part pertains to space heating the new school building together with the new existing wing. An addendum was added for new well and production pump costs. DOE

N81-11495# Oregon Inst. of Tech., Klamath Falls. Geo-Heat Utilization Center.
ALASKA: A GUIDE TO GEOTHERMAL ENERGY DEVELOPMENT
Neil Basescu, R. Gordon Bloomquist, Charles Higbee, Debra Justus, and Stuart Simpson Jun. 1980 125 p refs
(Contracts DE-AS06-77ET-28476; EY-77-C-06-1066)
(DOE/ET-28476/T2) Avail: NTIS HC A06/MF A01

A brief overview is given of the geological characteristics of each region of the state as they relate to potential geothermal development. Those exploration methods which can lead to the siting of a deep exploration well are described. Requirements and techniques needed for drilling deeper higher temperature exploration and production wells are presented. Electrical generation, direct utilization, and indirect utilization are reviewed. Economic factors of direct use projects are presented. A general guide to the regulatory framework affecting geothermal energy development is provided. The general steps necessary to gain access to explore, develop, distribute, and use geothermal resources are outlined. DOE

N81-11496# Oak Ridge National Lab., Tenn.
FOSSIL ENERGY MATERIALS NEEDS ASSESSMENT
R. T. King, comp. and R. R. Judkins, comp. Jul. 1980 144 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7232) Avail: NTIS HC A07/MF A01

An assessment of needs for materials of construction for fossil energy systems was prepared by Oak Ridge National Laboratories staff members who conducted a literature search and interviewed various individuals and organizations that are active in the area of fossil energy technology. Critical materials problems associated with fossil energy systems are identified. Background information relative to the various technologies is given and materials research needed to enhance the viability and improve the economics of fossil energy processes is discussed. The assessment is presented on the basis of materials-related disciplines that impact fossil energy material development. These disciplines include the design-materials interface, materials fabrication technology, corrosion and materials compatibility, wear phenomena, ceramic materials, and nondestructive testing. DOE

N81-11589# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
LASER-RAMAN POINT MONITORING OF CH4 VAPOR IN THE LNG STORAGE FIELD Final Report, 1 Jan. - 31 Dec. 1979
Richard K. Chang and Robert E. Benner Dec. 1979 39 p
Sponsored by Gas Research Inst.
(PB80-205347; GRI-79/0050) Avail: NTIS HC A03/MF A01 CSCL 07D

Use of an eight component hydrocarbon gas which simulated the contents of natural gas demonstrated that unique Raman signatures for each species exist and real time Raman monitoring of each species is possible by detection with an optical multichannel analyzer which can measure simultaneously a large portion of the Raman spectrum. The feasibility of using optical fibers to guide the laser radiation to a remote probe site and to collect/guide the Raman scattered radiation back to the detection system was investigated. GRA

N81-11605# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
APPLICATION OF NATURAL ELECTROMAGNETIC FIELD MAGNETIC FIELD METHODS (MAGNETOTELLURICS/GEOMAGNETIC VARIATIONS) TO EXPLORING FOR ENERGY RESOURCES: DEVELOPMENT OF A BROAD-BAND DATA ACQUISITION/PROCESSING FACILITY Topical Report, 1 May 1979 - 30 Apr. 1980
J. F. Hermance 1980 5 p refs
(Contract DE-AC02-79ER-10401)
(DOE/ER-10401/T1) Avail: NTIS HC A02/MF A01

A review of the present state of knowledge of the deep thermal regimes associated with major rift systems of the world is presented. Field studies of several major tectonomagnetic systems are described. A new magnetotelluric/geomagnetic variation field system for studying thermal regimes in the continental crust was designed and tested. DOE

N81-12196# Midwest Research Inst., Golden, Colo.
RESEARCH INTO THE PYROLYSIS OF PURE CELLULOSE, LIGNIN, AND BIRCH WOOD FLOUR IN THE CHINA LAKE ENTRAINED-FLOW REACTOR
J. Diebold Jun. 1980 41 p refs
(Contract DE-AC02-76CH-00178)
(SERI/TR-332-586) Avail: NTIS HC A03/MF A01

It was determined that the cellulose and wood flour do pyrolyze to produce primarily gaseous products containing significant amounts of ethylene and other useful hydrocarbons. During attempts to pyrolyze powdered lignin, the material melted and bubbled to block the reactor entrance. The pure cellulose and wood flour produced C2 + yields of 12% to 14% by weight, which were less than yields from an organic feedstock derived from processed municipal trash. The char yields were 0.1% by weight from cellulose and 1.5% from birch wood flour one to two orders of magnitude less than were produced from the trash derived feedstock. In scanning electron microscope photographs, most of the wood flour char had a sintered and agglomerated appearance, although some particles retained the gross cell characteristics of the wood flour. The appearance of the char particles indicated that the material had once been molten and possibly vapor before it formed spheroidal particles about 1 micron m diameter which agglomerated to form larger char particles. DOE

N81-12203# Brookhaven National Lab., Upton, N. Y. Process Sciences Div.
REGENERATIVE PROCESS FOR DESULFURIZATION OF HIGH TEMPERATURE COMBUSTION AND FUEL GASES
A. S. Albanese, D. S. Sethi, G. Farber, J. Pruzansky, and F. B. Kainz Mar. 1980 24 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51223) Avail: NTIS HC A02/MF A01

The characteristics of Portland Type III cement (PC III) as a potential sorbent for use in a regenerative process for desulfurization of coal in fluidized-bed combustion were examined. The sulfation rates for PC III + 5% amorphous SiO2 at temperatures between 860 C and 1100 C and at 1 atm were studied thermogravimetrically, using a simulated combustion gas mixture containing 0.25% SO2. The sulfation rates were found to be idenpendent of temperature between 950 C and 1050 C. The isothermal regeneration with a mixture consisting of 5% CO, 15% CO2 and the balance N2, in the above temperature interval of 100 C approached an equilibrium value of over 90% within thirty minutes. Sulfation/regeneration efficiency did not decrease with cycling and was unaffected by additives introduced to increase the porosity and/or conversion of free CaO in PC III to silicates which are known to be more regenerative than CaSO4. Pressurized TGA experiments within the optimum sulfation temperature range were conducted at 5 and 10 atm to establish the viability of this sorbent for pressurized fluidized-bed combustion use. Author

N81-12213# Battelle Columbus Labs., Ohio.
CORRELATION OF THE HIGH-TEMPERATURE CORROSION BEHAVIOR OF STRUCTURAL ALLOYS IN COAL CONVERSION ENVIRONMENTS WITH THE COMPONENTS OF THE ALLOYS AND OF THE CORROSIVE ENVIRONMENTS Final Report, May 1976 - Nov. 1979
I. G. Wright, R. O. Dodds, R. B. Palmer, H. A. Link, W. E. Merz,

and G. H. Beatty 29 Feb. 1980 141 p refs
(Contract EY-76-C-02-0092)
(BMI-2059) Avail: NTIS HC A07/MF A01

Four alloys (Inconel 671, AISI 310, Incoloy 800, and USS 18-18-2) were exposed in a series of statistically designed experiments for times up to 1000 hr in simulated coal gasifier atmospheres at total pressures of 500, 1000 and 1500 psig, and at temperatures of 1382, 1600 and 1800 F. Some data were also generated for alloys GE 1541 and Sandvik 253 MA. The progress of corrosion was evaluated by standardized metallographic techniques, with effects on mechanical properties assessed by post-test tensile tests. The data generated were statistically analyzed to determine trends. The results indicated that increasing temperature exerted a significant effect by increasing the extent of corrosion of Inconel 671, Incoloy 800 and USS 18-18-2, whereas increasing total pressure caused a significant decrease in the extent of corrosion of Incoloy 800 and AISI 310. Temperature was the most important variable affecting the tensile strength of the corroded specimens; the ultimate tensile strength of Inconel 671, AISI 310 and USS 18-18-2 increased (relative to aged specimens) with increasing temperature, suggesting that some corrosion morphologies may not be significantly detrimental. R.C.T.

N81-12216# Argonne National Lab., Ill. Materials Science Div.
CORROSION AND MECHANICAL BEHAVIOR OF MATERIALS FOR COAL GASIFICATION APPLICATIONS
K. Natesan May 1980 98 p refs
(Contract W-31-109-eng-38)
(ANL-80-5) Avail: NTIS HC A05/MF A01

A state-of-the-art review is presented on the corrosion and mechanical behavior of materials at elevated temperatures in coal-gasification environments. The gas atmospheres in coal-conversion processes are, in general, complex mixtures which contain sulfur-bearing components (H2S, SO2, and COS) as well as oxidants (CO2/CO and H2O/H2). Information developed clearly shows sulfidation to be the major mode of material degradation in these environments. The corrosion behavior of structural materials in complex gas environments is examined to evaluate the interrelationships between gas chemistry, alloy chemistry, temperature, and pressure. Thermodynamic aspects of high-temperature corrosion processes that pertain to coal conversion are discussed, and kinetic data are used to compare the behavior of different commercial materials of interest. Areas of additional research with particular emphasis on the development of a better understanding of corrosion processes in complex environments and on alloy design for improved corrosion resistance are discussed. Author

N81-12266# Chem Systems, Inc., Fairfield, N.J.
DEVELOPMENT OF ALCOHOL-BASED SYNTHETIC TRANSPORTATION FUELS FROM COAL-DERIVED SYNTHESIS GASES Quarterly Progress Report, 1 Jan. - 31 Mar. 1980
15 Aug. 1980 77 p refs
(Contract DE-AC22-79ET-14858)
(DOE/ET-14858/2; QPR-2) Avail: NTIS HC A05/MF A01

Nineteen catalysts were prepared by (1) evaporation of metal nitrate citric acid solutions; (2) coprecipitation of nitrates with carbonates; (3) mechanical blending of the metal oxide (or nitrate) powders or (4) modification of commercial methanol synthesis catalysts. Fourteen catalysts were tested in either the Berty gradientless reactor or the plug flow reactor. Previously reported selectivities to liquid products were determined with a more refined gas chromatographic system. A preliminary technoeconomic assessment of three potential synthesis reactor systems (liquid fluidized, multitube, jacketed fixed bed or adiabatic fixed bed) was made which indicated that there are significant capital cost and operating cost savings associated with the use of a liquid fluidized reactor system. DOE

N81-12268# Department of Energy, Bartlesville, Okla. Bartlesville Energy Technology Center.
COMPOSITION OF LIQUIDS FROM COALS OF DIFFERENT RANK
G. P. Sturm, Jr., J. S. Thomson, P. W. Woodward, and J. W. Vogh Sep. 1980 48 p refs
(DOE/BETC-RI-80/1) Avail: NTIS HC A03/MF A01

Eight coal liquids prepared from six coals of widely differing rank were compared with respect to their suitability as potential feedstocks for production of refined fuels. The coal liquids were prepared and upgraded by hydrogenation in a batch autoclave. The reaction conditions employed were selected to minimize hydrocarbon ring opening reactions and, at the same time, to produce most of the hydrocarbon liquids potentially available from the coals. The degree of hydrogenation of the raw coal liquids was varied as required to decrease the nitrogen content to about the same level and to provide a predominantly hydrocarbon liquid for analysis. In general, the results show that liquids of comparable suitability as feedstocks for production of refined fuels can be produced from coals of different rank. DOE

N81-12269# AMAF Industries, Columbia, Md.
COAL CONVERSION ENGINEERING ANALYSIS FOR CENTRAL HUDSON GAS AND ELECTRIC CORPORATION, DANSKAMMER GENERATING STATION, UNITS 3 AND 4 Final Report
1980 40 p refs
(Contract DE-AC01-79RG-10075)
(DOE/RG-10075/T1) Avail: NTIS HC A03/MF A01

The technical and economic feasibility of converting from oil to coal firing power plants was examined. Oil to coal conversion is technically feasible, but modifications or additions to existing plant equipment are required to meet coal handling needs and pollution control regulations. DOE

N81-12270# Department of Energy, Bartlesville, Okla. Energy Technology Center.
EXHAUST AND EVAPORATIVE EMISSIONS FROM GASOHOL-TYPE FUELS
T. M. Naman and J. R. Allsup Aug. 1980 13 p refs
(DOE/BETC-RI-80/7) Avail: NTIS HC A02/MF A01

An experimental study was conducted to determine the characteristics of gasohol-type fuels with respect to exhaust and evaporative emissions. Five fuels, 2 gasolines (reference and commercial unleaded) and 3 gasohols (90% gasoline/10% ethanol) were tested in a fleet of 10 late-model automobiles. Six were equipped with oxidation catalysts and 4 were equipped with three-way catalysts. The results obtained from the 1978 Federal test procedure indicate that the addition of ethanol to the base gasoline, whether it is a reference fuel (Indolene) or a commercial fuel, has measurable effects on exhaust and evaporative emissions. However, on the average, the magnitude of these effects was generally within the 1978 emission standards established by the EPA. DOE

N81-12271# Battelle Columbus Labs., Ohio.
ASSESSMENT OF THE POTENTIAL OF COLLOIDAL FUELS IN FUTURE ENERGY USAGE Final Report
25 Feb. 1980 121 p refs
(Contract DE-AC01-79ER-10062)
(DOE/ER-10062/T1) Avail: NTIS HC A06/MF A01

Pulverized coal has been an increasing important source of energy over the past century. Most large utility boilers, all modern coking plants, and many industrial boilers and blast furnaces employ pulverized coal as a major feed stream. In periods of oil shortages, such as during World Wars I and II, the concept of adding powered coal to oil for use in combustion equipment originally designed for oil was actively pursued but rarely used. Over this same period of time, there were attempts to use air suspensions of coal dust in diesel engines in Germany, and in turbines in various countries. The economic advantages to be enjoyed by substitution of powdered coal in oil are not generally realized. Oil costs at $30/bbl represent a fuel value of about $5.00/10 Btu; coal at $25/ton is equivalent to approximately $1.00/10 Btu. Although capital costs for the use of coal are higher than those associated with the use of oil, coal is clearly becoming the least costly fuel. DOE

N81-12273# Colorado School of Mines, Golden. Dept. of Chemical and Petroleum Refining Engineering.
MECHANISMS AND KINETICS OF COAL HYDROGENATION Progress Report, Jan. - Jun. 1980
J. H. Gary, R. M. Baldwin, and R. L. Bain Jul. 1980 37 p refs
(Contract DE-AC01-79ET-14881)
(DOE/ET-14881/2) Avail: NTIS HC A03/MF A01

The objective of this task was to utilize the continuous flow bench scale coal liquefaction reactor system to investigate the rate of reaction of different coals at different processing conditions. Particularly, reaction rates at short residence times are to be measured in a Continuous Flow Stirred Tank Reactor and this information used to model reactions in the Plug Flow Reactor section of the unit. Work during the past six months was focused on completing modifications to the unit itself, as the bench scale system was originally designed to be operated at residence times just under 30 minutes. The new residence times are to be, at the least, just less than six minutes. The experimental portion will be a comparative study of the effect of different processing conditions on the rate of coal liquefaction. During the past six months, work on the continuous unit has been confined to modifications and system tuneup. DOE

N81-12277# Brookhaven National Lab., Upton, N. Y. Process Sciences Div.
THE FLASH HYDROGENATION OF BIOMASS
Meyer Steinberg 1980 7 p refs Presented at the 11th Biomass Thermochem. Conversion Contractors Meeting, Richland, Wash., 23-24 Sep. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28297; CONF-800973-2) Avail: NTIS HC A02/MF A01

It is proposed to obtain process chemistry information on the rapid hydrogenation of biomass (wood and other agricultural products) to produce light liquid and gaseous hydrocarbon fuels and feedstocks. The process is referred to as Flash Hydropyrolysis. The information will be of use in the design and evaluation of processes for the conversion of biomass to synthetic fuels and petrochemical feedstocks. Author

N81-12278# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
ALTERNATIVE PROCESS SCHEMES FOR COAL CONVERSION
Michael J. Sansone, Richard Sapienza, and William Stieger Apr. 1980 50 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51233; PR-4) Avail: NTIS HC A03/MF A01

The separation of H2/CH4 and H2/CH4/CO mixtures resulting from coal gasification processes is discussed. The separation calculations were performed for ideal, cryogenic, clathrate (gas-hydrate), and absorption/stripping separation processes. The cryogenic separation indicates the least energy requirement. A review of existing and developing coal gasification processes is presented. The relative merits of gasifier type, heating method, operating mode, process conditions, and gasifying medium are considered. M.G.

N81-12280# Argonne National Lab., Ill. Chemical Engineering Div.
SUPPORT STUDIES IN FLUIDIZED-BED COMBUSTION Annual Report, Oct. 1978 - Sep. 1979
Irving Johnson, K. M. Myles, W. M. Swift, S. H. D. Lee, J. A. Shearer, A. A. Siczek, F. G. Teats, W. I. Wilson, W. A. Boyd, E. B. Smyk et al 1979 85 p refs
(Contracts W-31-109-eng-38; EPA-IAG-D5-E681)
(ANL/CEN/FE-79-14) Avail: NTIS HC A05/MF A01

The technical data base needed for the design of granular filters to remove gaseous alkali metal compounds from hot flue gas, with either diatomaceous Earth or activated bauxite used as a sorbent was developed. The effect of NaCl vapor concentration in flue gas on the sorption performance of diatomaceous earth and activated bauxite was studied. The ultimate NaCl vapor sorption capacities of diatomaceous Earth and activated bauxite was obtained. R.C.T.

N81-12429# Ames Lab., Iowa.
PRESSURE VESSELS FOR COAL LIQUEFACTION: AN OVERVIEW
T. E. Scott 1980 37 p refs Presented at ASTM Symp. on the Appl. of 2 1/4 CR-1 mo Steel for Thick Wall Pressure Vessels, Denver, 18 May 1980
(Contract W-7405-eng-82)
(IS-M-282; CONF-8005108-1) Avail: NTIS HC A03/MF A01

The existing world economic and political climate has intensified the need for a domestic source of liquid fuels. With dwindling crude oil reserves the need for alternative sources of liquid fuels has become pressing. Coal derived liquids can be an important substitute for crude oil. A key component of process plants designed to liquify coals is the reactor. Coal liquefaction pressure vessels (reactors) for anticipated commercial operations are large by conventional standards. They must maintain a high level of reliability for lifetimes from 20 to 30 years while operating at temperatures near 425 C and while containing a variety of sulfurous species and hydrogen at pressures up to about 28 MPa. This paper attempts to emphasize the role of reactors in the coal liquefaction process and to point out potential life limiting aspects which must be considered in the design, construction, and operation of these large, thick walled pressure vessels. DOE

N81-12523*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OVERALL REQUIREMENTS FOR AN ADVANCED UNDERGROUND COAL EXTRACTION SYSTEM
Martin Goldsmith and Milton L. Lavin 15 Oct. 1980 102 p refs
(Contracts NAS7-100; DE-AI01-76ET-12548)
(NASA-CR-163748; JPL-Pub-80-39; DOE/ET-12548/1) Avail: NTIS HC A06/MF A01 CSCL 08I

Underground mining systems suitable for coal seams expoitable in the year 2000 are examined with particular relevance to the resources of Central Appalachia. Requirements for such systems may be summarized as follows: (1) production cost; (2)miner safety; (3) miner health; (4) environmental impact; and (5) coal conservation. No significant trade offs between production cost and other performance indices were found. A.R.H.

N81-12524*# Southwest Research Inst., San Antonio, Tex.
COAL THICKNESS GUAGE USING RRAS TECHNIQUES, PARTS 2 AND 3 Final Report
J. Derwin King and W. L. Rollwitz Sep. 1980 62 p refs
(Contract NAS8-32606)
(NASA-CR-161607) Avail: NTIS HC A04/MF A01 CSCL 08I

Electron magnetic resonance was investigated as a sensing technique for use in measuring the thickness of the layer of coal overlying the rock substrate. The goal is development of a thickness gauge which will be usable for control of mining machinery to maintain the coal thickness within selected bounds. A sensor must be noncontracting, have a measurement range of 6 inches or more, and an accuracy of 1/2 inch or better. The sensor should be insensitive to variations in spacing between the sensor and the surface, the response speed should be adequate to permit use on continuous mining equipment, and the device should be rugged and otherwise suited for operation under conditions of high vibration, moisture, and dust. Finally, the sensor measurement must not be adversely affected by the natural effects occurring in coal such as impurities, voids, cracks, layering, high moisture level, and other conditions that are likely to be encountered. Author

N81-12533# University of Southern California, Los Angeles. Dept. of Petroleum Engineering.
CARBON DIOXIDE FOR THE RECOVERY OF CRUDE OIL Annual Report, Nov. 1978 - Nov. 1979
T. M. Doscher Aug. 1980 61 p refs
(Contracts DE-AM03-76SF-00113; EY-76-S-03-0113)
(DOE/SF-0113/4) Avail: NTIS HC A04/MF A01

The ratios of gravitational and viscous forces which exist in tertiary recovery operations, using carbon dioxide as a recovery reagent, were approximated in a scaled physical model at ambient pressure and temperature. The viscosity ratio was now very unfavorable and displacement of moveable water was inefficient. Consequently, the displacement of the residual oil by the solvent, which was simulating the role of carbon dioxide, was also poor. The recovery efficiency could not be improved by reasonable increases in the fluid velocity because the unfavorable mobility caused viscous fingering was so dominant. Insomuch as carbon dioxide flooding, an imperfectly miscible recovery process, these experiments point to the need for imposing a strong measure of mobility control if the injection of carbon dioxide is to achieve widespread usage for the recovery of residual oil. DOE

N81-12534# Battelle Columbus Labs., Ohio.
SORGHUMS AS ENERGY CROPS
E. S. Lipinsky and S. Kresovich 1980 18 p Presented at the BioEnergy World Congress and Exposition, Atlanta, 21-24 Apr. 1980
(Contract W-7405-eng-92)
(CONF-800482-5) Avail: NTIS HC A02/MF A01

The botanical, physiological, and agronomic characteristics of sorghum are described. Integration concepts to improve sorghum prospects are discussed as follows: multiple sweet sorghum crops each year, integration with sugarcane, integration with sugar beets, integration with starch crops, sweet stemmed grain sorghum, and integration with lignocellulosic crops. DOE

N81-12550*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN INDUSTRIAL APPLICATION OF THE JPL ACTS WITH ENERGY RECOVERY
Marshall F. Humphrey, George E. Wilson (Eutek, Inc., Sacramento, Calif.), and Terry W. Schroepfer (Eutek, Inc., Sacramento, Calif.) 23 Sep. 1980 49 p refs
(Contract NAS7-100)
(NASA-CR-163807; JPL-9950-449) Avail: NTIS HC A03/MF A01 CSCL 10A

The JPL Activated Carbon Treatment System (ACTS) uses sewage solids derived from municipal wastewater treatment systems as a source of organic material for powdered activated carbons (PAC). The PAC is used for the COD removal from wastewater and as a filter aid in the recovery of additional sewage solids. L.F.M.

N81-12649# Joint Economic Committee (U. S. Congress).
THE IMPACT OF AN ACCELERATED COAL-BASED SYNFUELS PROGRAM ON WESTERN WATER RESOURCES
Washington GPO 1980 108 p refs Avail: SOD HC (GPO-61-316)

Effects of an accelerated synthetic fuels program on the water resources of the northern Great Plains are discussed. S.F.

N81-12861# Brookhaven National Lab., Upton, N. Y. Dept. of Nuclear Energy.
THE APEX ACCELERATOR CYCLE FOR TRANSMUTATION OF LONG-LIVED FISSION WASTES
J. Powell, M. Steinberg, H. Takahashi, P. Grand, T. Botts, and H. J. C. Kouts 1980 30 p refs Presented at the Intern. Conf. on Nucl. Wastes Transmutation, Austin, Tex., Jul. 1980
(BNL-28282; CONF-800743-1) Avail: NTIS HC A03/MF A01

The accelerator fuel enricher and fission product exterminator (APEX) approach to the transmutation of fission wastes is described. Using an accelerator-driven neutron source, fissile fuel can be bred in situ (e.g., 238 U is converted to 239 Pu by neutron absorption) in reactor fuel assemblies. The rejuvenated fuel is reused in reactors. After fuel reprocessing and partitioning, stable and low hazard fission products are disposed of. Transuranics are returned to the nuclear fuel cycle, along with the remaining fissile and fertile fuel. Selected fission products (e.g., 90Sr and 137Cs) can either be recycled along with the nuclear fuel (APEX-1) or transmuted (APEX-2). The necessary accelerator and target technologies are relatively well developed and can be applied in a few years. One accelerator fuel enricher/transmutor can service a substantial number of reactors (e.g., 3 to 10), depending on type of target and nature of fuel cycle. M.G.

N81-12988*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COAL GASIFIER COGENERATION POWERPLANT PROJECT
Lloyd I. Shure and Harvey S. Bloomfield *In its* Impact for the 80's: Proc. of a Conf. on Selected Technol. for Business and Ind. Nov. 1980 p 123-131

Avail: NTIS HC A11/MF A01 CSCL 21D

Industrial cogeneration and utility pr systems were analyzed and a conceptual design study was conducted to evaluate the economic feasibility of a coal gasifier power plant for NASA Lewis Research Center. Site location, plant size, and electric power demand were considered in criteria developed for screening and selecting candidates that could use a wide variety of coals, including that from Ohio. A fluidized bed gasifier concept was chosen as the baseline design and key components of the powerplant were technically assessed. No barriers to environmental acceptability are foreseen. If funded, the powerplant will not only meet the needs of the research center, but will reduce the commercial risk for utilities and industries by fully verifying and demonstrating the technology, thus accelerating commercialization. A.R.H.

N81-13182# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
DEVELOPMENT OF ARMY HIGH ENERGY FUEL FOR DIESEL/TURBINE POWERED SURFACE EQUIPMENT Interim Technical Report, Oct. 1977 - Oct. 1979
William W. Wimer and Edwin C. Owens Oct. 1979 119 p refs
(Contracts DAAK70-78-C-0001; DAAK70-80-C-0001; DA Proj. 1L7-62733-AH-20)
(AD-A091318; AFLRL-120) Avail: NTIS HC A06/MF A01 CSCL 21/4

This is a status report on the U.S. Army's ongoing program on high energy fuels for diesel/turbine powered surface equipment. The Army is interested in those fuels that have a high energy content per unit volume and therefore result in increased payload capabilities and/or extended operational range of their vehicles. Two types of high energy fuels are discussed in this report. The first being the synthetic liquid hydrocarbon fuels of the polycondensed cycloparaffinic type; the second being the powdered solids/hydrocarbon slurries. Background information is provided on several of the synthetic liquid hydrocarbon fuels; the Air Force's and the Navy's interests in these fuels are discussed; and a brief review of their chemistry and properties are included. Examples of these fuels are JP-9, JP-10 (exo-tetrahydrodicyclopentadiene), and RJ-5. Background material is also provided on various carbonaceous materials considered for use in slurry preparation. The selection of the carbons to be used along with their properties, are described. Also discussed are the mixing devices used in the preparation; the various dispersants considered; the stability of the various slurries; and the methods and techniques for measuring their settling rates and determining their stability. GRA

N81-13183# Sandia Labs., Albuquerque, N. Mex. Systems Analysis.
CONSIDERATION FOR BIOMASS ENERGY SYSTEMS
Charles C. Carson and Carolyne M. Hart May 1980 80 p refs Sponsored by DOE
(SAND-80-0073) Avail: NTIS HC A05/MF A01

Several different biomass forms, or feedstocks, contribute to the total potential for biomass energy. A summary of the energy potentials of the U.S. biomass resource base is presented along with a survey of existing thermochemical and biochemical processes for converting the feedstocks into usable energy products. Energy requirements, economics, and alternate uses for biomass resources are included in the discussion. It is concluded that the current biomass resources could provide up to 2.5 EJ of usable energy and that with a concentrated, long-term program this contribution could grow to between 10 and 15 EJ. The biomass feedstock with the largest potential is wood, which provides more than half of the estimated total. DOE

N81-13185# Fluor Engineers and Constructors, Inc., Irvine, Calif.
ENTRAINED GASIFICATION COMBINED CYCLE CONTROL STUDY, VOLUME 1. SUMMARY OF RESULTS AND CONCLUSIONS Final Report
J. Clark, L. Denton, M. Hashemi, J. Joiner, S. Smelser, C. Chowaniec, M. Hobbs, S. Jennings, and E. Phelts Jun. 1980 119 p Prepared in cooperation with Westinghouse Electric Corp., *Concordville, Pa.*
(EPRI Proj. 913-1)
(EPRI-AP-1422-Vol-1) Avail: NTIS HC A06/MF A01

Two control strategies are evaluated for an entrained coal gasifier fueling a gas turbine/steam turbine combined-cycle power plant which was simulated by computer. Transient operation of this gasification-combined-cycle (GCC) plant was studied to determine open-loop response as a stand-alone plant, as well as closed-loop response while functioning in a typical utility power system. The GCC plant may be controlled satisfactorily in either gasifier-lead or turbine-lead control mode. The absorber column consistently removed 90% of the hydrogen sulfide (H2S) in the raw fuel gas produced from high sulfur Illinois coal during the closed loop control runs. GCC plant pressure control must be installed to minimize plant pressure transients of the absorber column in the acid gas removal unit. The local controllers adequately maintained the GCC plant operation during all the emergency upsets examined. Supplemental fuel gas storage is not required. The design and operating characteristics of the oxygen plant can affect the response time of the GCC plant. DOE

N81-13186# Mueller Associates, Inc., Baltimore, Md.
POTENTIAL SOURCES OF NON-PETROLEUM BASED ALCOHOLS FOR VEHICULAR FLEET TESTING
Dec. 1979 23 p refs
(Contract EX-76-C-01-2098)
(DOE/CS-56051/2) Avail: NTIS HC A02/MF A01

The commercialization of alternative fuels as a supplement to or replacement for petroleum based fuels is considered. Fuel fleet tests are described which are to employ alcohol/gasoline blends. The prospects of obtaining these alcohols from nonpetroleum/nonnatural gas feedback is discussed in terms of fuel efficiency and cost. A number of sources are described from which methanol and ethanol can be obtained. R.C.T.

N81-13187# Dynatech Corp., Cambridge, Mass.
LIQUID FUELS PRODUCTION FROM BIOMASS Progress Report, 1 Jul. - 30 Sep. 1979
J. E. Sanderson, D. L. Wise, P. F. Levy, and M. S. Molyneaux 15 Oct. 1979 33 p refs
(Contract EG-77-C-02-4388)
(COO-4833-9; PR-8; Rept-1956) Avail: NTIS HC A03/MF A01

A current program to convert biomass into liquid hydrocarbon fuels is described. It it shown that marine algae could be converted to higher aliphatic organic acids and that these acids could be readily removed from the fermentation broth by membrane or liquid-liquid extraction. It is also shown that these higher organic acids can be converted to aliphatic hydrocarbons via Kolbe Electrolysis, which may be used as a diesel fuel. R.C.T.

N81-13188# Mueller Associates, Inc., Baltimore, Md.
BIOMASS AS A FEEDSTOCK FOR HIGHWAY VEHICLE FUELS: A RESOURCE AND AVAILABILITY SURVEY
Dec. 1979 54 p refs
(Contract EX-76-C-01-2098)
(DOE/CS-56051/1) Avail: NTIS HC A04/MF A01

The use of biomass as a feedback for highway vehicle transportation fuels (alcohols) is addressed. The scope is limited to aggregate, nationwide supply aspects without consideration for overall system economics or the availability of alcohol processing facilities (which, of course, would be major factors that would affect the implementation of biomass based transportation fuels). A first ordered estimate is presented of the range of alcohol fuels that could be produced (again, from strictly a supply viewpoint) based on known biomass availability and with consideration for land use limitations, time factors and technology improvements. R.C.T.

N81-13191# Chevron Research Co., Richmond, Calif.
REFINING AND UPGRADING OF SYNFUELS FROM COAL AND OIL SHALES BY ADVANCED CATALYTIC PROCESSES Quarterly Report, Jan. - Mar. 1980
R. F. Sullivan and D. J. ORear Mar. 1980 41 p
(Contract EX-76-C-01-2315)
(FE-2315-52) Avail: NTIS HC A03/MF A01

Asphaltenelike impurities in the Illinois and Wyodak H-Coal syncrudes were found to have a large effect on the performance of the hydrotreating catalyst which upgrades these syncrudes to jet or diesel fuels. When these impurities are removed by redistilling the syncrudes, the space rate of the Illinois H-Coal syncrude hydrotreater can be increased from 0.5 to 1.5 with constant product quality and catalyst performance. After hydrotreating, a small amount of 600 F + oil in the products from the whole H-Coal syncrudes made the products fail several jet fuel tests: gravity, gum content, end point, and occasionally freeze point. When the 600 F + oil was removed, either by distilling the syncrude or hydrotreated product, these specifications were met. DOE

N81-13192# Department of Energy, Washington, D. C. Energy Information Administration.
CRUDE PETROLEUM, PETROLEUM PRODUCTS, AND NATURAL GAS LIQUIDS, 1978 Final Report
Nov. 1979 38 p
(DOE/EIA-0108/78) Avail: NTIS HC A03/MF A01

Production of crude petroleum (including lease condensate) in the United States in 1978 averaged 8,707,000 barrels per day, an increase of 5.6% above 1977 levels. Imports of crude petroleum in 1978 averaged 5,356,000 barrels per day, 3.9% lower than the previous year. Thirty-two tables are presented which demonstrate the contrast between domestic energy production and the importation of foreign fuel stocks. R.C.T.

N81-13193# Sandia Labs., Albuquerque, N. Mex.
KINETICS AND MECHANISMS OF THE HYDROLIQUEFACTION OF COAL: ILLINOIS NO. 6, BURNING STAR COAL IN SRC-2 HEAVY DISTILLATE
M. G. Thomas and T. C. Dickel 1980 13 p refs
(SAND-80-0232C; CONF-800929-1) Avail: NTIS HC A02/MF A01

The study was conducted to obtain rates of reaction and activation energies for one coal - Illinois no. 6, Burning Star high volatile bituminous coal and one solvent - coal process derived SRC-11 Heavy Distillate (450 to 850 F distillation range). Coal to solvent ratio, reaction time, temperature, and pressure are variables in a parametric study between 275 C and 475 C. Two different types of reactors were employed, a microreactor system for screening and a continuous flow reactor for the derivation of kinetic data. No attempt to generalize the results is made. L.F.M.

N81-13194# Sandia Labs., Albuquerque, N. Mex.
COAL LIQUEFACTION PROCESS RESEARCH Quarterly Report, Jan. - Mar. 1980
T. C. Bickel, R. M. Curlee, B. Granoff, T. D. Padrick, F. V. Stohl, and M. G. Thomas 1980 59 p refs Sponsored by DOE
(SAND-80-1426) Avail: NTIS HC A04/MF A01

Coal liquefaction is discussed in order to provide a fundamental understanding of the process. Studies of three major subjects are presented: short-contact-time coal liquefaction, mineral effects, and catalyst studies. The tasks associated with each are outlined prior to a discussion of specific accomplishments. L.F.M.

N81-13195# *Oak Ridge National Lab., Tenn.*
FUELS AND CHEMICALS FROM WOODY BIOMASS PROGRAM, SUMMARY. CONTRACTOR REPORTS Quarterly Progress Report, Sep. - Dec. 1979
1979 93 p
(Contract W-7405-eng-26)
(DOE/TIC-11254; QPR-6) Avail: NTIS HC A05/MF A01

Species selection, stand establishment, cultural treatments and management alternatives are discussed. Harvest, collection, transport, and storage are described. DOE

N81-13196# Institute of Gas Technology, Chicago, Ill.
PREPARATION OF A COAL CONVERSION SYSTEMS TECHNICAL DATA BOOK Quarterly Report, 1 Aug. - 31 Oct. 1979
Sep. 1980 397 p
(Contract DE-AC01-76ET-10255)
(FE-2286-56) Avail: NTIS HC A17/MF A01
Coal storage, handling, and preparation are discussed. The Data Book format was used. DOE

N81-13198# Schnittker Associates, Washington, D.C.
ETHANOL: FARM AND FUEL ISSUES
Aug. 1980 160 p
(PB80-215692; NAFC-80-04) Avail: NTIS HC A08/MF A01 CSCL 21D
The current U.S. and world grain situations are described as well as adjustments which would be likely for fuel production of 1,2 and 4 billion gallons of ethanol annually in the 1985-86 period. Predicted acreage shifts in corn, soybeans, wheat and the total of seven major crops are shown. The most likely effects on the feed grains markets both here and abroad are discussed. The value of corn for fuel both with and without the gasoline tax exemption is compared to the actual farm price expected if in the base case (1 billion gallons) real corn prices do not rise. In the higher 2 and 4 billion gallon cases, increases in the real cost of corn and its impact on food prices and the CPI are estimated. GRA

N81-13201# Massachusetts Inst. of Tech., Cambridge. LNG Research Center.
LIQUEFIED NATURAL GAS GELS: STRUCTURE, RHEOLOGY, AND PRODUCTION ENERGY REQUIREMENTS Final Report, Jan. 1976 - Dec. 1979
Robert C. Reid, Lucile M. Shanes, and Preetinder S. Virk Dec. 1979 81 p refs
(Contract GRI-5010-352-0011)
(PB80-210685: GRI-77/0012) Avail: NTIS HC A05/MF A01 CSCL 21D
Liquefied natural gas was gelled with two gelants, water and methanol, using a vapor condensation technique. Gelant particle structure analysis, by X-ray diffraction, composition determination and microscopic observation showed that the particles were crystalline clathrate solids with hydrogen bonding between gel particles likely responsible for the observed gel structure. LNG gels offer safety benefits in transporting natural gas. Measurements of LNG gel vaporization from a water surface showed that the gels boiled at rates about one-half those of normal LNG. With rheological data used to predict gel spreading behavior, it was estimated that a typical gel could reduce the maximum distance for flammable mixtures fivefold. GRA

N81-13409*# London Univ. (England).
HCMM IMAGERY FOR THE DISCRIMINATION OF ROCK TYPES, THE DETECTION OF GEOTHERMAL ENERGY SOURCES AND THE ASSESSMENT OF SOIL MOISTURE CONTENT IN WESTERN QUEENSLAND AND ADJACENT PARTS OF NEW SOUTH WALES AND SOUTH AUSTRALIA Progress Report
Monica M. Cole, Principal Investigator 30 Apr. 1980 4 p
Sponsored by NASA HCMM
(E81-10050; NASA-CR-163760) Avail: NTIS HC A02/MF A01 CSCL 05B
Only photographic prints and negative films of day-visible, day-IR and night-IR imagery were received. For northwest Queensland, only five day-visible and day-IR frames of acceptable quality were received. A master-grid was established over these frames within which selected grid sections are being enlarged photographically for the identification of stream courses and geological features permitting an interpretation of the imagery relative to ground truth information. The imagery is also being scanned and digitized using a Joyce-Loebl microdensitometer for classification purposes. For areas for which good quality HCMM imagery is available, valuable information is obtained on ephemeral and seasonal drainage systems. The day-IR cover is particularly helpful. A.R.H.

N81-13434*# Mississippi State Univ., Mississippi State.
APPLICATION OF REMOTE SENSING TO STATE AND REGIONAL PROBLEMS Semiannual Progress Report, 1 May - 31 Oct. 1980
W. Frank Miller, Bradley D. Carter, Jimmy L. Solomon, Sidney G. Williams, John S. Powers, and Jon R. Clark, Principal Investigators 1 Nov. 1980 63 p Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Grant NGR-25-001-054)
(E81-10078; NASA-CR-163776; SAPR-14) Avail: NTIS HC A04/MF A01 CSCL 08B
Progress is reported in the following areas: remote sensing applications to land use planning Lowndes County, applications of LANDSAT data to strip mine inventory and reclamation, white tailed deer habitat evaluation using LANDSAT data, remote sensing data analysis support system, and discrimination of unique forest habitats in potential lignite areas of Mississippi. Other projects discussed include LANDSAT change discrimination in gravel operations, environmental impact modeling for highway corridors, and discrimination of fresh water wetlands for inventory and monitoring. E.D.K.

N81-13504# Dow Chemical Co., Midland, Mich. Dept. of Process Development.
ENERGY FROM TRUE IN SITU PROCESSING OF ANTRIM SHALE: SAMPLING AND ANALYTICAL SYSTEMS
R. K. Pihlaja Aug. 1980 106 p refs
(Contract DE-AC01-76ET-12153)
(FE-2346-75) Avail: NTIS HC A06/MF A01
Reliable on-line analysis of production gas composition is fundamental to the success of an in situ extraction experiment in Antrim shale. An automated sampling and analysis system designed to meet this need provided high quality analytical data for three extraction trials without a single day when no data were taken. The production gas samples were routinely analyzed by both gas chromatography and a bank of continuous on-line process gas analyzers. The process gas analyzers measured CO, CO2, total hydrocarbons and O2 continuously. The process gas analyzers were shown to be especially well suited for this application because of their fast response. The GC data provided itemized composition details as well as the independent check of process analyzer data. The combination of the two analytical techniques and automated data handling yielded a versatile and powerful system. DOE

N81-13505# Dow Chemical Co., Midland, Mich. Dept. of Process Development.
ENERGY FROM TRUE IN SITU PROCESSING OF ANTRIM SHALE: EXTRACTION TRIALS IN AN EXPLOSIVELY FRACTURED SITE
M. L. VanDerPloeg, C. A. Peil, C. G. Kinkel, R. K. Pihlaja, D. A. Murdick, J. R. Frost, and M. M. Lund Aug. 1980 135 p refs
(Contract DE-AC01-76ET-12153)
(FE-2346-73) Avail: NTIS HC A07/MF A01
Three in situ energy extraction trials were conducted at an oil shale site in Michigan. Here the Antrim shale layer occurs between 1200 and 1400 feet underground. The three trials, lasting 7, 60 and 17 days respectively, were conducted in a formation prepared by explosive fracturing. Ignition energy was generated with a methane burner. Some energy in the form of a dilute fuel gas was recovered in each trial but upon ignition drastic decreases in flow communication occurred between injection and production wells. That problem prevented the planned exploration of techniques which would raise the energy value of the production gas. Upon cool down of the formation after each trial, air permeability tests showed inter-well communication levels returning to near preburn levels. Thermal expansion is the most likely cause of the reduced permeability experienced under retorting conditions. DOE

N81-13507# Engineering Societies Commission on Energy, Inc., Washington, D. C.
RESEARCH PROGRAMS RELEVANT TO FOSSIL-ENERGY TECHNOLOGY Final Report
L. D. Conta Aug. 1980 61 p
(Contracts DE-AC01-77ET-10679; EF-77-C-01-2468)
(FE-2468-81) Avail: NTIS HC A04/MF A01

An overview of energy R, D, and D programs in government agencies, industry, and the professional societies as they appear to be of particular importance to the development of fossil-energy technologies is presented. The diversity of programs and sponsoring organizations involved are discussed and the interrelationship of the research activities is pointed out. A framework is provided upon which the potential for additional technology transfer and cooperative efforts can be examined. DOE

N81-13536# Purdue Univ., Lafayette, Ind.
SELECTIVE SOLVENTS EXTRACTION IN UTILIZATION OF STORED SOLAR ENERGY IN CELLULOSIC BIOMASS Final Report, 1 Jan. 1978 - 31 Dec. 1979
George T. Tsao 1 Jul. 1980 292 p refs
(Contract DE-AC02-78ET-20481)
(DOE/ET-20481/4) Avail: NTIS HC A13/MF A01

Work on cellulose utilization which analyzes treatment of lignocellulose materials with various cellulose solvents to enhance the rate and extent of cellulose conversion to glucose is discussed. The mechanism of cellulose solvents in dissolving cellulose the hydrolysis of solvent treated cellulose, aqueous gel permeation chromatography, membrane reactor for enzymatic hydrolysis of cellulose, and the fermentation of corn stover hemicellulose hydrolysis to butanediol and ethanol are included. DOE

N81-13538# NEUS, Inc., Santa Monica, Calif.
BIOSOURCES DIGEST: A JOURNAL ON BIOMASS UTILIZATION, VOLUME 2, NO. 1 Quarterly Report
Harry Sobel Jan. 1980 74 p refs
(Grant NSF PFR-77-12500)
(PB80-209364; NSF/RA-800060-Vol-2-No-1) Avail: NTIS HC A04/MF A01 CSCL 10A

Current research in biotechnology in Turkey is summarized. Grant awards are listed by title, author, and institution together with abstracts. Publications received are itemized as are pertinent patents and a schedule of forthcoming meetings. Five technical articles are presented: kinetics and mechanisms of steam gasification of biomass in the presence of alkali carbonates; a low investment approach to alcohol fermentation; Sheldon-Arleta Landfill gas recovery Facility; strip-mined land revegetation using municpal sludge; and bioconversion of plant residues into chemicals; production of chemicals from lignin. GRA

N81-13539# NEUS, Inc., Santa Monica, Calif.
BIOSOURCES DIGEST: A JOURNAL ON BIOMASS UTILIZATION, VOLUME 2, NO. 2 Quarterly Report
Harry Sobel Apr. 1980 81 p refs
(Grant NSF PFR-77-12500)
(PB80-210214; NSF/RA-800084-Vol-2-No-2) Avail: NTIS HC A05/MF A01 CSCL 10A

Technical papers are presented on the following subjects: thermochemical conversion activities funded by the biomass energy systems branch, U.S. Dept. of Energy; a microbial route for acrylic acid production; the supply of Douglas Fir and its potential for biomass utilization; California's program converts biomass residues to energy; opportunites and plans for a biosolar economy in Brazil, and its challenge to the developed world; and testimony on alcohol fuels. Grant awards are listed by title, award number, principle investigator institution, and project description. The title, author, and price of recent publications are given. Pertinent patents are listed by number, title, and inventor. GRA

N81-13576# Massachusetts Inst. of Tech., Cambridge.
SEISMOLOGICAL INVESTIGATION OF CRACK FORMATION IN HYDRAULIC ROCK FRACTURING EXPERIMENTS AND IN NATURAL GEOTHERMAL ENVIRONMENTS Progress Report, 1 Sep. 1979 - 31 Aug. 1980
Keiiti Aki Sep. 1980 93 p refs
(Contract DE-AS02-76ER-02634)
(DOE/ER-02534/6) Avail: NTIS HC A05/MF A01

Seismic experiments, attenuation of high frequency shear waves in the lithosphere, a new kinematic source model for deep volcanic tremors, ground motion in the near-field of a fluid-driven crack and its interpretation in the study of shallow volcanic tremore, low velocity bodies under geothermal areas are described. Events on Mt. St. Helens and Newberry Peak are included. DOE

N81-13579# Woods Hole Oceanographic Institution, Mass.
GEOTHERMAL PROCESSES AT THE GALAPAGOS SPREADING CENTER Ph.D. Thesis
Kenneth E. Green Aug. 1980 237 p refs
(Grants NSF OCE-77-28281; NSF OCE-77-23470; NSF OCE-75-23352)
(PB80-220247; WHOI-800-33) Avail: NTIS HC A11/MF A01 CSCL 08G

Measurements of the heat flow field of the Galapagos Spreading Center in an area of about 570 sq km revealed the planform of the conductive flux. This permitted an areal estimate of the near-axis flux for comparison with theoretical plate cooling models. GRA

N81-13582# Texas Univ. at Austin. Bureau of Economic Geology.
GEOLOGIC STUDIES OF GEOPRESSURED AND HYDROPRESSURED ZONES IN TEXAS Annual Report, Jan. 1979 - Jan. 1980
R. A. Morton, B. R. Weise, and A. R. Gregory 30 Jan. 1980 54 p refs
(Contract GRI-5011-321-0125)
(PB80-219611; GRI-79/0061) Avail: NTIS HC A04/MF A01 CSCL 08G

Zones were defined on the basis of pressure gradients and temperatures. High-sandstone corridors, corresponding to the trends of the Wilcox group and Frio Formation, were identified for the Geopressured and deep hydropressured zones. Five fairways, or areas of maximum sandstone, were located within the corridors. Areas most prospective for testing entrained methane resources in the shallow geopressured and deep hydropressured zones were identified in each fairway. GRA

N81-13586 Virginia Polytechnic Inst. and State Univ., Blacksburg.
THE REFLECTED WAVEFORM OF A SPHERICAL SEISMIC WAVE Ph.D. Thesis
Paul Michael Krail 1980 143 p
Avail: Univ. Microfilms Order No. 8028149

In oil exploration, it is customary to analyze the seismic waves produced by a test explosion in terms of plane elastic waves interacting with plane homogeneous layers. The analysis is extended to spherical waves, using Sommerfeld's expansion of a spherical wave as a contour integral over plane waves and then obtaining the spherical reflection coefficient by integration over the (plane wave) Zoeppritz coefficient. The result is evaluated analytically by the method of steepest descent (following Brekhovskikh's treatment for the simpler case of fluid media). Computer plots comparing the spherical and plane wave coefficients vs. angle and material parameters are given. It is demonstrated that, when the source to receiver distance is comparable with the wavelength, the plane wave analysis can make an error in the velocity ratio of the order of 30%. With the new expression for the spherical reflection coefficient, both the magnitude and the phase of the reflected waveform depend substantively upon the properties of the media (whereas the phase information is discarded in the plane wave analysis). Dissert. Abstr.

N81-13601# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
WEATHER AND CURRENTS IN THE VICINITY OF 23 DEG N, 46 DEG W, NORTH ATLANTIC OCEAN

Peter Fleischer Sep. 1980 24 p refs
(AD-A090630; NORDA-TN-74) Avail: NTIS HC A02/MF A01 CSCL 04/2

This technical note is a review of climate, sea conditions, and currents in March at Deep Sea Drilling Project Site 395A. The site is located on the upper west flank of the Mid-Atlantic Ridge. Weather is favorable for hole re-entry and related operations. Frequencies of storms, high winds, high seas and low visibility are well below 5%. Normal surface current speeds are 0.34-0.66 kn; intermediate and bottom current speeds are 0.19-0.29 kn, with infrequent maximum speeds to 0.78 kn.GRA

N81-14044# Department of Energy, Morgantown, W. Va. Energy Technology Center.

DEVELOPMENT OF A SIMPLE FLUIDIZED-BED COAL COMBUSTION MODEL FOR THE ASSESSMENT OF A PRESSURIZED FLUIDIZED-BED COMBUSTION SYSTEM FOR ELECTRICAL POWER GENERATION

S. C. Saxena (Illinois Univ., Chicago) and D. G. Turek (Science Applications, Inc., Morgantown, W. Va.) Jul. 1980 141 p refs
(DOE/METC/SP-80/15) Avail: NTIS HC A07/MF A01

The model considered all the essential ingredients of coal combustion and sulfur absorption in fluidized bed reactors. These included coal devolatilization, char combustion in a bed of dolomite or calcium carbonate, sulfur retention in the fluidized bed elutriation from the bed, and heat removal by cooling tubes imbedded in the bed. The model is presented and a numerical scheme was proposed which will permit the calculation of bed temperature, coal combustion efficiency, sulfur retention, flue gas composition, and overflow from the bed. Numerical results are presented in which the dependence of the various combustion and operating parameters was examined. Author

N81-14056# Argonne National Lab., Ill. Chemical Engineering Div.

SUPPORT STUDIES IN FLUIDIZED-BED COMBUSTION Annual Report, Oct. 1978 - Sep. 1979

Irving Johnson, K. M. Myles, W. M. Swift, S. H. D. Lee, J. A. Shearer, A. A. Siczek, F. G. Teats, W. I. Wilson, W. A. Boyd, and E. B. Smyk Aug. 1980 81 p refs
(Contracts W-31-109-eng-38; EPA-IAG-DS-E681)
(PB80-218613; ANL/CEN/FE-79-14; EPA-600/7-80-156; IERL-RTP-1082) Avail: NTIS HC A05/MF A01 CSCL 13B

Laboratory and process development studies were aimed at providing needed information on limestone utilization. The removal of particulates and alkali metal compounds from the flue gas, control of SO2 and trace pollutant emissions, the mechanism of attrition in fluidized beds, a method of determining the attrition resistance of sorbents, and other aspects of fluidized bed coal combustion are described. GRA

N81-14070# Pittsburgh Univ., Pa. Dept. of Metallurgical and Materials Engineering.

HOT CORROSIVITY OF COAL GASIFICATION PRODUCTS ON GAS TURBINE ALLOYS Summary Report, 15 Apr. 1978 - 15 Nov. 1979

G. H. Meier and E. A. Gulbransen 1979 115 p refs
(Contract DE-AC01-79ET-13547)
(DOE/ET-13547/T1) Avail: NTIS HC A06/MF A01

The major steps in the chronology of hot corrosion of Ni-, Co-, and Fe-base alloys under the influence of deposits likely to form when coal conversion products are used as fuels were studied. These steps involve the melting and wetting behavior of sulfate deposits, the initiation of rapid hot corrosion, and the propagation of the attack. The effects of alloy composition and microstructure, salt composition, temperature, atmosphere composition and thermal cycling on these phenomena were observed. Results show that (1) simple Cr_2O_3 forming alloys of both Co and Ni have good hot corrosion resistance to most of the deposits likely to form in turbines burning coal conversion products with the exception of deposits containing considerable amounts of chlorides; (2) uncoated alloys will not be able to provide the required combination of corrosion resistance and high temperature strength for any of the components in turbines running on coal gas; and (3) several alloys including Co-18Cr-6A1-1Hf, Co-27Cr, Co-20Ni-27Cr, Ni-50Cr, and Fe-18Cr-6A1-Hf have corrosion resistance for use as coatings and claddings at high temperatures (900-1000 C). A.R.H.

N81-14089# University of Southern Mississippi, Hattiesburg.

IMPROVED POLYMERS FOR ENHANCED OIL RECOVERY SYNTHESIS AND RHEOLOGY

Jun. 1980 253 p refs
(Contract EF-77-S-05-5603)
(DOE/BETC-5603/10) Avail: NTIS HC A12/MF A01

The effects of macromolecular structure on aqueous rheological behavior were studied. Simple, yet effective screening tests were developed to project performance under field conditions. Random- and graft-copolymers served as models for use as mobility control agents in enhanced oil recovery. T.M.

N81-14111# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

AN EXPERIMENTAL STUDY OF METHANOL REFORMATION M.S. Thesis - Arizona Univ.

John Bradford Shafer Dec. 1979 111 p refs
(AD-A091412; AFIT-CI-79-240T) Avail: NTIS HC A06/MF A01 CSCL 07/3

Transportation vehicles: overall efficiency could be greatly increased if a hydrogen-air fuel cell served as the power source. Carrying hydrogen on board a vehicle presents immense weight and safety problems, however, and the fuel cell vehicle has so far been successful only in space or research study. Reforming of a source fuel into a hydrogen-rich gas offers a solution to the problems, especially if waste heat from the fuel cell can be used in the reforming. This paper discusses the ideas behind fuel cell vehicles, the choice of methanol as the source fuel and the detailed design and construction of a reformer system to test the possibilities. The reformer system is now operating at The University of Arizona, and early data has provided successful results. The system was designed to be reliable and capable of testing methanol reforming using variables of temperature, pressure, methanol to water ratio, carbon buildup, flow rate and differing catalysts. Early results predict that at temperatures of 400 F and below a larger catalyst volume may be required to produce the volume of hydrogen needed at fuel cell maximum power. Ethanol research is proposed. GRA

N81-14113# American Energy Research Co., Mclean, Va.

OPPORTUNITIES FOR COAL TO METHANOL CONVERSION

Apr. 1980 80 p refs
(Contract DE-AC01-79CS-50009)
(DOE/CS-50009/01) Avail: NTIS HC A05/MF A01

The accumulations of mining residues in the anthracite coal regions of Pennsylvania offer a unique opportunity to convert the coal content into methanol that could be utilized in that area as an alternative to gasoline or to extend the supplies through blending. Additional demand may develop through the requirements of public utility gas turbines located in that region. The delivered cost at the pump for methanol produced from coal mining wastes could range between $6.20 and $7.86 per million Btu. L.F.M.

N81-14114# Ohio State Univ., Columbus. Dept. of Chemistry.

DEVELOPMENT AND OPTIMIZATION OF METHODOLOGIES FOR ANALYSIS OF COMPLEX HYDROCARBON MIXTURES Progress Report, 1 Jan. - 31 Aug. 1980

Richard J. Laub 1980 12 p
(Contract DE-AC02-80ER-10554)
(DOE/ER-10554-T1) Avail: NTIS HC A02/MF A01

Studies designed to explore and to clarify the a priori prediction of optimum conditions for the chromatographic separation of complex mixtures of organic compounds are described. Optimization strategies with regard to open tubular columns in analytical gas chromatography are presented. Studies of various modes of liquid chromatographic fractionation and separation of complex hydrocarbon mixtures are described. A very useful fractionation methodology, termed rotating disk thin layer chromatography, was developed. T.M.

N81-14115# Pennsylvania State Univ., University Park.
GASIFICATION OF DISORDERED CARBONS (CHARS) Annual Progress Report, 1 Aug. 1979 - 31 Oct. 1980
P. L. Walker, Jr. and R. G. Jenkins Jun. 1980 72 p refs
(Contract DE-AC02-79ER-10488)
(DOE/ER-10488-1) Avail: NTIS HC A04/MF A01

It was shown that rates of gasification of chars derived from coals vary widely with the rank of coal and the gasification medium used. Variation in rates is thought to be attributable to: (1) variation in active surface area and (2) extent to which gasification is catalyzed by inorganic impurities present. Progress in research covers three areas: (1) measurement of rate constants for the adsorption step in the reaction of O2 with a high purity char at low pressures, (2) design and construction of a high pressure reactor to be used to measure rate constants for the desorption step in the reaction of O2 with carbons, and (3) development of small angle X-ray scattering to characterize both dispersion of catalysts supported on carbon and the micropore system of chars. Author

N81-14116# Pittsburgh and Midway Coal Mining Co., Shawnee Mission, Kans.
EXPLORATORY RESEARCH ON SOLVENT REFINED COAL LIQUEFACTION Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1979
Jul. 1980 56 p refs
(Contract DE-AC01-79ET-14800)
(DOE/ET-14800/11) Avail: NTIS HC A04/MF A01

In a series of experiments with varying feed gas composition, high levels (20-40 mole %) of carbon monoxide resulted in a 3 general degradation of operability and reduced oil yields from Powhatan coal (Pittsburgh Seam). Addition of finely divided pyrite to the reactive Powhatan coal had little effect on oil yields although the molecular weight of the distillation residue was apparently decreased. When finely divided pyrite and magnetite were added to the less reactive Loveridge coal (also Pittsburgh Seam), however, a substantial increase in oil yields and product quality was obtained. Author

N81-14117# Pittsburgh and Midway Coal Mining Co., Shawnee Mission, Kans.
EXPLORATORY RESEARCH ON SOLVENT REFINED COAL LIQUEFACTION Annual Technical Progress Report, 1 Jan. - 31 Dec. 1979
Sep. 1980 100 p refs
(Contract DE-AC22-79ET-14800)
(DOE/ET-14800/13) Avail: NTIS HC A05/MF A01

Process alterations and reactor performance characteristics were analyzed. In a series of experiments with varying feed gas composition, low levels (5-10 mole percent) of carbon monoxide had little effect on the SRC II processing of Pittsburgh Seam coal while higher levels (20-40 mole percent) resulted in a general degradation of operability and reduced oil yields. Addition of finely divided pyrite to the reactive Powhatan coal had little effect on oil yields although the molecular weight of the distillation residue was apparently decreased. When finely divided pyrite and magnetite were added to the less reactive coals, however, substantial increases in oil yields and product quality were obtained. In a comparison of upflow and downflow dissolver configurations with Powhatan coal in the SRC II mode, there was no difference in yields or product quality. M.G.

N81-14118# 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. 1980
Calvin H. Bartholomew 10 Jul. 1980 26 p refs
(Contract DE-AC01-79ET-14809)
(DOE/ET-14809/3) Avail: NTIS HC A03/MF A01

A 15% Fe-3% K2O on SiO2 catalyst, a 15% Co-3% K2O on SiO catalyst and a 15% CoB/SiO2 catalyst were prepared. H2 and CO chemisorption uptakes were measured for the catalysts prepared to date. It was noted that calcining the iron catalysts in air before reduction in flowing H2 aided in increasing metal dispersion. Liquid and wax traps for use in the reactor system were completed as were plans for chromatographic product analysis. Author

N81-14119# Colorado School of Mines, Golden. Dept. of Chemical and Petroleum-Refining Engineering.
ENTHALPY MEASUREMENT OF COAL-DERIVED LIQUIDS Quarterly Technical Progress Report, Oct. 1979 - Mar. 1980
A. J. Kidnay and V. F. Yesavage 15 Sep. 1980 103 p refs
(Contract DE-AC22-79ET-13395)
(DOE/ET-13395/3-4) Avail: NTIS HC A06/MF A01

A survey of the existing methods for detecting and quantifying the effect of association, owing to hydrogen-bonding, resulted in the selection of viscosity measurements and cryoscopic molecular weight determinations as the two techniques most suitable for determining the effect of association. Viscosity measurements from 70 to 190 F and at atmospheric pressure were made on 8 pure compounds and 7 coal liquids. The accuracy of the measurements was determined to be within plus or minus 5% of the measured value. Viscous enthalpies were then calculated using the above data and effective molecular weights determined. Author

N81-14120# California Univ., Berkeley. Dept. of Chemical Engineering.
PHASE-EQUILIBRIA FOR DESIGN OF COAL GASIFICATION PROCESSES. DEW POINTS OF HOT GASES CONTAINING CONDENSIBLE TARS Final Report
J. M. Prausnitz May 1980 142 p refs
(Contract EF-76-C-01-2046)
(DOE/ET-10603/T1) Avail: NTIS HC A07/MF A01

Small quantities of tar samples were fractionated in a spinning-band column. Each fraction was then chemically classified with elemental analysis and proton NMR. Based on approximate chemical classification, methods are presented for the estimation of vapor pressures and molecular weights required for predicting tar condensation conditions. Results are presented for two tars. T.M.

N81-14123# Bechtel National, Inc., San Francisco, Calif.
ETHANOL PRODUCTION FOR AUTOMOTIVE FUEL USAGE Final Technical Report, Jul. 1979 - Aug. 1980
R. A. Stenzel, J. Yu, T. E. Lindemuth, R. Soo-Hoo, S. C. May, Y. J. Yim, and E. H. Houle Aug. 1980 152 p refs
(Contract DE-AC07-79ID-12050)
(DOE/ID-12050/3) Avail: NTIS HC A08/MF A01

Production of ethanol from potatoes, sugar beets, and wheat using geothermal resources in the Raft River area of Idaho is evaluated. A 20 million gallon per year ethanol facility was selected as the largest scale plant that can be supported with the current agricultural resources. The conceptual plant is designed to operate on each of these three feedstocks for a portion of the year, but could operate year round on any of them. The processing facility uses conventional alcohol technology and uses geothermal energy for all process heating. There are three feedstock preparation sections, although the liquefaction and saccharification steps for potatoes and wheat involve common equipment. The fermentation, distillation, and by-product handling sections are common to all three feedstocks. The results of the evaluation suggest that a commercial scale geothermal alcohol facility in the Raft River is technically feasible and could be economically attractive, given the state and federal gasohol tax incentives. M.G.

N81-14124# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
CROSSED REACTION NETWORKS IN THE CATALYTIC HYDRODENITROGENATION OF SYNTHETIC LIQUID FUELS Quarterly Report, 1 Feb. - 30 Apr. 1980
Charles N. Satterfield and Shan Hsi 1980 11 p refs
(Contract DE-AC22-80PC-30094)
(DOE/PC-30094/1) Avail: NTIS HC A02/MF A01

The design of a hydrodenitrogenation reactor is discussed. The hydrodenitrogenation reactions are carried out in a laboratory scale trickle bed reactor, where the gas phase and liquid phase flow concurrently downward through a fixed bed of catalyst particles while the reaction takes place. The overall process flow sheet is given. The system is divided into the following sections: gas feed control system; liquid feed system; trickle bed reactor; gas liquid separation and sampling; sample analysis; automatic safety design; and clean up system. Each is described in some detail. M.G.

N81-14125# Argonne National Lab., Ill.
ALCOHOL PRODUCTION FROM AGRICULTURAL AND FORESTRY RESIDUES
L. Dale, R. Opilla, and T. Surles Sep. 1980 56 p refs Sponsored by DOE
(DOE/EV-0108) Avail: NTIS HC A04/MF A01

The production of ethanol from whole corn is discussed, with emphasis placed on the environmental aspects of the process, including land utilization and possible air and water pollutants. Ethanol is derived from renewable cellulosic substances by either enzymatic or acid hydrolysis of cellulose to sugar, followed by conventional fermentation and distillation. The use of two agricultural residues is reviewed: corn stover (field stalks remaining after harvest) and straw from wheat crops as a cellulosic feedstock. Two processes were evaluated with regard to environmental impact: a two stage acid process and an enzymatic process. The environmental residuals expected from the manufacture of methyl and ethyl alcohols from woody biomass are examined. The methanol is produced in a gasification process, whereas ethanol is produced by hydroloysis and fermentation processes similar to those used to derive ethanol from cellulosic materials. S.F.

N81-14126# Department of Energy, Washington, D. C. Coal Conversion Div.
COAL GASIFICATION QUARTERLY REPORT, APRIL - JUNE 1979
Apr. 1980 69 p refs
(DOE/FE-0002-79/2) Avail: NTIS HC A04/MF A01

DOE's program for the conversion of coal to gaseous fuels is discussed. Both high and low Btu gasification processes are being developed. High-Btu gas can be distributed economically to consumers in the same pipeline systems now used to carry natural gas. Low Btu gas, the cheapest of the gaseous fuels produced from coal, can be used economically only on site, either for electric power generation or by industrial and petrochemical plants. Author

N81-14127# Department of Energy, Morgantown, W. Va.
METHANE RECOVERY FROM COALBEDS. PROJECT PLAN DOCUMENT, FY 1981 Executive Summary Report
Sep. 1980 41 p refs
(DOE/TIC-11269) Avail: NTIS HC A03/MF A01

The Methane Recovery from Coalbeds Project for the utilization of the resource as an alternate fuel source is discussed. The project has clearly identified technology needs, potential uses, and some of the environmental, legislative, and social barriers. Some of the major milestones are as follows: (1) over 30 wells were drilled, cored, logged, and tested and well test reports prepared; (2) six reports were issued defining the characteristics of coal basins, including updated estimates of the coalbed methane resources; (3) research performed on fracture mechanics, stimulation, directional drilling, and horizontal drilling; (4) environmental, economic, and legal aspects of the technology were described; (5) ten production technology development projects are either in progress, or completed. L.F.M.

N81-14128# Missouri Univ. -Rolla.
PROGRESS IN WOOD GASIFICATION AT THE UNIVERSITY OF MISSOURI-ROLLA
M. E. Findley, V. J. Flanigan, Y. Omurtag, and H. H. Sineath 1980 25 p Presented at the 11th Biomass Thermochemical Conversion Contractors Meeting, Richland, Wash., 23-24 Sep. 1980
(Contract DE-AC02-79ET-23029)
(CONF-800973-1) Avail: NTIS HC A02/MF A01

The system provides recycle gas to fluidize the 40 inch reactor and permits the use of catalyst. The design allows the recycle gas to be scrubbed for CO2 removal if desired. Data from the preliminary testing of the facility is included. Some of the data was taken from a 6 inch reactor duplicating the larger system. The smaller reactor is also described. Gas Btu measurements were made with levels of 376 Btu using oxygen in the bed and 369 Btu in recycle alone. Principal factors affecting product gas quality and quantity are the material balance factors and the quantity of char and tar produced. The char and tar production is related primarily to reactor bed temperature, and can be used with feed rate and air rate to calculate the ratio of total carbon in all gas components to nitrogen. The carbon to nitrogen ratio allows estimation of heating value and total carbon and hydrogen concentrations in the dry gas from correlations. DOE

N81-14130# Engineering Societies Commission on Energy, Inc., Washington, D. C.
ALTERNATE FUELS FOR INDUSTRIAL COMBUSTION ENGINES. REPORT ON TASK 018
R. L. Thomas Jun. 1980 92 p refs
(Contracts DE-AC01-77ET-10679; EF-77-C-01-2468)
(FE-2468-77) Avail: NTIS HC A05/MF A01

The various options for producing alternate fuels (synfuels) for large industrial combustion engine use are examined from the standpoint of current fuel usage and future engine development trends. This general class of engine in sizes above 1500 horsepower is widely utilized in the utility, transportation and industrial sectors to meet a variety of mechanical power needs. Consequently, industrial engine fuel demands are expected to be an important consideration as to which alternate fuels are developed as well as their commercial properties. The current emphasis on the development of various concepts for the processing of gaseous and distillate fuels from coal and shale will provide a reliable fossil fuel source for industrial engine utilization well beyond the year 2000. DOE

N81-14133# National Bureau of Standards, Washington, D.C. Office of Recycled Materials.
RECYCLED PROGRAM: PHASE 1-TEST PROCEDURES FOR RECYCLED OIL USED AS BURNED FUEL Final Report
D. A. Becker and J. J. Comeford Aug. 1980 97 p refs
Supersedes NBSIR78-1453
(PB80-215536; NBS-TN-1130; NBSIR-78-1453) Avail: NTIS HC A05/MF A01 CSCL 21D

The Energy Policy and Conservation Act requires the National Bureau of Standards (NBS) to develop test procedures which can be used to establish the substantial equivalence of recycled oils with new oils. The first phase of the NBS program is described. Test procedures are given which may be used for establishing the substantial equivalency of recycled petroleum oils (including blends of recycled oils with new oils) to new oils for use as a burner fuel. The test procedures were selected and evaluated for their ability to reliably measure the property under test. GRA

N81-14135# Dynatech Corp., Cambridge, Mass.
BIOCONVERSION OF BIOMASS GASIFIER PRODUCT GASES TO ORGANIC CHEMICALS Final Report, 1 Nov. 1978 - 13 Apr. 1980
P. F. Levy, G. W. Barnard, S. P. Evangelos, A. M. Boyer, and C. A. Tracy Apr. 1980 105 p refs
(Grant NSF PER-78-16404)
(PB80-216641; DYNATECH-2021; NSF/RA-800187) Avail: NTIS HC A06/MF A01 CSCL 21D

A simple and efficient high pressure culturing technique was developed as a means of selecting bacterial populations that could use gaseous substrates. A number of bacterial cultures were selected on the basis of their ability to use either carbon monoxide/hydrogen (CO/H2) or carbon dioxide/hydrogen (CO2/H2). Cultures were successfully developed from mixed bacterial sources that utilize CO2/H2 or CO/H2. The primary liquid product is acetic acid which is formed from carbon contained in the feed gas. Other organic acids (propionic, butyric, valeric) were detected in the cultures, but the carbon source for these acids was not conclusively shown to be the feed gas. GRA

N81-14252# Utah Univ., Salt Lake City. Earth Science Lab. Div.

INTERPRETATION OF DIPOLE-DIPOLE ELECTRICAL RESISTIVITY SURVEY, COLADO GEOTHERMAL AREA, PERSHING COUNTY, NEVADA

Claron E. Mackelprang Sep. 1980 94 p refs
(Contract DE-AC07-80ID-12079)
(DOE/ID-12079/11; ESL-41) Avail: NTIS HC A05/MF A01

An electrical resistivity survey in the Colado geothermal area, Pershing County, Nevada has defined areas of low resistivity on each of five lines surveyed. Some of these areas appear to be fault controlled. Thermal fluids encountered in several drill holes support the assumption that the hot fluids may be associated with areas of low resistivity. The evidence of faulting as interpreted from modeling of the observed resistivity data is therefore particularly significant since these structures may be the conduits for the thermal fluids. Sub-alluvial fault zones are interpreted to occur between stations 0-5 NW on Line D and on Line A between stations 4 NW and 4 SE. Fault zones are also interpreted on Line C near stations 1 NW, 1 SE, and 3 SE, and on Line E between stations 2-4 NW and near 1 SE. No faulting is evident under the alluvial cover on the southwest end of Line B. A deep conductive zone is noted within the mountain range on two resistivity lines. There is no definite indication that thermal fluids are associated with this resistivity feature. DOE

N81-14386# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN UNITED STATES: EVALUATION OF POTENTIAL GEOTHERMAL RESOURCE AREAS

Franklin O. Mitchell Jul. 1980 53 p refs Revised
(Contracts EX-76-A-36-1008; DE-AL01-79ET-27025)
(PB80-212806; APL/JHU/QM-79-163R/GT-Rev) Avail: NTIS HC A04/MF A01 CSCL 08I

A method for the comparative evaluation of geothermal prospects in the eastern United States is proposed and illustrated. Comparisons are based on quantified data from geologic, engineering, and socioeconomic sources including temperature gradient, depth to basement, drilling costs, population, and distribution by town size, as well as energy use in residential, commercial, and industrial applications. This revision incorporates new data for Mississippi and Pennsylvania. GRA

N81-14396*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CATALYTIC COMBUSTION OF COAL-DERIVED LIQUIDS

Daniel L. Bulzan and Robert R. Tacina 1981 25 p refs Presented at 26th Ann. Intern. Gas Turbine Conf., Houston, Tex., 8-12 Mar. 1981; sponsored by ASME
(Contract DE-AI01-77ET-10350)
(NASA-TM-81594; E-661; DOE/NASA/10350-21) Avail: NTIS HC A02/MF A01 CSCL 10B

A noble metal catalytic reactor was tested with three grades of SRC 2 coal derived liquids, naphtha, middle distillate, and a blend of three parts middle distillate to one part heavy distillate. A petroleum derived number 2 diesel fuel was also tested to provide a direct comparison. The catalytic reactor was tested at inlet temperatures from 600 to 800 K, reference velocities from 10 to 20 m/s, lean fuel air ratios, and a pressure of 3 x 10 to the 5th power Pa. Compared to the diesel, the naphtha gave slightly better combustion efficiency, the middle distillate was almost identical, and the middle heavy blend was slightly poorer. The coal derived liquid fuels contained from 0.58 to 0.95 percent nitrogen by weight. Conversion of fuel nitrogen to NOx was approximately 75 percent for all three grades of the coal derived liquids. Author

N81-14398*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ULTRA-LEAN COMBUSTION AT HIGH INLET TEMPERATURES

David N. Anderson 1981 20 p refs Presented at 26th Intern. Gas Turbine Conf., Houston, Tex., 8-21 Mar. 1981; sponsored by ASME
(Contract EC-77-A-31-1101)
(NASA-TM-81640; E-677; DOE/NASA/1011-33) Avail: NTIS HC A02/MF A01 CSCL 21B

Combustion at inlet air temperatures of 1100 to 1250 K was studied for application to advanced automotive gas turbine engines. Combustion was initiated by the hot environment, and therefore no external ignition source was used. Combustion was stabilized without a flameholder. The tests were performed in a 12 cm diameter test section at a pressure of 2.5 x 10 to the 5th power Pa, with reference velocities of 32 to 60 m/sec and at maximum combustion temperatures of 1350 to 1850 K. Number 2 diesel fuel was injected by means of a multiple source fuel injector. Unburned hydrocarbons emissions were negligible for all test conditions. Nitrogen oxides emissions were less than 1.9 g NO2/kg fuel for combustion temperatures below 1680 K. Carbon monoxide emissions were less than 16 g CO/kg fuel for combustion temperatures greater than 1600 K, inlet air temperatures higher than 1150 K, and residence times greater than 4.3 microseconds. Author

N81-14399*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF FUEL NITROGEN AND HYDROGEN CONTENT ON EMISSIONS IN HYDROCARBON COMBUSTION

David A. Bittker and Gary Wolfbrandt 1981 24 p refs Presented at 26th Ann. Intern. Gas Turbine Conf., Houston, Tex. 8-12 Mar. 1981; sponsored by ASME
(Contract DE-AI01-77ET-10350)
(NASA-TM-81612; E-614; DOE/NASA-10350-19) Avail: NTIS HC A02/MF A01 CSCL 10B

How the emissions of nitrogen oxides and carbon monoxide are affected by: (1) the decreased hydrogen content and (2) the increased organic nitrogen content of coal derived fuels is investigated. Previous CRT experimental work in a two stage flame tube has shown the effectiveness of rich lean two stage combustion in reducing fuel nitrogen conversion to nitrogen oxides. Previous theoretical work gave preliminary indications that emissions trends from the flame tube experiment could be predicted by a two stage, well stirred reactor combustor model using a detailed chemical mechanism for propane oxidation and nitrogen oxide formation. Additional computations are reported and comparisons with experimental results for two additional fuels and a wide range of operating conditions are given. Fuels used in the modeling are pure propane, a propane toluene mixture and pure toluene. These give hydrogen contents 18, 11 and 9 percent by weight, respectively. Fuel bound nitrogen contents of 0.5 and 1.0 percent were used. Results are presented for oxides of nitrogen and also carbon monoxide concentrations as a function of primary equivalence ratio, hydrogen content and fuel bound nitrogen content. Author

N81-14405# IEA Coal Research, London (England).

CONVERSION TO COAL AND COAL/OIL FIRING

G. F. Morrison Dec. 1979 70 p refs
(ICTS/TR-07; ISBN-92-9029-047-1) Avail: NTIS HC A04/MF A01

The literature on the conversion of power stations currently burning fuel oil or natural gas to coal or coal oil mixtures (COM) is reviewed. The influence of fuel type on power station design is discussed. It is concluded that only boilers designed originally for coal, but currently burning an alternate fuel, can be retrofitted to burn coal. Not all such boilers can be converted as sufficient space for coal handling and storage equipment may no longer be available. COM can be burned in the majority of boilers designed for coal or oil firing with only minor modifications to combustion equipment. Thus, COM provides a short term means of increasing the use of coal for power generation. The history of COM combustion and current research programs are discussed. Particular attention is given to COM stability, equipment design and atmospheric emissions from COM combustion. References are given within the text to substantiate facts, to indicate further relevant published material and to give an indication of people and organizations with particular interests in specific fields of fuel substitution. Author

N81-14434# Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
COASTAL ZONE WIND ENERGY. PART 1: SYNOPTIC AND MESOSCALE CONTROLS AND DISTRIBUTIONS OF COASTAL WIND ENERGY Final Report
Michael Garstand, Soronadi Nnaji, Roger A. Pielke, John Gusdorf, Charles Lindsey, and Joseph W. Snow Mar. 1980 192 p refs
(Contract DE-AS06-76ET-20274)
(DOE/ET-20274/7-Pt-1) Avail: NTIS HC A09/MF A01

A method of determining coastal wind energy resources is described. Climatological data and a mesoscale numerical model were used to delineate the available wind energy along the Atlantic and Gulf coasts of the United States. The spatial distribution of this energy is dependent on the locations of the observing sites in relation to the major synoptic weather features as well as the particular orientation of the coastline with respect to the large scale wind. The synoptic weather situation at a site was categorized according to its location relative to the wave cyclones on the polar front and to the subtropical ridge. Fundamental physical concepts were used to define these classifications. Six categories describe almost all weather situations: in the warm sector, ahead of the warm front, behind the cold front, under the polar ridge, west of the subtropical ridge, and under the subtropical ridge. The four seasons were defined quantitatively in terms of the variation of these categories within the year. Author

N81-14454# Idaho State Office of Energy, Boise.
INDUSTRIAL APPLICATION OF GEOTHERMAL ENERGY IN SOUTHEAST IDAHO
James A. Batdorf, David W. McClain, Mark Gross, and George M. Simmons Feb. 1980 86 p refs
(Contract DE-FC07-79ID-12010)
(DOE/ID-12010/4) Avail: NTIS HC A05/MF A01

The main industries in Southeastern Idaho are phosphorus/phosphate production and potato processing. Most of the energy required in the phosphate industries is electrical and therefore not replaceable by direct application of geothermal energy. The main area for direct use of geothermal energy in the phosphate industry is for drying of the ore at the mine site; however, most of this is energy now supplied by waste heat from the calcining process. There exists a large need for a dedicated supply of electrical energy to these industries and the possibility of using geothermal energy to generate electricity for these areas should be investigated. The potato processing industry uses most of its energy to provide process steam for drying and cooking. Geothermal energy can potentially replace most of these energy requirements provided a high energy source temperature can be located. A 200 F geothermal source could supply about 40% of the industry's needs. A 400 F geothermal source could supply nearly 90% of the industry's needs. Author

N81-14546# Northrop Services, Inc., Huntsville, Ala.
SITE INSOLATION AND WIND POWER CHARACTERISTICS Summary Report
Roger E. Bray Aug. 1980 155 p refs 6 Vol.
(Contracts DE-AC01-77ET-20160; EG-77-C-01-4016)
(DOE/CS-20160/01-Vol-1) Avail: NTIS HC A08/MF A01

Historic solar and wind data available at 101 National Weather Service stations were processed statistically. Preliminary planning data are provided for selected daily average solar and wind power conditions occurring and persisting for time periods of interest. Solar data are global radiation incident on a horizontal surface, and wind data represent wind power normal to the air flow. Empirical probabilities were constructed from the historic data to provide a reasonable inference of the chance of similar climatological conditions occurring at any given time in the future. Data used to obtain the daily average solar and wind power probabilities were combined into monthly averages and are presented. Average monthly seasonal and annual solar and wind power trends were prepared to provide an overview for identifying areas for further investigation. Author

N81-14586# Northrop Services, Inc., Huntsville, Ala.
SITE INSOLATION AND WIND POWER CHARACTERISTICS: TECHNICAL REPORT MIDWEST REGION
Aug. 1980 220 p refs 6 Vol.
(Contract DE-AC01-77ET-20160)
(DOE/CS-20160-01-Vol-4) Avail: NTIS HC A10/MF A01

Selected insolation and windpower conditions were investigated for their occurrence and persistence, for defined periods of time, on a monthly basis. Hourly solar insolation and collateral meteorological information was gathered from 22 National Weather Service stations. These stations were in the states of North Dakota, South Dakota, Nebraska, Kansas, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Michigan, Indiana, and Ohio. The information gathered is used for site selections of solar generators and windpowered generators. T.M.

N81-14587# Northrop Services, Inc., Huntsville, Ala.
SITE INSOLATION AND WIND POWER CHARACTERISTICS: TECHNICAL REPORT WESTERN REGION (SOUTH SECTION)
Aug. 1980 221 p refs
(Contract DE-AC01-77ET-20160)
(DOE/CS-20160-01-Vol-6) Avail: NTIS HC A10/MF A01

Estimates of future trends in the parameters affecting the utilization of windpower and solar energy are presented. Selected insolation and windpower conditions were monitored on an hourly basis at 22 National Weather Service stations. These stations are located in California, Nevada, Utah, Arizona, Colorado, and New Mexico. The estimates are used in site selections for windpowered generators and solar generators. T.M.

N81-14588# Northrop Services, Inc., Huntsville, Ala.
SITE INSOLATION AND WIND POWER CHARACTERISTICS: TECHNICAL REPORT WESTERN REGION (NORTH SECTION)
Aug. 1980 213 p refs
(Contract DE-AC01-77ET-20160)
(DOE/CS-20160/01-Vol-5) Avail: NTIS HC A10/MF A01

Hourly measurements of solar insolation and other meteorological parameters were gathered at 21 National Weather Service stations. These stations are located in Alaska, Washington, Oregon, Idaho, Montana, and Wyoming. The data is used to provide an estimate of future trends in the parameters affecting the utilization of windpower and solar energy. Solar data are global radiation incident on a horizontal surface and wind data represent windpower normal to the air flow. T.M.

N81-14589# Northrop Services, Inc., Huntsville, Ala.
SITE INSOLATION OF WIND POWER CHARACTERISTICS: SOUTHERN REGION Technical Report
Aug. 1980 270 p refs
(Contract DE-AC01-77ET-20160)
(DOE/CS-20160/01-Vol-3) Avail: NTIS HC A12/MF A01

Site Insolation and Wind Power Characteristics studies were performed to provide statistical information on the expected future availability of solar and wind power at various sites in the Southern Region of the U.S. Historic data at 28 National Weather Service stations with hourly solar insolation and collateral meteorological information, were interrogated to provide an estimate of future trends. Selected insolation and wind power conditions were investigated for their occurrence and persistence, for defined periods of time, on a monthly basis. Global horizontal insolation are related to inclined surfaces at each site. Ratios are provided, monthly, for multiplying global insolation to obtain insolation estimates on south-facing surfaces inclined at different angles with respect to the horizontal. Also, joint probability distribution tables are constructed showing the number of occurrences, out of a finite sample size, of daily average solar and wind power within selected intervals, by month. Author

N81-14931# Institute of Gas Technology, Chicago, Ill.
URBAN WASTE CONVERSION SYSTEMS Final Report, 1 Oct. 1978 - 31 Mar. 1979
D. S. Cowen, Edward J. Daniels, and Martin Novil Feb. 1980 72 p refs
(Contract EI-78-X-01-5580)
(DSE-5580-T1) Avail: NTIS HC A04/MF A01

The market potential of the various systems available, or under development, for converting urban wastes into synthetic gas or liquids was assessed and the primary data base for this assessment is a survey which IGT has sent out to experts in this field. The experts were asked to evaluate various conversion systems by assigning point totals to an evaluation matrix. They were also asked to summarize their work in urban waste conversion, critical paths which represent obstacles to be surmounted by R & D were identified. These included materials handling and separation techniques, and protection of equipment from abrasive, caustic, or corrosive chemicals in the wastes. Prohibitive capital and operating costs in some existing systems were cited, since investor confidence is eroded by evidence of such experiences. Downtime was excessive with many systems, stemming from feed problems brought on by the heterogeneous nature of the feedstock. Systems using homogeneous feeds show considerably fewer problems. DOE

N81-15021# Oak Ridge National Lab., Tenn. Chemical Technology Div.
STABILITY OF COAL-DERIVED PARTICLES IN ORGANIC MEDIA Ph.D. Thesis Tenn. Univ.
Billy R. Rodgers Aug. 1980 233 p refs
(Contract W-7405-eng-26)
(ORNL-5631) Avail: NTIS HC A11/MF A01

A method of solubility class fractionation originally developed for petroleum asphalts was adapted to coal liquids. The behavior of the resulting component classes was found to be the key factor in delineating the mechanisms of the stability of particles in coal liquids. The component classes (asphaltols, asphaltenes, resins, and oils) were separated according to their solubility in pyridine, benzene, pentane, and propane, respectively. Important, physical and thermodynamic properties (viscosity, density dielectric constant, and conductivity) of these fractions were determined as a function of temperature to aid in subsequent determinations of properties related to particle stability. R.C.T.

N81-15022# Metal Properties Council, Inc., New York.
A PROGRAM TO DISCOVER MATERIALS SUITABLE FOR SERVICE UNDER HOSTILE CONDITIONS OBTAINING IN EQUIPMENT FOR THE GASIFICATION OF COAL AND OTHER SOLID FUELS Quarterly Progress Report, 1 Jul. - 30 Sep. 1979
B. A. Humphreys, V. L. Hill, R. Yurkewycz, R. F. Firestone, Y. Harada, U. S. Lindholm, S. Bhattacharyya, J. Torok, E. J. Vesely, and D. R. Diercks 28 Jan. 1980 161 p refs
(Contract EX-76-C-01-1784)
(FE-1784-57) Avail: NTIS HC A08/MF A01

The phases of this materials screening program discussed are: (1) high temperature corrosion; (2) pilot plant studies (metals and refraction); (3) aqueous corrosion; (4) erosion/corrosion (atmospheric pressure and high pressure); and (5) engineering properties of materials. S.F.

N81-15045# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
THE EFFECT OF ZINC CHLORIDE ON ORGANIC SOLVENTS AND COMPOUNDS MODELING CERTAIN BONDS IN COAL Ph.D. Thesis
Jon L. Maienschein and Edward A. Grens, II Sep. 1980 115 p refs
(Contract W-7405-eng-48)
(LBL-11395) Avail: NTIS HC A06/MF A01

The action of treatment with organic solvent/zinc chloride mixtures on compounds modeling certain ether and aliphatic structures present in coal was examined at temperatures from 175 to 280 C. In coal liquefaction, ether and aliphatic linkages between aromatic units are among the most important bonds to be broken. Treatment of diaryl ethers and alkyl aryl ethers with a 600 fold molar excess of zinc chloride resulted in cleavage of most ethers. Cleavage of ether carbon oxygen bonds was not achieved only for those bonds in which the oxygen atom was attached directly to an aromatic ring. The reaction products for the ethers and diaryl alkanes confirmed previously proposed carbonium ion mechanisms. For both ether and alipatic compounds, substituents on the aromatic rings accelerated the rate of the cleavage reaction. S.F.

N81-15073# Argonne National Lab., Ill. Materials Science Div.
THE THERMOCHEMISTRY OF HIGH-TEMPERATURE CORROSION
K. Natesan 1980 14 p refs Presented at Environ. Degradation of High-Temp. Mater., Isle of Man, United Kingdom, 31 Mar. - 3 Apr. 1980
(Contract W-31-109-eng-38)
(CONF-800391-1) Avail: NTIS HC A02/MF A01

Thermodynamic aspects of high-temperature corrosion processes occuring in complex gas mixtures are discussed, with emphasis on the role of thermochemical diagrams. The interrelationships between the corrosion behavior of materials and gas composition, alloy chemistry, and temperatures are examined. A number of examples from studies on materials behaviors in coal-gasification environments are used to elucidate the role of thermochemistry in the understanding of corrosion processes that occur in complex gas mixtures. Author

N81-15079# International Nickel Co., Inc., Suffern, N. Y. INCO Research and Development Center.
EVALUATION OF HIGH CHROMIUM OVERLAYS TO PROTECT LESS ALLOYED SUBSTRATES FROM CORROSION IN A COAL GASIFICATION ATMOSPHERE Quarterly Report, 1 Dec. 1978 - 28 Feb. 1979
Edward P. Sadowski 1979 53 p refs
(Contract EF-77-C-01-2621)
(FE-2621-10) Avail: NTIS HC A04/MF A01

The 1000 hour exposure at 1800 F in the coal gasification atmosphere was completed. The gas composition consisted of 12 percent CO2, 18 pecent CO, 24 percent H2, 5 percent CH4, 1 percent NH3, 1 percent H2S and 39 percent H2O. The gas was exchanged hourly. A detailed description of the test procedure and operation is appended to this report. Visual observation of unwelded samples of the substrate after exposure indicate that the corrosive environment was quite severe. The 304L coupons were completely disintegrated and the INCONEL alloy 800H was scaled severely. The 310 SS appeared to be reasonably corrosion resistant. The overlays of INCONEL filler metals 72, and R139 appeared corrosion resistant whereas the 309 overlay formed a scale which spalled. Stress rupture testing of composite specimens is essentially complete. The composition of the substrate had most effects on the stress rupture strength and the overlaid INCOLOY alloy 800H had the highest stress rupture strength. Generally, the gas metal arc processes gave higher stress rupture strength than the submerged arc process. DOE

N81-15086# California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
WEAR RESISTANT ALLOYS FOR COAL HANDLING EQUIPMENT Progress Report, 1 Oct. 1977 - 30 Sep. 1979
M. S. Bhat, V. F. Zackay, E. R. Parker, and I. Finnie 1979 319 p refs
(Contracts DE-AM03-76SF-00034; DE-AT03-76ET-10698)
(DOE/ET-10698/T2) Avail: NTIS HC A14/MF A01

A laboratory wear tester capable of simulating high stress two-body abrasive wear and low stress three-body wear was designed, constructed and calibrated. Experiments run on some standard metals and alloys in the annealed, work hardened, and heat treated conditions under both two-body and three-body wear revealed that three-body wear is about an order of magnitude less severe than two-body wear, however, the influence of many of the variables was similar for two- and three-body wear. The mechanical properties, microstructure and abrasive wear rates of some alloy steels were determined. Significant correlations between microstructural features and wear rate were established. There was less success in correlating the mechanical properties with wear rate. Optimal combinations of strength, toughness, and wear resistance can be obtained by the proper choice of composition and heat treatment. Secondary hardening Martensite; Bainitic, and Matrix steels were studied as well as low alloy 4340 type and low alloy Cr-Si-Mo steels. A.R.H.

N81-15112# Gary Energy Corp., Englewood, Colo.
BELL CREEK FIELD MICELLAR-POLYMER PILOT DEMONSTRATION Annual Report, Oct. 1978 - Sep. 1979
Arnold Goldburg, P. Stevens, J. Vargo, L. W. Holm (Union Oil Co.), L. J. OBrien (Union Oil Co.), S. D. Robertson (Union Oil Co.), M. J. Todd (Intercomp), and J. K. Dietrich (Intercomp) Jul. 1980 92 p refs
(Contract DE-AC03-78SF-01802)
(DOE/SF-01802/39; AR-3) Avail: NTIS HC A05/MF A01

The economic feasibility of micellar-polymer flooding to enhance oil recovery from the field was investigated. Geological models were developed to estimate the oil recovery process efficiency. Test site development included a radioactive tracer survey and analysis, a core analysis, pressure pulse tests, a reservoir description, and construction of the test facilities. T.M.

N81-15123# California Univ., Livermore. Lawrence Livermore Lab.
LLL IN SITU COAL GASIFICATION PROJECT Quarterly Progress Report, Jan. - Mar. 1980
D. U. Olness, ed. 30 May 1980 26 p refs Sponsored by DOE
(UCRL-50026-80-1) Avail: NTIS HC A03/MF A01

The feasibility of converting coal into a clean efficient energy source by underground coal gasification was investigated. A process for producing medium heating value gas that can be economically upgraded to pipeline quality gas or used to produce transportation fuels, such as methanol or gasoline was developed. Two different coal permiability enhancement techniques were designed and constructed: explosive fracturing in the case of Hoe Creek No. 1; and countercurrent combustion linking in Hoe Creek No. 2. Several significant observations are reported. R.C.T.

N81-15124# Oklahoma State Univ., Stillwater. School of Chemical Engineering.
CATALYSTS FOR UPGRADING COAL-DERIVED LIQUIDS Quarterly Report, 1 Apr. - 30 Jun. 1980
Billy L. Crynes 15 Jul. 1980 30 p refs
(Contract DE-AC01-79ET-14876)
(DOE/ET-14876/3) Avail: NTIS HC A03/MF A01

Five experimental runs were conducted in the trickle bed reactor. The experiments were designed to obtain data on zoned catalyst beds. This reactor system demonstrated satisfactory performance in temperature, pressure and flow control. High desulfurization and denitrogenation were achieved on both catalysts tested at conditions of 815 F, 1500 psig. The level of nitrogen removal was initially high, but activity decay was significant over the operational interval of 100 hours. Two experimental runs were completed in the Catalyst Life Test Unit utilizing a liquid containing 50 percent synthoil and 50 percent raw anthracene oil. This fluid has a 0.54 weight percent sulfur and a 1.21 weight percent nitrogen. S.F.

N81-15125# Brigham Young Univ., Provo, Utah.
ALLOY CATALYSTS WITH MONOLITH SUPPORTS FOR METHANATION OF COAL-DERIVED GASES Quarterly Technical Progress Report, 21 Dec. 1979 - 20 Mar. 1980
Calvin H. Bartholomew and Erek Erekson 5 Apr. 1980 43 p refs
(Contract EF-77-S-01-2729)
(FE-2729-10) Avail: NTIS HC A03/MF A01

During CO adsorption at room temperature on nickel catalysts significant amounts of Ni(CO)4 were observed to have formed. The H2S poisoning increased Ni(CO)4 formation. In methanation kinetic tests methane concentration had little effect on methanation rates, while water (H2O) vapor severely inhibited the reaction. In some cases water (H2O) vapor deactivated nickel catalysts. It was determined that H2S adsorption on Al2O3 is very significant; thus H2S deactivation rates were measured on INCO nickel powder. Ruthenium has an apparent activation energy for methanation of 113 kj/mo1. Considerable deactivation is observed at 600 K and above. If deactivation of the catalyst is considered, there is no shift in apparent activation energy over a wide range of temperature as was seen on Ni. DOE

N81-15127# Air Products and Chemicals, Inc., Allentown, Pa.
CRYOGENIC METHANE SEPARATION/CATALYTIC HYDROGASIFICATION PROCESS ANALYSIS Final Report
A. A. Cassano, M. F. Hilton, T. C. Li, and T. R. Tsao 14 Feb. 1980 356 p refs
(Contract ET-78-C-01-3044)
(FE-3044-T12) Avail: NTIS HC A16/MF A01

The best combinations of acid gas removal and methane separation systems for the Exxon Catalytic Coal Gasification (CCG) and the Rockwell Hydrogasificaton processes are discussed. The program was comprised of the following tasks: (1) screening to define the most promising integration scheme for each gasification process; (2) development of a process flowsheet, heat and material balance, P&Id, equipment specification, utility summary, and plot plan for the process combination selected in 1; and (3) preparation of detailed economics and final report. The evaluations were performed using data supplied by the prime coal gasification contractors and from the vendors of proprietary acid gas removal processes. This information, combined with Air Products' in-house capabilities in acid gas and cryogenic separation processes, was used to develop process designs and cost estimates for each integrated system. S.F.

N81-15128# Institute of Gas Technology, Chicago, Ill.
RESEARCH AND DEVELOPMENT OF RAPID HYDROGENATION FOR COAL CONVERSION TO SYNTHETIC MOTOR FUELS (RISER CRACKING OF COAL) Annual Report, 1 Apr. 1979 - 31 Mar. 1980
Dennis A. Duncan, Justin L. Beeson, and R. Donald Oberle Sep. 1980 89 p refs
(Contracts DE-AC21-76ET-10520; EX-76-C-01-2307)
(FE-2307-67) Avail: NTIS HC A05/MF A01

A noncatalytic short-residence-time entrained flow reactor for the production of feedstocks for synthetic motor fuels was investigated. The experimental investigation employed operating temperatures from 900 to 1000 F with operating pressures up to 2000 psig in the experimental investigation. Both a bench scale unit (5 to 10 lb/hr) and a process development unit (PDU, 50 to 100 lb/hr) were used. Twenty-eight trial runs were made in the bench scale unit to study the use of hydrogen preheated to pyrolysis temperatures prior to being admixed with feed lignite; the use of mixtures of steam and hydrogen as a carrier gas, and the effects of increasing coal particle size. Trials were also made, using syngas as the carrier gas. Four trial runs were made for processing North Dakota lignite treated with a disposable catalyst. The construction of the PDU was completed, and 13 trial runs were made. Most of these were long enough to permit complete sampling and product work up. These runs were made at system operating pressures of 1000, 1500, and 2000 psig, and coal feed rates as high as 84.2 lb/hr. The maximum reactor temperature was 1400 F. J.M.S.

N81-15129# California Univ., Livermore. Lawrence Livermore Lab.
INTRODUCTION TO UNDERGROUND COAL GASIFICATION
Douglas R. Stephens Aug. 1980 30 p refs
(Contract W-7405-eng-48)
(UCID-18801) Avail: NTIS HC A03/MF A01

The potential advantages of underground coal gasification (UCG) are considered. It is shown that UCG offers a relatively low cost, environmentally sound method to produce clean fuels from coal. It is further shown that projected costs are comparable to or lower than that of conventional coal gasification systems. R.C.T.

N81-15130# Gulf Research and Development Co., Pittsburgh, Pa.
INVESTIGATION OF MECHANISMS OF HYDROGEN TRANSFER IN COAL HYDROGENATION Final Report
D. C. Cronauer, R. G. Ruberto, and D. C. Young Jul. 1980 119 p refs
(FE-2305-39) Avail: NTIS HC A06/MF A01

Hydrogen transfer reactions were studied together with model compounds to develop an understanding of the mechanism of the type of reactions that occurs during coal liquefaction. Bituminous coals from the Illinois No. 6 and Kentucky No. 9 and 14 seams were liquefied in a batch microreactor using labeled tetralin and octahydrophenanthrene with catalyst in some cases. In addition to following the level of coal conversion, the level of hydrogen transfer was observed along with determining the site of transfer. DOE

N81-15132# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
LOW TEMPERATURE COAL LIQUEFACTION BY ZINC CHLORIDE AND TETRALIN Ph.D. Thesis
Frank Hershkowitz and Edward A. Grens, II Sep. 1980 160 p refs
(Contract W-7405-eng-48)
(LBL-11325) Avail: NTIS HC A08/MF A01

High conversions of subbituminous coal to liquid or soluble products were obtained by treatment with large amounts of zinc chloride together with tetralin at temperatures below those of coal pyrolysis. Treatments were carried out in a stirred batch reactor at 250 to 325 C for durations of 10 to 120 min with hydrogen at 3.5 MPa total pressure. The extent of conversion was determined by solvent extractions with cyclohexane, toluene, and pyridine, and products were characterized by elemental analysis, gel permeation chromatogrpahy, proton nuclear magnetic resonance, and oxygen functional group analysis. The conversions to soluble products reached 50% solubility in cyclohexane and 85% in pyridine for treatment at 300 C. This conversion increased with increasing temperature and duration of treatment, and was accompanied by progressive reductions in molecular weight as well as by elimination of oxygen (especially ether oxygen) in coal. This behavior, along with the increase in product aromaticity with increasing conversion, indicates a mechanism involving $ZnCl_2$-catalyzed cleavage of crosslinking bonds in the coal. DOE

N81-15133# Brookhaven National Lab., Upton, N. Y. Process Sciences Div.
THE KINETICS OF FLASH HYDROGENATION OF LIGNITE AND SUBBITUMINOUS COAL
B. Bhatt, P. T. Fallon, and M. Steinberg 1980 20 p refs
(BNL-28390; CONF-801125-2) Avail: NTIS HC A02/MF A01

A reaction model, based on a single coal particle surrounded by H_2 gas, is developed for the hydrogenation of lignite and subbituminous coal. Conversion data from experiments conducted at various pressures, temperatures, particle residence times, and gas residence times are correlated to calculate activation energies and to obtain one set of kinetic parameters. A single object function formulated from the weighted errors for the four dependent variables, CH_4, C_2H_6, BTX, and oil yields, was minimized using a program containing three independent iterative techniques. The results of the nonlinaer regression analysis for lignite show that a first-order chemical reaction model with respect to C conversion, satisfactorily describes the dilute phase hydrogenation. The conversion data obtained from hydrogenation experiments using subbituminous coal is correlated using similar techniques. The results obtained from data analysis of the two types of coals are compared. The mechanism, the rate expressions, and the design curves developed can be used for scale-up and reactor design. Author

N81-15134# Battelle Columbus Labs., Ohio. Fuels and Combustion Section.
THERMOPHYSICAL PROPERTIES OF COAL LIQUIDS Quarterly Technical Status Report, 1 Jul. - 30 Sep. 1980
J. W. Droege, G. H. Stickford, J. R. Longanbach, and S. P. Chauhan 20 Oct. 1980 35 p refs
(Contract DE-AC22-79ET-14941)
(BMI-2068; QTSR-4) Avail: NTIS HC A03/MF A01

A sample of simulated preheater product was prepared. Apparatus was assembled for obtaining well controlled uniform temperatures in each of two interconnected autoclaves, one of which is the viscometer. Constant temperature measurements were initiated in which slurry was transferred into the preheated viscometer, reaching a constant temperature very quickly. One measurement was also made at constantly increasing temperature. Density measurements were made to temperatures as high as 600 K at 7 MPa. Formation of gases or vapors terminated the experiments. Thermal conductivity measurements were made on two coal slurries, on the solvent and on a prepared product liquid. Results appear to be satisfactory through the gel range. At higher temperatures, above 600 K, the low viscosities and difficulties in getting uniform temperatures have brought about greater scatter and uncertainty in the results. R.C.T.

N81-15135# Hamilton Standard, Windsor Locks, Conn.
METHANE GENERATION FROM CATTLE RESIDUE AT A DIRT FEEDLOT Final Report
Daniel J. Lizdas, Warren B. Coe, Michael Turk, and F. Scott Fowler Aug. 1980 156 p
(Contract EY-76-V-02-2952)
(DOE/ET-20039/2) Avail: NTIS HC A08/MF A01

The feasibility of producing fuel gas and an energy-intensive refeed product from dirt feedlot residues by anaerobic fermentation was investigated. A stable fermentation was achieved utilizing aged feedlot pen residue after a sufficient adaption period was provided. Methane yields varied considerably as a function of feedstock source; as low as 1.3 cubic feet per pound of volatile solids from the feedlot stockpile, and as high as 3.5 cubic feet from one of the feedlot pens. Average yield from all pens was 2.5 cubic feet of methane per pound of volatile solids processed. The fermentor liquid effluent and dewatered effluent were acceptable to cattle as a feed ingredient and were used to provide one-half the daily supplemental protein for two groups of twenty steers each. Weight gains and feed conversion were nearly the same as for cattle fed the normal ration. R.C.T.

N81-15139# Missouri Univ., Rolla. Ceramics Engineering Dept.
CHEMICAL AND PHYSICAL STABILITY OF REFRACTORIES FOR USE IN COAL GASIFICATION Final Report, 1 May 1976 - 31 Jul. 1980
Abbas Fakhr, Gordon L. Lewis, and Delbert E. Day 1 Sep. 1980 105 p refs
(Contracts DE-AS02-76ET-10544; EY-76-S-02-2904)
(COO-2904-17) Avail: NTIS HC A06/MF A01

The dimensional stability, density, porosity, flexural strength and thermal expansion of eighteen cement bonded, dense and lightweight refractory castables and three phosphate bonded refractories were determined. Chemical reactions occurring in the refractories during exposure were determined by X-ray diffraction, differential thermal analysis/thermogravimetric analysis and scanning electron microscopy and correlated with the above properties. The variables investigated were: (1) exposure time, 60 days maximum; (2) temperature, up to 538 C; (3) pressure, 6.9 MPa maximum; (4) gas composition, particularly CO/steam ratio (0.1, 1, and 3.0) and presence of 1 vol percent H_2S; (5) degree of saturation and (6) liquid versus vapor contact. The degree of saturation of the test atmosphere was the single most important factor affecting the properties after exposure. In dry atmospheres, the properties were close to those for specimens heated to the same temperature in air. In 100 percent saturated atmospheres, however, the dense cement bonded castables typically had a flexural strength two to three times higher than that before exposure and a significantly lower porosity. DOE

N81-15140# Oak Ridge National Lab., Tenn. Analytical Chemistry Div.
CHEMICAL CHARACTERIZATION OF THE NEUTRAL FRACTION OF SYNFUELS
C.-H. Ho, M. V. Buchanan, B. R. Clark, and M. R. Guerin 1980 22 p refs

(Contract W-7504-eng-26)
(CONF-801039-1) Avail: NTIS HC A02/MF A01

The neutral components of coal and shale derived petroleum substitutes are thought to contain important carcinogens and mutagens. It is suggested that the polar constituents of the neutral fraction are more important than are the polycyclic aromatic hydrocarbons with respect to bacterial mutagenicity. Sequential Sephadex LH-20 and silicic acid chromatography is found to be an effective means of isolating aliphatic, polycyclic aromatic hydrocarbon, neutral azarene, and aromatic polar constituents from the neutral fraction of a coal oil. The aromatic polar composition of petroleum substitutes is found to differ from that from petroleum by containing polycyclic aromatic amines, alkaline azarenes, polycyclic hydroxyaromatics, and, in some cases, carbonyl containing polycyclic aromatics. DOE

N81-15141# Institute of Gas Technology, Chicago, Ill.
SYNTHETIC FUELS FROM PEAT BY THE IGT PEATGAS PROCESS
D. V. Punwani, A. M. Rader (Minnesota Gas Co., Minneapolis), and M. J. Kopstein (DOE, Washington, D.C.) Aug. 1980 29 p refs Presented at 6th Intern. Peat Congr., Duluth, Minn., 17-23 Aug. 1980 Sponsored in part by DOE, Minnesota Gas Co., Gas Research Inst. and Northern Natural Gas Co.
(CONF-800876-2) Avail: NTIS HC A03/MF A01

A two stage gasifier (PEATGAS) for converting peat to synthetic fuels was developed based on experimental results obtained in the laboratory scale tests. The PEATGAS process is also used for making medium and high Btu gas as well as liquid fuels. A process design and cost estimates prepared for a plant producing 250 million cubic feet of SNG per day from Minnesota peat containing 50% moisture show that the conversion of peat is competitive with other alternative methods of SNG production. The important and significant gasification characteristics of peats evaluated are discussed as well as the use of the PEATGAS process for production of medium Btu gas, methanol, and gasoline. J.M.S.

N81-15142# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
DOE SMALL SCALE FUEL ALCOHOL PLANT DESIGN
Donald M. LaRue and John G. Richardson 1980 13 p Presented at the Geothermal Resources Council, 1980, Boise, Idaho
(Contract DE-AC07-76ID-01570)
(CONF-800629-3) Avail: NTIS HC A02/MF A01

In an effort to facilitate the deployment of rural based ethanol production capability, this effort was undertaken to develop a basic small scale plant capable of producing anhydrous ethanol. The design, when completed, will contain all necessary specifications and diagrams sufficient for the construction of a plant. The design concept is modular: that is, sections of the plant can stand alone or be integrated into other designs with comparable throughput rates. The plant design will be easily scaled up or down from the designed flow rate of 25 gallons of ethanol per hour. Conversion factors will be provided with the final design package to explain scale up and scale down procedures. The intent of this program is to provide potential small scale producers with sound information about the size, engineering requirements, costs and level of effort in building such a system. Author

N81-15143# Brookhaven National Lab., Upton, N. Y.
FLASH HYDROPYROLYSIS OF COAL Quarterly Report, 1 Oct. - 31 Dec. 1979
Meyer Steinberg, Peter Fallon, and Rharat L. Bhatt Feb. 1980 120 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51227; QR-11) Avail: NTIS HC A06/MF A01

The hydrogasification of caking bituminous coal was investigated. Two coals were used, Illinois No. 6 and Pittsburgh No. 8. The coals were used with diluents of limestone and sand in order to avoid any effects pretreatment to render the coals noncaking may have on experimental results. Up to 40% Illinois No. 6 coal could be used with either diluents but only 20% Pittsburgh No. 8 could be used probably due to its higher free swelling index (3 vs. 2). Most of the experiments were conducted at 900 C and 1000 psi to maximize gaseous hydrocarbon yields. Using Illinois No. 6, it was found that the gaseous HC yields from experiments using limestone were greater than for those using sand (34-43% vs. 27-31%) and that considerable BTX is also produced (8-13%). At 850 C where experience with other coals gave increased BTX yield, no increase was observed for this coal. R.C.T.

N81-15144# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
AN ECONOMIC ANALYSIS OF SMALL-SCALE FUEL ALCOHOL PLANTS
James J. Schafer, Jr. 1980 6 p
(CONF-8010100-1) Avail: NTIS HC A02/MF A01

The reference EG&G Small Scale Plant is estimated to cost $400.00. Given the baseline conditions defined in this report, it is calculated that this plant will provide an annual after tax return on equity of 15%, with alcohol selling at $1.62 per gallon. It is concluded that this plant is an excellent investment in today's market, where 200 proof ethanol sells for between $1.80 and $2.00 per gallon. The baseline conditions which have a significant effect on the economics include plant design parameters, cost estimates, financial assumptions and economic forecasts. Plant operation will verify alcohol yield per bushel of corn, labor costs, maintenance costs, plant availability and by-product value. Author

N81-15146# Oak Ridge National Lab., Tenn.
COAL LIQUIDS EVALUATION AND PARAHO-SOHIO SHALE OIL Quarterly Progress Report for period ending 31 Dec. 1979
K. E. Cowser 31 Dec. 1979 75 p refs Sponsored by DOE
(ORNL/TM-7271) Avail: NTIS HC A04/MF A01

Environmental and health evaluations are reported for products, by-products, and effluents derived from processes which convert coal to coal liquids and from shale oil. The toxic nature of these materials is investigated by a variety of chemical, physical, biological, and ecological test protocols. Results are presented according to the functional character of the studies, many of which are generic to fossil energy derived liquids. S.F.

N81-15147# Oak Ridge National Lab., Tenn. Fossil Energy Program.
PRODUCTION OF METHANOL AND METHANOL-RELATED FUELS FROM COALS
Royes Salmon, M. S. Edwards, and R. M. Wham May 1980 102 p refs
(Contract W-7405-eng-26)
(ORNL-5564) Avail: NTIS HC A06/MF A01

The technological and economic factors involved in the optimization of a methanol production plant are discussed. Production of synthesis gas and methanol from coal was reviewed, both from the standpoint of existing technology using Lurgi gasifiers and proposed processes using other gasifiers. An overview of the technology and economics of the Mobil MTG process for converting methanol to gasoline is presented. A search was made for obsolete or discarded processes that might be useful for the production of low purity methanol for fuels purposes. It was concluded that none of these older processes offers any advantage over current commercial technology for fuel grade methanol production. T.M.

N81-15149# Montana State Univ., Bozeman.
CATALYTIC HYDROGENATION OF COAL-DERIVED LIQUIDS Interim Report, Mar. - May 1980
Lloyd Berg and F. P. McCandless Jun. 1980 30 p
(Contract EX-76-C-01-2034)
(FE-2034-19) Avail: NTIS HC A03/MF A01

The development of catalysts capable of converting solvent refined coal into a feedstock suitable for a conventional petroleum refinery is described. A process which reduces the nitrogen content is detailed. A catalyst containing MoO3, CoO, NiO and WO3 was evaluated, subjected to an air burnoff to remove the carbon laydown and reevaluated. It gave acceptable denitrogenation and desulfurization. Two catalysts containing only MoO3 and CoO were fabricated and evaluated both before and after burnoff with air. Two different base materials were evaluated with no metal loading. A study of the nitrogen removed showed that most of it is in the carbon laydown, lesser amounts in the liquid product and the least in the offgases. S.F.

N81-15151# Science Applications, Inc., McLean, Va. Energy Utilization Group.
OVERVIEW OF UNCONVENTIONAL NATURAL GAS RESEARCH AND DEVELOPMENT ACTIVITIES
Sep. 1980 224 p refs Sponsored by Gas Research Inst.
(PB80-227986; GRI-80/0006) Avail: NTIS HC A10/MF A01 CSCL 21D

This overview is organized into four major sections. Section 1, the Executive Summary provides the essential findings of the overall report. Section 2, Trends in Uncoventional Natural Gas Production, provides a relative perspective of the resources, production history, and future role in the U.S. gas supply of the unconventional gas sources. Section 3, Unconventional Gas Sources, includes five subsections relating to each of the four major unconventional gas sources: 3.1 Western Tight Gas Sands, 3.2 Eastern Devorian Gas Shales, 3.3 methane from Coalbeds, 3.4 Geopressured brines, and 3.5 Other Unconventional Natural Gas Sources. Each subsection provides a brief description of the resources involved, a review of the major RD&D activities, identification of major constraints to commercialization, and a list of technical problems needed to be addressed by additional research work. GRA

N81-15153# Ohio River Basin Commission, Cincinnati.
SYNFUELS IN THE OHIO RIVER. A WATER RESOURCES ASSESSMENT OF EMERGING COAL TECHNOLOGIES Final Report
Jan. 1980 102 p refs Sponsored in part by Water Resources Council
(PB80-226491) Avail: NTIS HC A06/MF A01 CSCL 10A

Among the potential uses of coal in the Ohio River Basin are coal conversions into pipeline or industrial gas (coal gasification) and liquid hydrocarbons (coal liquefaction). The water resources implications of development of these emerging energy technologies in the Ohio River Basin are discussed. GRA

N81-15154* National Aeronautics and Space Administration. Pasadena Office, Calif.
CONTINUOUS COAL PROCESSING METHOD Patent
Porter R. Ryason, inventor (to NASA) (JPL, California Inst. of Tech., Pasadena) Issued 10 Jun. 1980 11 p Filed 28 Sep. 1976 Supersedes N80-10377 (18 - 01, p 0052) Continuation-in-part of abandoned US Patent Appl. SN-623389, filed 17 Oct. 1975 Sponsored by NASA
(NASA-Case-NPO-13758-2; US-Patent-4,206,713; US-Patent-Appl-SN-727444; US-Patent-Class-110-347; US-Patent-Class-110-218; US-Patent-Class-110-229; US-Patent-Class-110-232; US-Patent-Class-110-343; US-Patent-Class-202-118; US-Patent-Class-264-23; US-Patent-Class-425-378R; US-Patent-Appl-SN-623389) Avail: US Patent and Trademark Office CSCL 13H

A coal pump is provided in which solid coal is heated in the barrel of an extruder under pressure to a temperature at which the coal assumes plastic properties. The coal is continuously extruded, without static zones, using, for example, screw extrusion preferably without venting through a reduced diameter die to form a dispersed spray. As a result, the dispersed coal may be continuously injected into vessels or combustors at any pressure up to the maximum pressure developed in the extrusion device. The coal may be premixed with other materials such as desulfurization aids or reducible metal ores so that reactions occur, during or after conversion to its plastic state. Alternatively, the coal may be processed and caused to react after extrusion, through the die, with, for example, liquid oxidizers, whereby a coal reactor is provided.

Official Gazette of the U.S. Patent and Trademark Office

N81-15453# ICF, Inc., Washington, D. C.
COAL RESOURCE INFORMATION. VOLUME 3: CASE STUDIES IN EVALUATING ADEQUACY OF INFORMATION, CAMPBELL COUNTY, WYOMING AND PIKE COUNTY, KENTUCKY Final Report
D. E. Klein Mar. 1980 267 p refs
(EPRI Proj. 868-1)
(EPRI-EA-673-Vol-3) Avail: NTIS HC A12/MF A01

The case studies are developed as separate, stand alone studies. The findings applicable to each case study are summarized in the studies themselves. In addition to these case specific findings, there are also findings of a broader nature which tend to be relevant to coal resources in general. These general findings are summarized as follows: (1) the quantities of estimated coal reserves can both rise and fall over time due to influences of geologic knowledge, resource depletion and, to a lesser extent, economic criteria; (2) existing data are plentiful but incomplete, and not all existing relevant information is incorporated into present reserve and resource estimates, e.g., the U.S. Bureau of Mines Demonstrated Reserve Base; (3) publicly available information is of limited use to the detailed assessment of coal mineability; (4) information on coal quality is much less extensive than that of coal quantity; and (5) no simple relationship governing the distribution of coal tonnages versus seam thickness has been demonstrated. J.M.S.

N81-15454# Puerto Rico Univ., Rio Piedras. Center for Energy and Environment Research.
PRODUCTION OF SUGARCANE AND TROPICAL GRASSES AS A RENEWABLE ENERGY SOURCE Annual Report, 1 Jun. 1979 - 31 May 1980
Alex G. Alexander, W. Allison, M. Garcia, G. Ramirez, T. L. Chu, J. Velez-Santiago, and L. Smith 1980 74 p refs
(Contract DE-AS05-78ET-20071)
(DOE/ET-20071/T2; AR-3) Avail: NTIS HC A04/MF A01

Research continued on tropical grasses from Saccharum and related genera as sources of intensively propagated fiber and fermentable solids. Candidate screening for short rotation grasses was expanded to include six sorghum x Sudan grass hybrids. Sugarcane and napier grass yield trends in year 3 include: (1) increased yields with delay of harvest frequency; (2) lack of response to close spacing; (3) a superiority of napier grass over sugarcane when harvested at intervals of six months or less; and (4) a general superiority of the sugarcane variety NCo 310 over varieties PR 980 and PR 64-1791. Delayed tasseling of a wild, early flowering S. spontaneum hybrid enabled three crosses to be made in December using commercial hybrids as female parents. Approximately 1000 seedlings were produced. E.D.K.

N81-15472# OAO Corp., Washington, D.C.
BIOMASS ENERGY SYSTEMS PROGRAM SUMMARY
Jul. 1980 220 p
(Contract DE-AC01-77ET-21069; Contracts DE-AC01-78ET-20122; DE-AC02-77ET-21059)
(DOE/CS-20122/01) Avail: NTIS HC A10/MF A01

Research and development in appropriate conversion technologies is reported. The technologies include direct combustion, biochemical conversion, and thermochemical conversion techniques. Biomass sources were reviewed. Estimates indicate that the conversion of unused agricultural residues, forestry residues, and noncommercial timber growth can provide 6 to 10% of the national energy needs. The use of biomass energy conversion in fuel production, chemical production, residential space heating, and electricity supplies is discussed. T. M.

N81-15491# Oregon State Univ., Corvallis.
DIRECT APPLICATION OF GEOTHERMAL ENERGY
Gordon M. Reistad 1980 73 p refs Prepared in cooperation with the American Society of Heating, Refrigerating and Air-Conditioning Engineers, New York
(Contract DE-AC02-78ET-20501)
(DOE/ET-20501/T1) Avail: NTIS HC A04/MF A01

The application of geothermal energy to space heating and cooling, domestic water heating, and industrial processing is considered. The types of geothermal resources and their general extent in the U.S. are discussed and the potential market that may be served with geothermal energy is assessed. Special design aspects, application approaches for geothermal energy use in each of the applications, and present applications in the U.S. are among the topics included. Emphasis is placed on the engineering applications of the use of geothermal energy. S.F.

N81-15493# Battelle Pacific Northwest Labs., Richland, Wash.
COAL-GASIFICATION/MHD/STEAM-TURBINE D-CYCLE (GMS) POWER GENERATION
J. M. Lytle and D. D. Marchant Nov. 1980 29 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3483) Avail: NTIS HC A03/MF A01

Advantages of a clean fuel system are presented and include the elimination of mineral matter or slag from all components other than the coal gasifier and gas cleanup system; reduced wear and corrosion on components; and increased seed recovery resulting from reduced exposure of seed to mineral matter or slag. Efficiencies in some specific GMS power plants were shown to be higher than for a comparably sized coal burning MHD power plant. The use of energy from the MHD exhaust gas to gasify coal (rather than the typical approach of burning part of the coal) results in these higher efficiencies. Author

N81-15515# Los Alamos Scientific Lab., N. Mex.
THE DOE GEOTHERMAL WELL STIMULATION PROGRAM
Robert J. Hanold, Donald A. Campbell (Republic Geothermal, Inc., Santa Fe Springs, Calif.), and A. Richard Sinclair (Maurer Engineering, Inc., Houston, Tex.) 1980 10 p refs Presented at DOE/ENEL Geothermal Workshop, Berkeley, Calif., 20-23 Oct. 1980
(Contract W-7405-ENG-36)
(LA-UR-80-3011; CONF-801098-1) Avail: NTIS HC A02/MF A01

Stimulation treatments were conducted in formations which produce hot water as a result of both matrix permeability and from natural existing fracture systems. The following targets of opportunity were of particular interest to this program: wells that require additional drainage because of insufficient formation permeability; wells that did not intersect nearby major fracture systems; wells that suffered man-made damage during drilling or completion operations including mud or cement invasion; and wells that require periodic remedial treatment as a result of fluid production related damage. Although numerous criteria were established for the selection of candidate wells, the most significant were definite proof of a good producing reservoir. These data are normally obtained from offset well production. T.M.

N81-15546# Pacific Northwest Lab., Richland, Wash.
PRELIMINARY EVALUATION OF WIND ENERGY POTENTIAL, COOK INLET AREA, ALASKA
T. R. Hiester Jun. 1980 103 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3408) Avail: NTIS HC A06/MF A01

Likely candidate regions for windpower utilization were analyzed in blocks of 25 to 100 square miles each. A monitoring system was developed to quantity tne energy potential of each area. Screening factors included match between time of occurrance of wind power and load; access to adequate transmission and distribution systems; hazards at the site; environmental considerations of the site; and public acceptance of wind turbines at the site. T.M.

N81-15567# Midwest Research Inst., Golden, Colo.
PROCEEDINGS: PANEL ON INFORMATION DISSEMINATION FOR WIND ENERGY
Patrica Weis Apr. 1980 86 p refs Proceedings held at Albuquerque, N. Mex., 2-3 Aug. 1979
(Contract EG-77-C-01-4042)
(SERI/TP-732-343) Avail: NTIS HC A05/MF A01

A program for coordinating and strengthening technical information activities related to the commercialization of solar energy research and development results is described. The program contains a project for each of the following technologies: biomass; ocean thermal energy conversion; photovoltaics; solar thermal power; and wind energy conversion systems. In addition to the production and dissemination of several types of information materials, the wind energy project aims to support efforts of others in the field. The meeting is the first attempt to acquaint people with the information activities of others, to discuss information needs as an aid to planning, and to promote cooperation in disseminating information on wind energy. S.F.

N81-15573# Utah Water Research Lab., Logan.
USE OF SALINE WATER IN ENERGY DEVELOPMENT Final Report
C. Earl Israelsen, V. Dean Adams, J. Clair Batty, Dennis B. George, and Trevor C. Hughes Jun. 1980 144 p refs
(Contract DI-14-34-0001-8553)
(PB81-102980; W80-06698; OWRT-C-80322-S(8553)(1))
Avail: NTIS HC A07/MF A01 CSCL 10B

Information was assembled relative to future energy related projects in the upper basin, and estimates were made of their anticipated water needs. Using computer models, various options were tested for using saline water for coal fired power plant cooling. Both cooling powers and brine evaporation ponds were included. Information is presented of several proven water treatment technologies and comparisons are made of their cost effectiveness when placed in various combinations in the power plant makeup and blowdown water systems. Coal from several different mines was slurried in waters of different salinities. Samples were analyzed in the laboratory to determine which constituents had been leached from or absorbed by the coal. GRA

N81-15711# California Univ., Livermore. Lawrence Livermore Lab.
MICROCOMPUTER FIRMWARE DESCRIPTION, LGF DATA ACQUISITION SYSTEM
John Baker 26 Jun. 1980 19 p
(Contract W-7405-eng-48)
(UCID-18745) Avail: NTIS HC A02/MF A01

The firmware developed for the Data Acquisition System for Liquefied Gaseous Fuels Program is described. Approximately 4000 lines of assembly language coding were developed using 'structured macros' and 'top down structured programming' design techniques. This coding executes from read-only memory in 51 Complementary Metal Oxide Semiconductor (CMOS) battery powered data acquisition systems. The systems are deployed for acquiring data during liquefied natural gas dispersion tests. S.F.

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05
ENERGY CONVERSION

Includes photovoltaic, thermoelectric, geothermal, ocean thermal, and wind energy conversion. Also includes nuclear reactors and magnetohydrodynamic generators.

A81-10034 # **Steady-state approximation in the theory of flows excited by a traveling field (Statsionarnoe priblizhenie v teorii techenii, vozbuzhdaemykh begushchim polem).** N. A. Britov (Akademiia Nauk Belorusskoi SSR, Institut Matematiki, Gomel, Belorussian SSR). *Matematicheskaia Fizika,* no. 27, 1980, p. 81-84. In Russian.

The paper examines the conditions under which the steady-state approximation can be applied to MHD flow excited by a traveling magnetic field in an MHD generator. It is shown that at low relative frequencies the steady-state approximation coincides with the inductionless approximation. B.J.

A81-10042 # **Characteristics of pulsed magnetohydrodynamic generators with two-phase combustion product flow (Osobennosti raboty impul'snykh MGDG s dvukhfaznym rabochim telom).** R. V. Dogadaev, L. A. Bukhteev, N. V. Lobanov, B. A. Tikhonov, and A. A. Iakushev (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Promyshlennaia Teplotekhnika,* vol. 2, Sept.-Oct. 1980, p. 76-83. 12 refs. In Russian.

The paper examines the effect of two-phase flow of combustion products on the operation of pulsed magnetohydrodynamic (MHD) generators. Experimental data are presented on the erosion of MHD walls resulting from the two-phase flow; the measurements of heat fluxes affecting the movement of Al2O3 films on MHD walls are given. The effects of the Al2O3 film on electric and physical properties of MHD processes are analyzed. A.T.

A81-10182 **Computed cross sections for electron transfer in Ba/+/ + Ba/+/ collisions.** S. J. Sramek, J. H. Macek, and G. A. Gallup (Nebraska, University, Lincoln, Neb.). *Physical Review A - General Physics, 3rd Series,* vol. 22, Oct. 1980, p. 1467-1481. 11 refs. Contract No. EG-77-S-02-4379.

Cross sections have been computed for the electron-transfer process Ba(+) + Ba(+) yields Ba + Ba(2+), for collision energies ranging from 25 to 500 keV. The straight-line classical-trajectory method has been used, with basis functions obtained by the multiconfiguration valence-bond method. Several numerical procedures applicable to future treatments of similar large systems were developed. The system's transient behavior has also been studied in detail during the collision, and it has been found that most electron-transfer events involve migration of the electron across internuclear distances considerably larger than the ionic diameter. (Author)

A81-10525 **Electrooptic prepulse suppression for fusion laser systems.** G. Mourou, J. Bunkenburg, and W. Seka (Rochester, University, Rochester, N.Y.). *Optics Communications,* vol. 34, Aug. 1980, p. 252-254. 8 refs. Research supported by the Exxon Research and Engineering Co., Northeast Utilities Service Co., General Electric Co., Empire State Electric Energy Research Corp., and New York State Energy Research and Development Administration.

An effective electrooptic prepulse suppression technique with particular applicability to fusion laser systems is discussed. Three optically timed Pockels cells in series have a contrast of 1 billion. They are driven by a laser-activated Si high voltage switch of 5 ps jitter and less than 100 ps rise time. The resulting overall rise time of the three Pockels cells is 600 ps over the first six decades and 1.5 to 2 ns over nine decades. (Author)

A81-10550 **Demonstration of high efficiency third harmonic conversion of high power Nd-glass laser radiation.** W. Seka, S. D. Jacobs, J. E. Rizzo, R. Boni, and R. S. Craxton (Rochester, University, Rochester, N.Y.). *Optics Communications,* vol. 34, Sept. 1980, p. 469-473. 7 refs. Research supported by the Exxon Research and Engineering Co., General Electric Co., Northeast Utilities Service Co., New York, State Energy Research and Development Authority, Standard Oil Co., University of Rochester, and Empire State Electric Energy Research Corp.

Efficient conversion from 1.054 to 0.35 micron by third harmonic generation in two type II KDP crystals is reported. Energy conversion efficiencies of up to 80% have been measured under conditions applicable to large glass laser systems. A new tripling scheme used for these experiments requires a minimum of optical components and is insensitive to exact crystal alignment and laser beam divergence. A convenient scaling law allows tripling optimization for many different laser conditions. (Author)

A81-10623 **Status of fusion energy R&D.** M. Roberts (U.S. Department of Energy, Office of Fusion Energy, Washington, D.C.). *Energy,* vol. 5, Fall 1980, p. 13, 14, 26.

The status of the United States program of magnetic fusion energy research and development is reviewed. The Department of Energy policy on fusion, developed in 1978, is discussed, and scientific successes in the mirror confinement program with the tandem mirror concept, in the tokamak program with the attainment of reactor level ion temperatures and near reactor level beta factor and the use of the poloidal divertor to control density and purity, in stellarator operation and in the bumpy torus confinement program are indicated. It is pointed out that the above achievements demonstrate that conditions adequate for reactor level operation can be achieved. Technical gains including the development of the radio frequency quadrupole accelerator and the high energy neutral beam plasma heating system are also indicated. The major judgements of the status of the program on which future plans are to be based are discussed, including the perceived need for further engineering development and focusing on fewer possible concepts, and future plans for pilot plant construction and operation, which are dependent on the level of funding received, are outlined. A.L.W.

A81-10717 **Turbulence and wind-turbine performance.** A. C. Hansen (Rockwell International Corp., Energy Systems Group, Golden, Colo.). *(American Society of Civil Engineers, Convention and Exposition, Boston, Mass., Apr. 2-6, 1979.) ASCE, Transportation Engineering Journal,* vol. 106, Nov. 1980, p. 675-683.

Random data analysis methods used in wind system testing and the effect of turbulence on structural design are discussed. It is shown that the method of bins is the most valid method for analyzing continuously sampled equal-interval data; frequency matching and most-probable-power methods, though not rigorously correct, produce similar results for the data set presented. Analysis results demonstrate the importance of wind turbulence data for the design of small wind-turbine systems. V.L.

A81-10802 **Evolution of magnetic islands in tokamaks.** M. Dubois and A. Samain (EURATOM and Commissariat à l'Energie Atomique, Département de Physique du Plasma et de la Fusion Contrôlée, Fontenay-aux-Roses, Hauts-de-Seine, France). *Nuclear Fusion,* vol. 20, Sept. 1980, p. 1101-1109. 12 refs.

The evolution of magnetic islands is studied by a variational method on the assumption that it consists of a sequence of equilibria. The characteristic time of the evolution is then a resistive time. The sequence may, however, reach a configuration where the angle of the flux lines at the X-point vanishes. This behavior is plausible in the case of q equals 1 islands, in contrast to the case of q greater than 1. The subsequent evolution must assign a certain role to inertia. It is shown that this role cannot consist of a rapid displacement of the separatrix preserving its topology, but must be due to the onset of small-grain kinetic and magnetic turbulence extending from the separatrix in a large domain. (Author)

A81-10808 **Effect of magnetic field ripple on energetic ions in Alcator A.** A. J. J. Schuss (MIT, Cambridge, Mass.). *Nuclear Fusion,* vol. 20, Sept. 1980, p. 1160-1164. 11 refs. Contract No. DE-AC02-78ET-51013-A002.

The effect of toroidal magnetic field ripple on energetic ion confinement in Alcator A is theoretically investigated. A heuristic Monte Carlo particle simulation shows that for sufficiently large parallel-V/V the ion loss rate due to ripple trapping is independent of the toroidal fraction of the torus contained in the magnetic well. The resulting power loss is estimated to be large enough to limit the efficiency of RF heating on Alcator A. (Author)

A81-10811 **Production of a fat plasma in a reversed-field configuration of high efficiency.** K. I. Sato (Nagoya University, Nagoya, Japan), Y. Osanai (Nagoya University, Nagoya; Nihon University, Tokyo, Japan), and T. Aizawa (Nagoya University, Nagoya; Tokyo Metropolitan Technical College, Tokyo, Japan). *Nuclear Fusion,* vol. 20, Sept. 1980, p. 1173-1176. 16 refs.

The heating mechanism in the production of a fat (separatrix/tube wall radius ratio of approximately 1), hot (600-200 eV) plasma in a theta pinch with a reversed-field configuration is investigated. The plasma was produced in a large-diameter theta pinch by a relatively low confining field (0.3 T) with an efficiency of about 0.3, and plasma density and magnetic field profiles were monitored. Comparison of experimental results indicating the formation of the fat, hot plasma with numerical calculations based on the snowplow model reveal that it is the delayed pinch effect, which allows increased energy input to the plasma and trapped magnetic field, in combination with Joule heating due to anomalous plasma resistivity which enable the generation of such a plasma. A.L.W.

A81-10851 **Safety and reliability in superconducting fusion magnet systems.** S. Y. Hsieh, J. R. Powell, M. Reich (Brookhaven National Laboratory, Upton, N.Y.), and C. Laverick. *Cryogenics,* vol. 20, Oct. 1980, p. 575-586. 11 refs. Research sponsored by the U.S. Department of Energy.

Safetv and reliability issues involved in the operation of Sept. 1980, p. 293-312. 24 refs. Research supported by the Universität Karlsruhe.

Three discretization schemes for the computation of recirculating flows in approximating the convective terms are compared, namely: (1) the hybrid central/upwind differencing scheme, (2) the hybrid central/skew-upwind differencing scheme and (3) the quadratic, upstream-weighted differencing scheme. It is shown that the upwind formulation (1) may lead to severe solution errors due to artifical diffusion while the alternative formulations (2) and (3) are found to yield significantly better solution accuracy in a number of test cases, although they involve to a limited extent boundedness problems. The schemes are applied to two confined, laminar, recirculating flows, and it is found that in these cases artificial diffusion resulting from skewness is insignificant, but for turbulent flow cases the application of schemes (2) and (3) present definite advantages. S.S.

A81-10858 **Mechanisms for three-halves harmonic emission from laser-produced plasma.** P. D. Carter, S. M. L. Sim, and E. R. Wooding (Royal Holloway College, Egham, Surrey, England). *Optics Communications,* vol. 32, Mar. 1980, p. 443-446. 11 refs. Research supported by the Science Research Council.

Three-halves harmonic emission from thin foil targets irradiated with high power (more than 10 to the 16th W/sq cm) Nd laser pulses is reported. Spectral differences between forward and backscattered three-halves emission are seen, explained by plasmon/photon and three plasmon recombination. (Author)

A81-11060 **Ion temperature drift instabilities in a sheared magnetic field.** W. W. Lee, W. M. Tang, and H. Okuda (Princeton University, Princeton, N.J.). *Physics of Fluids,* vol. 23, Oct. 1980, p. 2007-2010. 17 refs. Contract No. EY-76-C-02-3073.

Results of particle simulation are reported which confirm the existence of ion-temperature-gradient-driven eigenmodes and their anomalous transport in a sheared slab geometry. The simulation code is basically the two-and-one-half-dimension model in which the adiabatic approximation for the electrons is used. The measured frequency, growth rate, and mode structure for the linear stage of the instability are in good agreement with the predictions from a linear theory which takes into account the detailed kinetic response of the ions. During the nonlinear stage, large ion energy transport caused by the unstable modes has been observed. For a system with only marginally stable modes, enhanced fluctuations have been observed whose frequencies and spatial structures closely match the theoretical values. V.L.

A81-11246 **Some aspects of small-scale wind structure and its effects on a vertical axis wind turbine.** S. D. Lamming, A. Ibbetson, and J. R. Milford (Reading, University, Reading, Berks., England). *Wind Engineering,* vol. 4, no. 3, 1980, p. 125-133. 9 refs.

The contribution of previously neglected small-scale fluctuations in wind velocity to the power available to a vertical-axis wind turbine is analyzed. Expressions are derived for the amount by which the mean power available is underestimated by neglecting the fluctuations and for the total variance of the deviation from the mean wind speed which is not contained in period-averaged wind data. Measurements are then presented of output voltages and input wind speeds of a 6-m vertical axis wind turbine having a response time between 15 and 80 sec. depending on the load. A neglected power due to wind fluctuations of about 15 to 6% of that estimated from hourly mean winds is obtained. Measurements also reveal lateral and longitudinal integral length scales of the turbulence in strong winds of 20 and 65 m, respectively, and allow the derivation of an expression for the spatial coherence of the turbulence. A.L.W.

A81-11247 **Direction-independent, concentration-augmented slow-running wind-rotors.** S. Sivapalan and S. Sivasegaram (Peradeniya, University, Peradeniya, Sri Lanka). *Wind Engineering,* vol. 4, no. 3, 1980, p. 134-141. 8 refs.

This paper presents an experimental investigation of a class of direction-independent concentration-augmentation systems of simple construction and shows that power augmentation by 60% is possible using concentrators of moderate size. It is suggested that larger concentrators could augment power by 100% or so. The influences of two of the major geometric parameters of the concentrator and the effect of the number of concentrator vanes are presented. The influence of wind direction on the performance of the rotor is also studied. (Author)

A81-11248 **The 12-m wind turbine blade manufactured by Volund A/S and O.L. Boats, Denmark.** H. Petersen (Riso National Laboratory, Roskilde, Denmark). *Wind Engineering,* vol. 4, no. 3, 1980, p. 142-154.

A 12 m long glass fiber blade has been developed for use as outer wing panels in the two Danish Nibe windmills. The outer wing is composed of a glass-fiber-reinforced plastic, in the form of a NACA 4412 section at the tip and a NACA 4420 section at the root and with chord and section thickness varying linearly along the wing. In bending tests of a 4-m portion of the blade, a compression stress of 137.5 MN/sq m was found to cause failure, and a flapwise bending moment was calculated. Natural frequencies of combined flapwise and chordwise bending have been calculated for the blade fixed at the root face and 1 m from the root face and have been verified experimentally. Aerodynamic calculations have also been performed of the power coefficient as a function of tip speed ratio for various tip chord angles for blades used in a 3-bladed and a 2-bladed rotor configuration with a diameter of 26 m. A.L.W.

A81-11249 **Wind generator choice for a remote location.** G. J. Bowden and J. Adler (New South Wales, University, Kensington, Australia). *Wind Engineering,* vol. 4, no. 3, 1980, p. 155-162. 10 refs.

Criteria for choice of wind generator in a remote location without storage are developed and applied. A new quantity, called the extractable energy is introduced and shown to be optimized for a rated speed of 1.25-1.4 times the mean windspeed for typical windspeed frequency curves. (Author)

A81-11375 # Aerodynamic performance of a 5-m diameter Darrieus turbine. R. E. Sheldahl, P. C. Klimas, and L. V. Feltz (Sandia Laboratories, Albuquerque, N. Mex.). *Journal of Energy,* vol. 4, Sept.-Oct. 1980, p. 227-232. 17 refs. Research supported by the U.S. Department of Energy.

A 5-diam vertical-axis wind turbine has undergone continued testing since 1976 at the Sandia National Laboratories Wind Turbine Site. The latest tests of this machine have been with extruded aluminum blades of NACA-0015 airfoil cross section. The results of these tests at several turbine rotational speeds are presented and compared with earlier test results. A performance comparison is made with a vortex/lifting line computational code. The performance of the turbine with the extruded blades met all expectations. (Author)

A81-11580 # Slag and other liquid behavior on vertical surface at near-freezing temperature. K. H. Im (Argonne National Laboratory, Argonne, Ill.) and P. M. Chung (Illinois, University, Chicago, Ill.). *AIAA Journal,* vol. 18, Nov. 1980, p. 1383-1389. 14 refs. Research supported by the U.S. Department of Energy.

Deposition of liquid droplets from turbulent stream to vertical surface and the subsequent transient behavior of the liquid layer are analyzed for the surface temperatures near the freezing point of the liquid. General wave behavior of the equations governing the liquid layer is elucidated. The analysis is applied to the problem of slag layer accumulation on the passage walls of a magnetohydrodynamic regenerative heat exchanger using the coal combustion product as the heat source. The wave behavior predicts the emergence of an accumulation shock that leads to clogging of the passages for certain cyclic operations. (Author)

A81-11797 New BBC high-efficiency gas turbines (Neue BBC-Gasturbinen grosser Leistung). E.-O. Müller and F. Pötz. *Energiewirtschaftliche Tagesfragen,* vol. 30, Oct. 1980, p. 775-781. In German.

BBC has designed and built more than 450 single-shaft gas turbines of various types and has developed a program for further developing and improving compressors, combustion chambers, and turbines. The present paper deals with two latest developments - the 13E gas turbine and Turbine-17, of 120 MW and 210 MW, respectively, and an efficiency of 0.32 and inlet temperature of 1000 C, each. A distinctive feature of these turbines is the ability to operate with low quality fuels, such as crude oils and lean gases. V.P.

A81-11906 # Experimental study of the electrical conductivity of a two-phase flow (Eksperimental'noe issledovanie elektroprovodnosti dvukhfaznogo potoka). A. P. Vasil'ev (Orenburgskii Politekhnicheskii Institut, Orenburg, USSR). *Inzhenerno-Fizicheskii Zhurnal,* vol. 39, Oct. 1980, p. 649-653. 9 refs. In Russian.

The effective electrical conductivity of liquid flow with gas bubbles is described as a function of the volumetric content of the gas phase. Experimental confirmation of the proposed functional relation shows good agreement with measurements at gas content levels below 25%. T.M.

A81-12597 An engine for direct conversion of concentration difference energy into mechanical work. S. Panse (Parle College, Bombay, India). *International Journal of Energy Research,* vol. 4, Oct.-Dec. 1980, p. 345-352. 7 refs.

The theory of an engine that can directly convert concentration difference energy into mechanical work is presented. Such an engine would work between two concentrations of a solution; unlike conventional heat engines, it would operate at a single temperature without violating any law of thermodynamics. It is shown that this engine, which operates without pollution of any kind, can tap a large amount of energy due to the salinity gradient at the interface of river water and sea water. The design of the engine is presented. B.J.

A81-12598 The development and testing of a heat pump for heating a single room. P. Freund and R. K. Cattell (Building Research Establishment, Garston, Lancs., England). *International Journal of Energy Research,* vol. 4, Oct.-Dec. 1980, p. 353-362. Commission of the European Communities Contract No. 372-78-1-EEUK.

The development and testing of a heat pump designed to provide heat only to a single room of a dwelling are discussed. The through-the-wall unit is an air-to-air heat pump based on standard refrigeration components, with various noise-reduction, control and heat exchanger components added. Measurements of heat output, the extraction of heat from a cold chamber, electric power consumption, air flow rates and temperatures at various points were performed in a test facility built to evaluate air-source heat pumps. Test results indicate that the expected rate of heat output is achieved at high temperatures; however heat output is less than expected at lower temperatures due to heat loss within the unit. The ratio of heat output to total electrical consumption indicates optimized performance in the region of 5 C ambient temperature, although at levels less than had been expected. Means of reducing heat losses and improving the efficiency of the unit are suggested. A.L.W.

A81-12778 # Electric arc plasmatrons (Elektrodugovye plazmotrony). A. S. Koroteev. Moscow, Izdatel'stvo Mashinostroenie, 1980. 176 p. 74 refs. In Russian.

The book deals with the design and principle of low-temperature plasma generators of the electric-arc plasmatron type. Particular attention is given to electric-arc plasmatron installations of various type, to the analysis of the factors which place constraints on the power and temperature characteristics, and to methods of improving plasmatron parameters. Some representative electric-arc plasmatron designs are examined. V.P.

A81-13012 Explosion-magnetic generator with a plasma load. I. I. Divnov, N. I. Zotov, O. P. Karpov, B. G. Klokov, and B. D. Khristoforov. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Nov.-Dec. 1979, p. 46-52.) *Journal of Applied Mechanics and Technical Physics,* vol. 20, no. 6, May 1980, p. 693-697. 9 refs. Translation.

The paper deals with an experimental study of the energy transfer from an explosive-driven magnetic generator to an active inductive load in the form of a high-current discharge in air at normal pressure. The highest energy value (340 kJ) was obtained at a close to optimal (calculated) resistance of 0.1 ohm. V.P.

A81-13124 Studies on setting up the reversed field pinch configuration by using the Heliotron C magnetic field. H. Oshiyama (Kyoto Technical University, Kyoto, Japan). *Physical Society of Japan, Journal,* vol. 49, Sept. 1980, p. 1199, 1200. 8 refs.

A81-13268 Two-wavelength laser transmissometer for measurements of the mean size and concentration of coal ash droplets in combustion flows. P. C. Ariessohn, S. A. Self, and R. H. Eustis (Stanford University, Stanford, Calif.). *Applied Optics,* vol. 19, Nov. 15, 1980, p. 3775-3781. 10 refs. Research supported by the Electric Power Research Institute; Contract No. DE-AC01-80ET-15611.

A two-wavelength transmissometer employing a He-Cd laser (0.325 micron) and a He-Ne laser (3.39 microns) has been developed for measuring the Sauter mean diameter of mineral ash droplets in high-temperature high-velocity coal-fired combustion flows. From transmission measurements at the two wavelengths, it is shown that mean diameters in the 0.3-3.5-micron range may be inferred with a weak sensitivity to particle refractive index and size distribution shape. The volume concentration or loading of the aerosol may then be determined from the measured transmission at either wavelength. The instrument has been used to measure the mean size and loading of ash droplets in a pulverized coal-fire channel flow at temperatures to 2900 K and velocities of up to 400 m/sec for combustion MHD power generation applications. (Author)

A81-13274 **A framework for evaluating the socioeconomic impacts of commercializing new energy technologies with an application to the on-site fuel cell energy system.** A. P. Sanghvi (ICF, Inc., Washington, D.C.), R. Ciliano (Mathematica, Inc., Princeton, N.J.), and R. Johnson (U.S. Department of Energy, Office of Commercialization, Washington, D.C.). *Energy* (UK), vol. 5, Dec. 1980, p. 1231-1244. 6 refs.

A81-13347 **The next step in fusion - What it is and how it is being taken.** J. F. Clarke (U.S. Department of Energy, Office of Energy Research, Washington, D.C.). *Science,* vol. 210, Nov. 28, 1980, p. 967-972. 27 refs.

After numerous disappointments in the effort to harness the fusion process for the production of energy, recent scientific achievements have revealed that magnetically confined plasmas can be made to produce energy. The challenge for the future in fusion lies with learning how to develop this resource. In the present paper, it is shown that magnetic fusion development is not limited by technology, ideas, or personnel. Also, the problem of choosing the appropriate strategy to ensure optimum fusion development has been resolved. The present controversy lies in the question of the appropriate pace for fusion development. V.P.

A81-13497 **Is there a better automobile engine.** J. Heywood and J. Wilkes (MIT, Cambridge, Mass.). *Technology Review,* vol. 83, Nov.-Dec. 1980, p. 19-29.

The current status and the developmental trends in the automobile industry are examined. It seems that the engines which have dominated the automobile industry will continue to do so at least through the 1980s, but continuous improvements will be made. The engineering resources behind these well-established engines are reviewed. The advantages and drawbacks of the gas turbine, the Stirling cycle engine, and electric power systems are pointed out, and the potentialities of hybrid power systems are assessed. V.P.

A81-13550 # **Influence of ambient temperature fluctuations on the parameters of thermoelectric converters (O vliianii kolebanii temperatury sredy na parametry termoelektricheskikh generatorov).** Iu. F. Kozlov and E. P. Oganov. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport,* Sept.-Oct. 1980, p. 147-153. 9 refs. In Russian.

The paper deals with a numerical analysis of the influence of inertial effects on the output parameters of radioisotope thermoelectric converters under conditions of regular diurnal air-temperature variations. Allowance for inertial effects is shown to lead to a phase shift and a change in the fluctuation amplitude of the thermal and electric converter parameters. The amplitude of fluctuations of the hot-junction temperature decreases, while that of the electric output power increases. V.P.

A81-13568 # **Electromagnetic processes in MHD channels at large magnetic Reynolds numbers (Elektrodinamicheskie protsessy v MGD-kanalakh pri bol'shikh magnitnykh chislakh Reinol'dsa).** I. V. Lavrent'ev and A. Ia. Shishko. *Magnitnaia Gidrodinamika,* July-Sept. 1980, p. 81-106. 40 refs. In Russian.

The current theoretical and experimental status of electrodynamic processes in MHD channel in the presence of strong induced magnetic fields is reviewed. Some aspects of the formulation of corresponding boundary value problems are examined, along with methods of solution. The local and integral characteristics of MHD channels at large magnetic Reynolds number are analyzed. New results are presented, concerning the influence of induced magnetic fields in two-channel MHD devices in the presence of effects caused by the three-dimensionality of the electromagnetic field distribution. V.P.

A81-13851 **Wind Energy Workshop, 1st, Cranfield Institute of Technology, Cranfield, Beds., England, April 19, 20, 1979, Proceedings.** Workshop sponsored by the British Wind Energy Association. London, Multi-Science Publishing Co., Ltd., 1979. 235 p. $44.

The workshop focused on the U.K. wind energy programs, wind turbines, rotors, and wind tunnel measurements. Papers were presented on field measurements on wind turbines, design of a wind turbine generator for small power systems, self-starting capabilities of low-solidity fixed pitch Darrieus rotors, blade design and construction for a horizontal axis wind turbine, towing tank tests on model turbine rotors, and wind tunnel measurements of turbine clusters. A.T.

A81-13852 **A collaborative programme of field measurements on wind turbines.** D. T. Swift-Hook (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 5-12. 14 refs.

Field measurements are needed on the largest available wind turbine machines in order to complement theoretical and small scale experimental (wind-tunnel) studies. A collaborative program is described which involves field measurements for five different windmills varying from 5 m to 17 m diameter in size and covering a range of important design features such as vertical and horizontal axes with fixed or variable blade pitch. Advantages of a unified program include the use of similar measuring techniques, methods of analysis and bases of comparison as well as the acquisition of equipment, computer programs, and data processing hardware and software. Field measurement techniques as proposed by CERL are discussed along with the process of data interpretation which would incorporate the application of several computer programs. The operations of the five specific windmills are reviewed in relation to the topography of their individual sites and the possible limitations for field measurements. A.C.W.

A81-13853 **Design of a wind turbine generator for small power systems.** D. F. Warne (Electrical Research Association, Ltd., Leatherhead, Surrey, England), G. R. Ketley (British Aerospace, Dynamics Group, Hatfield, Herts., England), D. H. Tyndall (Cleveland Bridge and Engineering Co., Ltd., Darlington, Durham, England), and R. Crowder (Taylor Woodrow Construction, Ltd., Southall, Middx., England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 14-23; Discussion, p. 21.

A medium scale wind turbine generator (WTG) for small power systems has been designed. The machine specification has been evolved by examination of conditions on the Falkland Islands and St. Helena as case studies. The selected design is of conventional horizontal axis type with a turbine diameter of 30 m and a maximum rating of 925 kW. The paper outlines some of the influences in arriving at the machine specification, describes the design and comments on its broader applicability. (Author)

A81-13854 **Observations of the flow in and around Savonius and Darrieus rotors.** B. R. Clayton (University College, London, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 24-30; Discussion, p. 31. 11 refs.

The work reported in this paper describes flow-visualization studies about vertical-axis rotors and is a preliminary to a more extensively planned investigation of the wake-shedding characteristics and subsequent wake interaction of large wind turbines in a cluster. A Savonius rotor, representative of high solidities, is driven by the flow in a water channel and flow visualization is effected by the hydrogen-bubble technique. Rotors with and without a center gap are examined and the beneficial effect on torque by the presence of the gap is readily identified. The low-solidity Darrieus rotor is of the straight-bladed type, but for the studies examined herein only that part of the rotor above the cross member has been constructed. Tests are carried out in a wind tunnel using a smoke generator and tufts. The use of a Savonius rotor as a starter is also reported along with measures of the aerodynamic performance of the Darrieus rotor. (Author)

A81-13855 **The self-starting capabilities of low-solidity fixed pitch Darrieus rotors.** G. R. Watson (Newcastle-upon-Tyne, University, Newcastle-upon-Tyne, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 32-39. 13 refs. Science Research Council Grant No. B/76/319999.

A method based on aerofoil data is proposed which enables the self-starting capabilities of an aerodynamic vertical-axis turbine to be determined. Aerofoil and rotor performance are evaluated at various blade angles and the effects of free-wind acting upon the operating rotor as well as the various parameters affecting the initial start are examined. All results are discussed in relation to operations of the Maximill turbine (Watson 1977) and the Canadian turbine at Magdalen Island. Consideration is also given to the possible benefits of low-speed operation for different rotor machines. A.C.W.

A81-13856 **A novel vertical axis sail rotor.** B. Hurley (College of Technology, Dublin, Ireland). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 40-47. 15 refs.

The history of vertical axis rotors is briefly outlined. A novel vertical axis sail rotor is described; aspects of the analysis of the operation of the rotor are discussed with special reference to the unique features of the flexible airfoil employed. The importance of the change in camber and the variation of the angle of attack during one complete revolution are examined. A maximum power coefficient of 0.3 with a rotor solidity just less than one has been measured. The rotor is self starting and develops considerable starting torque. The applications and potential of the rotor are assessed. Details of a slow speed high torque configuration are also included. (Author)

A81-13857 **Performance of the variable geometry vertical axis wind turbine at high and low solidities.** I. Mays (P.I. Specialist Engineers, Alresford, Hants., England) and P. J. Musgrove (Reading, University, Reading, Berks., England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 48-56; Discussion, p. 52, 53. 8 refs.

In an attempt to reduce scatter previously observed in the performance data for the variable geometry vertical axis wind turbine at Amsterdam (Musgrove and Mays, 1978), a second identical anemometer and recorder are installed and experiments for low solidity (0.17) as well as self-starting high solidity (0.6) machines are repeated. The anemometers are positioned 8 m on either side of the turbine such that the line joining them is perpendicular to the wind direction. In addition, an averaging technique is utilized which further reduces scatter and the analyzed data is compared with theoretical performance curves. Three theoretical performance prediction models including the simple analytical, single streamtube, and multiple streamtube models are compared. Since the high solidity turbine relies upon the effect of low aspect ratio (i.e. the downwash produced on the blades by the trailing vortices), the trajectories of the trailing vortices are plotted and the relationship between vortices and downwash is investigated. A.C.W.

A81-13858 **Horizontal axis wind turbines in yaw.** M. Anderson (Mullard Radio Astronomy Observatory, Cambridge, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 57-67; Discussion, p. 63. 5 refs. Research supported by the Science Research Council.

A modified strip theory is used to examine the effects of non-axial flow by incorporating the drag of the blade as well as tip losses which are determined by either a modified Goldstein or Prandtl solution of the potential flow about a helical vortex sheet. The lift, drag, axial, and rotational induced velocities are calculated for twenty-one radial positions and for five degree increments in blade rotation. It is found that under normal operating conditions a wind turbine will be subjected to non-axial flow caused by turbulence and that the amount of power loss will be dependent on two factors: (1) the amount of turbulence, and (2) the ability of the orientation system to follow the direction of the wind. Stability for three main methods of orientation which include servo control, upwind with a tailvane, and downwind are described. A.C.W.

A81-13859 **Blade design and construction for a horizontal axis wind turbine.** R. G. Herapath, M. G. Woollard, and R. T. Griffiths (Swansea, University College, Swansea, Wales). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 68-77. 7 refs. Research supported by the British Petroleum Co., Courtaulds, Ltd., Dowty-Rotol, Ltd., Royal Air Force, and Strand Glassfibre, Ltd.

The blades for the Swansea horizontal axis wind turbine have chord and setting angle varying with radius to give maximum power output at a tip speed ratio of five. The variable pitch mechanism will be continuously controlled to give optimum output at off-design conditions. In this paper an outline is given of the aerodynamic considerations, stress analysis and constructional techniques used in the design and manufacture of the blades. (Author)

A81-13860 **Towing tank tests on model wind turbine rotors.** M. G. Woollard and R. T. Griffiths (Swansea, University College, Swansea, Wales). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 78-85. 9 refs.

Experimental wind turbine performance data may be obtained from measurements made in the natural wind or from tests on wind tunnel models, with the associated problems of assessment of wind speed and blockage effects respectively. Another method, suggested here, is to tow a model turbine through a water tank and this technique has been developed as a student project at University College, Swansea. The torque, rotational and towing speeds are continuously monitored by a computer, enabling the performance characteristics to be determined over a complete range of tip speed ratios. The results are sufficiently encouraging to stimulate further development of the technique. (Author)

A81-13861 **Aerodynamic studies of a straight-bladed vertical-axis wind turbine.** W. S. Bannister (Napier College of Commerce and Technology, Edinburgh, Scotland). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 88-101. 7 refs.

A straight bladed vertical axis wind turbine has been constructed at Napier College. The turbine has a diameter of 3 m and vertical blades 2 m in length. The installation has been constructed as a test bed in order to test various blade configurations. A theoretical study, using the Musgrove type of analysis, has been completed on a design which incorporates a number of horizontal streamlined cross-arms connected to vertical blades. The analysis has included the drag of the cross-arms, the effect of operation at low Reynolds number and the effect of induced drag. The resulting design of turbine is simple, robust and capable of operating with high efficiency at high wind velocities. A relatively high annual energy output is obtainable with a load characteristic giving torque proportional to the square of the rotational speed. The test installation will be used to determine the characteristics of various turbine configurations and results will subsequently be compared with theoretical predictions. (Author)

A81-13862 **The Savonius rotor - Performance and flow.** C. N. Jones, R. D. Littler, and B. L. Manser (Exeter, University, Exeter, England; Queensland, University, Brisbane, Australia). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 102-108. 7 refs.

Comparative tests at constant Reynolds number suggest that a plain S-rotor may be as good as or better than the conventional Savonius rotor with an intervane gap. A single S-rotor gives a performance coefficient greater than 0.15 (0.225 uncorrected wind-tunnel value). Although duplex rotors have given a performance coefficient greater than 0.18 (0.32 uncorrected value), further confirmation is needed. Comparative particle flow visualization studies within these rotors (Savonius rotor with conventional gap, S-rotor with no gap, and a rotor with separated vanes (negative gap)) in a water channel suggest the importance of attached flow round the convex surfaces of the vanes, the doubtful value of the conventional gap, and the importance of vane shape. (Author)

A81-13863 **Low Reynolds number tests on the NACA 0015 section.** A. C. Willmer (British Aerospace, Aircraft Group, Bristol, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 109-116. 13 refs.

As part of a test program on a 3-m diameter vertical axis windmill, wind tunnel tests were conducted with one blade of the windmill mounted on the tunnel force balance. This paper presents the airfoil characteristics derived from these tests for the NACA 0015 section and compares them with other data for this and similar sections. The tested range of Reynolds number is 200,000 to 800,000. Using this and other published data, a consistent set of characteristics is presented for Reynolds numbers between 100,000 and 10,000,000. (Author)

A81-13864 **Unsteady aerodynamics of vertical axis wind turbines.** C. J. Duremberg (Exeter, University, Exeter, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 117-124; Discussion, p. 121, 122. 7 refs.

The unsteady aerodynamic analysis of the flow through a Vertical Axis Wind Turbine (VAWT) developed by Fanucci (1976) and improved by Migliore (1978) has been applied to the Wind Power Unit (WPU) and various improvements for the model are described. Research in the WPU has entailed vibration and stress analyses, and the study of the influence of wind characteristics and power take-off systems. Among the results are power coefficient curves compared with the multitube analysis for a nonvariable pitch machine, wind velocity description, shape of the wake, and aerodynamic forces acting on the blades. The suggested improvements for the model include: (1) reducing the convergence problems, (2) incorporating the effects of flow curvature, (3) using new sets of drag data, and (4) developing a time varying wind mathematical model. A.C.W.

A81-13865 **A vortex flow model for the vertical axis wind turbine.** D. J. Sharpe (Kingston Polytechnic, Kingston-upon-Thames, Surrey, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 125-133.

The flow is analyzed in the horizontal plane of symmetry of a high-speed vertical axis wind turbine having a large number of straight blades of infinite aspect ratio, after the manner proposed by Holme (1976). Using the method of finite elements to facilitate integration, the flow velocities at every point are determined by an iterative process which allows the wake to expand in the correct manner for inviscid flow. By this means even heavily loaded turbines may be considered without making assumptions about the nature of the wake. However, the process does not converge properly for turbines of high solidity. Performance coefficients for a turbine of solidity 0.2 are calculated using two dimensional airfoil data, and are shown to be in agreement with the values predicted by the multiple streamtube theory. Differences in blade loading are revealed between the upstream and downstream passes which it is possible to remove by the use of cambered airfoils. (Author)

A81-13866 **Integration of wind power onto an electricity supply system.** R. H. Taylor, R. J. Leicester, G. E. Gardner, and P. J. Franklin (Central Electricity Generating Board, Planning Dept., London, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 134-146.

Some of the problems involved in integrating a substantial complex of aerogenerators into a power system are examined. Annual, seasonal and diurnal variations in windspeed are compared for several location and the effect of varying aerogenerator rating on energy output and load factor is discussed. Estimates are obtained of the duration of periods of continuously low or high output at different ratings. Using historical wind data, the pattern of output from one or more aerogenerator complexes is compared with CEGB demand. These results, taken together with preliminary wind prediction data, are used to examine the implications of operating wind power as part of the CEGB system. The use of two-speed induction generators as a means of improving energy recovery and the problems of starting and providing reactive power control for aerogenerator complexes are discussed. (Author)

A81-13867 **A probabilistic simulation model for the calculation of the value of wind energy to electric utilities.** A. P. Rockingham (Imperial College of Science and Technology, London, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 147-156. 20 refs.

A81-13868 **Wind characteristics and the output of wind turbines.** E. A. Bossanyi, G. E. Whittle, P. D. Dunn, N. H. Lipman, and P. J. Musgrove (Reading, University, Reading, Berks., England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 157-164.

In designing a wind turbine for a given site, the choice of rated wind speed (i.e., the wind speed at which the generator achieves its maximum output) is very important. The trade-off between total energy output and load factor for different types of wind turbines is investigated as the rated wind speed is altered. Using the Weibull distribution form with different shape parameters, the effect of different wind speed distributions and different high speed cut-off characteristics on this trade-off is also examined. A.C.W.

A81-13869 **Permanent magnet alternators for small wind systems.** H. R. Bolton and V. C. Nicodemou (Imperial College of Science and Technology, London, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 165-180. Research supported by the Science Research Council.

The paper examines some of the basic technical factors relating to electrical generating systems for small wind turbines. The factors for and against the use of permanent magnet alternators are listed. Design and test data for some recently-developed PM alternators is presented, together with comments and information about control schemes. Some recent work on annual energy yield assessment is outlined. Preliminary results seem to show that although the use of a PM alternator increases energy yield by only 5-15% compared with that produced by a carefully-chosen wound field machine, and hence that correct choice of site, turbine, turbine operating mode, etc. are likely to be more crucial in maximizing energy yield per total capital cost than the use of a PM alternator per se, other factors such as the PM machine's extra reliability and virtually zero maintenance needs, may often be deciding factors. (Author)

A81-13870 **Improving the mechanical load matching of wind energy converters.** J. C. Dixon (Open University, Milton Keynes, Bucks., England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings.
London, Multi-Science Publishing Co., Ltd., 1979, p. 181-189; Discussion, p. 185. 5 refs.

The efficiency of the conventional design of the windpump as an energy converter is about 0.05. This is due to three main factors: (1) rotor aerodynamics, with an efficiency of 0.3; (2) bad matching of pump to rotor with speed variation, with an efficiency of 0.4; and (3) cyclic variations of torque required by the pump, with an efficiency of 0.4. A high-speed horizontal axis rotor or vertical axis rotor, although economically attractive, has a torque characteristic particularly unsuitable for use with a typical positive displacement pump. Some methods of overcoming these difficulties are compared. The use of controlled leakage on a basically positive displacement pump can be used to overcome cyclic pump-torque problems and low rotor starting torques. There are several possibilities for improving matching across the speed range including variable swept volume, and variable volumetric efficiency possibly by utilizing the inertia of the pumped fluid. (Author)

A81-13871 **Wind tunnel measurements on wind turbine clusters.** D. J. Milborrow (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England). In: Wind Energy Workshop, 1st, Cranfield, Beds., England, April 19, 20, 1979, Proceedings. London, Multi-Science Publishing Co., Ltd., 1979, p. 190-198; Discussion, p. 195, 196. 5 refs.

A series of wind tunnel tests are conducted in order to examine the performance of clusters of wind turbines. Small models consisting of vane anemometers fitted with wire gauze screens are used and are shown to give satisfactory results. The use of wire gauze screens to accomplish the momentum deficit is achieved by entropy increase rather than work extraction and it is confirmed that this approach is valid in incompressible flow. Some factors which influence the output from large arrays of wind turbines such as the rotor height and the ambient turbulence level, are identified and it is concluded that the loss of power output due to interference effects need not be large. A.C.W.

A81-13898 **A discrete ordinates solution of the Fokker-Planck equation characterizing charged particle transport.** T. A. Mehlhorn (Michigan, University, Ann Arbor, Mich.; Sandia Laboratories, Albuquerque, N. Mex.) and J. J. Duderstadt (Michigan, University, Ann Arbor, Mich.). *Journal of Computational Physics,* vol. 38, Nov. 1, 1980, p. 86-106. 21 refs. USAF-supported research.

A formalism for obtaining a discrete ordinates solution of the time and space dependent Fokker-Planck equation governing the transport of charged particles in multispecies plasmas is developed. In the absence of macroscopic electromagnetic fields and assuming isotropic Rosenbluth potentials, the Fokker-Planck equation is solved for a test particle distribution; both angular dispersion and velocity diffusion are accounted for. Difference relations are obtained and a series of validation problems are discussed. The conservation of both particles and energy are continuously monitored. In addition to providing the single-particle distribution function, spatially dependent energy deposition profiles are calculated. Comparisons with reported energy deposition profiles for a central source of 3.5-MeV alpha particles in a spherical D-T plasma are made and are found to be in good agreement. (Author)

A81-13982 **A method for determining a solid solution of the Pb/Hf(1-y)Zr(y)/(1-x)Ti(x)O3 type used for electromechanical energy conversion.** G. Grange, M. Troccaz, L. Eyraud (Lyon, Institut National des Sciences Appliquées, Villeurbanne, Rhône, France), and F. Bauer (Institut Franco-Allemand de Recherches, Saint-Louis, Haut-Rhin, France). *Applied Physics,* vol. 23, Nov. 1980, p. 289-293. 8 refs.

The mechanical stress-forced Ferroelectric F-Antiferroelectric AF transition energy conversion is reviewed. The temperature-composition phase diagram of PbHf(1-x)Ti(x)/O3 plus 1 percent La2O3 is established. The composition of a suitable material such as a ternary solid solution of the Pb/Hf(1-y)Zr(y)/(1-x)Ti(x)O3 type, characterized by a low transition pressure, is theoretically determined by a graphic construction using the Goldschmidt factor. Experimental results on the prepared material are given. (Author)

A81-13990 **Phased waveguide array with fixed tuning elements.** R. W. Motley, S. Bernabei, W. M. Hooke (Princeton University, Princeton, N.J.), and F. J. Paoloni (Princeton University, Princeton, N.J.; Wollongong University, Wollongong, Australia). *Nuclear Fusion,* vol. 20, Oct. 1980, p. 1207-1212. 23 refs. Contract No. DE-AC02-76CHO-3073.

Results are reported for a simple twin guide and a twin guide modified by the addition of two fixed tuning elements on each side tested by means of a linear H-1 plasma source which provides a 2 m long, 10 cm diameter plasma column of moderate density immersed in a 13 kG magnetic field. It is shown that the tuners can reduce the surface wave component of a twin grill by a factor of 3. V.L.

A81-13994 **Reversed-field-pinch research.** H. A. B. Bodin and A. A. Newton (EURATOM and U.K. Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England). *Nuclear Fusion,* vol. 20, Oct. 1980, p. 1255-1324. 234 refs.

Theoretical and experimental research on the reversed-field pinch (RFP) is reviewed. The basic theoretical properties of the RFP are considered including equilibrium, toroidal displacement, diffusion, confinement, and ideal and dissipative MHD stability. A general review of RFP experiments is presented including fast experiments, which utilize small-bore insulating tori in which the distribution is usually set up by fast programming on microsecond timescales; and slow experiments, carried out in large metal-walled tori in which the field configuration is set up slowly by self-reversal on millisecond timescales. B.J.

A81-14236 # **Control of dispersed vertical axis wind turbines.** Y.-H. Wan, C. W. Dodd, and J. L. Evers (Southern Illinois University, Carbondale, Ill.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6.
Rolla, Mo., University of Missouri-Rolla, 1980, p. 413-417. 8 refs.

Wind turbines used as the primary source of energy in a remote region are called dispersed wino energy systems. The use of a Vertical Axis Wind Turbine (VAWT) in this mode of operation requires special control considerations. A computer simulation examining the turbine's output voltage under time varying wind conditions evaluates three possible control techniques. (Author)

A81-14598 **Nonuniform model of a helical dynamo.** A. Gailitis and Ia. Freiberg. *(Magnitnaia Gidrodinamika,* Jan.-Mar. 1980, p. 15-19.) *Magnetohydrodynamics,* vol. 16, no. 1, July 1980, p. 11-15. 5 refs. Translation.

An inhomogeneous model of a helical dynamo is presented. The self-excitation of a magnetic field with a rigid helical movement of a circular cylinder is investigated in a kinematic approximation taking the finite extension in the radial direction and different electric conductivities of moving and stationary media into account. The dispersion relation of the model for the three cylindrical regions whose characteristics and movements are considered constant is presented; the relation of self-excitation characteristics and the relative thickness and electrical conductivity of the pipe walls and the helical movement pitch is computed by a dispersion equation. A.T.

05 ENERGY CONVERSION

A81-14603 **Decreasing the harmful effect of Hall currents on the characteristics of an MHD generator.** A. A. Beloglazov, V. A. Bashkatov, and E. E. Shpil'rain. *(Magnitnaia Gidrodinamika,* Jan.-Mar. 1980, p. 99-104.) *Magnetohydrodynamics,* vol. 16, no. 1, July 1980, p. 80-85. Translation.

The paper proposes methods of decreasing parasitic effects of Hall currents by designing the channel cross-section and the magnetic field. The results show the practicality of additional development of these methods. A.T.

A81-14604 **Numerical investigation of some three-dimensional effects in a segmented channel of an MHD generator with series-connected electrodes.** A. V. Gubarev and V. L. Ovchinnikov. *(Magnitnaia Gidrodinamika,* Jan.-Mar. 1980, p. 105-110.) *Magnetohydrodynamics,* vol. 16, no. 1, July 1980, p. 86-91. 18 refs. Translation.

A81-14619 **A high-efficiency reversible transformer of electrical energy into kinetic energy of an electron beam.** B. I. Grishanov, I. N. Meshkov, and A. N. Skrinskii (Akademiia Nauk SSSR, Institut Iadernoi Fiziki, Novosibirsk, USSR). *(Akademiia Nauk SSSR, Doklady,* vol. 251, no. 4, 1980, p. 859-863.) *Soviet Physics - Doklady,* vol. 25, Apr. 1980, p. 294-296. Translation.

The paper describes an accelerator-converter system for the reversible conversion of electrical energy into electron-beam kinetic energy. A continuous electron beam is obtained in the electron energy range of several MeV to several tens of MeV; converted power is of the order of several gigawatts or several tens of gigawatts. Several accelerator-converter configurations are examined. B.J.

A81-14631 # **Giant laser systems for D-T compression.** S. Kaliski. *Poznan, Uniwersytet im. Adama Mickiewicza, Instytut Fizyki, Seria Fizyka,* no. 35, 1980, p. 7-47. 19 refs.

The paper reviews scientific and design work at the Warsaw Institute of Plasma Physics and Laser Microfusion relating to high-power lasers and their application to thermonuclear microfusion research. Emphasis is on the following: four-channel and eight-channel Nd-lasers for the compression of microballoons filled with D-T; CO2 lasers for the spherical compression of macropellets; and combined high-power laser methods (i.e., both CO2 and Nd) of fusion plasma production. The experimental setups are described, and experimental results are presented. B.J.

A81-14776 # **Closed cycle gas turbine for atomic power stations based on high-temperature gas-cooled and fusion reactors (Gazoturbinnye ustanovki zamknutogo tsikla dlia AES s vysokotemperaturnymi gazookhlazhdaemymi i termoiadernymi reaktorami).** V. S. Beknev, V. L. Ivanov, I. G. Surovtsev, R. Z. Tumashev, K. L. Shmidt, R. A. Ianson (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR), R. G. Bogoiavlenskii (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Aviatsionnykh Materialov, Moscow, USSR), and V. N. Grebennik (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Promyshlennaia Teplotekhnika,* vol. 2, Nov.-Dec. 1980, p. 5-11. 9 refs. In Russian.

The design of closed cycle gas-turbine He cooled and fusion reactors with closed-cycle gas turbines of the VGR-50 and VG-400 types which provide heat cycle efficiencies of about 40% are examined. It is shown that He-steam installations can increase efficiencies up to 40-50%, and a combination of a closed cycle gas turbine with a nuclear reactor can provide efficiencies up to 53-55%. The construction of compressors, turbines, heat exchangers, and sealing bearings is discussed. A.T.

A81-14778 # **Experimental design in gas-turbine engine and automotive fields at the Research Automobile Design Institute (Osnovnye napravleniia nauchno-issledovatel'skikh i eksperimental'no-konstruktorskikh rabot NAMI v oblasti gazoturbinnykh dvigatelei dlia avtomobilei).** G. A. Averin, S. I. Tsvetkov, and E. E. Shvartsman (Tsentral'nyi Nauchno-Issledovatel'skii Avtomobil'nyi i Avtomotornyi Institut, Moscow, USSR). *Promyshlennaia Teplotekhnika,* vol. 2, Nov.-Dec. 1980, p. 24-28. In Russian.

A81-14779 # **Prospects for the development of automotive gas-turbine engines (Perspektivy razvitiia avtomobil'nykh gazoturbinnykh dvigatelei).** Ia. A. Spunde (Moskovskii Avtomekhanicheskii Institut, Moscow, USSR). *Promyshlennaia Teplotekhnika,* vol. 2, Nov.-Dec. 1980, p. 28-35. In Russian.

An evaluation of technical and economic efficiency of automotive gas-turbine engines is presented. The principal factor which prevents their use in motor vehicle transportation is the lack of serviceable heat exchangers. The necessity of developing special gas-turbine automotive transmissions which affect fuel consumption is emphasized. A.T.

A81-14788 # **Steam-gas installations with closed-cycle gasification of solid fuels under pressure (Parogazovye ustanovki s vnutritsiklovoi gazifikatsiei tverdogo topliva pod davleniem).** N. M. Markov, E. N. Prutkovskii, Iu. G. Korsov, and L. L. Bachilo (Tsentral'nyi Nauchno-Issledovatel'skii Kotloturbinnyi Institut, Leningrad, USSR). *Promyshlennaia Teplotekhnika,* vol. 2, Nov.-Dec. 1980, p. 90-100. 14 refs. In Russian.

The practicality of constructing steam-gas installations with closed-cycle coal gasification using pressurized steam-blast is discussed. A comparative analysis of steam-gas plants of various designs is performed; an installation which provides maximum efficiency with 'wet' cleaning of gas is presented. The design parameters of 250 and 100 MWt installations are specified. A.T.

A81-14790 # **Peak loading Gt-100 gas turbines at U.S.S.R. power stations (Opyt ekspluatatsii pikovykh gazoturbinnykh ustanovok tipa Gt-100 na elektrostantsiiakh minenergo SSSR).** G. G. Ol'khovskii (Vsesoiuznyi Teplotekhnicheskii Institut, Moscow, USSR), I. S. Bodrov (Leningradskii Metallicheskii Zavod, Leningrad, USSR), A. K. Kirsh (Soiuztekhenergo, Moscow, USSR), G. V. Ptitsyn (Gosudarstvennaia Raionnaia Elektrostantsiia, Elektrogorsk, USSR), and M. V. Karalkin (Krasnodarskaia Teploelektrotsentral', Krasnodar, USSR). *Promyshlennaia Teplotekhnika,* vol. 2, Nov.-Dec. 1980, p. 108-116. In Russian.

A81-14842 # **The calculation of current of maintaining field in toroidal plasma equilibrium.** C.-Y. Zhang, C.-R. Qing (Academia Sinica, Physics Institute, Peking, Communist China), and J.-G. Sun (Academia Sinica, Computing Center, Communist China). *Acta Physica Sinica,* vol. 29, Sept. 1980, p. 1110-1120. 9 refs. In Chinese, with abstract in English.

A method is presented for solving the equilibrium problem with axisymmetry for arbitrary plasma configuration by using the finite element technique for a specified boundary and current distribution. The virtual-casing current which produces the maintaining magnetic field required for the equilibrium is determined by using the equilibrium equation; the current distribution of a maintaining field on a given contour outside the plasma is found by solving the integral equation. Seven types of plasma configuration including circular, elliptic, doublet, race-track, and banana shapes were considered along with three kinds of plasma current distribution: the quasiuniform, diffusion-type, and skin-type. A.T.

A81-14888 **/rho R/ measurements in ion fusion targets with a fast-proton beam probe.** T. R. Fisher and J. D. Perez (Lockheed Research Laboratories, Palo Alto, Calif.). *Applied Physics Letters,* vol. 37, Oct. 15, 1980, p. 702-704. 6 refs.

A technique for measurement of /rho R/ in ion fusion targets is proposed which determines the contribution of both pusher and fuel independently by measuring both the energy loss and angular spread of a fast-proton beam after passage through the target. Some model calculations are presented which illustrate the potential accuracy of this technique. (Author)

A81-14896 **Electrical power extraction from standing shock waves.** J. B. Pearson, J. Kwan, and B. A. Ahlborn (British

Columbia, University, Vancouver, Canada). *Applied Physics Letters,* vol. 37, Oct. 15, 1980, p. 755-757. 5 refs.

The generation of electric power from a gradient of electron pressure across a standing shock wave in a high-temperature supersonic flow is reported. A standing shock was generated by inserting wedge-shaped or conical obstacles into a supersonic flow of partially ionized argon gas produced in a combustion shock tube, and electrodes were placed on either side (upstream and downstream) of the shock. V-I curves calculated from measurements of the voltage across a resistor connected across the electrodes are presented which indicate potentials of 1 V and currents of up to 200 milliamperes. In a separate series of experiments an increase in output power was obtained by extracting currents from electrodes on either side of two obstructions, indicating that the concept may be useful as a topping mechanism for conventional power generators. A.L.W.

A81-15032 **Some electrochemical properties of strong organic acids for use as fuel cell electrolytes - Methane sulfonic, methane di-sulfonic, trichloroacetic, chloro-difluoroacetic, pentafluoropropanoic, benzoic, and benzene sulfonic acids.** N. Rebert, B. G. Ateya, T. Poweigha, and L. G. Austin (Pennsylvania State University, University Park, Pa.). *Electrochemical Society, Journal,* vol. 127, Dec. 1980, p. 2641-2646. 10 refs. Contract No. EY-76-S-02-2927.

A81-15123 **Low temperature energy conversion in an organic-fluid-vapor alternating engine (Conversion d'énergie à basse température dans un moteur alternatif à vapeur de fluide organique).** P. Arques, F. Gublin, and L. Vivier (Ecole Nationale Supérieure d'Arts et Métiers, Paris, France). *Entropie,* vol. 16, no. 92, 1980, p. 15-18. 5 refs. In French.

The characteristics of a double-effect Rankine-cycle alternating engine that uses organic vapor (e.g., Freon) as the working fluid are presented. The principal use of the engine is the conversion of solar energy to mechanical energy. The design of the engine is described in detail, and experimental results are presented. B.J.

A81-15124 **Closed-cycle volumetric engines - A little explored direction in energy technology (Les moteurs volumétriques à cycle fermé - Une voie peu prospectée dans le redéploiement énergétique).** A. Kovacs. *Entropie,* vol. 16, no. 92, 1980, p. 23-30. In French.

Closed-cycle volumetric engines have efficiency and volumetric power comparable to those of internal combustion engines. The only engine of this type to be industrially manufactured is the Stirling engine; however, this cycle is disadvantageous because of the need to use hydrogen. This paper presents the concept of another type of volumetric engine which uses another cycle and overcomes the constraint associated with the Stirling engine without decreased performance. Experimental results on this engine are presented, and attention is given to possible architectures (single-effect parallel cylinders and double-effect cylinders). B.J.

A81-15142 **High-power neodymium glass laser systems for fusion research.** C. Yamanaka (Osaka University, Suita, Japan). *(Royal Society, Discussion on Ultra-Short Laser Pulses, London, England; May 23, 24, 1979.) Royal Society (London), Philosophical Transactions, Series A,* vol. 298, no. 1439, Nov. 11, 1980, p. 393-405.

The three high-power glass laser systems in use and planned for laser fusion feasibility research at Osaka University are presented. Gekko II is a two-beam silicate glass laser system with an output power of 0.4 TW at 100 psec used mainly for laser-plasma interaction experiments and the development of diagnostics. The Gekko IV system is a four-beam phosphate glass laser capable of output powers up to 4 TW at 100 psec and 2 kJ in 1 nsec, and has been used since 1978 in a computer-controlled facility in the irradiation of multilayer targets and the implosion of glass microballoons containing D2 gas. Gekko XII is a modular 12-beam glass laser system currently under development which will utilize glasses of lower nonlinear refractive index to provide a peak focusable output power of 40 TW in 0.1 nsec for isentropic compression experiments yielding pellet gains of over 1%. A.L.W.

A81-15274 **Start and removal problems with waste-heat systems, in particular behind turbines (An- und Abfahrprobleme bei Abhitzesystemen insbesondere hinter Gasturbinen).** B. Gericke (Schmidt Reuter, West Germany). *Brennstoff-Wärme-Kraft,* vol. 32, Nov. 1980, p. 502-512. 19 refs. In German.

It is shown that by measuring gas-turbine outlet temperatures as a function of time, the influence of turbine starts on waste-heat systems can be analyzed by relatively simple mathematical means. The solutions obtained make it possible to obtain the proper waste-heat system for a given turbine and vice versa. The relations derived are exact only for thin-walled tubes. V.P.

A81-15301 # **Investigation and calculation of the influence of field diffusion processes on the effectiveness of inductive power takeoff in surge-current linear electromechanical generators (Issledovanie i raschet vliianiia protsessov diffuzii polia na effektivnost' induktsionnogo otbora energii v lineinykh elektromekhanicheskikh generatorakh impul'snogo toka).** V. T. Chemeris and S. A. Gavrilko (Akademiia Nauk Ukrainskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR). *Tekhnicheskaia Elektrodinamika,* Sept.-Oct. 1980, p. 3-8. 5 refs. In Russian.

A81-15303 # **Investigation of the thermal mechanism of interelectrode breakdown in MHD generators (Issledovanie teplovogo mekhanizma mezhelektrodnogo proboia v MGD generatorakh).** A. I. Bystryi, R. V. Ganefel'd, N. I. Mazur, A. A. Miroshnichenko, and V. V. Naletov (Akademiia Nauk Ukrainskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR). *Tekhnicheskaia Elektrodinamika,* Sept.-Oct. 1980, p. 15-21. 10 refs. In Russian.

The paper deals with a theoretical and experimental investigation of the thermal mechanism of breakdown in open-cycle MHD electrical power generators. An approximate theory is proposed for calculating the parameters of thermal breakdown in gaps of various width. Experimental results obtained with a K-1 MHD generator correlate well with the theory at insulating-wall temperatures above 1600 K, whereas the role of the electrical breakdown increases below this temperature. The fluctuation level of the electric field is found to be a major factor of breakdown; in the presence of fluctuations, there is a substantial decrease in breakdown voltage and breakdown time. V.P.

A81-15444 **MHD model of conversion of the plasma energy of a thermonuclear microexplosion.** L. P. Bychkova, A. V. Kalinin, and I. M. Rutkevich (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR). *(Akademiia Nauk SSSR, Doklady,* vol. 252, no. 3, 1980, p. 586-589.) *Soviet Physics - Doklady,* vol. 25, May 1980, p. 386-388. 11 refs. Translation.

A preliminary analysis is presented of the direct conversion of the energy of a thermonuclear microexplosion into electrical energy in a reactor which is combined with a pulsed induction-type MHD generator connected to a resistive load. The following factors are taken into account: (1) the relation between the average parameters of the plasma and the magnetic field, (2) the finite dimensions of the region of magnetic energy localization, and (3) the effect of the high initial energy density of the plasma. It is found that the choice of the size of the load significantly determines the maximum efficiency of the generator. B.J.

A81-15550 **Characteristics of electro-gas-dynamic wind energy devices.** G. De Mey (Gent, Rijksuniversiteit, Ghent, Belgium). *Energy Conversion and Management,* vol. 20, no. 3, 1980, p. 201-203.

A simple model is proposed to describe the operation of the electron-gas-dynamic generator which converts wind energy directly into electricity. It is shown that the efficiency of the generator is improved if the ion mobility is low. V.L.

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A81-15825 **Magnetic fusion power.** E. J. Lerner. *IEEE Spectrum*, vol. 17, Dec. 1980, p. 44-50.

The development of nuclear fusion reactors with magnetic fields that could confine 100 million K plasmas is discussed. Emphasis is placed on the tokamak reactor which generates powerful external fields and relatively weak induced fields. Units in various countries aimed at achieving scientific breakeven in the fusion reaction are considered. The use of alternative fuels other than deuterium and tritium is explored which would produce a greater proportion of energy in the form of charged particles and less in the form of neutrons. Systems using exclusively external fields are considered as an alternative to the tokamak process. Such units exhibit high beta, steady-state operation, simple design, and an ability to use advanced fuels at high temperatures. Compact toroid machines which make use of strong induced fields in the plasma are also examined. R.C.

A81-15978 **Fracture strength of a porous lithium aluminate structure for application in molten carbonate fuel cells.** R. N. Singh (Argonne National Laboratory, Argonne, Ill.). *(American Ceramic Society, Annual Conference on Composites and Advanced Materials, 4th, Cocoa Beach, Fla., Jan. 20-24, 1980.) Ceramic Engineering and Science Proceedings*, vol. 1, no. 7-8 (B), July-Aug. 1980, p. 500-507. 6 refs. Research supported by the U.S. Department of Energy.

Electrically insulating ceramics in the form of flat plates with controlled porosities are used in molten carbonate fuel cells to retain electrolyte at 925 K. For long fuel-cell lifetimes, these electrolyte tiles must be structurally stable under steady-state and thermal-cycling conditions. The results of fracture-strength measurements on sintered $LiAlO_2$ structures with and without electrolyte over the temperature range of 300-925 K are presented. Predominantly brittle fracture was observed for porous samples up to 925 K; however, the electrolyte-impregnated samples showed considerable ductility above 675 K. The results of a Weibull statistical analysis of the fracture-strength data are discussed. (Author)

A81-16255 **Materials for open cycle MHD generators.** S. J. Schneider, H. P. R. Frederikse, T. Negas (National Bureau of Standards, Washington, D.C.), and G. Rudins (U.S. Department of Energy, Washington, D.C.). In: Current topics in materials science. Volume 4. Amsterdam, North-Holland Publishing Co., 1980, p. 89-149. 79 refs.

The MHD generator materials problems are discussed with reference to the relevant physical and chemical properties of candidate materials, including zirconia based materials, lanthanum-chromite based materials, spinels, copper (for cold metal electrodes), and steel, nickel, and platinum (for hot metal electrodes in a slagging environment). The effects of process contaminants (seed and slag) on the operation and chemical stability of the electrodes and insulator are also considered. V.L.

A81-16337 **Radiative heat exchange in the combustion chamber of an MHD electric power plant using methane gas.** L. M. Biberman, M. B. Zhelezniak, A. Kh. Mnatsakanian, A. G. Rotinov, and S. A. Tager (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR). *(Teplofizika Vysokikh Temperatur*, vol. 18, Mar.-Apr. 1980, p. 394-402.) *High Temperature*, vol. 18, no. 2, Sept. 1980, p. 326-333. 20 refs. Translation.

A method is proposed for calculating radiative thermal fluxes on the wall of the combustion chamber of an MHD electric power plant operating with methane gas. The calculations are performed on the basis of spectral characteristics of the molecular components of the combustion products and ionizing potassium impurity, with allowance for multiple reflection of radiation from the wall of the chamber. It is shown that the effect of particles of vaporizing impurity on the optical properties of the working medium is insignificant. It follows from the calculations that emission from the potassium impurity atoms amounts to about one half the radiative thermal flux density received on the wall, the magnitude of which reaches 2-3 MW/sq m. (Author)

A81-16539 **Low-frequency linear response of a cylindrical tokamak with arbitrary cross-section to 'helical' perturbations.** T. H. Jensen and M. S. Chu (General Atomic Co., San Diego, Calif.). *Journal of Plasma Physics*, vol. 24, Oct. 1980, p. 229-236. 10 refs. Contract No. DE-AT03-76ET-51011.

Current driven, 'helical' (nonaxisymmetric) modes of a tokamak with arbitrary cross-section are considered in the straight (cylindrical) geometry approximation. The plasma is considered surrounded by a resistive wall. The plasma may be unstable on a fast time-scale, namely the MHD or tearing mode time-scale, on a slow time-scale given by the wall properties or it may be stable. The formalism given in this paper allows determination of stability by relatively simple numerical means. In the case of instability on the slow time-scale, the formalism allows determination of growth rates and mode structures. Since the formalism is an eigenvalue formalism with orthogonal eigenfunctions, it is well suited for calculation of the effects on a stable plasma of slow error fields caused by externally driven error currents flowing predominantly in the direction of the ignorable coordinate. (Author)

A81-16843 # **Generation of high-power electric pulses by means of a cumulative explosion (Generatsiia elektricheskikh impul'sov vysokoi moshchnosti s pomoshch'iu kumuliativnogo vzryva).** V. M. Titov and G. A. Shvetsov. *Fizika Goreniia i Vzryva*, vol. 16, Sept.-Oct. 1980, p. 47-56. 15 refs. In Russian.

Experimental results are presented concerning a pulsed MHD-generator whose operation is based on detonation products formed in the explosion of a cylindrical gas-cumulative charge. Measurements are presented of the velocity, electroconductivity, and efficiency of charge energy conversion into the kinetic energy of the gas-cumulative jet. Magnetic induction in the MHD channel varied from 5 to 25 T; the energy conversion efficiency attained a value of 5%. B.J.

A81-17615 **Helical hydromagnetic dynamo.** Iu. B. Ponomarenko. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, Mar.-Apr. 1980, p. 22-28.) *Journal of Applied Mechanics and Technical Physics*, vol. 21, no. 2, Sept. 1980, p. 177-181. 9 refs. Translation.

The analysis deals with the steady-state electrodynamics in a conducting fluid in which external forces maintain a velocity field. In earlier studies of self-sustaining dynamos, it has been shown that, in a helical geometry, a magnetic field is excited by discontinuous axisymmetric motion of an electrically conducting fluid. In the present paper, the question whether the solutions hold in the case where the axisymmetric motion is continuous is examined. The problem is formulated as the excitation of a magnetic field by the helical motion of a conducting fluid in which the angular and axial velocities are constant within a cylinder of unit radius, are inversely proportional to the square of the radius beyond the cylinder, and are discontinuous on the cylinder. In the case of continuous motion, the number of eigenvalues with a positive increment is shown to increase indefinitely with increasing angular velocity. V.P.

A81-17799 **A contribution to the characterization of heat-treated electrocatalytically active tetramethoxyphenylporphyrinato-cobalt-II.** A. Fuhrmann, K. Wiesener (Dresden, Technische Universität, Dresden, East Germany), I. Iliev, S. Gamburzev, and A. Kaisheva (B'glarska Akademiia na Naukite, Tsentralna Laboratoriia po Elektrokhimichni Iztochnitsi na Tok, Sofia, Bulgaria). *Journal of Power Sources*, vol. 6, Jan. 1981, p. 69-81. 24 refs.

The physico-chemical properties of activated material for electrodes for the electrochemical reduction of oxygen are discussed. These electrodes contained either tetramethoxyphenylporphyrinato cobalt II or cobalt acetate, and had been treated in a stream of inert gas at temperatures between 80 and 1200 C. In this context, the current density-potential behavior, electrochemical stability, electronic conductivity, and catalytic activity for the decomposition of hydrogen peroxide are presented. The most stable material of good performance is obtained by pyrolysis in an argon stream for 5 h.

X-ray spectra confirm that carbon and beta cobalt are formed in the pyrolysis of the substrate-free compounds but, on the other hand, no beta cobalt can be detected in the pyrolysis of the material deposited on a substrate. Primarily, the carbon generated by the pyrolysis of the chelate should be considered responsible for the electrocatalytic activity of the oxygen or air electrodes prepared therefrom. (Author)

A81-17998 **Measurement and prediction of the pressure difference through a two-phase liquid-metal MHD generator.** P. F. Dunn (Argonne National Laboratory, Argonne, Ill.). *International Journal of Heat and Mass Transfer,* vol. 23, Dec. 1980, p. 1686-1690. 19 refs. Research supported by the U.S. Department of Energy and U.S. Navy.

The effects of a magnetic field and other parameters on the pressure gradient through a liquid-metal MHD (LMMHD) generator are examined. Pressure-gradient data are reported and discussed for both single-phase (sodium) flow and two-phase (sodium-nitrogen) flow through the Argonne National Laboratory high-temperature two-phase LMMHD generator. A model is presented which considers the effect of the liquid-metal shunt layer; it is shown that this model can predict, to within experimental error, the total pressure difference through a two-phase LMMHD generator operator at high Hartmann numbers under open-circuit conditions. B.J.

A81-18710 # **On the major design parameters of two low temperature difference heat engines - The Minto and Sununu wheels.** C. D. Los and J. H. Sununu (Tufts University, Medford, Mass.). *American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-9.* 9 p. 5 refs. Members, $1.50; nonmembers, $3.00.

This paper examines the performance and design characteristics of the Minto wheel. It attempts to identify the critical design parameters and develop relationships which can be used to lead to more efficient wheel designs. A technique for analyzing and modeling the Minto wheel has been developed. The numerical model permits simulation of the performance of a specific design under external operating conditions. The analysis and modeling were used to determine the best working fluids, optimum pipe diameters, the effect of size on efficiency, the effect of materials, and the benefits of using flywheels for improving operation. A significantly different design is also proposed which, like the Minto wheel, uses a thermally forced, gravity-driven rotation to produce power. Some of the benefits of this design are reviewed based on experimental observations of this configuration and the results of the Minto wheel analysis. (Author)

A81-18732 # **MHD/steam electrical power production - Promise, progress and problems.** J. N. Chapman, S. S. Strom, and Y. C. L. Wu (Tennessee, University, Tullahoma, Tenn.). *American Society of Mechanical Engineers, Century 2 Potpourri Conference, San Francisco, Calif., Aug. 13-15, 1980, Paper 80-C2/Pwr-4.* 6 p. 19 refs. Members, $1.50; nonmembers, $3.00. Contract No. DE-AC02-79ET-10815.

The MHD/Steam Power Plant has promise to burn coal and produce electrical power more efficiently than conventional coal fired plants while producing less environmental intrusion. Problems have been encountered in developing a high temperature air heater (HTAH) using coal exhaust products. Early commercial plants have been proposed that use either a gasifier to produce clean fuel for a separately fired HTAH or use oxygen enrichment to avoid the need for a HTAH. Component development is progressing rapidly but test data is needed at intermediate sizes before a commercial plant can be designed with high confidence of success. Related commercial technology is being adapted for the steam bottoming plant. (Author)

A81-18733 # **An assessment of the development of geothermal energy.** R. W. Potter, II (Occidental Research Corp., Irvine, Calif.). *American Society of Mechanical Engineers, Century 2 Potpourri Conference, San Francisco, Calif., Aug. 13-15, 1980, Paper 80-C2/Pwr-5.* 3 p. 8 refs. Members, $1.50; nonmembers, $3.00.

Geothermal energy has been being exploited for electrical energy production since 1904. Currently installed electrical generating capacity is increasing at a rate of 19 percent per year and substantial increases in direct/space heating utilization have occurred. Current estimates for the U.S. geothermal potential indicate an electric generation capacity of 23,000 to 150,000 MW electric for 30 years. Geothermal power plants have been demonstrated to be highly reliable with system availability of 70 to 100 percent. Current costs of geothermal electricity are competitive with other conventional sources. The current estimates of geothermal potential ore are based on the assumption of current technology. Substantial improvements in the existing technology are possible which would increase the production of geothermal electricity and other forms of energy substantially. (Author)

A81-18802 **Inertial confinement fusion.** J. A. Maniscalco (TRW, Inc., Redondo Beach, Calif.). In: Annual review of energy. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1980, p. 33-60. 33 refs.

The progress in inertial confinement fusion experiments and driver development is reviewed with emphasis on the performance of the basic elements required in power production and various other commercial and military applications. A specific reactor design concept is used as an example to provide an assessment of the social and economic costs associated with inertial fusion electricity production. V.L.

A81-18896 **Nonlinear generation of spatial harmonics at the edge of lower hybrid heated plasma.** R. Klima, I. M. Pankratov, P. Pavlo, and V. A. Petrzilka (Ceskoslovenska Akademie Ved, Ustav Fysiky Plasmatu, Prague, Czechoslovakia). *Plasma Physics,* vol. 22, Dec. 1980, p. 1109-1111. 8 refs.

Owing to ponderomotive forces, a large-amplitude wave will modulate the plasma density in the low-temperature boundary layer. The density modifications at the plasma edge can affect the propagation of lower hybrid waves, as in the case of the Alcator tokamak. In the present paper, it is shown that the action of ponderomotive forces in the boundary layer leads to the generation of (at least one) spatial harmonic that propagates into the plasma bulk. This effect, which stems from the Z-dependence of nonlinear density modulations, should be taken into consideration in the analysis of lower hybrid wave propagation. V.P.

A81-18902 # **A survey of the U.S. magnetic fusion program.** E. E. Kintner (U.S. Department of Energy, Office of Energy Research, Washington, D.C.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1-7.

The development of fusion technology in the United States is reviewed with reference to the confinement of plasmas, heating of plasmas, impurities in plasmas, diagnostics for plasmas, and magnetics for fusion power. Other problems discussed include: materials for fusion power, plasma engineering, environmental and safety aspects of fusion, and, finally, the maintainability of fusion plants. V.L.

A81-18922 **TFTR TF coil support restraint structure.** L. Blumenau (Ebasco Services, Inc., New York, N.Y.), J. Citrolo, J. Bialek (Princeton University, Princeton, N.J.), and G. Cargulia (Grumman Aerospace Corp., Bethpage, N.Y.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 113-116. Contract No. EY-76-C-02-3073.

The restrain structure of the toroidal field coil of the TFTR (Tokamak Fusion Test Reactor) device has been optimized to meet the design goal of 300,000 cycles of operation at full power. The toroidal field coil is restrained by the combined action of the inner support structure (ISS) and the shear/compression panels. It has been decided that the inplane centering force on the coil would be distributed so that 82% appeared at the ISS and 18% on the shear/compression panels, and the overturning moment distribution would be such that 20% would be supported by the ISS and 80% by the shear/compression panels. The distribution is not the optimum one but represents the best compromise between available space, schedule, and funding. V.L.

A81-18937 **Final design and performance of a two gap magnet.** R. DeWitt (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 187-190. Contract No. W-7405-eng-48.

The basic design features of the Doublet III Neutral Beam Injection System magnet are reviewed, and performance test results are correlated with the design criteria. Consideration is given to the yoke design, coils, field shaping, energy shielding, mechanical adjustments, electrical controls, and power supply. The actual performance of the magnet during testing is found to be slightly better than designed. V.L.

A81-18938 # **The U.S. neutral beam development program - Status and plans.** F. E. Coffman, G. M. Haas, and H. S. Staten (U.S. Department of Energy, Washington, D.C.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 191-194. 9 refs.

Neutral beam injection experiments are reviewed and a national plan to develop advanced injection systems for the late 1980's is presented. Data are examined which indicate that the neutral beam injection is a cost effective proven method of plasma heating. V.L.

A81-18960 **Mechanical design aspects of a large RFP assembly.** A. Bond, K. E. Lavender, R. J. Hucklesby, P. D. F. Jones, J. Phillpott, and J. E. Partridge (EURATOM and U.K. Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 297-301.

Results of the design and development work on a large reversed field pinch are summarized. The proposed toroidal assembly comprises a vacuum chamber (1.8/0.6 m) which consists of a bakeable thin Inconel bellows liner enclosed in a 65 mm thick aluminum alloy shell split in the theta and phi directions. The shell is fed directly with theta current from pulse transformers via a collector plate connected across the outer equatorial gap. The I phi and vertical field windings are mounted directly onto the shell; the flux from the I phi windings is coupled to the plasma by a 9.0 volt-second iron core. The design features and specifications of the shell, liner, core, I phi and vertical field windings are presented. V.L.

A81-18973 **Protective devices for the TFTR energy conversion and storage systems.** C. Neumeyer, S. Ramakrishman, W. Moo (Ebasco Services, Inc., New York, N.Y.), and R. Cassel (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 369-375. Contract No. EY-76-C-02-3073.

The special operating conditions of the TFTR electrical energy conversion system along with the large amount of stored energy necessitated the development of a comprehensive fault detection and protection scheme to insure safety, reliability and operational flexibility. This paper describes the various protection methods which are being implemented along with their integration at the subsystem and overall system levels. The protection schemes which are addressed include dc circuit ground fault detection, I(2)T and overcurrent detection, power supply fault detection and breaker coordination. The interface and interconnection of the protection equipment with the central control computer and the hardwired control system is also described. (Author)

A81-18980 **Design considerations for the Fusion Engineering Test Facility.** P. H. Sager, Jr. (General Atomic Co., San Diego, Calif.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 416-420. 9 refs. Contract No. DE-AT03-76ET-51011.

A conceptual design is presented for the Engineering Test Facility whose basic mission is to provide a fusion environment test bed for reactor components and subsystems required for the reactor demonstration phase of the fusion development program. The facility is designed as an ignited D-T burning long-pulse air-core tokamak. It has a D-shaped plasma with a major radius of 5 m, a minor radius of 1.2 m, and an elongation ratio of 1.6. Design features of the major reactor components and subsystems are discussed. V.L.

A81-18987 **The Large Coil Test Facility instrumentation system design.** P. L. Walstrom, W. M. Fletcher, J. S. Goddard, and J. L. Murphy (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 459-463. Contract No. W-7405-eng-26.

The design of the instrumentation system for the Large Coil Test Facility is described. Sensors are divided into two categories: coil diagnostic sensors, installed in the test coils; and facility sensors, installed in the various systems of the test facility in order to monitor their performance. After signal conditioning, data from the 'fast' channels (e.g., voltage taps) are multiplexed, digitized, and stored in four microcomputer systems programmed to be used in a ring buffer mode to record data before and after receipt of a random trigger from the normal zone detection circuitry. 'Slow' channels (i.e., channels from which high frequency data are not required) are digitized by a scanner and buffered by a microcomputer. Selected data channels are continuously displayed on digital or recorded on strip chart recorders. The microcomputer systems are interfaced to a central minicomputer system for display and archival storage. Facility variables are digitized by a separate scanner system. Certain critical fault variables are compared with set point values, and if they are out of range, cause a programmable logic controller to initiate an emergency coil energy dump. (Author)

A81-18990 **Mechanical design of a neutron spectrometer for TFTR.** A. D. Hay (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 475-478.

This paper describes the mechanical aspects of the design of a neutron collimator-spectrometer which will be used to measure the energy spectrum of the virgin neutrons from the Tokamak Fusion Test Reactor. To cover the range of neutron fluxes (about 10 to the 5th - 10 to the 10th N/sq cm-sec) and D-D and D-T energies (2.5 MeV and 14.5 MeV), three different types of neutron spectrometers will be used in the collimator: NE213 Scintillators, He-3 detectors, and proton-recoil telescopes. Over 150 tons of material are required to provide the required shielding against neutron and gamma radiation. Different combinations of shielding material were considered and evaluated for economy and performance. The final shielding is composed of 304 stainless steel, iron, polyethylene and boron, and boron-loaded concrete. A description of the proposed method of supporting and orienting the device with respect to the plasma is included. (Author)

A81-19010 **Determining the compatibility of a fusion power plant with the needs of future utility systems.** B. K. Jensen, R. D. Endicott, T. M. Piascik (Public Service Electric and Gas Co., Newark, N.J.), and J. R. Rankin (Public Service Electric and Gas Co., Newark; Rutgers University, New Brunswick, N.J.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 574-581. 12 refs. Research supported by the Electric Power Research Institute.

The acceptability of the fusion program will be determined by a comparison of fusion reactor characteristics with available competing technologies. The paper identifies significant elements of this comparison from a utility's point of view. Power supply expansion on an electric power system is evaluated on a long range basis to minimize the present worth of all future revenue requirements (capital and operating costs) and the environmental impact, while maintaining an adequate level of reliability. Tradeoffs must therefore be made between alternate generating schemes to obtain adequate generating capacity at the least cost. Some examples utilizing the tradeoffs are given and the implication of this reliability and economic analysis for proposed fusion reactors is discussed. A facility-sharing concept is expected to reduce capital cost requirements and has been proposed by magnetic and inertial confinement fusion designers. (Author)

A81-19026 **Study on a rectangular plasma generator for extracting 30 A/10 sec ion beams.** C. C. Tsai, H. H. Haselton, M. M. Menon, N. S. Ponte, P. M. Ryan, D. E. Schechter, and W. L. Stirling (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 665-668. 8 refs. Contract No. W-7405-eng-26.

Success of plasma heating on ATC, TFR, ORMAK, PLT, and ISX has demonstrated that neutral beam injection of atomic hydrogen isotopes is a powerful and effective heating technique for fusion devices. Next generation heating experiments call for advanced ion sources capable of delivering ion beams of approximately 100 A with approximately 100 keV/nucleon and approximately 10 sec pulse duration. The problem areas envisioned for developing such long pulse ion sources lie in the area of electron feed and ion accelerator electrodes. The electron feed of this plasma generator will be either a duoPIGatron type, a hollow cathode type, or a hydrid of the two. To improve the pulse length capability, the accelerator electrodes are designed with a rectangular hole pattern having cooling water channels along the shorter dimension. Mechanical stability and water cooling effectiveness are both increased. To study the feasibility of this design a plasma generator (25 cm x 35 cm) for a 30-A ion beam with a 10 cm x 25 cm beam cross section is being developed. (Author)

A81-19030 **Performance of two large volume magnetic multipole plasma sources.** A. P. H. Goede and T. S. Green (EURATOM and U.K. Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 680-684. 6 refs.

Two multipole plasma sources, differing in their magnetic field configuration, have been tested as plasma generators without extraction. Operated in hydrogen both sources reliably produce a uniform ion flux over 37 x 14 sq cm to 38 x 15 sq cm, containing over 80% protons at current densities ranging from 100-300 mA/sq cm and pressures from 3-10 mtorr. Discharge power efficiency for producing ions useful for extraction is about 1.5 A/kW at 3.3 mtorr. (Author)

A81-19031 **Interrupter and hybrid-switch testing for fusion devices.** W. M. Parsons, E. M. Honig, J. D. G. Lindsay (California, University, Los Alamos, N. Mex.), R. W. Warren (California, University, Los Alamos, N. Mex.; Westinghouse Research Laboratories, Pittsburgh, Pa.), P. Bellamo (Ebasco Services, Inc., New York, N.Y.), and R. L. Cassel (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 689-692. 6 refs. Research sponsored by the U.S. Department of Energy.

This paper discusses recent and ongoing switch testing for fusion devices. The first part describes testing for the TFTR ohmic-heating circuit. In this set of tests, which simulated the stresses produced during a plasma initiation pulse, circuit breakers were required to interrupt a current of 24 kA with an associated recovery voltage of 25 kV. The second part discusses hybrid-switch development for superconducting coil protection. Test results at 13 kA continuous current and future plans for extending the steady-state rating to 25 kA are presented. The third part presents preliminary results on an early-counterpulse technique applied to vacuum interrupters. Implementation of this technique has resulted in large increases in interruptible current as well as a marked reduction in contact erosion. (Author)

A81-19035 **Superconducting magnets for MHD and fusion: Common problems - Joint solutions.** A. M. Dawson, D. B. Montgomery, and P. G. Marston (MIT, Cambridge, Mass.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 734-738. 7 refs. Research supported by the U.S. Department of Energy and NSF.

The design of MHD magnetic systems is briefly discussed with emphasis on the features analogous to those of the magnets for fusion systems. Common problem areas which might be considered for joint research programs are identified, including materials and their cryogenic properties, fabrication and transportation, instrumentation, cryogenic systems, power supplies, environmental impact, testing, and safety codes. V.L.

A81-19048 **Neutral-beam/torus connecting duct for the Tokamak Fusion Test Reactor.** V. Simone, J. Glicksman (Grumman Aerospace Corp., Bethpage, N.Y.), K. Wright, and B. Prichard (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 798-802. Contract No. EY-76-C-02-3073.

The Tokamak Fusion Test Reactor (TFTR), presently under construction, will have a total of four neutral beam lines active during operation with the option to add two future beam lines. The primary function of the neutral beam/torus connecting duct (NB/TCD) is to provide a vacuum boundary aperture of ample size through which the beams of energetic neutral particles from the neutral beam injector can pass into the torus without deleterious effects from the beam striking the duct walls. The NB/TCD must also include components to isolate the NBL from the torus vacuum vessel, minimize flow of tritium from the torus into the NBL, electrically isolate the NBL from the torus, allow for alignment of the NBL, and permit maintenance by remotely operable apparatus. The NB/TCD includes an absolute valve, fast shutter valve, electrical insulator, alignment bellows, and remotely operable joints and seals. The NB/TCD is supported by the TFTR Neutral Beam Support System. (Author)

A81-19049 **TFTR energy conversion system simulation.** C. Paulson and F. Petree (Ebasco Services, Inc., New York, N.Y.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 803-806. Contract No. EY-76-C-02-3073.

The Tokamak Fusion Test Reactor (TFTR) is a magnetic confinement device, using several sets of mutually coupled field coils to provide the required controlling magnetic fields. This paper presents a model and a computer program which were developed by the TFTR electrical design group to aid in the design of the poloidal field portion of the dc energy conversion system and to verify the operational parameters of the individual system elements. The major features of the model including the feedback controlled power supplies, the interrupter circuitry, and the controlled switch elements are presented together with a description of their derivation and operation in the code. Results are provided which show how the code was utilized to determine the design parameters of the compensation capacitor network and to verify the operation of the ohmic heating interrupter circuitry. (Author)

A81-19097 **Design of JT-60 grounding system.** K. Arakawa, R. Shimada, H. Kishimoto, S. Tamura (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan), K. Yabuno, Y. Ishigaki, and R. Saito (Hitachi, Ltd., Hitachi, Ibaraki, Japan). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1113-1118.

The paper deals with a grounding system, intended for the JT-60 tokamak, which will ensure personnel safety and control and operation requirements. The principal design features of the grounding system are discussed. V.P.

A81-19114 **Development of JT-60 dc power supply equipment.** S. Tamura, R. Shimada (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan), T. Sasaki, T. Shibata, Y. Sato, and N. Fujiwara (Toshiba Corp., Tokyo, Japan). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3 Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1231-1236.

This paper examines equipment for the poloidal field power supply of JT-60. Thyristor convertors in the ohmic heating and the vertical field coil circuit are designed with 4kV-3kA thyristors to make the convertor banks compact. A light signal trigger method is used for the thyristor switch with large thyristors connected 18 in series and 6 in parallel. A nitrogen gas gap with current conduction capability of 92 kA-20msec and a triggering function is tested as a protection device. The response and accuracy of dc current transformers with Hall-effect semiconductors are also investigated. R.C.

A81-19125 **Assembly and commissioning of the ASDEX tokamak.** H. Finkelmeyer, J. Franzspeck, J. Gernhardt, F. Gresser, G. Haas, F. Hartz, G. Herppich, M. Keilhacker, G. Klement, and M. Kornherr (EURATOM and Max-Planck-Institut für Plasmaphysik, Garching, West Germany). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1299-1302. 6 refs.

The assembly and startup of the ASDEX tokamak is reviewed including completion of the inner poloidal field coils, vertical and radial field coils, and switching circuitry. The two halves of the vacuum vessel were mounted inside the core of the toroidal field coils, connected by laminated fiberglass insulating gaps, and leak-tested. The Ti sublimators and the LN2-cooled getter panels of the divertor pumping system were assembled and tested; the ASDEX experiment was performed and the tokamak readied for operation. A.T.

A81-19133 **Design of the bundle divertor experiment for the ISX-B tokamak.** R. B. Wysor, T. C. Jernigan, W. R. Wing, B. E. Nelson, D. H. Gray, J. W. Yarbrough, R. B. Easter (Union Carbide Corp., Nuclear Div., Oak Ridge, Tenn.), J. A. O'Toole (Grumman Aerospace Corp., Bethpage, N.Y.), E. J. Rapperport, and J. E. Tracey (MIT, Cambridge, Mass.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1337-1341. 7 refs. Contract No. W-7405-eng-26.

The emphasis in the ISX-B Program is the attainment of high-beta in a tokamak discharge using massive auxiliary heating and noncircular plasmas. It is anticipated that with 3 MW of neutral injection, the associated wall power loading will sputter large amounts of wall material into the plasma. These impurities will limit the energy confinement time of the plasma and will limit a complete exploration of any high-beta limits to IXS-B operations. A bundle divertor offers a means of controlling impurities in ISX-B and will allow studies of plasma-wall interactions. The divertor consists of two small copper coils that extract a tube of magnetic flux and plasma from the discharge and carry it to an external chamber. Problem areas include design of the diverted magnetic flux bundle, large electromagnetic forces between the TF coil and divertor, cooling control of the coil windings, large particle throughput, very high thermal power density on the target, and integration of the divertor with the existing ISX-B tokamak system. (Author)

A81-19139 **Design of upgrades to the PLT neutral beam injectors for use on PDX and ISX-B.** R. L. Johnson, W. L. Gardner, R. A. Michelotti, J. R. Moore, T. L. Ryan, J. E. Warwick, H. C. McCurdy, R. E. Worsham, P. L. Goranson, and P. W. Whitfield (Union Carbide Corp., Nuclear Div., Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1375-1378. 8 refs. Contract No. W-7405-eng-26.

The design of neutral beam injection systems for PLT provided adequate heating of the device plasma. This design with some minor modification was used on ISX. In order to achieve injection of 1.5 MW from each neutral beam system for PDX and ISX-B, major changes in the base line design were required in a number of mechanical systems. The paper describes these changes along with modification for the ISX-B systems. A prototype system was designed, constructed, and operated to verify design and to provide facility for source development and testing qualification. (Author)

A81-19151 **Reference design of a commercial tokamak hybrid reactor.** R. P. Rose, J. L. Kelly, and T. C. Varljen (Westinghouse Electric Corp. Fusion Power Systems Dept., Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1509-1514. 14 refs. Contract No. EG-77-C-02-4544-A003.

The preconceptual design of a first generation commercial tokamak hybrid reactor uses an ignited plasma with a near-ignition operation and a high beta of 6.3%. A compact-D toroidal field coil system was incorporated with a plasma exhaust device containing a bundle divertor; accessibility was enhanced by near vertical beam injectors. The neutronic advantages of complete blanket coverage in the poloidal direction are marginal when compared with lower availability resulting from longer downtime for replacement of inner blanket elements. In-situ tritium removal is possible with LiO2, but not with LiH and conventional structural materials; fuel production figures showed that enrichment to 3 wt% fissile can be achieved with four years of irradiation. A.T.

A81-19156 **Blanket and shield design for a commercial tokamak hybrid reactor /CTHR/.** L. Green, D. L. Chapin, A. Y. Lee, and M. E. Culbert (Westinghouse Electric Corp., Fusion Power Systems Dept., Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1562-1567. 13 refs. Contract No. EG-77-C-02-4544-A003.

Neutronic scoping calculations, conceptual mechanical designs, and thermal-hydraulic analyses are reported for the blanket of a near term commercial tokamak hybrid reactor (CTHR). The fertile fuels considered were UO2 and UC, boiling water cooled and helium cooled, respectively. LiH and Li2O were selected for the tritum breeding media. Neutronics performance estimates were based on realistic fuel/clad/coolant volume fractions, wall coverage, and plant availability factors. Tritium self sufficiency was required of all configurations. The consequences of utilizing the inner blanket for tritium breeding only is examined. (Author)

A81-19163 **STARFIRE - A commercial tokamak reactor.** C. C. Baker, M. A. Abdou (Argonne National Laboratory, Argonne, Ill.), D. A. DeFreece, C. A. Trachsel (McDonnell Douglas Astronautics Co., St. Louis, Mo.), D. Graumann (General Atomic Co., San Diego, Calif.), and J. Kokoszenski (Ralph M. Parsons Co., Pasadena, Calif.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1614-1619. Research supported by the U.S. Department of Energy.

The design study of the STARFIRE project was completed in late 1980. In the present paper, the major design features that have been tentatively selected for the STARFIRE tokamak fusion electric power plant are reviewed. V.P.

A81-19164 **Results of systems studies for the STARFIRE commercial tokamak.** M. A. Abdou, D. A. Ehst (Argonne National Laboratory, Argonne, Ill.), and L. M. Waganer (McDonnell Douglas Astronautics Co., St. Louis, Mo.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1620-1624. 10 refs. Research supported by the U.S. Department of Energy.

Extensive system and tradeoff studies were performed to support the selection process for the major parameters and design features of the STARFIRE commercial reactor. With a thermal power of 3800 MW, a neutron wall load of 3.5 MW/sq m results in a relatively small-size reactor without imposing excessive requirements on the first-wall cooling capability, maximum toroidal-magnetic field, and frequency of structural material requirements. This moderately high-wall load requires that the first-wall coolant be liquid (water or lithium) and the lifetime of the structural material is greater than 15 MW-yr/sq m. With moderate plasma elongation and beta the required maximum toroidal-field is about 11 T. STARFIRE is operated steady-state with no OH coil. (Author)

A81-19165 **Superconducting poloidal coils for 'STARFIRE' commercial reactor.** S.-T. Wang, K. Evans, Jr., L. R. Turner, Y.-C. Huang (Argonne National Laboratory, Argonne, Ill.), R. Prater, and J. Alcorn (General Atomic Co., San Diego, Calif.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1625-1628. Research supported by the U.S. Department of Energy.

STARFIRE is considered to be the tenth commercial tokamak power plant. A preliminary design study on its superconducting poloidal coil system is presented. Key features of the design studies are: the elimination of the ohmic heating coil; the trade-off studies of the equilibrium field coil locations; and the development of a conceptual design for the superconducting equilibrium field coils. Described are the 100 kA cryostable conductor design, the coil structure and evaluation of the coil forces. (Author)

A81-19167 **The impurity control system for the STARFIRE commercial fusion reactor.** J. N. Brooks, C. C. Baker, H. C. Stevens (Argonne National Laboratory, Argonne, Ill.), and C. A. Trachsel (McDonnell Douglas Astronautics Co., St. Louis, Mo.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1634-1637. 9 refs. Research supported by the U.S. Department of Energy.

The STARFIRE impurity control system is based on a low-Z coated limiter/vacuum system which collects and pumps about 30% of the particle flux at the edge of the plasma. This pumping efficiency, when combined with about a 1.5-T additional margin in the toroidal magnetic field, is sufficient to maintain the steady-state helium concentration to approximately 10% while permitting a tritium burnup fraction at approximately 10%. In order to keep the heat load on the limiter to reasonable limits, about 80% of the alpha-particle energy is radiated to the first wall by injecting a very small amount of appropriate impurity ions. (Author)

A81-19168 **Tritium handling and vacuum considerations for the STARFIRE commercial tokamak reactor.** P. A. Finn, R. G. Clemmer, V. A. Maroni (Argonne National Laboratory, Argonne, Ill.), and C. Dillow (McDonnell Douglas Astronautics Co., St. Louis, Mo.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1638-1642. 8 refs. Research supported by the U.S. Department of Energy.

Tritium processing and vacuum pumping requirements were analyzed for the STARFIRE commercial fusion reactor design. It was found that vacuum pumps having a helium capture probability of 0.5 (total helium pump speed 1.2 x 10 to the 4th cu m/s) in combination with the proposed STARFIRE limiter-vacuum concept is sufficient to achieve plasma impurity control and, simultaneously, high fractional burnup (11%). The high fractional burnup and minimum fuel recycle time result in a very low fuel cycle tritium inventory, about 1300 g. A 'Lean-T burn' method that can further reduce the fuel cycle inventory by 30-50% is discussed. D2O is proposed as a first wall coolant from considerations of plasma contamination (due to hydrogen isotope permeation through coolant tubes) and enrichment of recycled tritium from the coolant circuit. (Author)

A81-19170 **First wall and blanket design for the STARFIRE commercial tokamak power reactor.** G. D. Morgan, C. A. Trachsel, B. A. Cramer, D. A. Bowers (McDonnell Douglas Astronautics Co., St. Louis, Mo.), and D. L. Smith (Argonne National Laboratory, Argonne, Ill.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 3. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1648-1652. Research sponsored by the U.S. Department of Energy.

The first wall and blanket design concepts being evaluated for the STARFIRE commercial tokamak reactor study are presented. The two concepts represent different approaches to the mechanical design of a tritium breeding blanket using the reference materials options. Each concept has a separate ferritic steel first wall cooled by heavy water, and a ferritic steel blanket with solid lithium oxide breeder cooled by helium. A separate helium purge system is used in both concepts to extract tritium. The two concepts are compared and relative advantages and disadvantages for each are discussed. (Author)

A81-19184 **Losses in a built-up conductor for large pulsed coils.** J. D. Thompson, J. J. Wollan, R. I. Schermer (California, University, Los Alamos, N. Mex.), and B. Turck (California, University, Los Alamos, N. Mex.; Commissariat à l'Energie Atomique, Centre d'Etudes Nucléaires de Saclay, Gif-sur-Yvette, Essonne, France). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 4. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1739-1742. 7 refs. Research sponsored by the U.S. Department of Energy.

Measurements of hysteretic and pulse-field losses have been performed on a basic composite multifilamentary Nb-Ti conductor and on cables built-up from this conductor. Analysis of the measurements indicates that contact resistance between constituent conductors in both first- and second-level cables plays an important role in determining the pulse-field loss value. When the contact is good, as in solder-filled cables, the losses increase by a factor of 7.5 for long pulse times relative to non-solder-filled, noncompacted cables. For relatively high contact resistances, as in unsoldered cables, the constituent conductors are more decoupled from each other, which results in low losses. V.L.

A81-19216 **Direct digital control of plasma position in JFT-2 tokamak without shell.** Y. Matsuzaki, N. Fujisawa, N. Suzuki, M. Maeno, T. Yamamoto, T. Tani (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan), Y. Miyahara, K. Murai, D. Iba, and T. Kawasaki (Hitachi Ltd., Hitachi, Ibaraki, Japan). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 4. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1899-1902. 10 refs.

A system for the feedback of plasma position is installed in the remodelled shell-less JFT-2 tokamak. The power supply of the control field is operated by the direct digital control using a 16-bit digital process computer with 48 K words of memory and a 16-bit microprocessor-controlled regulator for double three-phase bridge thyristor rectifiers. The response time of the digital control loop is 2.3 msec. The preliminary experiments show that the plasma current is sustained for approximately 160 msec. (Author)

A81-19230 **Real time acquisition processing and archiving of Doublet III diagnostic data employing table driven software.** A. Glad, P. Henline, L. Gross, and B. McHarg (General Atomic Co., San Diego, Calif.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 4. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1964-1969.

A81-19247 **High temperature blankets and power cycles for high efficiency power conversion.** R. T. Taussig (Mathematical Sciences Northwest, Inc., Bellevue, Wash.) and J. R. Powell (Brookhaven National Laboratory, Upton, N.Y.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 4. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 2060-2065. 14 refs. Research supported by the Electric Power Research Institute.

High temperature blanket and advanced power conversion technology is applied to near-term fusion device designs to establish the possibility of net power production. The combination of solid lithium compounds for breeding with ceramic materials leads to peak blanket temperatures on the order of 1800 K to 2500 K, depending on choice of coolant and interior blanket material. The high temperature blanket regions may absorb 60 to 70 percent of the total fusion power output. Energy exchanger/turbine and high temperature gas turbine technology is used to convert the blanket energy to electricity with overall plant efficiencies of 60 percent or higher. This technology can be applied to near term fusion devices based on TFTR-like confinement physics to overcome low Q operation and give net power production. Similar technology will also benefit ignited reactors by reducing the thermal plant size and costs. (Author)

A81-19283 **Establishing fusion component failure limits through availability goals.** G. M. Fuller and H. S. Zahn (McDonnell Douglas Astronautics Co., St. Louis, Mo.). In: Symposium on Engineering Problems of Fusion Research, 8th, San Francisco, Calif., November 13-16, 1979, Proceedings. Volume 4. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 2236-2240.

Scheduled and unscheduled maintenance downtimes are allocated to availabilities representing levels desired for a commercial fusion power system (75%) and experimental fusion devices (50% and 25%) representative of ETF or INTOR. Critical path scheduled activities are defined. These consist of replacing failed redundant components, replacement of life limited components, and allowances for maintenance equipment failures. Components whose failure would shut down the reactor are identified and permissible failure frequencies are assigned which, in combination with the downtimes required to repair/replace, account for the total unscheduled downtime budget. Eleven components were found to account for 75% of all of the allowable unscheduled downtime. (Author)

A81-19323 # **Method for calculating the parameters of the internal circuit of a Stirling engine (Metodika rascheta parametrov vnutrennego kontura dvigatelia Stirlinga).** V. S. Trukhov and I. A. Tursunbaev. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport,* Nov.-Dec. 1980, p. 145-150. 10 refs. In Russian.

A mathematical model of the cycle has been developed for two modifications of the Stirling engine. The computer implementation of the model is described, and results are presented on the design of the internal cycle of the engine. B.J.

A81-19496 **High temperature fuel and electrolysis cells with zirconia solid electrolytes.** F. J. Rohr (Brown, Boveri et Cie. AG, Zentrales Forschungslaboratorium, Heidelberg, West Germany). In: Applications of solid electrolytes. Cleveland, Ohio, JEC Press, Inc., 1980, p. 196-205. 11 refs.

The present state of development of high-temperature fuel cells and electrolysis cells with oxygen-ion-conducting zirconia solid electrolytes is reviewed. The principles of high-temperature fuel and electrolysis cells, which are based on the high oxygen ion conductivity of zirconia at elevated temperatures (800-1000 C), are considered in the generation of electric potential by the fuel cell from a gaseous fuel and oxygen and the generation of hydrogen and oxygen from water, electrical energy and heat in electrolysis. The development of cell components, including the solid electrolyte, the electrodes, and the interconnection material, of single cells operating as fuel cells, electrolysis cells and alternating fuel cells/electrolysis cells, and of multicell modules is then discussed, and results of long-term tests carried out with single cells and multicell modules are presented. It is pointed out that the component technologies have been developed and successfully tested under laboratory conditions, with the longest laboratory test extending over 50,000 hours at 1000 C, and extensive development work will be required for the production and economic application of larger systems. A.L.W.

N81-10195# Engineering Societies Commission on Energy, Inc., Washington, D. C.
MATERIALS FOR COAL CONVERSION AND USE. VOLUME 3: MATERIALS OF CONSTRUCTION FOR ADVANCED POWER SYSTEMS Final Report
Vinod K. Nangia Aug. 1980 86 p refs
(Contract DE-AC01-77ET-10679; EF-77-C-01-2468)
(FE-2468-71-Vol-3) Avail: NTIS HC A05/MF A01

Two advanced coal based power generation systems and their materials related problems are described. The first system is an integrated coal gasifier-molten carbonate fuel cell power plant with a steam turbine/gas turbine bottoming cycle. The second is a combined cycle power plant using a pressurized fluidized bed coal combustor. E.D.K.

N81-10552# RAND Corp., Santa Monica, Calif.
QUANTITATIVE EVALUATION OF CLOSED-CYCLE OCEAN THERMAL ENERGY CONVERSION (OTEC) TECHNOLOGY IN CENTRAL STATION APPLICATIONS
E. C. Gritton, R. Y. Pei, J. Aroesty, M. M. Balaban, C. Gazley, R. W. Hess, and W. H. Krase May 1980 139 p refs
(Contract DE-AC01-79PE-70078)
(RAND/R-2595-E; LC-80-13615; ISBN-0-8330-0222-8) Avail: NTIS HC A07/MF A01

Closed cycle Ocean Thermal Energy Conversion (OTEC) for delivery of electric power to the United States is studied. Performance and costs of complete commercial OTEC systems are analyzed at the system level using inputs from component analyses and thermal resource data for sites in the Gulf of Mexico. Such sites could feed the Gulf Coast from the west coast of Florida to the New Orleans areas. In this evaluation, the energy conversion analysis, i.e., the study of the power system, is based on a thermodynamic analysis of the complete system, which includes allowances for losses in all circuits. A cost minimization scheme is used to ensure that the cycle component choices are near optimal. To make these cost minimization calculations, cost algorithms are developed for the principal components. Off design operations are of great importance in the Gulf of Mexico because of significant seasonal surface temperature variations and the quite large resulting variations of output power. DOE

N81-10561# Brookhaven National Lab., Upton, N. Y.
IMPROVED ALKALINE HYDROGEN/AIR FUEL CELLS FOR TRANSPORTATION APPLICATIONS
J. McBreen, G. Kissel, K. V. Kordesch, F. Kulesa, E. J. Taylor, E. Gannon, and S. Srinivasan 1980 6 p refs Presented at 15th Intersoc. Energy Conversion Eng. Conf., Seattle, 18-22 Aug. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28094; CONF-800806-32) Avail: NTIS HC A02/MF A01

Some alkaline air electrodes for air depolarized chloralkali cells were evaluated at Brookhaven National Laboratory in alkaline hydrogen/air fuel cells. In initial tests with 289 sq cm electrodes, power densities of 100 mW/sq cm were obtained at 0.65 V. This compares with power densities of 27 mW/sq cm obtained by Kordesch in his vehicle fuel cell in the late sixties. Further improvements in the air electrode flow field yielded power densities of 126 mW/sq cm at 0.65 V at an operating temperature of 70 C. At 30 C, nearly 60% of this power could be obtained at 0.65 V. The 289 sq cm cells were units in a 16 cell 0.5 kW module. This module yielded similar power densities, and its power/weight and power/volume are sufficiently attractive for it to be considered as a building block for a fuel cell power plant in a fuel cell/battery hybrid vehicle. DOE

N81-10569*# New England Research Application Center, Storrs, Conn.
INVERTER CONVERTERS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1970 - Apr. 1980
Robert Hippler May 1980 106 p Sponsored by NASA and NTIS
(NASA-CR-163649; PB80-809080) Avail: NTIS HC $30.00/MF $30.00 CSCL 10B

Cited works cover the field of electrical devices which convert direct to alternating current. Some of the applications discussed are motor and furnace drives, solar and wind generated electrical power conversion, variable frequency devices for motor speed control drives, and power frequency conversion devices. The components used in these devices, such as thyristors, SCRs, MOS devices, etc., and the associated circuitries, are described. GRA

N81-11157# American Univ., Washington, D. C.
DEFINITION OF CHEMICAL AND ELECTROCHEMICAL PROPERTIES OF A FUEL CELL ELECTROLYTE Final Technical Report, 25 Mar. 1977 - 24 Jun. 1980
R. T. Foley Jun. 1980 71 p refs
(Contract DAAK70-77-C-0080; DA Proj. 1K1-61102-AH-51)
(AD-A089776) Avail: NTIS HC A04/MF A01 CSCL 07/4

The research was oriented toward the task of developing an improved electrolyte for the hydrocarbon-air fuel cell. A literature study of the properties of organic acids indicated that the following types of compounds warranted investigation: aromatic polycarboxylic acids, perfluoroaliphatic carboxylic acids, mono, di and poly sulfonic acids, and substituted sulfonic acids. This was followed by an experimental program wherein the vapor pressure, wetting characteristics, electrical conductivity, chemical stability, and electrochemical stability of specific compounds were measured. The following compounds (acids) were among those evaluated: dichloroacetic, d1-10-camphor sulfonic, heptafluorobutyric, ethanedisulfonic, sulfosalicyclic, benzenesulfonic, 1,3,6 - napthalene trisulfonic, sulfosuccinic, sulfopropionic, methanedisulfonic, propanesulfonic, methanesulfonic, ethanesulfonic, and sulfoacetic. Most attention was given to the last three acids. The electrochemical behavior of methanesulfonic acid, ethanesulfonic acid, and sulfoacetic acid as fuel cell electrolytes was studied in half cells at various temperatures. The rate of the electro-oxidation of hydrogen at 115 C was very high in methanesulfonic acid and sulfoacetic acids. The rate of the electro-oxidation of propane in methanesulfonic acid and ethanesulfonic acid at 80 C and 115 C was low. GRA

N81-11162# California Univ., Berkeley. Lawrence Berkeley Lab.
CONDENSATION FILM COEFFICIENTS FOR MIXTURES OF ISOBUTANE AND ISOPENTANE
B. W. Tleimat, H. Rie (Envirotech-Sephton Development Center, Emeryville, Calif.), A. D. K. Laird, and S. Zhao May 1980 6 p refs Presented at the 15th IECEC, Seattle, 18-22 Aug. 1980 Prepared in cooperation with California Univ., Richmond and the Sea Water Conversion Lab.
(Contract W-7405-eng-48)
(LBL-11025; CONF-800806-34) Avail: NTIS HC A02/MF A01

Research designed to obtain baseline data on heat transfer for working fluids in geothermal binary cycle systems is described. The working fluid loop in the experimental apparatus simulates the binary cycle with steam as the heating fluid and a throttling valve instead of the turbine. Data on film coefficient for the condensation of 90/10 and 80/20 mixtures of isobutane-isopentane on a horizontal tube at various temperatures and condensation rates are presented. Data indicate that mixtures of isobutane-isopentane have lower condensation film coefficients than that of the pure isobutane under equivalent conditions of temperatures and condensation rates. Depending on the mass condensation rate, the film coefficient for the 80/20 mixture can be as low as 30 percent of the film coefficient for pure isobutane at the same mass condensation rate. DOE

N81-11399# Thermo Electron Corp., Waltham, Mass.
STATUS REPORT ON DIESEL ORGANIC-RANKINE COMPOUND ENGINE FOR LONG-HAUL TRUCKS
Oct. 1979 35 p Presented at the DOE Automotive Technol. Develop. Contractors Coord. Meeting, Dearborn, Mich., 23 Oct. 1979
(Contract DE-AC02-76CS-52832; EY-76-C-02-2832)
(TE-4257-72-80; CONF-791082-2) Avail: NTIS HC A03/MF A01

Completely integrated compound engine, consisting of a diesel engine coupled to a Rankine engine, which operates on the exhaust heat from the diesel engine was developed and demonstrated. The prototype compound engine is built around a standard Mack Truck diesel engine, and the waste heat recovery system is a thermo electron organic Rankine bottoming cycle system incorporating a turbine expander delivering power to the diesel engine drive train. The use of the diesel organic Rankine compound engine is in large, heavy duty trucks for long distance hauling. Here the engine load and speed requirements are nearly constant over a large portion of the operating hours, and high mileages are accumulated. Thus, the potential fuel savings is sufficient to justify the added cost of a bottoming cycle system. Based on engine dynamometer tests to date, the addition of an organic Rankine bottoming cycle to a long haul diesel truck can improve the fuel economy by 15 percent over a typical duty cycle. R.K.G.

N81-11429# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
CREEP-FATIGUE EFFECTS IN STRUCTURAL MATERIALS USED IN ADVANCED NUCLEAR POWER GENERATING SYSTEMS
C. R. Brinkman 1980 23 p refs Presented at the 27th Sagamore Army Materials Conf., Bolton Landing, N.Y., 14 Jul. 1980
(Contract W-7405-eng-26)
(CONF-800741-1) Avail: NTIS HC A02/MF A01
Various aspects of time dependent fatigue behavior of a number of structural alloys in use or planned for use in advanced nuclear power generating systems are reviewed. Materials included are types 304 and 316 stainless steel, Fe-2 1/4 Cr-1 Mo steel and alloy 800 H. Examples of environmental effects, including both chemical and physical interaction, are presented for a number of environments. The environments discussed are high purity liquid sodium, high vacuum, air, impure helium, and irradiation damage, including internal helium bubble generations. DOE

N81-11448*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A STEEL SPAR WIND TURBINE BLADE ON THE MOD-0 100 kW EXPERIMENTAL WIND TURBINE Final Report
Theo G. Keith, Jr. (Toledo Univ.), Timothy L. Sullivan, and Larry A. Viterna Sep. 1980 24 p refs
(Contract EX-76-I-01-1028)
(NASA-TM-81588; DOE/NASA/1028-27; E-567) Avail: NTIS HC A02/MF A01 CSCL 10B
The performance and loading of a large wind rotor, 38.4 m in diameter and composed of two low-cost steel spar blades were examined. Two blades were fabricated at Lewis Research Center and successfully operated on the Mod-0 wind turbine at Plum Brook. The blades were operated on a tower on which the natural bending frequency were altered by placing the tower on a leaf-spring apparatus. It was found that neither blade performance nor loading were affected significantly by this tower softening technique. Rotor performance exceeded prediction while blade loads were found to be in reasonable agreement with those predicted. Seventy-five hours of operation over a five month period resulted in no deterioration in the blade. Author

N81-11461# ECO, Inc., Cambridge, Mass.
ELECTROLYTES FOR HYDROCARBON AIR FUEL CELLS Interim Technical Report
M. Walsh, F. Walsh, D. N. Crouse, and R. S. Morris Apr. 1980 33 p refs
(Contract DAAK70-79-C-0165)
(AD-A089844) Avail: NTIS HC A03/MF A01 CSCL 10/2
The present research is directed towards obtaining an improved electrolyte for hydrocarbon-air fuel cells. No commercially available electrolyte appears to demonstrate promise. Two new electrolytes, difluoromethanediphosphonic acid and difluoromethanedisulfonic acid, have been synthesized and are being tested. The present status of the project and the outstanding problems are reviewed. GRA

N81-11462# Engelhard Minerals and Chemicals Corp., Edison, N. J. Industries Div.
PHOSPHORIC ACID FUEL CELL DEVELOPMENT Final Technical Report, Sep. 1977 - Nov. 1979
A. Kaufman and P. L. Terry Sep. 1980 103 p
(Contract DAAK70-77-C-0206; DA Proj. 1L7-63702-DG-11)
(AD-A090143) Avail: NTIS HC A05/MF A01 CSCL 10/2
Phosphoric acid fuel cells and fuel cell stacks were evaluated operating on simulated product gases from a methanol reformer. Three cell stack performance in a start-up/shut-down cycling mode was investigated. Improved matrix and electrode formulations were utilized later in the program, and these components accumulated a total of 8496 hours of testing and 268 shut-down cycles. GRA

N81-11477# Gilbert/Commonwealth, Reading, Pa.
FEASIBILITY STUDY: FUEL CELL COGENERATION IN A WATER POLLUTION CONTROL FACILITY, VOLUME 2 Final Report
Feb. 1980 164 p refs
(Contract DE-AC03-78ET-12431)
(DOE/ET-12431/T1-Vol-2) Avail: NTIS HC A08/MF A01
A conceptual design study was conducted to investigate the technical and economic feasibility of a cogeneration fuel cell power plant operating in a large water pollution control facility. The fuel cell power plant would use methane rich digester gas from the water pollution control facility as a fuel feedstock to provide electrical and thermal energy. Several design configurations were evaluated. These configurations were comprised of combinations of options for locating the fuel cell power plant at the site, electrically connecting it with the water pollution control facility, using the rejected power plant heat, supplying fuel to the power plant, and for ownership and operation. A configuration was selected which met institutional/regulatory constraints and provided a net cost savings to the industry and the electric utility. DOE

N81-11478# United Technologies Corp., South Windsor, Conn.
RELATION BETWEEN COMPONENT TECHNICAL PARAMETERS AND FUEL CELL POWER PLANT CHARACTERISTICS Final Technical Report, 15-30 Sep. 1979
Alexander Levy and Leslie Van Dine 1979 76 p
(Contracts DE-AC03-78ET-12445; ET-78-C-03-2111)
(DOE-ET-12445/T1; FCR-1737) Avail: NTIS HC A05/MF A01
The impact of applied technology improvements on fuel cell power plant operational and cost characteristics is determined. The results of this evaluation are intended to identify to DOE those areas which will provide the most significant payoff for long range research and development activities. The phosphoric acid fuel cell is emphasized and small multikilowatt on-site power plants as well as large multimegawatt systems intended for dispersed utility application are investigated. In addition, since complete power plants are considered, the potential improvements in major ancillary subsystems, such as fuel processing and power conditioning, are evaluated in terms of their impact on the entire system and its potential for meeting the requirements of various applications is presented and discussed. DOE

N81-11491# California Univ., Berkeley. Lawrence Berkeley Lab.
IMPORTANCE OF THE SPECIFIC HEAT ANOMALY IN THE DESIGN OF BINARY RANKINE CYCLE POWER PLANTS
William L. Pope, Padraic A. Doyle, Robert L. Fulton, and Lenard F. Silvester May 1980 5 p refs Presented at the Geothermal Resource Council Ann. Meeting, Salt Lake City, 9-11 Sep. 1980
(Contract W-7405-eng-48)
(LBL-10974; CONF-800920-5) Avail: NTIS HC A02/MF A01
The transposed critical temperature (TPCT) is shown to be an extremely important thermodynamic property in the selection of working fluids and turbine states for geothermal power plants operating on a closed organic (binary) Rankine cycle. When the optimum working fluid composition and process states are determined for specified source and sink conditions, turbine inlet states consistently lie adjacent to the working fluids TPCT line for all resource temperatures, constraints, and cost and efficiency factors investigated. DOE

N81-11492# AeroVironment, Inc., Pasadena, Calif. Aerosciences Group.
DEFINITIVE GENERIC STUDY FOR THE EFFECT OF HIGH LIFT AIRFOILS ON WIND TURBINE EFFECTIVENESS, EXECUTIVE SUMMARY Final Report
Peter B. S. Lissaman, Robert E. Wilson, R. W. Thresher, and Stel N. Walker May 1979 93 p refs

(Contract EG-77-C-01-4042)
(SERI/TR-98003-2) Avail: NTIS HC A05/MF A01

The effect of high lift airfoils on the cost effectiveness of HAWT and VAWT (horizontal and vertical axis wind turbine) machines is studied. The scope involved first studying modern two dimensional airfoils, and developing a generalized formulation for their performance in terms of lift, drag, and thickness at appropriate Reynolds numbers. Single element, multi-element, symmetrical, extra thick airfoils and jet flap airfoils were analyzed. The jet flap airfoils were considered to be unacceptable because of excessive power requirements. Then the effect of using the above airfoils on the rotors of a variety of wind turbines was made. Qualitative representation of the type of airfoils studied is given. DOE

N81-11504# Illinois Univ., Urbana. Dept. of Ceramic Engineering.
FERROELECTRIC CERAMICS FOR DIELECTRIC POWER CONVERSION Annual Report, 1 Mar. 1979 - 30 Apr. 1980
D. A. Payne and P. C. Held May 1980 46 p refs
(Contract DE-AS02-78ER-04679)
(DOE/ER-04679/3) Avail: NTIS HC A03/MF A01

Materials expected to have useful Curie temperatures, resistivities, coercive fields, and Devonshire coefficients are assessed including PZT (lead-zirconia-titania system), Bi(Na,K) Ti2O6, rare earth titanoniobates, other tantalates and niobates, and thin films. Graphs are given for spontaneous polarization as a function of composition, temperature dependence of spontaneous polarization and coercive field for modified PSZT dielectrics, temperature dependence of electric resistivity for modified PSZT dielectrics, and X-ray diffraction data. Materials forming and processing techniques are briefly described. DOE

N81-11505# Tennessee Univ., Tullahoma. Energy Conversion Div.
INTERELECTRODE INSULATOR DEVELOPMENT FOR THE UTSI MHD GENERATOR
M. K. White, M. S. Beaton, and C. W. Long Oct. 1979 37 p refs
(Contract DE-AC02-79ET-10815)
(DOE/ET-10815/T1; TR-7.6.2-79-01) Avail: NTIS HC A03/MF A01

Commercially available insulating materials that are easily workable, were used to enhance thermal conductivity and reduce moisture absorption and gas permeability. In two series of tests on numerous insulator systems under actual MHD run conditions, the best results were indicated by a woven leached silica cloth (Refrasil) coated with a commercial boron nitride slurry. Insulators made of solid plate boron nitride and also of boron nitride strips backed up with a gasketing material also gave promising performance. Results are presented and discussed. DOE

N81-11519# Montana Energy and MHB Research and Development Inst., Inc., Butte.
HIGH TEMPERATURE FUEL CELL RESEARCH AND DEVELOPMENT Final Technical Status Report, 1 Mar. 1979 - 31 Mar. 1980
Paul A. Lessing May 1980 133 p refs
(Contract DE-AC03-77ET-11320)
(DOE/ET-11320/T1) Avail: NTIS HC A07/MF A01

Eleven powdered candidate materials were selected based on previous physical and chemical stability tests at elevated temperatures on solid materials and/or their thermodynamic stability with respect to proposed degradation reactions. The eleven candidate materials, plus gamma lithium aluminate, were characterized prior to corrosion testing utilizing (1) Chemical Analysis, (2) X-ray Diffraction for Phase Identification, (3) Scanning Electron Microscopy (SEM), and (4) Surface Area Analysis. The powders were corrosion tested initially for 200 hours by heating to 700 C in a mixture of 62% Li2CO3-38% K2CO3 under a fuel gas atmosphere. The gas composition was based on reformed Naphtha at 700 C and consisted of 50.2% H2, 10.8% CO, 9.5% CO2, and 29.5% H2O. The samples were tested in an inert container made by coating the interior of alumina crucibles with a layer of 0.0002 inch gold. DOE

N81-11521# Institute of Gas Technology, Chicago, Ill.
FUEL CELL RESEARCH ON SECOND-GENERATION MOLTEN CARBONATE SYSTEM Final Report, 1 Oct. 1978 - 31 Jan. 1980
May 1980 405 p refs
(Contract DE-AC03-78ET-11276)
(SAN-11276-4) Avail: NTIS HC A18/MF A01

The effort was conducted along three major and closely interrelated tasks. Task 1 involved the quantification of the thermomechanical behavior of the electrolyte tile, formulation of the methodology required to predict the stresses generated in the cell package during a thermal cycle, and specification and design of cell components that both reduce the thermally generated stresses and are cost effective. In Task 2 the preferred electrolyte tile support, the factors/mechanisms responsible for morphological transformations, and cost effective electrolyte powder and electrolyte tile fabrication processes were determined. Task 3 was to verify the performance, endurance, and thermal cycling characteristics of standard and developmental cell components in both laboratory and bench scale testing. Progress is reported in detail. DOE

N81-11523# Argonne National Lab., Ill. Chemical Engineering Div.
ADVANCED FUEL CELL DEVELOPMENT Progress Report, Oct. - Dec. 1979
R. D. Pierce, G. H. Kucera, D. S. Kupperman, R. B. Poeppel, T. W. Sim, R. N. Singh, and J. L. Smith May 1980 47 p refs
(Contract W-31-109-eng-38)
(ANL-80-33) Avail: NTIS HC A03/MF A01

Advanced fuel cell research and development activities during October-December 1979 are described. These efforts were directed toward understanding and improving components of molten carbonate fuel cells and included operation of 10 cm square cells. The principal focus was on the development of electrolyte structures (LiAlO2 and Li2CO3-K2CO3) that have good electrolyte retention and mechanical properties as well as long term stability. The effort included work on preparation of sintered LiAlO2 as electrolyte support, use of a scanning laser acoustic microscope to evaluate electrolyte structures, and measurements of the thermal expansion coefficients of various mixtures of beta LiAlO2 and carbonate eutectic. DOE

N81-11532# Sandia Labs., Albuquerque, N. Mex. Applied Mechanics Div.
VAWTDYN: A NUMERICAL PACKAGE FOR THE DYNAMIC ANALYSIS OF VERTICAL AXIS WIND TURBINES
D. W. Lobitz and W. N. Sullivan Jul. 1980 64 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-0085) Avail: NTIS HC A04/MF A01

The VAWTDYN package which provides a tool for assessing dynamic amplifications in two bladed vertical axis wind turbines is described. The dynamic model on which the package is based contains turbine motions most commonly observed in existing research systems. Gyroscopic effects, structural damping, aerodynamic wind loading, and power generation through either an induction or synchronous generator are also included in the model. In addition to a comprehensive description of the model, the efforts that have gone into the verification, qualification, and demonstration of the package are documented. DOE

N81-11834*# Texas Univ., Arlington.
MHD GENERATOR OFF-DESIGN PERFORMANCE AND NOx CHEMICAL KINETICS ANALYSIS. VOLUME 1: ANALYSIS OF THE OFF-DESIGN PERFORMANCE OF THE ENGINEERING TEST FACILITY ETF MHD GENERATOR FLOW TRAIN
Donald R. Wilson and Gloyd A. Simmons Jun. 1980 77 p refs
(Grant NsG-3255)
(NASA-CR-165187; DOE/NASA/3255-1) Avail: NTIS CSCL 20I

A computer code for performing parametric design point calculations, and evaluating the off design performance of magnetohydrodynamic generators was developed. Details of the computer codes are presented. An assessment of the effect of preheat, stoichiometry, and oxygen enrichment on the design point electrical performance of the generator, and the NOx concentration at the exit of the radiant boiler are included. The off design study included variations in mass flow rate and oxygen enrichment. Maximum design point performance was achieved with a combination of high preheat, high stoichiometry, and no oxygen enrichment. The reduction in generator power was found to scale almost quadratically with the mass flow rate reduction. The power increased to a maximum level for off design operation at an oxygen enrichment value of 60 percent, then decreased with further increases in oxygen enrichment. The off design generator would not run at oxygen enrichment levels less than the 50 percent design level and simultaneously match the imposed thermal power input and downstream pressure constraints. S.F.

N81-11952*# Mechanical Technology, Inc., Latham, N. Y. Stirling Engine Systems Div.
AUTOMOTIVE STIRLING ENGINE DEVELOPMENT PROGRAM Quarterly Technical Progress Report, 30 Mar. - 28 Jun. 1980
Merton Allen, ed. Aug. 1980 96 p refs
(Contract DEN3-32; EC-77-A-31-1040)
(NASA-CR-165134; DOE/NASA/0032-80/8; MTI-80ASE144QT9) Avail: NTIS HC A05/MF A01 CSCL 13F

Progress is reported in the following: the Stirling reference engine system design; components and subsystems; F-40 baseline Stirling engine installation and test; the first automotive engine to be built on the program; computer development activities; and technical assistance to the Government. The overall program philosophy is outlined, and data and results are given. A.R.H.

N81-11992*# Colgate Univ., Hamilton, N.Y. Dept. of Chemistry.
PHOTOCHEMISTRY OF MONODENTATE AND BIDENTATE CARBONATO COMPLEXES OF RHODIUM (3)
Peter S. Sheridan *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 22 p refs
Avail: NTIS HC A99/MF A01 CSCL 07D

A scheme for the photochemical fixation of water is proposed which involves a five-step reaction sequence: the first step involves the 2 electron reduction of a metal by a coordinated carbonate ligand, with corresponding oxidation of the carbonate to CO2 and O2. Ligand field photolysis of trans- (RH(en)2 H2O CO3) ClO4, and (Rh(en)2 CO3) CLO4 have been studied in the solid state and in aqueous solution at various pH values. Both salts are photoinert in the solid phase, but are quite photoreactive in aqueous solution. In solution, the monodentate ion undergoes efficient isomerization to a mixture of cis and trans - (Rh(en)2 H2O CO3)+, presumably with water exchange. A minor pH increase upon photolysis is evidence of inefficient carbonate (CO3 =) release, with formation of (Rh(en)2 (H2O)2)3+. In contrast, aqueous solutions of the bidentate carbonato complex undergo efficient pH decrease upon ligand field photolysis. Changes in the electronic spectrum (200-500 nm) and pH changes indicate that the desired redox is occurring. The pH increase is due to the aqueous behavior of CO2. M.G.

N81-12446*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STABILITY OF LARGE HORIZONTAL-AXIS AXISYMMETRIC WIND TURBINES Ph.D. Thesis - Delaware Univ.
M. S. Hirschbein and M. I. Young (Delaware Univ., Newark) 1980 37 p refs Presented at 3d Miami Conf. on Alternative Energy Sources, Miami, 15-17 Dec. 1980
(NASA-TM-81623; E-633) Avail: NTIS HC A03/MF A01 CSCL 20K

The stability of large horizontal axis, axi-symmetric, power producing wind turbines was examined. The analytical model used included the dynamic coupling of the rotor, tower and power generating system. The aerodynamic loading was derived from blade element theory. Each rotor blade was permitted tow principal elastic bending degrees of freedom, one degree of freedom in torsion and controlled pitch as a rigid body. The rotor hub was mounted in a rigid nacelle which may yaw freely or in a controlled manner. The tower can bend in two principal directions and may twist. Also, the rotor speed can vary and may induce perturbation reactions within the power generating equipment. Stability was determined by the eigenvalues of a set of linearized constant coefficient differential equations. All results presented are based on a 3 bladed, 300 ft. diameter, 2.5 megawatt wind turbine. Some of the parameters varied were: wind speed, rotor speed structural stiffness and damping, the effective stiffness and damping of the power generating system and the principal bending directions of the rotor blades. Unstable or weakly stable behavior can be caused by aerodynamic forces due to motion of the rotor blades and tower in the plane of rotation or by mechanical coupling between the rotor system and the tower. Author

N81-12546*# STD Research Corp., Arcadia, Calif.
ANALYTICAL INVESTIGATION OF CRITICAL PHENOMENA IN MHD POWER GENERATORS Final Report
31 Jul. 1980 375 p refs
(Contracts DEN3-179; SC-77-AA-012674)
(NASA-CR-165143; DOE/NASA/0179-1; STDR-80-22) Avail: NTIS HC A16/MF A01 CSCL 10A

Critical phenomena in the Arnold Engineering Development Center (AEDC) High Performance Demonstration Experiment (HPDE) and the U.S. U-25 Experiment, are analyzed. The performance of a NASA specified 500 MW(th) flow train is analyzed. Critical phenomena analyzed include: Hall voltage overshoots; optimal load schedules; parametric dependence of the electrode voltage drops; boundary layer behavior; near electrode phenomena with finite electrode segmentation; current distribution in the end regions; scale up rules; optimum Mach number distribution; and the effects of alternative cross sectional shapes. R.C.T.

N81-12569# Army Mobility Equipment Command, Fort Belvoir, Va.
THE ADSORPTION AND ELECTROOXIDATION OF SIMPLE HYDROCARBONS FOR DIRECT OXIDATION HYDROCARBON AIR FUEL CELLS
Amos J. Coleman Jun. 1980 13 p refs
(AD-A090377) Avail: NTIS HC A02/MF A01 CSCL 10/2

The development of new and more sophisticated tactical weapon systems mandates that reliable electrical power sources are also available. The ideal tactical power source should be silent, lightweight and mobile. A fuel cell system would meet these requirements. Hydrogen-air fuel cells are now being considered for deployment for the near future. In order to obtain hydrogen rich mixtures for fuels, these fuel cell systems must be equipped with one of the following: hydrogen storage devices, thermal crackers, steam reformers, or partial oxidizers. A direct oxidation hydrocarbon-air fuel cell would be more attractive, since it would eliminate the above items and result in a lighter, less complex system. A fuel cell system which would operate interchangeably on a variety of fuels would be added benefit. This report describes the research effort at MERADCOM to develop such a system. The overall objective is to provide the basic information required for the development of a direct oxidation hydrocarbon-air fuel cell. GRA

N81-12573# Midwest Research Inst., Golden, Colo.
OPEN CYCLE OTEC SYSTEM WITH FALLING JET EVAPORATOR AND CONDENSER
A. Kogan, D. H. Johnson, H. J. Green, and D. A. Olson Jul. 1980 11 p refs Presented at 7th Ocean Energy Conf., Washington, D.C., 2 Jun. 1980
(Contract DE-AC02-76CH-00178)
(SERI/TP-631-791; CONF-800633-3) Avail: NTIS HC A02/MF A01

A configuration for the open cycle (OC) Ocean Thermal Energy Conversion (OTEC) system is presented incorporating a countercurrent falling jet evaporator and a concurrent falling jet condenser.

The parameters governing performance of the proposed configuration are discussed and the sizing of equipment for a 100 MWe net power output OC OTEC plant is performed, based on recent experimental falling jet heat and mass transfer results. The performance of an OC OTEC plant with falling jet evaporatocondenser is compared with the Westinghouse conceptual design that uses an open channel evaporator and a surface condenser. Preliminary calculations indicate that falling jet heat and mass transfer, when applied in the proposed configuration, leads to a very simple and compact plant assembly resulting in substantial capital cost savings. DOE

N81-12591# New Mexico Univ., Albuquerque. Dept. of Chemistry.
EFFECTS OF SEVERAL TRACE CONTAMINANTS ON FUEL CELL PERFORMANCE
S. M. Parks and T. J. OBrien (DOE, Morgantown, W. Va.) 1979 27 p refs
(DOE/METC-RI-80-17) Avail: NTIS HC A03/MF A01

The electrochemical reactivity of various trace contaminants in coal gas, i.e., Hg/HgS, PbS, CdS, Sn/SnCl2/SnCl4, and TiO2, in coal gas at the nickel anode and the nickel oxide cathode in a molten carbonate fuel cell are examined thermodynamically. Calculations indicate that only SnCl4 undergoes reduction at the cathode to SnCl2. Other species remain intact. Contaminants such as H2S/SO2 and HCl are included in the calculation. Possible chemical interactions between contaminants and electrodes or electrolytes have been examined. Mercury interacts physically with the anode by forming an alloy. Reactions of Sn, SnCl2, and HCl with the nickel oxide cathode have negative free energies. DOE

N81-12599# Oregon State Univ., Corvallis. Dept. of Civil Engineering.
WAVE POWER EXTRACTION FROM A TRANSIENT HEAVING CYLINDER
Robert T. Hudspeth and Larry S. Slotta Jan. 1980 18 p refs
(Contract DE-AP01-79ET-21019)
(DOE/ET-21019/T1) Avail: NTIS HC A02/MF A01

Waver power extracted from the transient motion of a periodically restrained released heaving circular cylinder proposed by Falnes and Budal is examined under the limitations of linear wave theory excitation. Numerical estimates for the normalized radiated wave amplitudes required for the waveforce excitation derived by Mei are computed from the computationally efficient variational method developed by Black and Mei for the wave force diffraction regime. Wave power estimates for the rising period only of the heaving motion are given; while the falling period of the motion is neglected. A graphical summary is presented which demonstrates the parametric dependency of the dimensionless wave power rate on the design wave parameters and the body geometry for three general types of transient power systems heaving in deep water conditions. The total power requirements for the complete power extraction system as well as the real fluid viscous effects are not included. DOE

N81-12621# Argonne National Lab., Ill. Energy and Environmental Systems Div.
RELIABILITY, ENERGY, AND COST EFFECTS OF WIND POWERED GENERATION INTEGRATED WITH A CONVENTIONAL GENERATING SYSTEM
J. C. VanKuiken, W. A. Buehring, C. C. Huber, and K. A. Hub Jan. 1980 114 p refs
(Contract W-31-107-eng-38)
(ANL/AA-17) Avail: NTIS HC A06/MF A01

The potential impacts of incorporating wind turbines, without the aid of energy storage devices, into a conventional electrical generating system were examined. Particular emphasis was given to the amount and type of generating capacity replaced by wind (potential variable cost savings), and the methods used to calculate these benefits. A cost model was developed to estimate breakeven costs for wind turbines on the basis of energy and capacity displacement savings. R.C.T.

N81-12626# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen.
STATIC AND DYNAMIC INVESTIGATIONS USING A WINDMILL MODEL [STATISCHE UND DYNAMISCHE UNTERSUCHUNGEN AN EINEM WINDROTORMODELL]
J. H. Argyris, K. A. Braun, B. Kirchgaessner, and R. Walther Jun. 1979 69 p refs In GERMAN; ENGLISH summary
(Contract BMFT-ET-4086A)
(ISD-259; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

In the framework of wind energy research a scale model of a wind rotor was constructed, then used to develop and test a data acquisition and data transmission system. With this system experimental data are collected from the operating model and displayed on a screen. Comparison between experimental data and computed results for the model were used to check applied static and dynamic analyses of the rotor model. During the dynamic analysis a response problem with variable stiffness in time was found for this case a solution method involving systems of equations is described. Author (ESA)

N81-12627# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen.
LOAD CYCLE VALUES AND MATERIALS DATA USED FOR THE DESCRIPTION OF A WIND TURBINE FEATURING A SPECIAL HUB CONSTRUCTION [LASTWECHSELZAHLEN UND MATERIALWERTE FUER DIE AUSLEGUNG EINER WINDTURBINE SPEZIELLER NABENKONSTRUKTION]
J. H. Argyris and K. A. Braun Jun. 1979 38 p refs In GERMAN; ENGLISH summary
(Contract BMFT-ET-4086-A)
(ISD-260; ISSN-0170-6071) Avail: NTIS HC A03/MF A01

For the layout of windmill rotor blades made from different materials, analyses of materials data and geometry were made. Of special interest are the admissible stresses which are dependent on the material as well as kind and number of loading cycles. The number of these loading cycles thought to be relevant are determined. The decisive parameters are the number of starts and the time of operation. The dependence of these parameters on the cut-in wind velocity, the vertical wind gradient, and the wind characteristics is discussed. Wind data collected in northern Germany were used in calculating admissible stresses. The fagigue strengths are also estimated in terms of the admissible stresses determined. The materials used are well known glass fiber and carbon filber reinforced plastics. Author (ESA)

N81-12628# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen.
STATIC AND DYNAMIC INVESTIGATIONS ON DIFFERENT TOWERS FOR WIND TURBINES [STATISCHE UND DYNAMISCHE UNTERSUCHUNG VERSCHIEDENER TUERME FUER WINDTURBINEN]
J. H. Argyris and K. A. Braun Jul. 1979 122 p refs In GERMAN; ENGLISH summary
(Contract BMFT-ET-4086A)
(ISD-261; ISSN-0170-6071) Avail: NTIS HC A06/MF A01

The static layouts of different tower designs are studied in terms of gust loads which a two bladed rotor (120 m diameter) transfers to 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. First a cylindrical cantilever steel tower is dimensioned such that the maximal loads enlarged by a dynamic magnification factor provoke tolerable stresses and displacements. Next, both a cantilver and guyed tower static layout are considered and a dynamic response calculation for several gusts is performed using finite element methods. The tower system and the rotor system are assumed to be dynamically decoupled. The guyed tower proves to be superior. Finally, a theoretical type of tower is statically conceived using a geometrically nonlinear finite element program. The kinematics of three towers with different guy arrays are investigated and compared. Author (ESA)

N81-12633# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
APPLICATION OF A METHOD FOR AERODYNAMIC

ANALYSIS AND DESIGN OF HORIZONTAL AXIS WIND TURBINES, PART 1
Anders L. Gustafsson, Stig Lundgren, and Boerje Frisk 26 Feb. 1980 74 p refs
(Contract NE-5061-012)
(FFA-TN-AU-1499-Pt-1) Avail: NTIS HC A04/MF A01

The application of a momentum theory method is presented for static performance analysis and for design of blades for horizontal axis wind turbines. The method is based on a combination of blade element and momentum theory. The performance results are presented as power coefficient or shaft power versus windspeed and static blade and turbine loads to be used for structural design. The combination of turbine performance and wind characteristics to obtain annual energy production is treated. The procedure to obtain the chord and twist distribution that maximizes blade performance at a specified wind is described. Numerical results for the Swedish wind power test unit Kalkugnen are presented. Author (ESA)

N81-12634# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
OPTIMIZED PITCH CONTROLLER FOR LOAD ALLEVIATION ON WIND TURBINES
Brad S. Liebst Stockholm Aeronautical Research Inst. of Sweden 19 Aug. 1980 195 p refs Sponsored in part by MIT Aeronautical Research Foundation
(Contract NE-5061-013)
(FFA-TN-HU-2189-Pt-1) Avail: NTIS HC A09/MF A01

An optimum feedback control law for load alleviation utilizing a pitching blade segment on a wind turbine is developed. The analysis is made for an isolated blade on a completely rigid tower. The blade is assumed to be completely rigid and constrained by three flexible springs. Pitch, flap, and lag blade degrees of freedom are included as well as shaft torsion and generator dynamics. A quasi-steady analysis is used in predicting aerodynamic loads. Gravity loads are included, as well as wind shear and tower shadow effects. The nonlinear equations of motion are linearized by perturbation methods. The controller determined minimizes a penalty integral that is the sum of a quadratic in state perturbations and a quadratic in the control. A FORTRAN program is presented which solves the resulting Riccati equations for the feedback gains. The program developed is used to determine the control law for the NASA-ERDA 100 kW wind turbine considering only the flapping degree of freedom. Author (ESA)

N81-12640# National Technical Information Service, Springfield, Va.
FUEL CELLS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1979 - Jun. 1980
Diane M. Cavagnaro Jul. 1980 144 p Supersedes NTIS/PS-79/0717; NTIS/PS-78/0633
(PB80-813397; NTIS/PS-79/0717; NTIS/PS-78/0633) Avail: NTIS HC $30.00/MF $30.00 CSCL 10B

Fuel cell applications, components, fabrication, design, catalysts, and chemistry are covered. The bibliography includes different types of fuel cells, such as hydrogen oxygen cells, hydrocarbon air cells, and biochemical cells. This updated bibliography contains 139 citations, 97 of which are new entries to the previous edition. GRA

N81-12641# National Technical Information Service, Springfield, Va.
FUEL CELLS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1977 - 1978
Diane M. Cavagnaro Aug. 1980 198 p
(PB80-813389) Avail: NTIS HC $30.00/MF $30.00 CSCL 10B

Fuel cell applications, components, fabrication, design, catalysts, and chemistry are covered. The citations discuss different types of fuel cells such as hydrogen oxygen cells, hydrocarbon air cells, and biochemical cells. GRA

N81-12704# Battelle Pacific Northwest Labs., Richland, Wash.
DOE CANDIDATE SITE METEOROLOGICAL MEASUREMENT PROGRAM
D. S. Renne and W. F. Sandusky Jan. 1980 10 p Presented at the IEA Expert Meeting, Boone, N. C., 26-28 Sep. 1979
(Contracts DE-AC06-76RL-01830; EY-76-C-06-1830)
(PNL-SA-7840; CONF-7909167-1) Avail: NTIS HC A02/MF A01

In March 1976, DOE issued an RFP to acquire, on a competitive basis, a group of candidate sites, proposed by utilities interested in the field testing program. A total of 17 candidate sites was selected from the 64 proposals submitted in response to the RFT. From these sites, five were chosen thus far to receive turbines for field testing. The meteorological measurement activities at these sites and details of the measurement program as it exists in late 1979 are decreased. In addition, the directions this program will take in the near future, and the options interested electric service organizations have for participating in the program are discussed. DOE

N81-12856# Department of Energy, Washington, D. C.
NEUTRAL BEAM DEVELOPMENT PLAN
H. S. Staten, comp. 1980 32 p refs
(DOE/ER-0075) Avail: NTIS HC A03/MF A01

The national plan is presented for developing advanced injection systems for use on upgrades of existing experiments, and use on future facilities such as the Engineering Test Facility, to be built in the late 1980's or early 90's where power production from magnetic fusion will move closer to a reality. Not only must higher power and longer pulse length systems be developed, but they must operate reliably; they must be a tool for the experimenter, not the experiment itself. Neutral beam systems handle large amounts of energy and as such, they often are as complicated as the plasma physics experiment itself. This presents a significant challenge to the neutral beam developer. DOE

N81-12881# Ben Gurion Univ. of the Negev, Beersheva (Israel). Dept. of Mechanical Engineering.
EFFECT OF WETTING LAYER AND VOID FRACTION NONUNIFORMITY ON THE CHARACTERISTICS OF A TWO-PHASE LIQUID-METAL MHD GENERATOR
Herman Branover 29 Nov. 1979 30 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Energy in Nov. - Dec. 1980
(Grant N00014-77-G-0034; NR Proj. 099-407)
(LOG-E379) Avail: NTIS HC A03/MF A01

An analytical model which makes it possible to estimate the effect of a liquid wetting layer on the nonconducting walls of a channel and of nonuniformity of the void fraction distribution on the generator performance is postulated. The question of the effect of this layer in the case of uniform void fraction distribution in the flow core for moderate values of the Hartmann number is examined. An analytic solution for high Hartmann numbers concluded that this layer did not have a significant effect on the efficiency of large generators. The presence of the wetting layer leads to a significant increase in the required pressure drop, and to a significant reduction in power output when the pressure drop is specified. S.F.

N81-12898# Argonne National Lab., Ill.
MHD HEAT AND SEED RECOVERY TECHNOLOGY PROJECT Quarterly Report, Oct. - Dec. 1979
Michael Petrick and Terry R. Johnson Aug. 1980 54 p refs
(Contract W-31-109-eng-38)
(ANL/MHD-80-1; QR-8) Avail: NTIS HC A04/MF A01

Heat and Seed Recovery Technology Project is discussed, including NOx behavior in the radiant boiler and secondary combustor, radiant boiler design to meet the multiple requirements of steam generation, NOx decomposition, and seed-slag separating, effects of solid or liquid seed deposits on heat transfer and gas flow in the steam and air heaters, formation, growth, and deposition of seed-slag particles, character of the combustion gas effluents, and the corrosion and erosion of ceramic and metallic materials of construction. S.F.

N81-12902# Fom-Instituut voor Plasmafysica, Jutphaas (Netherlands).
A REACTOR STUDY ON A BELT-SHAPED SCREW PINCH
M. Bustraan, B. Brandt, G. C. Damstra, W. M. P. Franken, J. A.

Hoekzema, Klein H. J. Nibbelink, H. T. Klippel, W. Schuurman, J. H. Veringa, and K. A. Verschuur Oct. 1979 51 p refs Sponsored by Nederlands Organization voor Zuiver-Wetenschappelijk Onderzoek (ZWO) and EURATOM Prepared in cooperation with Netherlands Energy Research Foundation, Petten and Kema (N.V.), Arnhem, Netherlands
(Rept-73-76; ECN-77) Avail: NTIS HC A04/MF A01

A previous study on a screw pinch reactor with circular cross section was extended to a belt configuration which raises beta to 0.5. Attention was paid to modular construction, non uniform distribution of wall loading, thermohydraulics, the design of and the losses in the coil systems, and energy storage and electric transmission systems. A potential use of the first wall of the blanket as part of the implosion coil system is suggested. A conceptual design of a reactor with a cost estimate is given. Numerical results are given of parameter variations around the values for the reference reactor. The belt screw pinch reactor with resistive coils turns out to be uneconomical, because of ist low net efficiency and its high capital costs. The application of superconducting coils to reduce the ohmic losses turns out to be a nonviable alternative. A more promising way to improve the energy balance seems to be using fuel injection during the burn. Author (ESA)

N81-12981*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LARGE WIND TURBINES: A UTILITY OPTION FOR THE GENERATION OF ELECTRICITY
William H. Robbins, Ronald L. Thomas, and Darrell H. Baldwin *In its* Impact for the 80's: Proc. of a Conf. on Selected Technol. for Business and Ind. Nov. 1980 p 27-41 refs Also presented at the Am. Power Conf., Chicago, 21-23 Apr. 1980

Avail: NTIS HC A11/MF A01 CSCL 10B

The economic and technical potential of wind energy in the United States is discussed. Particular attention is given to the status of wind turbine operational experience as well as the environmental posture of the technology. R.C.T.

N81-13463*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DATA ACQUISITION AND ANALYSIS IN THE DOE/NASA WIND ENERGY PROGRAM
Harold E. Neustadter, 1980 18 p refs Presented at Symp. on Detection Diagnosis and Prognosis, Santa Monica, Calif., 7-9 Oct. 1080; sponsored by NBS
(Contract EX-76-I-01-1028)
(NASA-TM-81603; E-594) Avail: NTIS HC A02/MF A01 CSCL 10B

Four categories of data systems, each responding to a distinct information need are presented. The categories are: control, technology, engineering and performance. The focus is on the technology data system which consists of the following elements: sensors which measure critical parameters such as wind speed and direction, output power, blade loads and strains, and tower vibrations; remote multiplexing units (RMU) mounted on each wind turbine which frequency modulate, multiplex and transmit sensor outputs; the instrumentation available to record, process and display these signals; and centralized computer analysis of data. The RMU characteristics and multiplexing techniques are presented. Data processing is illustrated by following a typical signal through instruments such as the analog tape recorder, analog to digital converter, data compressor, digital tape rocorder, video (CRT) display, and strip chart recorder. Author

N81-13464*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF COMMERCIAL PHOSPHORIC ACID FUEL CELL SYSTEM DEVELOPMENT
Marvin Warshay, Paul R. Prokopius, Steven N. Simons, and Robert B. King 1981 12 p refs Proposed for presentation at 19th Aerospace Sci. Meeting, St. Louis, 12-15 Jan. 1981; sponsored by AIAA
(Contract DE-AI03-79ET-11272)
(NASA-TM-81641; E-659; DOE/NASA/11272-2) Avail: NTIS HC A02/MF A01 CSCL 10A

In both the electric utility and onsite integrated energy system applications, reducing cost and increasing reliability are the main technology drivers. The longstanding barrier to the attainment of these goals, which manifests itself in a number of ways, was materials. The differences in approach among the three major participants (United Technologies Corporation, Westinghouse Electric Corporation/Energy Research Corporation, and Engelhard Industries) and their unique technological features, including electrodes, matrices, intercell cooling, bipolar/separator plates, electrolyte management, fuel selection and system design philosophy are discussed. Author

N81-13465*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IGNITION OF LEAN FUEL-AIR MIXTURES IN A PREMIXING-PREVAPORIZING DUCT AT TEMPERATURES UP TO 1000 K
Robert R. Tacine Dec. 1980 16 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-81645; E-9356-3; DOE/NASA/51040-19) Avail: NTIS HC A02/MF A01 CSCL 21B

Conditions were determined in a premixing prevaporizing fuel preparation duct at which ignition occurred. An air blast type fuel injector with nineteen fuel injection points was used to provide a uniform spatial fuel air mixture. The range of inlet conditions where ignition occurred were: inlet air temperatures of 600 to 1000 K air pressures of 180 to 660 kPa, equivalence ratios (fuel air ratio divided by stoichiometric fuel air ratio) from 0.12 to 1.05, and velocities from 3.5 to 30 m/s. The duct was insulated and the diameter was 12 cm. Mixing lengths were varied from 16.5 to 47.6 and residence times ranged from 4.6 to 107 ms. The fuel was no. 2 diesel. Results show a strong effect of equivalence ratio, pressure and temperature on the conditions where ignition occurred. The data did not fit the most commonly used model of auto-ignition. A correlation of the conditions where ignition would occur which apply to this test apparatus over the conditions tested is (p/V) phi to the 1.3 power = 0.62 e to the 2804/T power where p is the pressure in kPa, V is the velocity in m/e, phi is the equivalence ratio, and T is the temperature in K. The data scatter was considerable, varying by a maximum value of 5 at a given temperature and equivalence ratio. There was wide spread in the autoignition data contained in the references. A.R.H.

N81-13466*# Burns and Roe, Inc., Woodbury, N. Y.
ENGINEERING SUPPORT FOR MAGNETOHYDRODYNAMIC POWER PLANT ANALYSIS AND DESIGN STUDIES
A. W. Carlson, I. L. Chait, G. Marchmont, R. Rogali, and D. Shikar Aug. 1980 288 p refs
(Contracts DEN3-107; EC-77-A-01-2674)
(NASA-CR-159690; DOE/NASA/0197-1) Avail: NTIS HC A13/MF A01 CSCL 10B

The major factors which influence the economic engineering selection of stack inlet temperatures in combined cycle MHD powerplants are identified and the range of suitable stack inlet temperatures under typical operating conditions is indicated. Engineering data and cost estimates are provided for four separately fired high temperature air heater (HTAH) system designs for HTAH system thermal capacity levels of 100, 250, 500 and 1000 MWt. An engineering survey of coal drying and pulverizing equipment for MHD powerplant application is presented as well as capital and operating cost estimates for varying degrees of coal pulverization. A.R.H.

N81-13467*# Burns and Roe, Inc., Woodbury, N. Y.
MODIFICATION OF THE ECAS REFERENCE STEAM POWER GENERATING PLANT TO COMPLY WITH THE EPA 1979 NEW SOURCE PERFORMANCE STANDARDS Final Report
S. A. Fogelson, I. L. Chait, W. J. Bradley, and W. Benson Aug. 1980 246 p refs

(Contracts DEN3-107; DE-AI01-77ET-10769)
(NASA-CR-159853; DOE/NASA/0107-2) Avail: NTIS HC A11/MF A01 CSCL 10B

Detailed capital cost estimates for the ECAS and modified reference plants in mid-1978 dollars for both 250 and 175 F (394 and 353 K) stack gas reheat temperatures based on the cost estimates developed for the ECAS study are presented. The scope of the work included technical assessment of sulfur dioxide scrubber system design, on site calcination versus purchased lime, reheat of stack gas, effect of sulfur dioxide scrubber on particulate emission, and control of nitrogen oxides. Author

N81-13471# Aeronautical Research Inst. of Sweden, Stockholm.
THE VELOCITY INDUCED BY THE WAKE OF A WIND TURBINE IN A SHEAR LAYER, INCLUDING GROUND EFFECT
Bo C. A. Johansson Jun. 1980 41 p
(FFA-133) Avail: NTIS HC A03/MF A01

A theory was developed for the calculation of the velocity field induced by the wake of a horizontal axis wind turbine in a wind shear layer and in the vicinity of a plane ground surface, when the force distribution of the turbine is known. The turbine was approximated by a disk area of continuous distributions of thrust and force parallel to the disk plane. Its wake was represented by a semi-infinite cylinder of distributed vorticity. A numerical example was calculated. The theory was based upon assumptions strictly valid only for small perturbations of the undisturbed flow. R.C.T.

N81-13508# General Electric Co., Schenectady, N. Y. Dept. of Energy Systems Programs.
DEVELOPMENT OF MOLTEN CARBONATE FUEL CELL POWER PLANT Quarterly Report, 1 May - 31 Jul. 1980
J. R. Peterson 4 Sep. 1980 172 p refs
(Contract DE-AC02-80ET-17019)
(DOE/ET-17019/2) Avail: NTIS HC A08/MF A01

Development of a molten carbonate fuel cell power plant to establish and demonstrate readiness for fabrication and test of full scale prototype stacks is discussed. A detailed design for a prototype stack is defined and a tenth-size of full scale cells are tested. Component and manufacturing processes are developed based upon commercial cost goals. Coal-fired utility central station and industrial cogeneration power plant requirements are defined and plant options evaluated, leading to selection of a single reference design. Specific program objectives are: (1) to define a reference power plant for a coal-fired molten carbonate power plant; (2) to develop and verify cell and stack design based upon the requirements of the reference power plant design; (3) to establish and demonstrate readiness to fabricate and test full length stacks of full scale cells, called prototype stacks; and (4) to quantify contaminant effects and establish a program to verify performance of molten carbonate fuel cells operating on products of coal gasification. DOE

N81-13517# Kinetics Technology International Corp., Pasadena, Calif.
ASSESSMENT OF FUEL PROCESSING SYSTEMS FOR DISPERSED FUEL CELL POWER PLANTS Interim Report, Mar. - Aug. 1980
R. G. Minet, D. Warren, T. Tomita, K. Hirokawa, K. Osaki, and T. Shinjo Aug. 1980 132 p refs Prepared in cooperation with Toyo Engineering Corp., Chiba, Japan
(EPRI Proj. 1041-1)
(EPRI-EM-1487) Avail: NTIS HC A07/MF A01

The results of bench scale reforming tests of No. 2 fuel oil using sulfur tolerant reforming catalysts were examined. The comparative economics for use of such a catalyst in a Hybrid reformer train and a regenerative type light temperature steam reformer HTSR alone are presented. The sulfur tolerant catalyst system was tested over a wide range of conditions using No. 2 fuel oils of different sulfur and aromatic content. Tests were carried out using a regenerative type reformer tube as well as a conventional single pass tube. The experimental results were reviewed, the data correlated, and preliminary design parameters for this catalyst were developed. In addition, the catalyst limitations and the requirements of the reformer trains to integrate efficiently with the fuel cell are outlined. Estimates are presented for two fuel processing trains for a nominal 4.8 MW fuel cell power plant: a regenerative type HTSR and a Hybrid system using a regenerative HTSR in a combination with an auto thermal reformer. DOE

N81-13520# Sandia Labs., Albuquerque, N. Mex.
VERTICAL AXIS WIND TURBINE FOUNDATION PARAMETER STUDY
P. F. Ludde Jul. 1980 38 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-7015) Avail: NTIS HC A03/MF A01

The foundation/anchor requirements for the Vertical Axis Wind Turbine are identified. Information is supplied concerning the selection, design, and cost estimates for the geologic conditions which may be encountered at potential wind turbine sites. L.F.M.

N81-13522# Sandia Labs., Albuquerque, N. Mex.
MODAL TESTING OF THE VERTICAL AXIS WIND TURBINE
Doris E. Miller and Arlo R. Nord 1980 23 p ref
(SAND-80-1639C; CONF-800746-1) Avail: NTIS HC A02/MF A01

Modal tests performed on two bladed and three bladed vertical axis wind turbines are described. Results are inconclusive and further testing is recommended. L.F.M.

N81-13523# Sandia Labs., Albuquerque, N. Mex.
TORQUE RIPPLE IN A DARRIEUS, VERTICAL AXIS WIND
Robert C. Reuter, Jr. 1980 17 p refs Presented at the ASME Winter Ann. Meeting, Chicago, 16 Nov. 1980
(Contracts DE-AC04-76DP-00789; AT(29-1)-789)
(SAND-80-0475C; CONF-801102-3) Avail: NTIS HC A02/MF A01

Interaction between a steady wind and a rotating, Darrieus, vertical axis wind turbine produces time periodic aerodynamic loads which cause time dependent torque variations, referred to as torque ripple, to occur in the mechanical link between the turbine and the electrical generator. The effect of torque ripple upon fatigue life of drive train components and upon power quality was investigated. An analytical solution characterizing the phenomenon of torque ripple was obtained which is based upon a Fourier expansion of the problem. Numerical results for torque ripple, some experimental data, determination of acceptable levels and methods of controlling it, are presented and discussed. DOE

N81-13429*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
LIMITED AREA COVERAGE/HIGH RESOLUTION PICTURE TRANSMISSION (LAC/HRPT) DATA VEGETATIVE INDEX CALCULATION PROCESSOR USER'S MANUAL
S. O. OBrien, Principal Investigator Sep. 1980 14 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of Interior and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10073; NASA-CR-160870; EW-LO-00703; LEMSCO-15327; JSC-16375) Avail: NTIS HC A02/MF A01 CSCL 08F

The program, LACVIN, calculates vegetative indexes numbers on limited area coverage/high resolution picture transmission data for selected IJ grid sections. The IJ grid sections were previously extracted from the full resolution data tapes and stored on disk files. Author

N81-14404# AEG-Telefunken, Frankfurt am Main (West Germany). Dept. of Material Sciences.
DEVELOPMENT OF A CRUDE GAS/AIR FUEL CELL SYSTEM Final Report
Harald Boehm, Robert Fleischmann, and Joachim Heffler Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 40 p refs In GERMAN; ENGLISH summary Sponsored by

Bundesministerium fuer Forschung und Technologie (BMFT-FB-T-79-103; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 8,40

A matrix type fuel cell with WC anode and Pt cathode was developed operating at 150 C with concentrated phosphoric acid as the electrolyte. Batteries with 5 and 40 cells were stacked to ether delivering an output up to 8 W/cell under H2/air. No decay in the power density was observed in long term tests over more than 5000 hours. These tests also showed no problems in the water balance of the batteries and proved a maintenance free operation of the stacks. Author

N81-14408# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abt. Elastomechanik und Aeroelastische Stabilitaet.

A GENERAL CALCULATION METHOD FOR THE DYNAMIC RESPONSE TO DISCRETE GUST DISTRIBUTIONS AS EXEMPLIFIED BY THE ROTORBLADE OF A WIND ENERGY CONVERTER

Dieter Ludwig Mar. 1980 63 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-684)

(DFVLR-FB-80-12) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 13,60

An analytical method to calculate the dynamic response of elastic structure to discrete gust distributions is presented. The formulation is based on the assumption that the modal parameters of the structure are known and can be received by eigenanalysis or gound vibration test. No restriction is made concerning the number of flapwise bending modes nor the distribution of discrete gusts. The generalized forces due to excitation and due to motion are approximated by means of the known exponential forms of Wagner's function and Kussner's function to get an analytical solution in the shortest possible computing time. E.D.K.

N81-14417# Sandia Labs., Albuquerque, N. Mex. Applied Mechanics Div.

TORQUE RIPPLE IN A DARRIEUS, VERTICAL AXIS WIND TURBINE

Robert C. Reuter, Jr. Sep. 1980 36 p refs Sponsored by DOE

(SAND-80-0475) Avail: NTIS HC A03/MF A01

Interaction between a steady wind and a rotating, Darrieus, vertical axis wind turbine produces time periodic aerodynamic loads which cause time dependent torque variations, referred to as torque ripple, to occur in the mechanical link between the turbine and the electrical generator. There is concern for the effect of torque ripple upon fatigue life of drive train components and upon power quality. An analytical solution characterizing the phenomenon of torque ripple was obtained which is based upon a Fourier expansion of the time dependent features of the problem. Numerical results for torque ripple, some experimental data, determination of acceptable levels and methods of controlling it, are presented and discussed. Author

N81-14432# United Technologies Corp., South Windsor, Conn. Power Systems Div.

DEVELOPMENT OF MOLTEN CARBONATE FUEL CELL POWER PLANT TECHNOLOGY Quarterly Technical Progress Report, 1 Jan. - 31 Mar. 1980

H. C. Healy, R. A. Sanderson, F. J. Wertheim, P. F. Farris, A. P. Mientek, D. L. Maricle, T. A. Briggs, J. L. Preston, Jr., G. A. Louis, M. L. Abrams et al Aug. 1980 93 p refs

(Contract DE-AC01-79ET-15440)

(DOE/ET-15440/2; FCR-2268; QTPR-2) Avail: NTIS HC A05/MF A01

During this quarter, effort was continued in all four major task areas: system studies to define the reference power plant design; cell and stack design, development and verification; preparation for fabrication and testing of the full-scale prototype stack; and developing the capability for operation of stacks on coal-derived gas. Preliminary module and cell stack design requirements were completed. Fuel processor characterization was completed. Design approaches for full-scale stack busbars and electrical isolation of reactant manifolds and reactant piping were defined. Preliminary design requirements were completed for the anode. Conductive nickel oxide for cathode fabrication was made by oxidation and lithiation of porous nickel sheet stock. A method of mechanizing the tape casting process for increased production rates was successfully demonstrated. Theoretical calculations indicated that hydrogen cyanide and ammonia, when present as impurities in the stack fuel gas, will have no harmful effects. Laboratory experiments using higher than anticipated levels of ethylene showed no harmful effects. Author

N81-14433# Tennessee Univ. Space Inst., Tullahoma. Energy Conversion Div.

MHD COAL-FIRED FLOW FACILITY Quarterly Technical Progress Report, Jan. - Mar. 1980

M. C. Altstatt, R. C. Attig, W. E. Baucum, D. A. Brosnan, J. N. Chapman, J. A. Cooper, L. W. Crawford, L. B. Picks, T. E. Dowdy, J. W. Frazier et al 30 May 1980 59 p refs

(Contracts DE-AC02-79ET-10815; EX-76-C-01-1760)

(DOE/ET-10815/47; QR-1) Avail: NTIS HC A04/MF A01

Generator experiments describing local current distributions are reported along with behavior under conditions of imposed leakage. The shelter for a cold flow modeling facility was constructed. A jet turbine combustor was tested for use as a vitiation burner. Samples taken from the exhaust duct showed that the refractories used performed well in alleviating heat loss while exhibiting acceptable degradation. A resistive power take-off network was designed and implemented. T.M.

N81-14435# Babcock and Wilcox Co., Alliance, Ohio.

STUDY OF SEED REPROCESSING SYSTEMS FOR OPEN CYCLE COAL FIRED MHD POWER PLANTS. TASK 1: SELECTION OF PROCESSES FOR MORE DETAILED STUDY

17 Jul. 1980 153 p refs

(Contract DE-AC02-79ET-15613)

(DOE/ET-15613/T1) Avail: NTIS HC A08/MF A01

In most of the processes, a portion of the potassium seed material is converted to a compound not containing sulfur. The potassium in this form can, when injected upstream of the MHD channel, capture the sulfur released during the combustion of coal and eliminate the need for flue gas desulfurization equipment. Criteria considered in the evaluation included cost, state of development, seed loss, power requirements, availability, durability, key component risk, environmental impact, safety, controllability, and impurities buildup. T.M.

N81-14436# General Electric Co., Schenectady, N. Y. Energy Systems Programs Dept.

DEVELOPMENT OF MOLTEN CARBONATE FUEL CELL POWER PLANT Quarterly Technical Progress Report, 1 Feb. - 30 Apr. 1980

J. R. Peterson 1980 140 p refs

(Contract DE-AC02-80ET-17019)

(DOE/ET-17019/1) Avail: NTIS HC A07/MF A01

User requirements and power plant subsystem alternatives and characteristics were defined. A total of 27 laboratory cells were operated and a total of nine cells continued on test at the end of the quarter. Investigation of alternative anode and cathode materials proceeded; a dual-porosity anode was fabricated and tested. Over 10,000 endurance hours on a state of the art cell carried-over from a previous program was achieved and 1500 hours endurance was obtained with sheet metal cells. Results presented for electrolyte structure development include comparative data for spray-dried and modified aqueous slurry process powders. Shakedown tests with a rotating disc electrode apparatus for fundamental measurements are described. Concept designs for both prototype and subscale stacks were identified. An overall test plan to commercialization for molten carbonate fuels cells and a functional specification for the tenth-scale stack test facility were proposed. Cost-effective manufacturing assessment of available designs and processes was initiated. Available contaminants concentration and effects information was gathered and initial projections of contaminant ranges and concentrations were prepared. Author

N81-14463# Los Alamos Scientific Lab., N. Mex.
TECHNOLOGY ASSESSMENT OF WIND ENERGY CONVERSION SYSTEMS
B. W. Meier and T. J. Merson Sep. 1980 48 p refs Sponsored in part by DOE
(DOE/EV-0103) Avail: NTIS HC A03/MF A01

Two candidates that might be deployed if this technology makes a significant contribution to the national energy requirements were chosen. One is a large machine of 1.5 MW rated capacity that can be used by utilities. The other is a small machine that is characteristic of units that might be used to meet residential or small business energy requirements. Energy storage systems are discussed for each machine. Cost estimates were made for both large and small systems. Material requirements are discussed and a general discussion of environmental impacts is presented. The site specific nature and the design dependency of these impacts are discussed as the wind energy resource is not constant in all regions of the nation. Author

N81-14465# Department of Energy, Morgantown, W. Va.
EFFECTS OF SEVERAL TRACE CONTAMINANTS ON FUEL CELL PERFORMANCE
Su-Moon Park (New Mexico Univ., Albuquerque) and Thomas J. OBrien Aug. 1980 29 p refs
(DOE/METC/RI-80/16) Avail: NTIS HC A03/MF A01

The electrochemical reactivity of Hg/HgS, PbS, CdS, $Sn/SnCl_2/SnCl_4$, and TiO_2 in coal gas at the nickel anode and the nickel oxide cathode were examined thermodynamically. Calculations indicate that only $SnCl_4$ would undergo reduction at the cathode to $SnCl_2$. Other species would remain intact. Contaminants such as H_2S/SO_2 and HC1 were included in the calculation. The results are consistent with the limited observations. Possible chemical interactions between contaminants and electrodes or electrolytes were examined. Reactions with the nickel anode have negative free energies. Mercury would interact physically with the anode by forming an alloy. Reactions with the nickel oxide cathode also have negative free energies. Reactions with carbonates have large negative free energies. Born's model of ion transfer was used to calculate the free energy change for the transfer of ions from aqueous solution to the molten carbonate solution. Author

N81-14468# General Electric Co., St. Petersburg, Fla.
CALCIUM/CALCIUM CHROMATE THERMAL BATTERY AND THERMAL BATTERY ASSIGNMENT AT THE GENERAL ELECTRIC NEUTRON DEVICES DEPARTMENT
J. B. Neale and R. D. Walton 10 Oct. 1980 39 p
(Contract DE-AC04-76DP-00656)
(GEPP-TIS-529) Avail: NTIS HC A03/MF A01

A nontechnical overview of thermal battery design and fabrication methods is given. A thermal battery is a primary, reserve electrochemical power source; that is, it can be used only once and then for a relatively short period, measured in minutes. To energize the battery, an external electrical signal ignites a heat source in the battery to melt the electrolyte and initiate an electrochemical reaction. The battery is made up of several series-connected cells, each with an anode, a cathode, and a current collector. A cell's anode is calcium; its cathode is hexavalent chromium. The electrochemical reaction takes place when the electrolyte is melted by heat suppled from ignition of an iron potassium perchlorate disk. Since no reaction occurs while the electrolyte is in the solid state, the battery does not deteriorate with time and has a shelf life exceeding 20 years. DOE

N81-14475# Rockwell International Corp., Golden, Colo.
TECHNICAL AND MANAGEMENT SUPPORT FOR THE DEVELOPMENT OF SMALL WIND SYSTEMS Annual Report, 1 Oct. 1978 - 28 Sep. 1979
Dec. 1979 127 p refs
(Contract DE-AC04-76DP-03533)
(RFP-3126/3533/80/2) Avail: NTIS HC A07/MF A01

The Rocky Flats Wind Systems Program is described in terms of the objectives, approach, and achievements of the program and each of its task areas during the period October 1, 1978 - September 28, 1979. Additional testing of 17 small wind energy conversion systems was conducted and include controlled velocity and vibration testing of SWECS. Work on eight design and analysis projects for advanced prototypes in three size ranges progressed through a series of design reviews and fabrication was initiated. DOE

N81-14476# Rockwell International Corp., Golden, Colo.
TECHNICAL AND MANAGEMENT SUPPORT FOR THE DEVELOPMENT OF SMALL WIND SYSTEMS: FY 1980 PROGRAM SUMMARY
1 Mar. 1980 41 p
(Contract DE-AC04-76DP-03533)
(RFP-3121/3533/80/8) Avail: NTIS HC A03/MF A01

An overview of the Rocky Flats Small Wind Systems Program is given. The manufacture of small wind energy conversion systems by the private sector and utilization of these systems by the public are discussed. The current program is described in terms of its objectives and role, interprogram relationships, program administration, activity highlights, and plans for 1980 as well as projections through 1982. DOE

N81-14478# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
AIR/GAS SYSTEM DYNAMICS OF FOSSIL FUEL POWER PLANTS. VOLUME 3: EXPERIMENTAL PRESSURE TEST DATA OF A 500 MW UNIT AND OF A 125 MW UNIT Final Report
D. N. Wormley, D. Rowell, and J. E. Brown, Jr. Sep. 1980 113 p refs Prepared in cooperation with MIT, Cambridge, and NUS Corp., Clearwater, Fla.
(EPRI Proj. 1651-3)
(EPRI-CS-1444-Vol-3) Avail: NTIS HC A06/MF A01

Methods were developed for instrumenting plants and analyzing data to identify sources of air/gas system dynamic problems. These techniques were applied to two oil-fired, balanced draft plants to obtain data for cold and hot operation. The data analysis identified low frequency periodic oscillations in both plants that resulted from air preheater rotation. Also pressure spectra were measured for forced draft, induced draft, and recirculation fans and the associated ductworks. The data analysis indicated that force draft fans in both plants had relatively low variations in pressure amplitude, and induced draft fans had significant levels of pressure variation. The analysis of data for one plant indicated the existence of conditions in the recirculation loop at low load levels in which a component of fan rotating stall noise matched in frequency and was amplified by a duct acoustic natural mode of vibration. DOE

N81-14495# National Technical Information Service, Springfield, Va.
GEOTHERMAL ENERGY. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, Aug. 1978 - Jul. 1980
Audrey S. Hundemann Sep. 1980 277 p Supersedes NTIS/PS-79/0819 and NTIS/PS-78/0667
(PB80-814692; NTIS/PS-79/0819; NTIS/PS-78/0667) Copyright. Avail: NTIS HC $30.00/MF $30.00 CSCL 10A

Citations from worldwide literature on geothermal energy conversion, feasibility, development, and cost estimates are presented. Studies on geothermal exploration, drilling technology, fluid flow, convection, thermodynamics, heat extraction, and electric power plants are covered. Equipment, corrosion, reservoir engineering, and remote sensing are included. This updated bibliography contains 143 citations, all of which are new entries to the previous edition. GRA

N81-14496# National Technical Information Service, Springfield, Va.
GEOTHERMAL ENERGY. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, Aug. 1978 - Jul. 1979
Audrey S. Hundemann Sep. 1980 148 p

(PB80-814684) Copyright. Avail: NTIS HC $30.00/MF $30.00 CSCL 10A

Geothermal energy conversion, feasibility, development and cost estimates are presented in approximately 143 citations. Geothermal exploration, drilling technology, fluid flow, convection, thermodynamics, heat extraction, and electric power plants are covered. Equipment, corrosion, reservoir engineering, and remote sensing are included. GRA

N81-14497# National Technical Information Service, Springfield, Va.

GEOTHERMAL ENERGY: TECHNOLOGY AND GENERAL STUDIES. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1978 - Jul. 1980

Audrey S. Hundemann Sep. 1980 200 p Supersedes NTIS/PS-79/0817; NTIS/PS-78/0666

(PB80-814676; NTIS/PS-79/0817; NTIS/PS-78/0666) Copyright. Avail: NTIS HC $30.00/MF $30.00 CSCL 10A

This bibliography contains 311 citations of Government-sponsored research on geothermal energy conversion, power plants, heat extraction, and space heating. Studies on fluid flow, heat transfer, rock fracturing, environmental impacts, pressure, and reservoir engineering are included. Reports on economics, legislation, technology assessment, comparative evaluation with other energy sources, Government policies, and planning are also cited. GRA

N81-14498# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN UNITED STATES GEOTHERMAL SPACE HEATING - NAVAL AIR REWORK FACILITY, NORFOLK, VIRGINIA

F. K. Hill and R. W. Henderson 10 Jun. 1980 43 p refs

(Contract EX-76-A-36-1008)

(PB80-217490; JHU/APL/QM-80-102) Avail: NTIS HC A03/MF A01 CSCL 13A

The technical and economic feasibility of using geothermal energy for space heating the Naval Air Rework Facility (NARF) electronic integration hangar was evaluated. The warm water output from a single well was used in several modes: to heat via a floor radiation system or via heat pumps, with and without a ground water reservoir to store heat in off hours. GRA

N81-14499# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN UNITED STATES. GEOTHERMAL SPACE HEATING, PITTSVILLE MIDDLE/ELEMENTARY SCHOOL, PITTSVILLE, MARYLAND Technical Assistance Report No. 4

Roy vonBriesen and Kwang Yu Jun. 1980 35 p

(Contracts EX-76-A-36-1008; DE-AI01-79ET-27025)

(PB80-221088; JHU/APL/QM-80-101) Avail: NTIS HC A03/MF A01 CSCL 13A

The old school building was undergoing a major rebuilding program, while the elementary school wing was just to have insulation added. Two cases were examined; both provided a production and reinjection well. One case evaluated a geothermal heating system sized for the new construction of the main school building. The other case examined retrofitting the elementary school wing existing heating system combined with the new construction of the main school building. GRA

N81-14500# National Oceanic and Atmospheric Administration, Rockville, Md. Office of Ocean Engineering.

ALTERNATIVE ENERGY SOURCES SESSION OCEAN THERMAL ENERGY CONVERSION: TECHNOLOGY DEVELOPMENT

William E. Richards and Joseph R. Vadus Mar. 1980 30 p refs Presented at the Oceanology Intern. '80 Conf., Brighton, England, 7 Mar. 1980 Sponsored in part by DOE, Washington, D.C.

(PB80-218159; NOAA-TR-OOE-9; NOAA-80071704) Avail: NTIS HC A03/MF A01 CSCL 10B

Four ocean-energy technologies with significant promise are explored: ocean thermal energy conversion; wave power; ocean currents; and salinity gradients. The major funding emphasis has been in OTEC. Technical developments, accomplishments and major findings, remaining problems, and proposed plans for the future are discussed. GRA

N81-14875# Westinghouse Electric Corp., Red Bank, N.J. Advanced Energy Systems Div.

MHD ELECTRODE DEVELOPMENT Quarterly Report, Apr. - Jun. 1980

John W. Sadler, Laurence H. Cadoff, Don L. Dietrick, James A. Dilmore, Edsel W. Frantti, Dave Jacobs, Edgar L. Kochka, Jack A. Kuszyk, S. K. Lau, and Joseph Lempert Jul. 1980 95 p refs

(Contract DE-AC01-79ET-15529)

(DOE/ET-15529/T1) Avail: NTIS HC A05/MF A01

Emphasis is now being directed towards the engineering development of cold metallic electrodes, and in particular the identification and evaluation of alternatives to platinum for use as anodes. A literature search, concentrating on hot corrosion resistant alloys, was undertaken and results are presented. In addition, results of platinum copper diffusion studies and a preliminary evaluation of sputter coated specimens of TiB2 clad copper are reported. Laboratory anode arc erosion studies continued. A number of modifications incorporated in the test setup are described. This modified test arrangement was used to obtain comparative data on a number of potential anode metal alloys. Further work is required to refine the test, particularly to provide a reliable method of applying corrodent to the specimens under test. No significant laboratory electrochemical corrosion tests were completed. Author

N81-14892# California Univ., Livermore. Lawrence Livermore Lab.

NATIONAL MIRROR FUSION PROGRAM PLAN

R. R. Borchers, ed. and C. M. VanAtta, ed. Jan. 1980 129 p refs Prepared in cooperation with DOE, Washington, D.C.

(Contract W-7405-eng-48)

(UCAR-10042-80) Avail: NTIS HC A07/MF A01

Experiments are under way in the Tandem Mirror Experiment (TMX) facility at Livermore. Recently this idea was greatly improved by incorporating a new element called the thermal barrier, a concept that promises a higher power gain factor (Q = 10 to 20) with much less demanding neutral beam and magnet technology and a higher fusion power density in the reactor. In addition to the tandem-mirror experiments in TMX, a new attempt will be made in the Beta 2 facility during FY 1980 to create and sustain a field-reversed mirror configuration, which is a different mirror fusion approach that could lead to early commercialization of small reactors. The plan presented here is designed to exploit the results of these and other mirror experiments and theoretical developments toward a variety of applications. The main objective is electric power generation. DOE

N81-14893# California Univ., Livermore. Lawrence Livermore Lab.

TECHNOLOGY OF DIRECT CONVERSION FOR MIRROR REACTOR END-LOSS PLASMA

W. L. Barr and R. W. Moir 7 Oct. 1980 11 p refs Presented at the 4th ANS Topical Meeting on the Technol. of Controlled Nucl. Fusion, King of Prussia, Pa., 14-17 Oct. 1980

(Contract W-7405-eng-48)

(UCRL-84235; CONF-801011-6) Avail: NTIS HC A02/MF A01

Design concepts are presented for plasma direct convertors (PDC) intended primarily for use on the end-loss plasma from tandem-mirror reactors. Recent experimental results confirm most of these design concepts. Both a one-stage and a two-stage PDC were tested in reactor-like conditions using a 100 kV, 6 kW ion beam. In a separate test on the end of the TMX machine, a single stage PDC recovered 79 W for a net efficiency of 50%. Tandem mirror devices are well suited to PDC. The high minimum energy of the end-loss ions, the magnetic expansion outside the mirrors, and the vacuum conditions in the end tanks required by the confined plasma, all preexist. The inclusion of a PDC is therefore a rather small addition. DOE

N81-14985# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
THE VELOCITY INDUCED BY THE WAKE OF A WIND TURBINE IN A SHEAR LAYER, INCLUDING GROUND EFFECT
Bo C. A. Johansson 17 Sep. 1980 51 p refs
(Contract NE-5061-013)
(FFA-TN-HU-2189-pt-3; ISSN-0081-5640; FFA-133) Avail: NTIS HC A04/MF A01

The turbine was approximated by a disk area of continuous distributions of thrust and force parallel to the disk plane. Its wake was represented by a semi-infinite cylinder of distributed vorticity. A numerical example was calculated. The theory is based upon assumptions strictly valid only for small perturbations of the undisturbed flow. However, the results may have a wider range of applicability. T.M.

N81-15034 State Univ. of New York at Stony Brook.
THE OXYGEN ELECTRODE REACTION ON ZIRCONIA Ph.D. Thesis
Leonard Jay Olmer 1980 298 p
Avail: Univ. Microfilms Order No. 8100516

The construction and performance of the high temperature fuel cell must be improved in order for it to be economically competitive with conventional energy producing systems. The solid oxide thin film fuel cell concept incorporating zirconia electrolytes provided electrolyte thickness of 20 to 30 micrometers resulting in small electrolyte ohmic losses leaving interfacial polarization losses as dominant. The slow steps in the overall air electrode reaction on zirconia electrolytes and the factors which influence the reaction rate are determined, and a means for electrode improvement such that interfacial polarization losses at the air electrode will be at a minimum is suggested. A mathematical model was formulated based on the oxygen adsorption kinetics. The theoretical dc and ac responses were calculated and a direct relationship was established.
Dissert. Abstr.

N81-15046# California Univ., Livermore. Lawrence Livermore Lab.
SOME CHEMICAL ENGINEERING CHALLENGES IN DRIVING THERMOCHEMICAL HYDROGEN PROCESSES WITH THE TANDEM MIRROR REACTOR
Terry R. Galloway and Richard W. Werner 10 Nov. 1980 49 p refs Presented at the 73rd Meeting of the Am. Inst. of Chem. Engr., Chicago, 16-20 Nov. 1980
(Contract W-7405-eng-48)
(UCRL-84632; CONF-801104-4) Avail: NTIS HC A03/MF A01

The way in which the magnetic fusion program and the future tandem mirror reactor can benefit and support the production of synthetic, portable fuels that are vital to the economy of the U.S. is studied. The reactor is used as a 1200 K heat source driving a thermochemical cycle whose output product is hydrogen. Principal focus for the reactor energy source is placed on the conceptual design of the blanket module. The module under study is a LiNa cauldron design which consists of a binary, liquid metal pool boiler that uses lithium as the neutron moderator and sodium vapor as the heat transfer fluid with the latent heat of vaporization of sodium providing the main mode of energy transport. The tandem mirror reactor is described and compared with Tokamaks. S.F.

N81-15380# Thermo Electron Corp., Waltham, Mass.
PERFORMANCE TESTS OF A SLOW-SPEED, TWO-STROKE DIESEL ENGINE USING COAL-BASED FUELS
J. B. Dunlay, J. P. Davis, H. A. Steiger (Sultzer Brothers, Ltd., Winterthur, Switzerland), and M. K. Eberle (Sultzer Brothers, Ltd., Winterthur, Switzerland) Jun. 1980 52 p ref
(Contract EF-77-C-01-2647)
(TE-7905-267-80) Avail: NTIS HC A04/MF A01

The diesel engine tests described were performed to investigate the potential of modern slow speed, two stroke diesel engines for coal based fuel operation and included the following areas of investigation: (1) diesel engine performance tests using COED and SRC-II coal derived liquid fuels and a micronized coal/oil slurry fuel; (2) powerplant design studies to assess the economics of diesel engine operation on coal based fuels for electric power generation; (3) technical assessment of fuel injection concepts applicable to coal based fuels; and (4) definition of technology development requirements. S.F.

N81-15461*# Little (Arthur D.), Inc., Cambridge, Mass.
STUDY OF COMPONENT TECHNOLOGIES FOR FUEL CELL ON-SITE INTEGRATED ENERGY SYSTEMS Final Report
W. David Lee and Siegfried Mathias Dec. 1980 129 p refs
(Contracts DEN3-121; DE-AI03-80ET-11272)
(NASA-CR-165152-Vol-1; DOE/NASA/0121-80/1-Vol-1; ADL-83613) Avail: NTIS HC A07/MF A01 CSCL 10A

Heating, ventilation and air conditioning equipment are integrated with three types of fuel cells. System design and computer simulations are developed to utilize the thermal energy discharge of the fuel in the most cost effective manner. The fuel provides all of the electric needs and a loss of load probability analysis is used to ensure adequate power plant reliability. Equipment cost is estimated for each of the systems analyzed. A levelized annual cost reflecting owning and operating costs including the cost of money was used to select the most promising integrated system configurations. Cash flows are presented for the most promising 16 systems. Several systems for the 96 unit apartment complex (a retail store was also studied) were cost competitive with both gas and electric based conventional systems. Thermal storage is shown to be beneficial and the optimum absorption chiller sizing (waste heat recovery) in connection with electric chillers are developed. Battery storage was analyzed since the system is not electric grid connected. Advanced absorption chillers were analyzed as well. Recommendations covering financing, technical development, and policy issues are given to accelerate the commercialization of the fuel cell for on-site power generation in buildings. Author

N81-15462*# Little (Arthur D.), Inc., Cambridge, Mass.
STUDY OF COMPONENT TECHNOLOGIES FOR FUEL CELL ON-SITE INTEGRATED ENERGY SYSTEM. VOLUME 2: APPENDICES Final Report
W. David Lee and Siegfried Mathias Dec. 1980 143 p refs
(Contracts DEN3-121; DE-AI03-80ET-11272)
(NASA-CR-165152-Vol-2; DOE/NASA/0121-80/1-Vol-2; ADL-83613) Avail: NTIS HC A07/MF A01 CSCL 10A

This data base catalogue was compiled in order to facilitate the analysis of various on site integrated energy system with fuel cell power plants. The catalogue is divided into two sections. The first characterizes individual components in terms of their performance profiles as a function of design parameters. The second characterizes total heating and cooling systems in terms of energy output as a function of input and control variables. The integrated fuel cell systems diagrams and the computer analysis of systems are included as well as the cash flows series for baseline systems. E.D.K.

N81-15467# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.
ROTOR MODEL FOR VERIFICATION OF COMPUTATION METHODS [ROTORMODELL ZUR VERIFIZIERUNG VON RECHENVERFAHREN]
J. H. Argyris, W. Aicher, F. Karl, W. Kuemmerle, and M. Mueller 1979 58 p refs In GERMAN; ENGLISH summary
(Contract BMFT-ET-4086-A)
(ISD-262; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

In order to prove the quality of idealization and the validity of computation for windmills, a driven model of a windmill with a 7.4 m diameter rotor was constructed. New data acquisition and data transmission systems with 16 channels and digitization in the rotating system were developed and tested. The dynamic response of the rotor blades to the cyclic loading of gravity was taken to compare measurements and computations. For the measurements and evaluation which were performed by a measurement system and a computer, the necessary software was built. T.M.

N81-15475# Grumman Energy Systems, Inc., Bohemia, N.Y.
DEVELOPMENT OF AN 8 KILOWATT WIND TURBINE GENERATOR FOR RESIDENTIAL TYPE APPLICATIONS. PHASE 1: DESIGN AND ANALYSES. VOLUME 1: EXECUTIVE SUMMARY
F. M. Adler, L. G. Angeloff, P. Henton, and P. W. King Mar. 1980 15 p
(Contract DE-AC04-76DP-03533)
(RFP-3007-Vol-1) Avail: NTIS HC A02/MF A01

The objectives for this program were threefold. The first was to develop a technology capable of designing, building, and selling (at a cost competitive with alternative energy) wind turbine generators (WTGs) in the 8 kW size range for use in a number of rural and residential applications The second was to provide fabrication cost data which may be used to determine the economic viability of WTGs of this size. The third was to develop an 8 kW WTG which may be used to demonstrate the practicality of WTGs in this size range. E.D.K.

N81-15482# Black and Veatch Consulting Engineers, Kansas City, Mo.
THERMOPHOTOVOLTAIC CONVERSION FROM CONVENTIONAL HEAT SOURCES Final Report
S. L. Levy Dec. 1979 112 p refs
(EPRI Proj. 1348-3)
(EPRI-ER-1262) Avail: NTIS HC A06/MF A01

Thermophotovoltaic (TPV) conversion with conventional heat sources is unattractive under current conditions; the reasons are presented and the circumstances under which this situation would change are given. The studies show that a TPV system would be inferior to competing systems, based on the inability to use it as a topping cycle, the inability to efficiently use a TPV system without recourse to expensive recuperators, the necessity to use expensive clean fuels, the high losses in a TPV stand alone system, and the inability to adapt t TPV system to use nuclear fuel. Research and development efforts which could improve the economic and functional attractiveness of TPV systems are outlined. Areas which influence the competitive position of TPV conversion to permit reappraisal if key R&D breakthroughs occur in the future are identified. Author

N81-15497# United Technologies Corp., South Windsor, Conn. Power Systems Div.
EVALUATION OF BATTERY CONVERTERS BASED ON 4.8-MW FUEL CELL DEMONSTRATOR INVERTER. VOLUME 2: APPENDICES Final Report
Frederick J. Kornbrust, Joseph R. Vivirito, John W. Walton, and Joseph M. King [1981] 228 p
(Contract EX-76-C-01-2122)
(FCR-0926-Vol-2) Avail: NTIS HC A11/MF A01

The maximum charge voltage, minimum discharge voltage, current and voltage profiles for 7 hour charge and 3, 5 and 10 hour discharges, design efficiency, bolted fault current, and equivalent circuit were the principal parameters of interest. The cell characteristics obtained from each of the six developers surveyed (4 battery types) is given on an individual basis. The types summarized are sodium sulfur, sodium-antimony trichloride, zinc chlorine, and lithium/metal sulfide. The individual battery summary describes the maximum and minimum cell potentials for the various discharge rates, identifies voltage and amp-hour efficiencies, and presents the duty cycle voltage and current profile curves. For relatively constant voltage and current, the product of voltage and amp-hour efficiency approximates the energy efficiences. However, energy efficiency is more accurately obtained by integrating over the duty cycle curves. Author

N81-15498# Ross (M. Andrew), Columbus, Ohio.
LOW PRESSURE HIGH SPEED STIRLING AIR ENGINE Final Report
M. Andrew Ross 16 Jun. 1980 30 p refs
(Contract DE-FG02-79R5-10142)
(DOE/R5-10142-2) Avail: NTIS HC A03/MF A01

A relatively simple, multifuel, low pressure (but high speed) Stirling air engine of useful power can be built with limited funds and resources, and can constitute appropriate technology for various applications. The project engine has a relatively large volume of piston displacement, a simple cylindrical (unfinned) heater, and a low pressure level; but like the Philips engines it operates at relatively high speed, employs modern materials, and is relatively lightweight. A simple, appropriate technology low pressure, high speed, wood-fired Stirling air engine of 100 watts output was developed. The project engine was completed and tested, using a propane burner for all tests as a matter of convenience. The 100 watt aim was exceeded, at atmospheric pressure, over a wide range of engine speed, with the maximum power being 112 watts at 1150 rpm. S.F.

N81-15510# Brookhaven National Lab., Upton, N. Y. Electrochemical Technology Group.
FUEL CELL APPLIED RESEARCH: ELECTROCATALYSIS AND MATERIALS Quarterly Report, 1 Jul. - 30 Sep. 1979
S. Srinivasan, H. S. Isaacs, J. McBreen, W. E. Ogrady, H. Olender, L. J. Olmer, E. J. L. Schoulder, and R. R. Adzic Mar. 1980 63 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51198) Avail: NTIS HC A04/MF A01

The effect of underpotential deposited metal layers on the electrocatalysis of fuel cell reactions is studied. The potential for developing organic compound/air fuel cells using underpotential deposited Pb adatoms to enhance the electrocatalysis of the fuel electrode is explored. The effects of adsorbed layers of Pb, Tl and Bi on formic acid and methanol oxidation on platinum in 85 percent H3PO4 were investigated. The effect of crystal orientation on formic acid oxidation on platinum in 1 M CHIO2 was investigated. The kinetics of the oxygen reduction and evolution reactions at the electrode (metal or oxide) solid electrolyte (yttria stabilized zirconia) interface were investigated using ac and dc techniques. S.F.

N81-15533# Battelle Pacific Northwest Labs., Richland, Wash.
FUSION-FISSION ENERGY SYSTEMS EVALUATION
V. L. Teofilo, D. T. Aase, W. E. Bickford, N. J. McCormick (Washington Univ.), B. R. Leonard, R. T. McGrath (Michigan Univ., Ann Arbor), J. E. Morrison (Stanford Univ., Palo Alto, Calif.), R. T. Perry (Wisconsin Univ., Madison), F. I. Ribe (Washington Univ.), and A. D. Rockwood Jan. 1980 355 p refs
(Contract EY-76-C-06-1830)
(PNL-3116) Avail: NTIS HC A16/MF A01

An assessment of nuclear energy systems which have potential for reducing the risk of nuclear weapons proliferation while satisfying the short- and long-term needs for nuclear energy was conducted. The fusion-fission hybrid is one of the nuclear energy systems which is considered for long-term applications. Although most of the combined driver-blanket hybrid systems considered have not been optimized for performance and cost, the resulting data provide valuable insights of the future prospects and potential of hybrid development. L.F.M.

N81-15534# General Electric Co., Schenectady, N. Y. Corporate Research and Development.
DEVELOPMENT OF MOLTEN CARBONATE FUEL CELLS FOR POWER GENERATION Final Report, Aug. 1977 - Dec. 1979
Apr. 1980 549 p refs
(Contract DE-AC03-77ET-11319)
(SRD-80-055) Avail: NTIS HC A23/MF A01

The broad and comprehensive program included elements of system definition, cell and system modeling, cell component development, cell testing in pure and contaminated environments, and the first stages of technology scale up. Single cells, with active areas of 45 sq cm and 582 sq cm, were operated at 650 C and improved to state of the art levels through the development of cell design concepts and improved electrolyte and electrode components. Performance was shown to degrade by the presence of fuel contaminants, such as sulfur and chlorine, and due to changes in electrode structure. Using conventional hot press fabrication techniques, electrolyte structures up to 20' x 20' were fabricated. Promising approaches were developed for nonhot pressed electrlyte structure fabrication and a promising electrolyte matrix material was identified. This program formed the basis for a long range effort to realize the benefits of molten carbonate fuel cell power plants. E.D.K.

N81-15542# West Virginia Univ., Morgantown. Dept. of Aerospace Engineering.
THE EFFECTS OF FLOW CURVATURE ON THE AERODYNAMICS OF DARRIEUS WIND TURBINES
P. G. Migliore, W. P. Wolfe, and Richard E. Walters, ed. Jul. 1980 113 p refs
(Contract EY-76-C-05-5135)
(ORO-5135-77/7; TR-60) Avail: NTIS HC A06/MF A01

Unusually large boundary layer radial pressure gradients and virtually altered camber and incidence were the phenomena of primary importance. Conformal mapping techniques were developed which transform the geometric turbine airfoils in curved flow to their virtual equivalents in rectilinear flow, thereby permitting the more accurate selection of airfoil aerodynamic coefficients from published sectional data. It was demonstrated that once the flow idiosyncracies are fully understood, they may be used to an advantage to improve the wind energy extraction efficiency of these machines. T.M.

N81-15558# Tetra Tech, Inc., Arlington, Va.
AUGMENTED HORIZONTAL AXIS WIND ENERGY SYSTEMS ASSESSMENT Final Report
Dec. 1979 94 p refs Prepared for Midwest Research Inst.
(Contract EG-77-C-01-4042)
(SERI/TR-98003-3) Avail: NTIS HC A05/MF A01

Three horizontal axis augmented systems are critically examined, and the technical status, performance characteristics, and cost projections of these systems are evaluated. Augmented and conventional systems are compared based on the cost of electricity for each system operating in the same wind environment. The status of horizontal axis augmented systems is discussed. R.C.T.

N81-15560# Washington Univ., St. Louis, Mo.
A DEFINITIVE GENERIC STUDY FOR SAILWING WIND ENERGY SYSTEMS Final Report
Kurt H. Hohenemser, Andrew H. P. Swift, and David A. Peters Oct. 1979 247 p refs Prepared for Midwest Research Inst.
(Contract EG-77-C-01-4042)
(SERI/TR-98003-05) Avail: NTIS HC A11/MF A01

The sailwing concept design results in low weight and cost per unit planform area. A sailwing section consists of a nose spar, two end ribs, a trailing edge wire attached to the end ribs under pretension, and a fabric sleeve stretched around the nose spar and trailing edge wire to form the upper and lower wing contour. This contour changes under the influence of the aerodynamic pressure forces. The concept was to the construction of rotary wings for windmills. The objective of this study was to determine, by a critical evaluation, whether wind energy conversion systems using sailwings have the potential of being cost effective energy resources. The study involves a critical technical review and cost of energy assessment of the rotary sailwing concept together with comparisons with conventional unaugmented wind systems. It was shown that sailwings can present acceptable aerodynamic characteristics and structural integrity. It appears that sailwings will not pose significant dynamic problems; however, several aspects of the design deserve further engineering analysis and testing programs. E.D.K.

N81-15568# Midwest Research Inst., Golden, Colo. Biomass Thermal Conversion and Exploratory Research Branch.
REVIEW OF THERMALLY REGENERATIVE ELECTROCHEMICAL SYSTEMS. VOLUME 1: SYNOPSIS AND EXECUTIVE SUMMARY
Helena L. Chum and Robert A. Osteryoung (State Univ. of New York at Buffalo) Aug. 1980 65 p refs
(Contract EG-77-C-01-4042)
(SERI/TR-332-416-Vol-1) Avail: NTIS HC A04/MF A01

The information in this review of thermally regenerative electrochemical systems (TRES) comes from literature searches and from visits to the laboratories of, and discussions with, technical personnel involved with this type of research. Work on TRES was classified and analyzed, with emphasis on the operation of the electrochemical systems. It is important to emphasize, however, that TRES involve the merging of several disciplines in addition to electromechemistry: thermal conversion, engineering, materials science, etc. The purpose of this review is to aid evaluations of the electrochemical technique of direct thermal to electrical conversion. The majority of the systems published in the open literature or patented are reviewed. Because this area was developed from the late fifties to the late sixties with the utilization of heat from nuclear reactors as a major mission, most of the systems operated at high temperatures. These systems are covered, as well as a variety of others developed or proposed, which operate under a wide variety of conditions. E.D.K.

N81-15799# Illinois Univ., Urbana. Fusion Studies Lab.
EXPLORATORY STUDIES OF HIGH-EFFICIENCY ADVANCED-FUEL FUSION REACTORS Annual Report
Jul. 1980 86 p refs Sponsored by EPRI 4 Vol.
(EPRI Proj. 645-1)
(EPRI-AP-1437; AR-3) Avail: NTIS HC A05/MF A01

The SAFFIRE concept for a D-3He pilot unit designed to demonstrate on a near time scale the feasibility of burning advanced fuels is described. SAFFIRE, based on the field reversed mirror concept, offers the high beta necessary for attractive advanced fuel burns. It includes features such as small size and low capital cost that are essential for a pilot plant demonstration. The SAFFIRE concept could lead to an attractive fusion economy via the D-3He satellite approach where small local power plants receive 3He from larger semicatalyzed deuterium 'generator' plants. Ways that advanced fuels can be burned in inertial confinement schemes are also described. The A-FLINT pellet concept, where the input energy requirement is reduced by igniting a small core of D-T fuel which then burn propagates into a deuterium regions, is discussed. S.F.

N81-15836# Argonne National Lab., Ill. Engineering Div.
PERFORMANCE ANALYSIS OF THE MHD-STEAM COMBINED CYCLE, INCLUDING THE INFLUENCE OF COST
G. F. Berry and C. B. Dennis Aug. 1980 73 p refs
(Contract W-31-109-eng-38)
(ANL/MHD-80-3) Avail: NTIS HC A04/MF A01

A range of possible performance variables is explored in order to determine the sensitivity of a specific plant design to variation in key system parameters and, ultimately, to establish probable system performance limits. The comprehensive computer code that was developed analyzes and simulates an MHD plant for any number of different configurations, and holds constraints automatically while conducting either sensitivity studies or optimization. A summary of a sensitivity analysis conducted for a combined cycle, MHD steam power plant is presented. The influence of several of the more important system parameters were investigated and the results are presented in graphical form. The ANL cost algorithm is described and it is demonstrated that good agreement is obtained for the calculated cost of electricity. J.M.S.

N81-15839# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
MHD HIGH PERFORMANCE DEMONSTRATION EXPERIMENT Quarterly Progress Report, 1 Jan. - 31 Mar. 1980
May 1980 53 p ref
(Contract ET-79-I-01-2895)
(FE-2895-8) Avail: NTIS HC A04/MF A01

Operation of the system in the Faraday power producing mode continued. A peak power of approximately 23.5 NW was produced with a magnetic field of 3.48 T. Tests at magnetic fields up to 3.92 T were also conducted; however, operational problems prevented the development of additional power. Significant results obtained include a more definitive description of transverse voltage characteristics, including the voltage drop near the electrode walls, and further definition of high Hall voltage transients during low to moderate conductivity conditions. Several operational problems were encountered including Hall potential shorting at the aft end of the diffuser and at the patch panels. Arcing at the patch panel during Run 006-016 initiated events which eventually precipitated substantial damage to the channel. A.R.H.

N81-15841# Brookhaven National Lab., Upton, N. Y.
FUSION BLANKETS FOR HIGH-EFFICIENCY POWER CYCLES
J. L. Usher, J. R. Powell, J. A. Fillo, F. L. Horn, O. W. Lazareth, and R. Taussig (Mathematical Sciences Northwest, Bellevue, Washington) 1980 8 p refs Presented at the 4th ANS Topical Meeting on the Technol. of Controlled Nucl. Fusion, King of Prussia, Pa., 14-17 Oct. 1980
(BNL-28442; CONF-801011-40) Avail: NTIS HC A02/MF A01

The efficiencies of blankets for fusion reactors are usually in the range of 30 to 40%, limited by the operating temperatures (500 C) of conventional structural materials such as stainless steels. In this project two zone blankets are proposed; these blankets consist of a low temperature shell surrounding a high temperature interior zone. A survey of nucleonics and thermal hydraulic parameters led to a reference blanket design consisting of a water cooled stainless steel shell around a BeO, ZrO2 interior (cooled by Ar) utilizing Li2O for tritium breeding. In this design, 60% of the fusion energy is deposited in the high temperature interior. The maximum Ar temperature is 2230 C leading to an overall efficiency estimate of 55 to 60% for this reference case. Author

N81-15844# California Univ., Livermore. Lawrence Livermore Lab.
THE DESIGN OF TANDEM MIRROR REACTORS WITH THERMAL BARRIERS
Gustav A. Carlson 1980 11 p refs Presented at 4th ANS Topical Meeting on the Technol. of Controlled Nucl. Fusion, King of Prussia, Pa., 14-17 Oct. 1980 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84518; CONF-801011-18) Avail: NTIS HC A02/MF A01

Rapidly evolving knowledge concerning tandem mirrors with thermal barriers resulted in a number of alternative end-plug configurations. Descriptions of various end-plug configurations and the design of the power-producing central cell for a typical tandem mirror reactor are presented. L.F.M.

N81-15860# Grumman Aerospace Corp., Bethpage, N.Y. Advanced Energy Systems.
STRUCTURAL SUPPORT CONCEPTUAL STUDIES FOR A YIN-YANG MAGNET OF A TANDEM MIRROR REACTOR Final Report, Sep. 1979 - Aug. 1980
I. U. Ojalvo and J. L. Erickson Jul. 1980 37 p refs Sponsored by DOE
(UCRL-15291) Avail: NTIS HC A03/MF A01

A study was performed to determine whether the TNR Yin-Yang coils will require the elaborate external structural restraints employed in earlier mirror reactor studies. The approach taken was to use a simple coil case of compact design and to add and modify structural members to transfer loads from one coil to the other. Design considerations to establish the feasibility of supporting the coils in ways that facilitated functional requirements while reducing peak stress levels were evaluated. The effects of coil supports were determined as well as continuous beam interconnections between coil cases. Support stiffnesses were varied and their effects assessed. L.F.M.

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06

ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

Includes transport of fuels by pipelines, tubes, etc., microwave power transmission, and superconducting power transmission.

A81-10493 **Logistics costs of solar power satellites.** R. H. Miller and D. L. Akin (MIT, Cambridge, Mass.). *Space Solar Power Review,* vol. 1, no. 3, 1980, p. 191-208. 8 refs. Research supported by the H. N. Slater Flight Transportation Development Fund.

A brief discussion details the current level of understanding of the problems associated with the proposed deployment of solar power satellites (SPS). A costing rationale is presented, based on standard systems analysis techniques. The problem is broken down into major cost-driving parameters of transportation, productivity, and solar collection device costs, and further broken down into sets of parameters which specify a construction scenario for the SPS. An analysis of transportation to low earth orbit shows that earth launch costs may be reduced to below $40 per kg through the full utilization of launch system capabilities. A computer program is developed which performs an estimation of the overall program costs of the SPS, based on a set of 55 parameters which impact systems costs. Baseline cases are selected, and sensitivity studies performed to find the cost impact of the major variables. It is found that the use of nonterrestrial materials is economically attractive from a very early point in the program, and that a program of SPS construction can compete favorably (less than $1,000/kW installed) with systems in the 1990 time frame and beyond. (Author)

A81-10494 **Parameterized power satellite systems design.** R. Sperber and G. Woodcock (Boeing Aerospace Co., Seattle, Wash.). *Space Solar Power Review,* vol. 1, no. 3, 1980, p. 209-219. 6 refs.

Knowledge gained in detailed studies of power satellites allows the construction of reliable and simple parametric models for first order comparisons and evaluation. These techniques are illustrated in a comparison of several types of power satellites using both laser and microwave power transmission options. Of the laser power transmission power satellite systems, photovoltaic free electron lasers and optically pumped laser power satellites appear most attractive but still more massive and costly than microwave power transmission power satellites. In addition, relationships for sizing system power for minimum system total cost and for power-limited transmission links are developed. (Author)

A81-10495 **Optimization of antenna pairs for microwave and power transmission.** C. E. Mack, Jr. (Grumman Aerospace Corp., Research Dept., Bethpage, N.Y.) and G. Moyer (Grumman Aerospace Corp., Software Systems Dept., Calverton, N.Y.). *Space Solar Power Review,* vol. 1, no. 3, 1980, p. 221-240.

The optimum transmitting distribution function is determined for an antenna beaming microwave power from space to a ground receiver. This is accomplished by minimizing a chosen cost function for the system using the methods of optimal control theory. It is the reverse of the usual methods of analysis wherein the distribution function is specified in advance. The distribution function calculated by the procedure developed here is the square of a finite linear sum of zero-order Bessel functions, each of which is multiplied by a constant. Very simple one-term formulas result from the analyses for the radii of the two antennas and for the minimum cost itself. For any given problem, the requisite computer runs are carried out once and for all and are only a few minutes in duration. What makes the method especially attractive is that the main results are simply a function of the ratio of the power collected to that transmitted. (Author)

A81-10824 **Superconductors in electric-power technology.** T. H. Geballe (Stanford University, Stanford, Calif.) and J. K. Hulm (Westinghouse Research and Development Center, Pittsburgh, Pa.). *Scientific American,* vol. 243, Nov. 1980, p. 138, 139, 141 (13 ff.).

The application of superconducting materials that can withstand high current densities and strong magnetic fields to electric power technology is discussed. Following a review of the history of electric power technology, the discovery and theory of superconductivity are presented. The discovery of superconducting materials (most commonly Nb3Sn and Nb40Ti60) that are not quenched by high current densities or magnetic fields is then related, and problems in the construction of a superconducting magnet are considered together with solutions adopted. Applications of superconducting technology to stationary magnets in elementary particle physics investigations, MHD generators, tokamak plasma confinement, the magnetic-mirror fusion reactor, conventional turbine-driven alternators, direct-current generators and motors, electrical energy storage, and high-power transmission lines are examined. Finally, areas of future research, including refrigeration systems, the selection of optimal materials, and operation at higher magnetic fields, are indicated. A.L.W.

A81-14084 # **The solar satellite power system as a future European energy source.** H. Stoewer, D. Kassing (ESA, Systems Engineering Dept., Noordwijk, Netherlands), and K. K. Reinhartz (ESA, Technology Dept., Noordwijk, Netherlands). *ESA Bulletin,* vol. 21, Feb. 1980, p. 8-14.

The potential of solar satellite power systems as an energy source for Europe is discussed. The current and future energy situation in Europe, which has to import 50-60% of its energy needs, is reviewed, and it is shown that a fleet of 40 solar-power satellites with an output of 5 GW each could satisfy current energy demands in all member countries of the European Economic Community. The concept of the satellite solar power system is then introduced, with consideration given to the DOE/NASA reference design and the space transportation system required to carry it into orbit. Advantages of the use of solar energy from space are discussed, and the status of SPS concept evaluations in the U.S., which have shown no definitive impedances to development, is indicated. Issues which must be addressed in the evaluation of the usefulness of solar power satellites in Europe are identified, including costs, available receiving sites, reliability, radiation levels and timeliness, and it is concluded that SPS could be a promising means for producing a significant portion of future European energy needs, although a considerable effort will be required to demonstrate its engineering, economic and environmental viability. A.L.W.

A81-18235 **Power generation from laser-produced plasma.** K. Kuriki and K. Akai (Tokyo, University, Tokyo, Japan). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-20.* 11 p. 5 refs.

Conversion of laser energy into electrical energy has been experimentally studied as a process subsequent to the power transmission from Solar Power Satellite to the earth or between space stations. In the scheme proposed here, the electrical power was generated by the charge separation at the expense of the kinetic energy of laser-produced plasma. (Author)

A81-18236 **A plan of experimental study in environmental impact by microwave power transmission.** N. Fugono and H. Mori (Ministry of Posts and Telecommunications, Radio Research Laboratories, Koganei, Tokyo, Japan). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-22.* 7 p.

An experimental system for the investigation of the effects of microwave transmissions from solar power satellites on the environment, particularly the ionosphere and neutral atmosphere, is proposed. In accordance with requirements that the experimental system resemble as closely as possible the operational characteristics of an actual system, the planned experimental system makes use of a phased array antenna of aperture 500 m transmitting at a frequency of 2.45 GHz at a power of 4 MW for 1 minute. The use of pulse code modulation would also enable backscattering measurements to be made of the effects of the transmission on the ionosphere, as well as ionospheric and neutral atmosphere sounding. Results of the proposed experiment are thus expected to contribute to solar power satellite design as well as the earth environmental observation, radio astronomy and the development of very long distance communication systems. A.L.W.

A81-18237 **Numerical estimation of SPS microwave impact on ionospheric environment.** H. Matsumoto (Kyoto University, Uji, Japan). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-A-23.* 9 p. 8 refs.

A possible interaction with the ionosphere of an intense microwave which will be used in energy transmission from Solar Power Satellite (SPS) to the earth, is numerically studied. Microwave heating of the ionosphere and nonlinear excitation of electron plasma waves and ion acoustic waves are numerically studied for a model ionosphere. (Author)

N81-10231# National Telecommunication Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
IMPACT OF SATELLITE POWER SYSTEM (SPS) HEATING ON VLF, LF, AND MF TELECOMMUNICATIONS SYSTEMS ASCERTAINED BY EXPERIMENTAL MEANS
C. M. Rush, E. J. Violette, R. H. Espeland, J. C. Carroll, and K. C. Allen Apr. 1980 105 p refs
(PB80-194459; NTIA-R-80-37) Avail: NTIS HC A06/MF A01

Using the high-power high-frequency transmitter facility loacated at Platteville, Colorado, power densities comparable to the Satellite Power System (SPS) can be delivered to the heights of 70 to 100 km above the surface of the earth. Observations of the performance of telecommunication systems that operate in the VLF, LF, and MF portions of the spectrum were investigated during times when the ionosphere was modified with SPS comparable power density and when it was not. The results obtained indicate that the SPS, as currently configured with a peak power density of 23 mW/sq cm, will not adversely impact upon the performance of VLF, LF, and MF telecommunicaiton systems. GRA

N81-10296# AEG-Telefunken, Bonn (West Germany).
ON MICROWAVE POWER TRANSMISSION AND THE FEASIBILITY OF POWER SATELLITES FOR EUROPE
Diederich Koehn *In* AGARD Propagation Effects in Space/Earth Paths Aug. 1980 6 p refs

Avail: NTIS HC A22/MF A01

Considerations of giant power plants in remote areas (because of the environmental contamination) or in space suggest or even force a noncable bound transmission of power, e.g., by a collimated microwave beam. However, the propagation of microwaves is affected by tropospheric and ionospheric effects (attenuation, diffraction, reflection, decollimation, depolarization) which degrade the power transmission efficiency. Power satellite concepts are discussed and the principles of the proposed microwave power transmission system are explained. The main interfering atmospheric effects are explained and an appraisal of their influence on the transmission path and the overall power transmission system is given. Some of those effects show a latitudinal dependence, and conclusions on the feasibility of power satellite systems for Europe are derived. S.F.

N81-10297# Institute for Telecommunication Sciences, Boulder, Colo.
POTENTIAL IMPACT OF THE SATELLITE POWER SYSTEM ON COMMUNICATION AND ELECTRONIC SYSTEMS AND THE IONOSPHERE
W. B. Grant, C. M. Rush, and E. L. Morrison *In* AGARD Propagation Effects in Space/Earth Paths Aug. 1980 19 p ref
Avail: NTIS HC A22/MF A01

The impact of the operation of the satellite power system upon the ionosphere and telecommunication systems is described. Analysis of possible functional and operational degradation of electromagnetic systems (communication systems, radars, navigation aids, satellites) and environment sensitive instruments and systems (computers, sensors, electronic medical instruments and security devices) due to direct SPS power coupling are studied in detail. Development of mitigating techniques when unacceptable degradation is discovered in a given equipment or system is described. Assessment of possible impacts upon telecommunication systems and implications for electromagnetic compatibility are discussed. The degree to which the ionosphere will be modified by the passage of the microwave power beam and what impact this modification has upon telecommunication systems are discussed. Theoretical efforts to simulate SPS operational impacts are described. S.F.

N81-11458*# Raytheon Co., Wayland, Mass. Equipment Div.
SOLID STATE SPS MICROWAVE GENERATION AND TRANSMISSION STUDY. VOLUME 1: PHASE 2 Final Report
Owen E. Maynard Washington Nov. 1980 236 p refs
(Contract NAS8-33157)
(NASA-CR-3338; M-311; ER80-4074-1) Avail: NTIS HC A11/MF A01 CSCL 10A

The solid state sandwich concept for Solar Power Station (SPS) was investigated. The design effort concentrated on the spacetenna, but did include some system analysis for parametric comparison reasons. The study specifically included definition and math modeling of basic solid state microwave devices, an initial conceptual subsystems and system design, sidelobe control and system selection, an assessment of selected system concept and parametric solid state microwave power transmission system data relevant to the SPS concept. Although device efficiency was not a goal, the sensitivities to design of this efficiency were parametrically treated. Sidelobe control consisted of various single step tapers, multistep tapers, and Gaussian tapers. A preliminary assessment of a hybrid concept using tubes and solid state is also included. There is a considerable amount of thermal analysis provided with emphasis on sensitivities to waste heat radiator form factor, emissivity, absorptivity, amplifier efficiency, material and junction temperature. Author

N81-11894# Los Alamos Scientific Lab., N. Mex.
LASL Nb3Ge CONDUCTOR DEVELOPMENT Quarterly Progress Report, 1 Jan. - 31 Mar. 1980
M. P. Maley, comp. 1980 17 p refs
(Contract W-7405-eng-36)
(LA-8446-PR; QPR-15) Avail: NTIS HC A02/MF A01

The development of Nb3Ge as a superconductor with potential applications to power transmission lines is discussed. Three Nb3(Ge sub 1-x Ga/sub x) pseudobinary compounds were prepared with compositions approaching the proper stoichiometry and with x = 0.08, 0.12, and 0.15, respectively. The replacement of germanium by gallium causes a slight depression (1.0 K) of T sub c and does not appear to influence H sub c2 significantly. A microscopic examination of the edge material on sections of Nb3Ge-clad tape revealed longitudinal cracks extending along the edges of tapes with Nb3Ge thickness T > or = 4.0 microns. Tapes with t = 3.0 microns show no evidence of such cracks, corroborating conclusions reached by ac loss measurements. The two layers of the inner conductor of the first 1-m test cable were wound with tapes coated with 4 to 6 microns of Nb3Ge and are expected to contain longitudinal cracks. The two layers of the outer conductor of this coaxial cable were fabricated from tapes coated with 3.0 microns of Nb3Ge and should exhibit lower ac losses. DOE

N81-12592# Argonne National Lab., Ill. Energy and Environmental Systems Div.
LASER SATELLITE POWER SYSTEMS
E. W. Walbridge Jan. 1980 84 p refs

(Contract W-31-109-eng-38)
(ANL/ES-92) Avail: NTIS HC A05/MF A01

A laser satellite power system (SPS) converts solar power captured by Earth-orbiting satellites into electrical power on the Earth's surface, the satellite-to-ground transmission of power being effected by laser beam. The system has four important advantages over a microwave system: land requirements are much less, radiation levels are low outside the laser ground stations, laser beam sidelobes are not expected to interfere with electromagnetic systems, and the laser system lends itself to small-scale demonstration. After describing lasers and how they work, the five lasers that are candidates for application in a laser SPS: electric discharge lasers, direct and indirect solar pumped lasers, free electron lasers, and closed-cycle chemical lasers are discussed. DOE

N81-13469*# Raytheon Co., Wayland, Mass. Advanced Development Lab.
SOLID STATE SPS MICROWAVE GENERATION AND TRANSMISSION STUDY. VOLUME 2, PHASE 2: APPENDICES Final Report
Owen E. Maynard Washington NASA Nov. 1980 115 p refs
(Contract NAS8-33157)
(NASA-CR-3339; ER80-4074-2) Avail: NTIS HC A06/MF A01 CSCL 10A

The solid state sandwich concept for SPS was further defined. The design effort concentrated on the spacetenna, but did include some system analysis for parametric comparison reasons. Basic solid state microwave devices were defined and modeled. An initial conceptual subsystems and system design was performed as well as sidelobe control and system selection. The selected system concept and parametric solid state microwave power transmission system data were assessed relevant to the SPS concept. Although device efficiency was not a goal, the sensitivities to design of this efficiency were parametrically treated. Sidelobe control consisted of various single step tapers, multistep tapers and Gaussian tapers. A hybrid concept using tubes and solid state was evaluated. Thermal analyses are included with emphasis on sensitivities to waste heat radiator form factor, emissivity, absorptivity, amplifier efficiency, material and junction temperature. A.R.H.

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07

ENERGY STORAGE

Includes flywheels, heat storage, underground air storage, compressed air, storage batteries, and electric hybrid vehicles.

A81-10043 # **Evaluation of thermal conditions of ethylene underground storage (Ob otsenke teplovogo rezhima sistemy podzemnogo khranenila etilena).** Iu. P. Dobrianskii and E. I. Bykorez (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Promyshlennaia Teplotekhnika,* vol. 2, Sept.-Oct. 1980, p. 83-89. 7 refs. In Russian.

The paper examines problems of optimizing the thermal conditions of underground storage of ethylene. Heat exchange processes in various parts of storage reservoirs in mountain regions were investigated; the effects of thermal conductivity, ambient conditions, and gas pressure were considered, along with the methods of predicting the temperatures of acidifying additives and of bulk ethylene. A.T.

A81-10125 # **Energy storage cells (Nakopitell energii).** N. V. Gulia. Moscow, Izdatel'stvo Nauka, 1980. 152 p. 15 refs. In Russian.

The book deals with the characteristics and potentialities of energy storage cells of various types. Attention is given to electrical energy storage cells (electrochemical, electrostatic, and electrodynamic cells), mechanical energy storage cells (mechanical flywheel storage cells), and hybrid storage systems. V.P.

A81-11026 **Molybdenum oxide cathodes in secondary lithium cells.** P. A. Christian, J. N. Carides, F. J. DiSalvo, and J. V. Waszczak (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). *Electrochemical Society, Journal,* vol. 127, Nov. 1980, p. 2315-2319. 30 refs.

The paper examines the electrochemical behavior of molybdenum oxide cathode materials with stoichiometries between MoO2 and MoO3 in nonaqueous lithium secondary cells as well as the magnetic properties of both Mo17047 and the lithium bronze Li1.41MoO2.765. In reactions of molybdenum oxides with n-butyllithium, the greatest reversible capacity (greater than 1 Li/Mo) after several deep discharge/charge cycles is exhibited by Mo17047 in cells containing a LiC104/propylene carbonate electrolyte. For most cases, the reversible capacities of the other molybdenum oxides are significantly less than that of Mo17047. The limiting reversible lithium capacity of 1.5 Li/Mo for Mo17047 is determined by treating Mo17047 with an n-butyllithium solution while the lithium bronze is formed with an I2 solution. For an average cell voltage of 1.85V and a capacity of 1.5 Li/Mo, a theoretical energy density of 490 W-hr/kg is calculated for Mo17047 and is found comparable to those reported for TiS2 and stoichiometric V6013 (the stabilized form for Mo5014), while considerably less than that for off-stoichiometric V6013. Therefore, Mo17047 is not so promising a candidate for use as the active cathode in secondary lithium batteries as is off-stoichiometric V6013. A.C.W.

A81-11033 **The sulfospinel-lithium battery system - Initial study of three sulfospinels.** M. Eisenberg (Electrochimica Corp., Mountain View, Calif.). *(Electrochemical Society, Meeting, Los Angeles, Calif., Oct. 14-19, 1979.) Electrochemical Society, Journal,* vol. 127, Nov. 1980, p. 2382, 2383.

A81-13498 **Natural energy storage in aquifers.** H. Umemiya and T. Yokoyama (Yamagata, University, Yonezawa, Japan). *(Japan Society of Mechanical Engineers, Journal,* vol. 83, May 1980, p. 550-557.) *Energy Developments in Japan,* vol. 3, July 1980, p. 51-66. Translation.

A thermal storage method for utilizing large-scale heat capacity aquifers was studied experimentally. Two deep wells, A and B, serve as the thermal reservoirs. In the winter, underground water is pumped up from well A, used to melt the snow, and then, sufficiently cooled, injected into well B. In summer, the direction of water flow is changed; the underground water, having remained cool in the aquifer, is pumped up from well B and used for air conditioning. The waste water is warmed by solar energy and injected into well A where it is stored for later use as a supply of heat in the winter. The experimental results show that about 30% of the stored heat could be recovered. B.J.

A81-13621 # **The application of inductively stored energy for generating high current pulses (Über die Verwendung induktiv gespeicherter Energie zur Hochstromimpulserzeugung).** U. Braunsberger. Braunschweig, Technische Universität, Fakultät für Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1979. 150 p. 68 refs. In German. Research supported by the Kernforschungsanlage Jülich GmbH and EURATOM.

A circuit is presented which combines the advantages of capacitive and inductive energy storage for generating high current pulses. Results show that the current pulse duration in the circuit can be increased without affecting the fast current rise. Parallel operation of two modules of the circuit is also presented. A commutating switch is described for which components are available or easily manufactured. The commutating voltage is generated by an exploding wire in a high pressure breaking element. Currents up to 30 kA are commutated into resistive loads at voltages up to 22 kV. A storage transformer with small leakage inductance is examined. R.C.

A81-14237 # **Compressed air energy storage /CAES/, Hume, Illinois.** M. J. King (URS Corp., San Francisco, Calif.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 425-430.

If the Hume aquifer, located in Edgar County, Illinois, is utilized to produce power by storing compressed air, utility costs can be reduced. Compressed air will be stored in the Hume anticlinal structure and later expanded through either a standard gas turbine or a turboexpander to drive a generator. This facility has the potential of eliminating the use of premium fossil fuels. (Author)

A81-14238 # **Optimal design of compressed air energy storage systems.** F. W. Ahrens (Argonne National Laboratory, Argonne, Ill.), A. Sharma (Illinois, University, Chicago, Ill.), and K. M. Ragsdell (Purdue University, West Lafayette, Ind.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 431-441. 33 refs. Research supported by the U.S. Department of Energy and Purdue University.

Compressed air energy storage (CAES) power systems are currently being considered by various electric utilities for load-leveling applications. This paper develops models of CAES systems which employ natural underground aquifer formations, and presents an optimal design methodology which demonstrates their economic viability. This approach is based upon a decomposition of the CAES plant and utility grid system into three partially-decoupled subsystems. Numerical results are given for a plant employing the Media, Illinois Galesville aquifer formation. (Author)

A81-14239 # **Economic analysis of compressed air energy storage power plants using the energy domain method.** D. R. Bervig and R. I. Egbert (Black and Veatch Consulting Engineers, Kansas City, Mo.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 442-447.

This paper presents the work that was done to determine the potential economic advantage of the compressed air energy storage (CAES) plants for the combined Kansas Power and Light and Central

Telephone and Utilities generation system. The economic evaluation was conducted by using an economic dispatch code to determine the total production costs (fuel, operation, and maintenance costs). The production costs were then included in a capital costs analysis which determined the total cumulative present-worth costs for each of the seven generation plans studied in order to determine possible cost savings by utilizing CAES power plants. (Author)

A81-14240 # Superconducting magnetic energy storage applications and benefits for electric utility power systems. R. D. Turner (California, University, Los Alamos, N. Mex.). In: Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, Rolla, Mo., October 16-18, 1979. Volume 6. Rolla, Mo., University of Missouri-Rolla, 1980, p. 448-457. 8 refs. Research sponsored by the U.S. Department of Energy.

A Superconducting Magnetic Energy Storage (SMES) system comprises a superconducting solenoid, its dewar, and a liquid He refrigerator with an ac-dc converter which stores or discharges magnetic energy in the superconducting inductor. Large SMES installations are considered for electrical applications including diurnal, load-curve leveling, and can be used as transient stabilizer units; small units are being designed for dynamic stability of electric power systems in cases when negatively damped systems conditions occur. A 30-MJ SMES system with a 10-MW rating can modulate (at 0.35 Hz) the HVAC intertie between the Pacific Northwest and southern California. A.T.

A81-15275 Heat storage in wet broken-stone beds (Speicherung von Wärme im nassen Schotterbett). A. Harasim, B. Weissenbach (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany), and R. Jank (Mitec GmbH, Ottobrunn, West Germany). *Brennstoff-Wärme-Kraft,* vol. 32, Nov. 1980, p. 512-515. In German.

The paper deals with research and development work concerning the design and construction of long-term heat storages. The discussion covers the wet bed concept, the principal engineering aspects, the cost and safety aspects, and possible chemical and biological effects on the environment. It is seen that the state of the art should permit construction of a pilot plant at a small risk. V.P.

A81-15762 LNG risk management. P. Martino (Aerospace Corp., Germantown, Md.). *Environmental Science and Technology,* vol. 14, Dec. 1980, p. 1446-1454. 17 refs.

A general methodology is presented for conducting an analysis of the various aspects of the hazards associated with the storage and transportation of liquefied natural gas (LNG) which should be considered during the planning stages of a typical LNG ship terminal. The procedure includes the performance of a hazards and system analysis of the proposed site, a probability analysis of accident scenarios and safety impacts, an analysis of the consequences of credible accidents such as tanker accidents, spills and fires, the assessment of risks and the design and evaluation of risk mitigation measures. A.L.W.

A81-15800 # The aluminum-air battery for electric vehicles - An update. *Energy and Technology Review,* Nov. 1980, p. 1-10. 16 refs.

The development of aluminum-air batteries as mechanically rechargeable power sources to be used in electric vehicles is discussed. The chemistry of the aluminum-air battery, which has a potential for providing the range, acceleration and rapid refueling capability of contemporary automobiles and is based on the reaction of aluminum metal with atmospheric oxygen in the presence of an aqueous sodium hydroxide/sodium aluminate electrolyte, is examined, and it is pointed out that the electric vehicle would be practically emissionless. The battery development program at the Lawrence Livermore National Laboratory, which includes evaluations of electrochemical and chemical phenomena, studies of the economics and energy balance of a transportation system based on aluminum, and power cell design and performance analysis, is presented. It is concluded that although difficult problems must be overcome before the technical and economic feasibility of aluminum-air batteries for electric vehicles can be established, projections indicate that the aluminum-air vehicle is potentially competitive with internal combustion vehicles powered by synthetic liquid fuels. A.L.W.

A81-15924 The study of KCl-CuCl eutectic fused salt as a potential intermediate temperature heat transfer and storage medium. D. E. Etter and C. J. Wiedenheft (Monsanto Research Corp., Miamisburg, Ohio). *Solar Energy Materials,* vol. 2, July-Aug. 1980, p. 423-431. 16 refs. Contract No. DE-AC04-76DP-00053.

A81-16863 # Specific mass energy capacity of composite disk-type flywheels (Udel'naia massovaia energoemkost' diskovykh makhovikov iz kompozitov). G. G. Portnov and V. L. Kulakov (Akademiia Nauk Latviiskoi SSR, Institut Mekhaniki Polimerov, Riga, Latvian SSR). *Mekhanika Kompozitnykh Materialov,* Sept.-Oct. 1980, p. 887-894. In Russian.

In the present paper, a maximum stress criterion is used to determine the maximum mass energy capacity of disk-type flywheels wound of fibers with given strength and deformation characteristics. The range of strength and rigidity parameters for designing flywheels for effective volumetric and mass energy capacity are determined. V.P.

A81-17796 Sealed Ni-Cd cells - The temperature behaviour of electrodes in excess of electrolyte. J. Marek, I. Mohyla (Bateria, Slany, Czechoslovakia), J. Mrha, and J. Jindra (Ceskoslovenska Akademie Ved, Ustav Fyzikalni Chemie a Elektrochemie, Prague, Czechoslovakia). *Journal of Power Sources,* vol. 6, Jan. 1981, p. 1-13. 57 refs.

The characteristics under extreme temperature conditions of cadmium and nickel oxide electrodes of the type used in sealed Ni-Cd cells are investigated. The capacity and service life of positive and negative electrodes were measured during charge-discharge cycles at temperatures from -28 to 75 C, and electrode samples were taken for surface area, scanning electron microscopy, thermal and chemical analysis. The capacity and service life of the positive electrodes are found to be decreased in regions of both high and low temperature, while no pronounced effect of elevated temperatures on the negative electrodes is observed. In addition, sintered negative electrodes prepared by a modified formate-nitrate procedure are found to exhibit more favorable service life curves at all temperatures studied than those prepared by the formate method. In the region of elevated temperatures, large crystals are observed to form on the negative electrodes, accompanied by a decrease in specific surface area. Finally, it is shown that plastic bonded negative Cd electrodes may also be suitable for use in the sealed Ni-Cd system at room and elevated temperatures. A.L.W.

A81-17798 Effect of additives on the corrosion of zinc in KOH solution. T. Keily and T. J. Sinclair (Royal Armament Research and Development Establishment, Sevenoaks, Kent, England). *Journal of Power Sources,* vol. 6, Jan. 1981, p. 47-62. 29 refs.

The influence of electrolyte additives on the corrosion of zinc electrodes in alkaline solution is investigated. Corrosion currents were determined from gas evolution and electrochemical measurements carried out for zinc disks in 8.8 mol/cu dm KOH solutions to which various anticorrosion substances had been added at concentrations up to 0.1 mol/cu dm (0.5 mol/cu dm for ZnO). The currents calculated from the gas evolution measurements are found to be lower than uncorrected values obtained from polarization resistance measurements. The most effective corrosion inhibitors are observed to be those consisting of a combination of zinc oxide (the discharge product) with one of several tetra-alkylammonium compounds. A.L.W.

A81-18651 # Parametric design analysis of a hybrid composite flywheel using a laminated central disc and a filament wound

outer ring. R. P. Nimmer (General Electric Co., Schenectady, N.Y.). *American Society of Mechanical Engineers, Design Engineering Technical Conference, Beverly Hills, Calif., Sept. 28-Oct. 1, 1980, Paper 80-DET-97.* 8 p. 13 refs. Members, $1.50; nonmembers, $3.00. Research supported by the U.S. Department of Energy.

A hybrid flywheel design concept based on the use of a laminated central disk with a filament-wound outer ring is analyzed for several different combinations of composite materials. Some of the results of this study are: (1) an optimized E-glass disk with Kevlar-49 outer ring offers the prospect of 30% additional energy density over a laminated disk without a ring; (2) a laminated S2-glass disk is capable of storing more energy per unit mass than an E-glass disk because of its higher tensile strength; and (3) the use of wound graphite outer rings with S2-glass disks leads to substantial reductions in the size of the interference fit while offering still higher energy densities than for a Kevlar-49 outer ring. V.L.

A81-18734 # **Coal-fired fluid bed combustion-augmented compressed air energy storage power plants - A technical and economic assessment.** R. D. Lessard and A. J. Girâmonti (United Technologies Research Center, East Hartford, Conn.). *American Society of Mechanical Engineers, Joint Power Generation Conference, Phoenix, Ariz., Sept. 28-Oct. 2, 1980, Paper 80-JPGC/GT-1.* 8 p. 7 refs. Members, $1.50; nonmembers, $3.00.

A81-18763 **A passive magnetic-thrust bearing for energy-storage flywheels.** D. F. Wilcock (Tribolock, Inc., Schenectady, N.Y.) and M. Eusepi (Mechanical Technology, Inc., Latham, N.Y.). *American Society of Lubrication Engineers and American Society of Mechanical Engineers, International Lubrication Conference, San Francisco, Calif., Aug. 18-21, 1980, ASLE Preprint 80-LC-4C-1.* 10 p. Research supported by the U.S. Department of Energy.

Flywheels for the storage and subsequent release of energy in general involve the suspension of rather large masses rotating at speeds limited by the strength of the flywheel material. Since drag torque on the flywheel represents an undesirable energy drain during storage, windage can be eliminated by operation in a vacuum, leaving bearing drag as a significant item. Using a vertical shaft configuration, a passive repulsion-type permanent-magnet thrust bearing is virtually frictionless while small, low-loss, oil-lubricated pintle bearings maintain the shaft radially. This paper discusses the analytical design of the passive magnetic-thrust bearing, including its nonrotating damper. Reliability of the system is high since no servo-control system is required. (Author)

A81-18803 **Secondary batteries for electrical energy storage.** D. L. Douglas and J. R. Birk (Electric Power Research Institute, Palo Alto, Calif.). In: Annual review of energy. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1980, p. 61-88. 46 refs.

The paper reviews the recent advances in the development and commercialization of new electrochemical energy storage systems for electric utility energy storage, electric vehicle propulsion, and solar electric energy storage. Storage systems discussed include: improved lead-acid, nickel-zinc, and nickel-iron for near-term development (before 1985); zinc-chlorine and zinc-bromine for intermediate term (1985-90); and sodium-sulfur, lithium-iron-sulfide, and redox battery for long term (after 1990). V.L.

A81-19322 # **Determination of the starting characteristics of electrical machines in systems with kinetic energy storage devices (Opredelenie puskovykh kharakteristik elektricheskikh mashin v sistemakh s kineticheskimi akkumuliatorami energii).** A. N. Ledovskii and A. M. Sugrobov. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport.* Nov.-Dec. 1980, p. 86-95. 11 refs. In Russian

The calculation of starting characteristics is considered for electrical machines for use in flywheel energy storage systems. A mathematical model describing the starting of the flywheel is presented, and a digital-computer algorithm for computing the starting characteristics of electrical machines is discussed. B.J.

N81-10440# New England Research Application Center, Storrs, Conn.

MAGNETIC BEARINGS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1974 - Apr. 1980

C Gilbert Young May 1980 22 p Sponsored in part by NTIS (PB80-809148) Avail: NTIS HC $30.00/MF $30.00 CSCL 13I

The design and applications of magnetic bearings are treated in this retrospective survey from a relatively new field. Quantitative discussions of the dynamic behavior, including stiffness and cross-axis stabilities, are included. This bibliography contains 14 citations. GRA

N81-10516 Arkansas Univ., Fayetteville.

AN INVESTIGATION OF SERVICE AND REFUELING INFRASTRUCTURE FOR ENERGY STORAGE VEHICLES Ph.D. Thesis

Jerry Don Wall 1980 120 p

Avail: Univ. Microfilms Order No. 8026082

The service infrastructure for energy storage vehicles (ESV's) is examined to determine barriers to the introduction of ESV's into the private transportation sector. Electrically rechargeable battery powered vehicles, aluminum/air fuel cell vehicles, and hydrogen powered vehicles are considered. Implications of infrastructure for hybrid vehicles are also discussed. Service delivery systems and refueling methods are identified. Refueling methods for electrically rechargeable vehicles, which are investigated, include overnight home recharging, recharging at parking facilities of businesses, employers and institutions (distributed refueling) and battern exchange systems. The potential for each method is examined and the relative cost of various alternatives is investigated. The production, distribution and supply of aluminum fuel and of hydrogen are considered. Retrofitting possibilities of existing service facilities are examined for each ESV type. Design implications for retrofitting and new facility construction are discussed. Dissert. Abstr.

N81-10534# ESB Technology Co., Yardley, Pa.

DEVELOPMENT OF THE SODIUM-ANTIMONY TRICHLORIDE BATTERY FOR UTILITY APPLICATION Final Report

Feb. 1980 167 p

(EPRI Proj. 109-3)

(EPRI-EM-1323) Avail: NTIS HC A08/MF A01

An overview is presented of the development of a moderate temperature molten salt Na alumina/SbC3 battery for load leveling and peaking applications. Cell tests are described on 2 Wh disc cells and 20, 50, and 80 Wh tube cells. Their charge discharge characteristics were used to project the design and performance of 200 Wh single tube subcells and 625 kWh modules for a 20 MW, 100 MWh load leveling battery. An updated price analysis predicted a price of $74/kWh for truck transportable 625 kWh modules, including weatherproof insulating housing, cooling system, voltage and temperature monitoring accessories. Basic electrochemical investigations are presented as the basis of an understanding of the corrosion of molybdenum and nickel current collectors in the positive mix. Tungsten coated nickel collectors are the preferred long life design. Polymeric sodium seals did not survive in larger cells. DOE

N81-10559# California Univ., Berkeley. Lawrence Berkeley Lab.

EXPERIMENTAL AND THEORETICAL STUDIES OF THERMAL ENERGY STORAGE IN AQUIFERS

Chin Fu Tsang, Fred J. Molz (Auburn Univ.), and A. David Parr (Auburn Univ.) May 1980 6 p refs Presented at the 15th Intersoc. Energy Conversion Eng. Conf., Seattle, 17-22 Aug. 1980

(Contract W-7405-eng-48)

(LBL-10889; CONF-800806-33) Avail: NTIS HC A02/MF A01

A coupled experimental and theoretical study of thermal energy storage in an aquifer is described. Water at an average temperature of 55 C is stored in a confined aquifer near Mobile, Alabama. Approximately 55,000 cubic meters of water was injected, stored, and then produced for two consecutive cycles. Data obtained were used to validate a numerical model, CCC. This model is able to calculate heat and fluid flow in a three dimensional, liquid saturated system. Without adjusting any parameters, the calculated results reproduce closely the observed data. The energy recovery factor of 66% for the first cycle and 76% for the second cycle indicate that the aquifer may be a very promising thermal energy storage medium. Furthermore, the thermohydrological processes involved appear to be properly accounted for by the numerical model, thus giving us some confidence in the current state-of-the-art in the performance forecast of future aquifer energy storage projects. DOE

N81-10560# California Univ., Livermore. Lawrence Livermore Lab.
MECHANICAL ENERGY STORAGE TECHNOLOGY PROJECT Annual Report for 1979
T. M. Barlow, W. T. Crothers, D. M. King, J. A. Rinde, T. T. Chiao, S. V. Kulkarni, and D. N. Frank 1 May 1980 151 p
(Contract W-7405-eng-48)
(UCRL-50056-79) Avail: NTIS HC A08/MF A01

The aim of the mechanical energy storage technology project is to demonstrate its potential for energy savings in vehicular and stationary systems. Primary emphasis is on flywheel energy storage systems. In house research and development work includes development and evaluation of the tapered thickness flywheel rotor concept and characterization of fiber composite materials for application to flywheel systems. The activities were organized into the following tasks: transportation applications; photovoltaic and wind applications; fiber composite materials technology; flywheel rotor and containment technology; advanced component technology; and project management and DOE support. DOE

N81-10563# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France). Div. Systemes Balistiques et Spatiaux.
HIGH SPEED FLYWHEELS OPERATING ON ONE ACTIVE AXIS MAGNETIC BEARINGS
P. C. Poubeau Paris 1979 11 p refs Presented at 1977 Flywheels Technol. Symp., San Francisco, 5-7 Oct. 1977
(SNIAS-792-422-107) Avail: NTIS HC A02/MF A01

The configurations of two momentum wheel were examined: one design for high angular momentum for a low mass, and the other utilizing two center rotating wheels. Several engineering models were built constituting small units able to store energy under kinetic form with input and output of power under electric form. The successful operation of these models demonstrated the compatibility for energy storage systems of high speed rotors with a magnetic suspension. The characteristics of the magnetic suspension and of the rotors which were developed are described. Author (ESA)

N81-11262# Department of Energy, Washington, D. C.
METHOD FOR ENGINEERING CALCULATION AND SELECTION OF PARAMETERS FOR THE POWER SYSTEMS OF BATTERY-POWERED ELECTRIC AUTOMOBILES
E. M. Dilanyan and A. A. Momdzhyan 1979 8 p Transl. into ENGLISH from 2nd Sov.-Am. Symp. on Elect. Automobiles (USSR), 1979 8 p Conf. held at Erevan, USSR, 1979
(DOE-TR-239) Avail: NTIS HC A02/MF A01

A method for engineering calculation and selection of parameters for the power systems of battery powered electric automobiles (EA) was examined. The EA range in capacity from 0.5 to 1.2 tons is dependent on the requirements imposed by the production assignment for the specifications of the EA being designed and operating conditions. DOE

N81-11400# Johns Hopkins Univ., Laurel, Md.
FLYWHEEL SEAL TEST PROGRAM
C. M. Blackburn May 1980 30 p
(Contract DE-AC04-76DP-00789)
(SAND-80-7019) Avail: NTIS HC A03/MF A01

The test program included a large number of meticulous disassembly and mechanical adjustment operations aimed at isolating the cause of inconsistent torque data. Although some acceptable torque measurements were eventually obtained, there was occasional evidence of mechanical interference between the stationary and rotating seal components. Neither of the seals tested was capable of sealing one atmosphere against the design pressure of 0.001 to 0.001 Torr, possibly because of internal interference problems. One seal and its test fixture were returned to the manufacturer for post testing examination. The manufacturer concluded that due to the high sensitivity of this unit to alignment, the first prototype hardware supplied to APL will not produce favorable results, even with further modifications. It is believed that the difficulties encountered with these seals were largely the result of the tight axial tolerances, and do not necessarily indicate any basic problem with the seal concept. DOE

N81-11472# Sandia Labs., Albuquerque, N. Mex. Energy Systems Analysis Div.
MECHANICAL ENERGY STORAGE FOR PHOTOVOLTAIC/WIND PROJECT Final Report
Bill C. Caskey and Harold E. Schildknecht Jun. 1980 66 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-2259) Avail: NTIS HC A04/MF A01

The Solar Mechanical Energy Storage program is described. Contractor and system analyses results for residential flywheel energy storage systems are presented. Various phases of the program addressed small to intermediate applications of photovoltaic/wind energy storage using flywheels, compressed air, and low head, underground pumped hydro technologies. Sandia National Laboratories' recommendations for continued work in specific areas are included. DOE

N81-11486# Zia Associates, Inc., Boulder, Colo.
ROCK BED STORAGE WITH HEAT PUMP Final Report
H. E. Remmers and G. L. Mills May 1979 170 p refs
(Contract EM-78-C-02-4704)
(COO-4704-3) Avail: NTIS HC A08/MF A01

The operating characteristics of off the shelf components of heat pump/rock bed storage systems were studied, and the results were used to formulate configurations of representative systems. These systems were modeled and subsequently analyzed using the TRNSYS computer program a life cycle cost analysis program called LCCA. A detailed load model of a baseline house was formulated as part of the TRNSYS analysis. Results of the analysis involved the development of a technique to confine the range of heat pump/rock bed storage systems to those systems which are economical for a specific location and set of economic conditions. Additionally, the results included a comparison of the detailed load model with simple UA models such as the ASHRAE bin method. Several modifications and additions were made to the TRNSYS and LCCA computer programs. DOE

N81-11503# California Univ., Berkeley. Lawrence Berkeley Lab.
ENERGY STORAGE IN AQUIFERS: A SURVEY OF RECENT THEORETICAL STUDIES
Chin Fu Tsang and Johan Claeson Mar. 1980 9 p refs Presented at the Rockstore 80 Conf., Stockholm, 23-29 Jun. 1980 Prepared in cooperation with Lund Univ., Sweden
(Contract W-7405-eng-48)
(LBL-11059; CONF-8006102-1) Avail: NTIS HC A02/MF A01

Theoretical efforts in aquifer storage research and the impact their results may have on field projects are reviewed. Semianalytic studies, numerical modeling studies, and site specific studies are examined. DOE

N81-11518# Argonne National Lab., Ill.
NEW APPLICATIONS OF ENERGY STORAGE IN ELECTRIC HEATING AND COOLING SYSTEMS
J. G. Asbury 1980 7 p refs Presented at the IEEE Region 6 Conf., San Diego, Calif., 20-22 Feb. 1980
(Contract W-31-109-eng-58)
(CONF-800210-4) Avail: NTIS HC A02/MF A01

Electricity, in combination with appropriate load management techniques, is a cost effective method of providing building heating and cooling services. Storage systems that enable the use of nighttime, off peak, energy to meet the following day's load are among the most promising load management techniques. Studies evaluated the total cost of providing space heating and cooling services with electricity and then compared these costs with oil and gas based systems. Detailed cost allocation models were used to compute gas and electric utility costs of supply. A number of different electric technologies were evaluated including electric storage heating, storage air conditioning, dual fuel heating, and solar heating with electric backup. An important finding is that several electric based heating technologies are cost competitive with oil and natural gas heating. DOE

N81-11525# Argonne National Lab., Ill. Chemical Engineering Div.
CONCEPTUAL DESIGNS FOR UTILITY LOAD-LEVELING BATTERY WITH Li/FeS CELLS
S. M. Zivi, H. Kacinskas, I. Pollack, A. A. Chilenkas (Rockwell International, Canoga Park, Calif.), W. Grieve (Rockwell International, Canoga Park, Calif.), B. L. McFarland (Rockwell International, Canoga Park, Calif.), and S. Sudar Jul. 1980 90 p refs
(Contract W-31-109-eng-38)
(ANL-80-20) Avail: NTIS HC A05/MF A01
A conceptual design of a 100 MW-h load leveling battery system having Li alloy/FeS cells was developed. Efforts were concentrated on lowering the hardware costs which resulted in the development of three modified designs which are presented in the report. The first consisted of a 30 kW-h cell/submodule and the electric vehicle equalization scheme. The hardware cost for this modified design was quite low, about $25/kW-h; however, this design was eventually rejected owing to the apparent impracticality of such a large cell. The two other modified designs had more conservative cell designs. One of them consisted of a 120 kW-h submodule consisting of one hundred 1.2 kW-h cells; the other consisted of a 1020 kW-h submodule consisting of four hundred and eight 2.5 kW-h cells. DOE

N81-11538# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DYNAMIC ANALYSIS OF A MAGNETICALLY SUSPENDED ENERGY STORAGE WHEEL
L. L. Bucciarelli (MIT, Cambridge) and A. Rangarajan 1980 8 p refs Presented at the Flywheel Technol. Symp., Scottsdale, Ariz., 26-30 Oct. 1980
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/102; CONF-801022-3) Avail: NTIS HC A03/MF A01
The results of an analysis conducted in support of the design of a l kWh flywheel fabricated and tested recently at the MIT Lincoln Laboratory are presented. The flywheel was a prototype of a 40 kWh residential unit to be used to store energy obtained from photovoltaic arrays. The l kWh system was designed to operate between 7500 and 15,000 rpm. The flywheel, made of seven 15 inch diameter steel disks, weighed about 400 pounds, and was suspended vertically by a flexible quill shaft from a set of six magnetic bearings. The magnetic bearings minimize frictional losses and require little maintenance over the design life of the system. The quill shaft, which permits self-alignment of the wheel's principal axis with the spin axis, was sized so that there are no critical frequencies in the operating range. An integral motor/generator unit was used to spin the wheel up when power is available and to generate power when required. DOE

N81-11550# Midwest Research Inst., Golden, Colo. Systems Development Branch.
PRELIMINARY REQUIREMENTS FOR THERMAL STORAGE SUBSYSTEMS IN SOLAR THERMAL APPLICATIONS
R. J. Copeland Apr. 1980 229 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/RR-731-364) Avail: NTIS HC A11/MF A01
Methodologies for the analysis of value and comparing thermal storage concepts are presented. Value is a measure of worth and is determined by the cost of conventional fuel systems. Value data for thermal storage in large solar thermal electric power applications are presented. Thermal storage concepts must be compared when all are performing the same mission. A method for doing that analysis, called the ranking index, is derived. Necessary data to use the methodology are included. DOE

N81-11554# Bickle/CM, Inc., Albuquerque, N. Mex.
PERFORMANCE DATA FOR PASSIVE SYSTEMS: THE LOS ALAMOS SCIENTIFIC LABORATORY TEST ROOMS
Jun. 1980 23 p
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-0924-2) Avail: NTIS HC A02/MF A01
Direct gain and Trombe wall test cells were constructed for use in assessing the performance of such systems and to provide data for the validation of a computer model. The environment, building, passive solar system, and data acquisition system are described for each cell. Graphs and tables of weather and validation variables are included. DOE

N81-11555# Bickle/CM, Inc., Albuquerque, N. Mex.
PERFORMANCE DATA FOR PASSIVE SYSTEMS: THE BRUCE HUNN HOUSE
Jun. 1980 38 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-0924-6) Avail: NTIS HC A03/MF A01
A 1955 sq ft house which uses a Trombe wall for space heating as well as direct gain is discussed. A rock bed storage box which is actively charged has not operated satisfactorily. The house, the envrionment, the solar system, and the data acquisition system are described. Annual and hourly test data for the house are presented. DOE

N81-11960# Department of Energy, Washington, D. C.
METHODS FOR PERFECTING NICKEL-ZINC STORAGE BATTERIES FOR THE POWER PLANTS OF ELECTRIC AUTOMOBILES
N. S. Lidorenko, V. I. Baulov, and V. Ye. Dmitrenko 1979 6 p Transl. into ENGLISH from 2nd Sov.-Am. Symp. on Elect. Automobiles (USSR), 1979 6 p Conf. held at Erevan, USSR, 1979
(DOE-Tr-231) Avail: NTIS HC A02/MF A01
Analysis of the results of bench tests of test models of storage batteries and tests of three sets of batteries in an electric automobile made it possible to determine methods for further perfecting nickel-zinc storage batteries for the power plants of electric automobiles. These methods are discussed. DOE

N81-11961# Department of Energy, Washington, D. C.
SELECTION OF POWER RATIOS IN THE ELECTRICAL EQUIPMENT OF AN ELECTRIC AUTOMOBILE WITH COMBINATION-TYPE POWER PLANT
A. A. Momdzhyan 1979 6 p Transl. into ENGLISH from the 2nd Sov.-Am. Symp. on Elect. Automobiles (USSR), 1979 6 p Conf. held at Erevan, USSR, 1979
(DOE-Tr-236) Avail: NTIS HC A02/MF A01
Due to the absence of a generally accepted method for selecting the basic parameters of power sources in electric automobiles with combination-type power plants, an algorithm was developed for solving the problem on a computer. Existing analytical dependences for power design for vehicles, equations for electric traction motors and SP equations obtained on the basis of the results of experimental research, as well as internal combustion engine equations, also obtained on the basis of results of experimental research, were used in the solution. DOE

N81-12589# Exxon Research and Engineering Co., Linden, N.J.
DEVELOPMENT OF EVALUATION TECHNIQUES FOR ELECTROCHEMICAL ENERGY STORAGE SYSTEMS Final Report, 1 Oct. 1978 - 31 Mar. 1980
Lewis H. Gaines and Kenneth Nazimek 15 Mar. 1980 93 p
(Contract EM-78-C-01-5157)
(CONS-5157-T1) Avail: NTIS HC A05/MF A01
The development of standardized techniques for the comparative evaluation of electric vehicle battery technologies is summarized. The methodology considers both the traditional measures of battery performance (energy density, energy storage costs, and cycle life) and the equally important usage related battery characteristics (probability of technical success, operating and maintenance parameters, and safety/environmental impact). This comparative rationale is supplemented by the ability to generate

battery test programs normalized to specific technologies and electric vehicle mission specifications. These test programs allow the evaluation of different battery technologies at comparable levels of electric vehicle performance. It was found that cost optimized electric passenger vehicles will have range specifications of 100 to 110 KM, depending on the specific performance of the battery. Longer range vehicles are penalized by higher first costs while shorter range vehicles suffer from reduced battery life and the need for more frequent alternative car rentals (presumably petroleum fueled) for trips which exceed the EV's range capability. DOE

N81-12614# Argonne National Lab., Ill.
HIGH-PERFORMANCE BATTERIES FOR ELECTRIC-VEHICLE PROPULSION AND STATIONARY ENERGY STORAGE Progress Report, Oct. 1978 - Sep. 1979
Mar. 1980 258 p refs
(Contract W-7405-eng-38)
(ANL-79-94) Avail: NTIS HC A12/MF A01

A 40 kW-hr electric vehicle battery (designated Mark 1A) was fabricated and delivered for testing. During the initial heat up, one of the two modules failed due to a short circuit. A failure analysis was conducted and the Mark 1A program completed. Development work on the next electric vehicle battery (Mark 2) was initiated. Work on stationary energy storage batteries during this period has consisted primarily of conceptual design studies. E.D.K.

N81-12618# Little (Arthur D.), Inc., Cambridge, Mass.
AN EVALUATION OF SUPERCONDUCTING MAGNETIC ENERGY STORAGE
Nov. 1979 97 p
(Contract W-31-109-eng-38)
(ANL-K-79-4917-1) Avail: NTIS HC A05/MF A01

Superconducting magnetic energy storage (SMES) systems were analyzed as to their possible benefits to the electric utility industry. The SMES systems will be able to store and delivery energy at very high efficiency while being able to switch from the charge to discharge mode in a few tens of milliseconds. An economic analysis for the SMES system is presented. T.M.

N81-12950# Ford Motor Co., Dearborn, Mich.
FORD/DOE SODIUM-SULFUR BATTERY ELECTRIC VEHICLE DEVELOPMENT AND DEMONSTRATION, PHASE 1-A Final Report
1979 184 p refs
(Contract EY-76-C-02-2566)
(COO-2566-53-T1; Rept-53) Avail: NTIS HC A09/MF A01

The results of Phase 1-A analyses and design studies conducted by Ford Motor Company for the U.S. Department of Energy are presented. The sodium-sulfur battery was evaluated, in an existing conventional production automobile, as a potential power source for an electric vehicle. T.M.

N81-12953# Energy Research Corp., Danbury, Conn.
RESEARCH, DEVELOPMENT AND DEMONSTRATION OF NICKEL-ZINC BATTERIES FOR ELECTRIC VEHICLE PROPULSION Annual Report
Jun. 1980 179 p
(Contracts W-31-109-38-4248; W-31-109-eng-38)
(ANL/OEPM-79-10; AR-1979-2) Avail: NTIS HC A09/MF A01

Nickel and zinc electrode development is discussed. Separator and sealed cell development is also discussed. The optimization of electrical performance, specifically, in terms of increased cycle life is described. T.M.

N81-12985*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PROPULSION SYSTEM RESEARCH AND DEVELOPMENT FOR ELECTRIC AND HYBRID VEHICLES
Harvey J. Schwartz *In its* Impact for the 80's: Proc. of a Conf. on Selected Technol. for Business and Ind. Nov. 1980 p 97-103 (For primary document see N81-12978 03-99)
Avail: NTIS HC A11/MF A01 CSCL 13F

An approach to propulsion subsystem technology is presented. Various tests of component reliability are described to aid in the production of better quality vehicles. component characterization work is described to provide engineering data to manufacturers on component performance and on important component propulsion system interactions. R.C.T.

N81-13105*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVEMENT AND SCALE-UP OF THE NASA REDOX STORAGE SYSTEM
Margaret A. Reid and Lawrence H. Thaller 1980 9 p refs Presented at 15th Intersoc. Energy Conversion Engineering Conf., Seattle, 18-21 Aug. 1980
(Contract DE-AI04-80AL-12726)
(NASA-TM-81632; DOE/NASA/12726-6; E-644) Avail: NTIS HC A02/MF A01 CSCL 10C

A preprototype 1.0 kW redox system (2 kW peak) with 11 kWh storage capacity was built and integrated with the NASA/DOE photovoltaic test facility at NASA Lewis. This full function redox system includes four substacks of 39 cells each (1/3 cu ft active area) which are connected hydraulically in parallel and electrically in series. An open circuit voltage cell and a set of rebalance cells are used to continuously monitor the system state of charge and automatically maintain the anode and cathode reactants electrochemically in balance. Recent membrane and electrode advances are summarized and the results of multicell stack tests of 1 cu ft are described. R.C.T.

N81-13484# Exide Management and Technology Co., Yardley, Pa.
RESEARCH, DEVELOPMENT AND DEMONSTRATION OF NICKEL-ZINC BATTERIES FOR ELECTRIC VEHICLE PROPULSION Annual Report, 1979
Jun. 1980 110 p refs
(Contract W-31-109-eng-38)
(ANL/OEPM-79-12) Avail: NTIS HC A06/MF A01

Activities in a program to develop a nickel zinc battery for electric vehicle propulsion are reported. Aspects discussed include battery design and development, nickel cathode study, and basic electrocnemistry. A numoer of engineering drawings are supplied. DOE

N81-13501# California Univ., Livermore. Lawrence Livermore Lab.
FLYWHEEL ENERGY STORAGE UNIT TECHNOLOGY DEVELOPMENT PROGRAM
Jun. 1980 212 p
(Contract W-7405-eng-48)
(UCRL-15280) Avail: NTIS HC A10/MF A01

A program to demonstrate an improved flywheel energy storage unit (ESU) to be used in combination with a heat engine for propelling a 1985 family sedan is described. Information is included on flywheel ESU design criteria, design, stress analysis thermal analysis, and performance. The ESU was designed, fabricated, and partially evaluated prior to the program being discontinued by LLL because of electrical machine failures and insufficient funds to correct the hardware discrepancies. DOE

N81-13502# California Univ., Livermore. Lawrence Livermore Lab.
HIGH DENSITY ENERGY STORAGE CAPACITOR
K. Whitham, M. M. Howland, and J. R. Hutzler Nov. 1979 5 p refs Presented at 8th Symp. on Eng. Probl. of Fusion Res., San Francisco, 13-16 Nov. 1979
(Contract W-7405-eng-48)
(UCRL-82937; CONF-791102-174) Avail: NTIS HC A02/MF A01

The Nova laser system will use 130 million joules of capacitive energy storage and have a peak power capability of

250,000 million volts. This capacitor bank is a significant portion of the laser cost and requires a large portion of the physical facilities. In order to reduce the cost and volume required by the bank, the Laser Fusion Program funded contracts with three energy storage capacitor reducers: to develop higher energy density, lower cost energy storage capacitors. Design and initial life testing are described. DOE

N81-13515# Midwest Research Inst., Golden, Colo.
CENTRAL UNRESOLVED ISSUES IN THERMAL ENERGY STORAGE FOR BUILDING HEATING AND COOLING
C. J. Swet and F. Baylin Jul. 1980 48 p refs
(Contract DE-AC02-77CH-00178)
(SERI/RR-721-455) Avail: NTIS HC A03/MF A01

Issues related to applications included value-based ranking of storage concepts, temperature constraints, consistency of assumptions, nomenclature and taxonomy, and screening criteria for materials. Issues related to technologies included assessing seasonal storage concepts, diurnal coolness storage, selection of hot-side storage concepts for cooling-only systems, phase-change storage in building materials, freeze protection for solar water heating systems, and justification of phase-change storage for active solar space heating. DOE

N81-13811# Department of Energy, Washington, D. C.
RECTIFIER ELECTRIC DRIVE FOR AN ELECTRIC AUTOMOBILE USING A NON-CONTACT SYNCHRONOUS MOTOR WITH PERMANENT MAGNETS
V. G. Yapuk [1979] 7 p refs Transl. into ENGLISH from Soviet-American Symp. paper Presented at 2d Soviet-American Symp. on Electric Automobiles, Yerevan, USSR, 1979
(DOE-TR-234) Avail: NTIS

A traction electric drive for an electric automobile using a rectifier electric drive was developed due to the number of advantages over other types of electric drives. The possibility for designing a compact engine reveals the promise for developing a motor wheel of a multimotor modification which will make it possible to improve the flexibility of the control and the reliability of the drive of an electric automobile. The basic technical requirements determined by the specifics of designing and developing a motor are: high ratios of torque when accelerating and climbing, high efficiency in a wide rpm range and limited weight and size with minimal possibilities for cooling and rigid operating conditions. The use of high energy permanent magnets made of rare earth elements made it possible to develop a motor which provides the required operating modes and performance at the required size. The design of a developed motor is discussed. DOE

N81-14402# Friedrichsfeld G.m.b.H., Mannheim (West Germany). Steinzeug- und Kunststoffwerke.
PRODUCTION TECHNOLOGY OF BETA-ALUMINA CERAMICS FOR Na/S BATTERIES Final Report
Guenter Heimke and Gerd Willmann Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 117 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-57; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 24,15

The development of the fabrication processes to produce tubes of beta-alumina ceramics for the Na/S-battery was made on the basis of the results in 1974 and in close cooperation with the Research Center of BBC in Heidelberg. The selection of raw materials, the handling of the beta-alumina powders and the shaping were clarified, except the parameters for spray drying. The results of firing in an tunnel kiln, with high pushing rates showed that the beta-alumina tubes could be produced with sufficient density, microstructure and chemical composition in a way that is transferable to a real production. Nevertheless there is the problem to reduce the consumption of the kiln furniture. It is possible to calculate the costs for producing beta-alumina tubes assuming the production of a large number of tubes and assuming that the problem of the kiln furniture is solved. Author

N81-14421# Department of Energy, Washington, D. C. Energy Information Administration.
UNDERGROUND NATURAL GAS STORAGE IN THE UNITED STATES 1979 - 1980 HEATING YEAR Progress Report, Apr. 1979 - Mar. 1980
Sep. 1980 27 p
(DOE/EIA-0239/79) Avail: NTIS HC A03/MF A01

Total gas in storage in the nation's active underground natural gas storage reservoirs as of March 31, 1980, the end of the 1979-1980 heating year, was reported at 5,129 billion cubic feet. Of this total, approximately 69.1 percent was base, or cushion, gas and 30.9 percent was working gas. Working gas totaled 1,586 billion cubic feet, approximately 28.2 percent above that available at the beginning of the heating year. The nation's 383 active storage reservoirs were operated by 77 companies. Total reservoir capacity was reported at 7,287 billion cubic feet, approximately 51.4 percent, or 3,744 billion cubic feet ofwhich was working gas capacity. Approximately 67.9 percent of this working gas capacity was in 228 reservoirs operated by 30 interstate pipeline companies, 29.1 percent was in 142 reservoirs operated by 42 intrastate companies, and 3.1 percent was in 13 reservoirs operated by 5 independent producers. A.R.H.

N81-14439# Wisconsin Univ. - Milwaukee.
SYNTHESIS OF RESEARCH AND DEVELOPMENT IN MECHANICAL ENERGY STORAGE TECHNOLOGIES Progress Report, 1 Sep. 1979 - 31 May 1980
Gabor M. Karadi 31 May 1980 12 p refs
(Contract DE-AC02-79ET-26106)
(DOE/ET-16106/T1) Avail: NTIS HC A02/MF A01

Techniques for underground energy storage are described. These techniques include underground pumped hydro storage, second generation compressed air energy storage, and seasonal aquifer thermal energy storage. An economic assessment for each of the techniques is presented. T.M.

N81-14447# Purdue Univ., Lafayette, Ind. Energy Sources and Systems Simulation Lab.
SECURITY ASSESSMENT OF POWER SYSTEMS Progress Report, 1 Oct. - 1 Dec. 1979
D. P. Carroll and P. C. Krause Jan. 1980 23 p refs
(Contracts EC-77-S-02-4206; DE-AS02-77ET-29100)
(DOE/ET-29100/11) Avail: NTIS HC A02/MF A01

Wind turbulence models and their effect on unsteady shaft torque of horizontal machines were studied. Reduced order aerodynamic models of wind machines were developed. T.M.

N81-14472# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
TWO WELL STORAGE SYSTEMS FOR COMBINED HEATING AND AIRCONDITIONING BY GROUNDWATER HEATPUMPS IN SHALLOW AQUIFERS
Walter Pelka Jul. 1980 81 p refs Prepared in cooperation with Technische Hochschule, Aachen, West Germany
(Contract W-7405-eng-48)
(LBL-11302) Avail: NTIS HC A05/MF A01

The use of soil and ground water as an energy source and heat storage systems for heat pumps in order to conserve energy in heating and air conditioning buildings is discussed. Information is included on heat pump operation and performance, aquifer characteristics, soil and ground water temperatures, and cooling and heating demands. Mathematical models are used to calculate flow and temperature fields in the aquifer. It is concluded that two well storage systems with ground water heat pumps are desirable, particularly in northern climates. DOE

N81-14480# Gould, Inc., Rolling Meadows, Ill.
RESEARCH, DEVELOPMENT AND DEMONSTRATION OF NICKEL-ZINC BATTERIES FOR ELECTRIC VEHICLE PROPULSION Annual Report, 1 Jul. 1978 - 31 Aug. 1979
Jun. 1980 108 p
(Contract W-31-109-eng-38)
(ANL/OEPM-79-11; AR-2) Avail: NTIS HC A06/MF A01

The feasibility of the nickel zinc battery for electric vehicle propulsion is discussed. The program is divided into seven distinct but highly interactive tasks collectively aimed at the development and commercialization of nickel zinc technology. These basic technical tasks are separator development, electrode development, product design and analysis, cell/module battery testing, process development, pilot manufacturing, and thermal manufacturing, and thermal management. Significant progress has been made in the understanding of separator failure mechanisms, and a generic category of materials has been specified for the 300+ deep discharge applications. Shape change has been reduced significantly. Progress in the area of thermal management was significant, with the development of a model that accurately represents heat generation and rejection rates during battery operation. DOE

N81-14484# General Electric Co., Schenectady, N. Y. Corporate Research and Development Dept.
REGENERATIVE FLYWHEEL ENERGY STORAGE SYSTEM. VOLUME 1: EXECUTIVE SUMMARY Final Report
27 Jun. 1980 37 p 3 Vol.
(Contract W-7405-eng-48)
(UCRL-15290-Vol-1; SRD-79-148-1-Vol-1) Avail: NTIS HC A03/MF A01

The development, fabrication, and test of a regenerative flywheel energy storage and recovery system for a battery/flywheel electric vehicle of the 3000 pound class are described. The vehicle propulsion system was simulated on a digital computer in order to determine the optimum system operating strategies and to establish a calculated range improvement over a nonregenerative, all electric vehicle. Fabrication of the inductor motor, the flywheel, the power conditioner, and the system control are described. Test results of the system operating over the SAE J227a Schedule D driving cycle are given and are compared to the calculated value. The flywheel energy storage system consists of a solid rotor, synchronous, inductor type, flywheel drive machine electrically coupled to a dc battery electric propulsion system through a load commutated inverter. The motor/alternator unit is coupled mechanically to a small steel flywheel which provides a portion of the vehicle's accelerating energy and regenerates the vehicle's braking energy. DOE

N81-14485# General Electric Co., Schenectady, N. Y. Corporate Research and Development Dept.
REGENERATIVE FLYWHEEL STORAGE SYSTEM, VOLUME 2 Final Report
27 Jun. 1980 226 p refs
(Contract W-7405-eng-48)
(UCRL-15290-Vol-2; SRD-79-148-2) Avail: NTIS HC A11/MF A01

A vehicle propulsion system was simulated on a digital computer in order to determine the optimum system operating strategies and to establish a calculated range improvement over a nonregenerative, all electric vehicle. Fabrication of the inductor motor, the flywheel, the power conditioner, and the system control are described. Test results of the system operating over the SAE J227a Schedule D driving cycle are given and are compared to the calculated value. The flywheel energy storage system consists of a solid rotor, synchronous, inductor type, flywheel drive machine electrically coupled to a dc battery electric propulsion system through a load commutated inverter. The motor/alternator unit is coupled mechanically to a small steel flywheel which provides a portion of the vehicle's accelerating energy and regenerates the vehicle's braking energy. DOE

N81-14486# General Electric Co., Schenectady, N. Y. Corporate Research and Development Dept.
REGENERATIVE FLYWHEEL ENERGY STORAGE SYSTEM. VOLUME 3: LIFE CYCLE AND COST-BENEFIT ANALYSIS OF A BATTERY-FLYWHEEL ELECTRIC CAR
27 Jun. 1980 194 p refs
(Contract W-7405-eng-48)
(UCRL-15290-Vol-3; SRD-79-148-3) Avail: NTIS HC A09/MF A01

Fabrication of the inductor motor, the flywheel, the power conditioner, and the system control is described. Test results of the system operating over the SAE j227a Schedule D driving cycle are given and are compared to the calculated value. The flywheel energy storage system consists of a solid rotor, synchronous, inductor-type, flywheel drive machine electrically coupled to a dc battery electric propulsion system through a load-commutated inverter. The motor/alernator unit is coupled mechanically to a small steel flywheel which provides a portion of the vehicle's accelerating energy and regenerates the vehicle's braking energy. Laboratory simulation of the electric vehicle propulsion system included a 108 volt, lead-acid battery bank and a separately excited dc propulsion motor coupled to a flywheel and generator which simulate the vehicle's inertia and losses. DOE

N81-15473# Argonne National Lab., Ill. Materials Science Div.
A REVIEW OF CURRENT R AND D IN THERMAL ENERGY STORAGE AND HEAT EXCHANGE IN SOLAR APPLICATIONS
Allan I. Michaels 1978 14 p refs Presented at 3rd Southeastern Conf. on Appl. of Solar Energy, Huntsville, Ala., 17-19 Apr. 1978
(Contract W-31-109-eng-38)
(CONF-780476-1) Avail: NTIS HC A02/MF A01

A survey of current research and development methods used for storing and transferring thermal energy is presented. The thermal energy storage and heat transfer methods discussed are innovative heat exchange and transport, advanced concept sensible heat storage in water, rock, Earth or a combination of these, for either short term or for annual storage periods, heat storage in the energy of phase change, and heat storage in the energy of reversible chemical reactions. E.D.K.

N81-15479# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
SEASONAL THERMAL ENERGY STORAGE IN AQUIFERS: MATHEMATICAL MODELING STUDIES IN 1979
Chin Fu Tsang Nov. 1979 17 p refs
(Contract W-7405-eng-48)
(LBL-10208) Avail: NTIS HC A02/MF A01

Studies included comprehensive generic calculations based on a numerical model to calculate the coupled heat and fluid flows in a three dimensional, complex-geometry aquifer system. Various situations were considered, including hot or cold water storage for different periods of time, inhomogeneity of the storage aquifer, the presence of barriers, regional flow, and the situation of a storage well partially or fully penetrating the aquifer. Thermal stratification dispersion, and buoyancy flow in an aquifer used for hot or cold water storage were also studied. T.M.

N81-15480# Battelle Pacific Northwest Labs., Richland, Wash.
COMPRESSED AIR ENERGY STORAGE (CAES) ENVIRONMENTAL CONTROL CONCERNS AND PROGRAM PLAN
M. A. Beckwith and D. W. Boehm Jun. 1980 55 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3431) Avail: NTIS HC A04/MF A01

Procedures, processes, systems, and strategies necessary to minimize adverse environmental impacts of compressed air energy storage are developed so as not to delay implementation of the technology. Compressed air energy storage technology and the expected major environmental concerns of the technology are described. Ongoing or planned research in related programs and the applicability of results from these programs to CAES environmental research are discussed. The additional research and development required to provide the necessary environmental data base and resolve concerns in CAES are outlined. A program plan to carry out this research and development effort is presented. DOE

N81-15513# Oak Ridge Y-12 Plant, Tenn. Nuclear Div.
COMPOSITE FLYWHEEL TESTING AND EVALUATION AT THE OAK RIDGE FLYWHEEL EVALUATION LABORATORY
R. S. Steele, Jr. and E. F. Babelay, Jr. 15 Oct. 1980 9 p

refs Presented at the Mech., Magnetic, and Underground Energy Storage 1980 Ann. Contractors Rev., Washington, D.C., 10 - 13 Nov. 1980
(Contract W-7405-eng-26)
(Y/DX-202; CONF-801128-5) Avail: NTIS HC A02/MF A01
The results of spin tests conducted for the purpose of determining the ultimate energy density capabilities of flywheel rotors are summarized. A short description of each test is presented as well as data used to determine each failure mode. Each of these flywheels tested were limited by generic problems involving the attachment of a heavy rim to a central shaft. T.M.

N81-15520# Lockheed Missiles and Space Co., Palo Alto, Calif.
REACTIVE METAL-AIR BATTERIES FOR AUTOMOTIVE PROPULSION Final Report, 1 Aug. 1978 - 30 Nov. 1979
W. R. Momyer and J. L. Morris 20 Dec. 1979 174 p refs
Prepared for Continental Group, Inc., New York, N.Y.
(Contract ET-78-C-03-1872)
(LMSC-D-683375) Avail: NTIS HC A08/MF A01
Lithium water air (Li-H2O-air) cells with electrode areas of 500 square centimeters were discharged in an acrylic cell casing. The design features: (1) a metal bellows compression system to maintain the Li anode against the electrode separator during discharge; (2) a wire screen that serves as both the electrode separator and the electrolyte flow channels; (3) monopolar electrodes; and (4) a cadmium (Cd) wire reference electrode for measuring the individual electrode potentials. The applicability of the aluminum-water-air cell concept as a power source for automotive propulsion is discussed. The characteristics of various candidate Al alloys were determined in both half cell corrosion studies and full cell discharge studies. Differences in the surface and crystallographic properties and the metal working process are critical with respect to the activity and corrosion resistance of the alloy. Candidate air cathodes from several sources were evaluated. S.F.

N81-15521# Lockheed Missiles and Space Co., Palo Alto, Calif. Chemistry Lab.
BASIC STUDIES ON NICKEL-ZINC BATTERIES Final Report, 20 Sep. 1976 - 28 Nov. 1979
Theodore Katan and P. J. Bergeron 1979 127 p refs
(Contract EM-78-C-01-5165)
(LMSC-D681417) Avail: NTIS HC A07/MF A01
An experimental program was conducted to impact Zn/NiO (OH) battery technology by ascertaining modes of transport and morphological change within the confines of electrode pores. A special single pore cell was used that confines reaction regimes to the dimensional domain existing within actual pores of electrodes in Ni-Zn batteries, approximately 20 micrometers or less. Author

N81-15522# Lockheed Missiles and Space Co., Palo Alto, Calif. Chemistry Lab.
RECHARGEABLE ALKALINE ZINC/FERRICYANIDE BATTERY Final Report, 29 Sep. 1978 - 28 Sep. 1979
George B. Adams, Roger P. Hollandsworth, and Bruce D. Webber 1979 212 p refs
(Contract EM-78-C-01-5163)
(LMSC-D678426) Avail: NTIS HC A10/MF A01
Technical and economic feasibility of the alkaline zinc/ferricy anide rechargeable battery for utility load leveling applications was assessed. This battery meets the requirements for this application with cell voltages of 1.94 V on charge and 1.78 V on discharge. Mean energy efficiency is 84% at 760 and 86% at 1110 4 hour cycles in full cell and redox half cell cycling, respectively. An updated, upgraded economic analysis suggests a battery selling price of $32/kWh, installed price of $230/kW and footprint of 8.7 kWh/sq ft as realistic goals for a 20 MW 100 MWh system. A major effort was successfully completed on design, construction, programming, and debugging of a microprocessor controlled battery cycling system. Other technical areas addressed include: electrode substrate evaluation, solubilities and conductivities of zinc oxide and sodium ferro and ferricyanide in sodium hydroxide electrolytes, mechanism of the slow chemical deligation of alkaline ferricyanide and its reversal, optimal compositions of zincate and iron redox electrolytes, effect of electrolyte flow rate and additions on quality of zinc electrodeposits, cell and electrode design and fabrication, and full and half cell cyclic testing. E.D.K.

N81-15525# Oak Ridge National Lab., Tenn.
THERMAL ENERGY STORAGE PROGRAM ANNUAL OPERATING PLAN FY 1980. BUILDING HEATING AND COOLING APPLICATIONS
D. M. Eissenberg and H. W. Hoffman 1980 47 p Sponsored by DOE
(ORNL/TM-7082) Avail: NTIS HC A03/MF A01
The thermal energy storage program operating plans for FY 1980 are described in terms of general program objectives (scope, justification, targets, and goals), the proposed approach and organization for achieving these objectives (program elements and schedules), and the specific technical activities being implemented. Building heating and cooling applications as well as fiscal data, are presented for each of the several program elements. S.F.

N81-15531# Delaware Univ., Newark. Inst. of Energy Conservation.
LIFE AND STABILITY TESTING OF PACKAGED LOW-COST ENERGY STORAGE MATERIALS
Galen R. Frysinger Jul. 1980 120 p
(Contract W-7405-eng-26)
(ORNL/Sub-7585-1) Avail: NTIS HC A06/MF A01
A low-cost laminated plastic film which is used to contain a Glauber's salt-based phase change thermal energy storage material in sausage like containers called Chubs was developed. Results of tests performed on the Chub packages themselves and on the thermal energy storage capacity of the packaged phase change material are described. From the test results, a set of specifications was drawn up for a film material which will satisfactorily contain the phase change material under anticipated operating conditions. Calorimetric testing of the phase change material with thermal cycling indicates that a design capacity of 45 to 50 Btu/lb for a delta T of 30 F can be used for the packaged material. Author

N81-15535# Interplan Corp., Santa Barbara, Calif.
PRELIMINARY ENERGY USE AND ECONOMIC ANALYSIS OF THE ALUMINUM-AIR BATTERY FOR AUTOMOTIVE PROPULSION
Charles L. Hudson and Evelyn S. Putnam Apr. 1980 45 p refs Sponsored by DOE Prepared for California Univ., Lawrence Livermore Lab.
(UCRL-15242; INTERPLAN-R7908) Avail: NTIS HC A03/MF A01
Cost and energy parameters were analyzed based on existing technology and resource pricing structures. The results of these status quo assessments were critiqued in the light of potential changes in technology and resource prices. Estimates of the operating characteristics of the vehicle were made on the basis of laboratory test results, performance simulation model test results, and hypotheses on the refueling infrastructural scenario. If the amount of energy currently used to produce aluminum remains the same, the energy efficiency of the aluminum air battery vehicle in 2000 was estimated to be less than the energy efficiency of future vehicles operating on coal-derived methanol or gasoline. T.M.

N81-15541# General Electric Co., Schenectady, N. Y.
FLYWHEEL CONTAINMENT TECHNOLOGY ASSESSMENT
Anthony P. Coppa, Carl H. Zweben, and L. Mirandy 10 Jul. 1980 138 p refs Sponsored by DOE
(UCRL-15261; Doc-80SDS4202) Avail: NTIS HC A07/MF A01
The important effect of containment weight on the density of a flywheel was examined for a selection of flywheel designs incorporating metallic and composite construction as contained by steel housings. Three different flywheel constructions are presented, namely laminated rotor, shaped disk, and multirim. Materials are steel for the first two types and E glass, S glass

and Kevlar composites for the third type. All of the flywheels were comparable in that their stress levels were based on long term high cycle operation. All of the specific energy values were penalized heavily by the containment weight, the least being the laminated rotor (-29 percent) and the greatest being the shaped disk (-72 percent). The penalties for the multirim designs are -45 percent (E glass), -55 percent (S glass), and -60 percent (Kevlar). The low penalty of the laminated steel rotor was due to the fact that the containment weight was based on withstanding the rupture of only one of the constituent disks. The high penalty of the shaped steel disk, on the other hand, reflects the severe containment action that resulted from its bursting into large, hard, and axially narrow fragments. The intermediate but nevertheless substantial containment penalty of the multidrum composite rotors resulted from their relatively mild containment behavior. T M

N81-15547# Pacific Northwest Lab., Richland, Wash.
COMPRESSED AIR ENERGY STORAGE TECHNOLOGY PROGRAM Annual Report
W. V. Loscutoff Jun. 1980 197 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3395) Avail: NTIS HC A09/MF A01

Progress in the development of compressed air energy storage (CAES) technologies for central station electric utility applications is reported. It is reported that the concept improves the effectiveness of a gas turbine using petroleum fuels, could reduce petroleum fuel consumption of electric utility peaking plants, and is technically feasible and economically viable. Specific topics discussed include stability criteria for large underground reservoirs in salt domes, hard rock, and porous rock used for air storage in utility applications and second-generation technologies that have minimal or no dependence on petroleum fuels. The latter includes integration of thermal energy storage, fluidized bed combustion, or coal gasification with CAES. J.M.S.

N81-15548# Pacific Northwest Lab., Richland, Wash.
A DESCRIPTIVE ANALYSIS OF AQUIFER THERMAL ENERGY STORAGE SYSTEMS. EXECUTIVE SUMMARY
R.W. Reilly Jun. 1980 83 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3298) Avail: NTIS HC A05/MF A01

The storage device consists of two ordinary water wells drilled into an aquifer, connected at the surface by piping and a heat exchanger. During the storage cycle water is pumped out of the aquifer through the heat exchanger to absorb thermal energy, and then back down into the aquifer through the second well. The thermal energy remains in the aquifer 'storage bubble' until required for use, when it is recovered by reversing the storage operation. The storage medium, water, is inexpensive. Well drilling and equipment costs constitute the only capital storage expense and so the cost of the storage container is essentially independent of the amount of energy to be stored. T.M.

N81-15554# California Univ., Livermore. Lawrence Livermore Lab.
AN OVERVIEW OF THE MECHANICAL ENERGY STORAGE TECHNOLOGY (MEST) PROJECT
Thomas M. Barlow 23 Oct. 1980 6 p Presented at the 1980 Ann. Contractors Rev., Bethesda, Md., 10-13 Nov. 1980
(Contract W-7405-eng-48)
(UCRL-85085) Avail: NTIS HC A02/MF A01

The objectives of the MEST project are to develop, demonstrate, and evaluate mechanical energy storage technology for vehicular and fixed base applications, and to carry out the research, design, and development activities in a manner that maximizes the commercialization potential of the technology. The management approach which is followed in the conduct of the MEST project includes five principal actions: (1) identify technology areas and applications to be investigated; (2) provide an operating structure; (3) identify interrelationships, both within the project and with related work elsewhere; (4) develop and maintain a system of controls and accountability; and (5) promote and develop participation by industry in all phases of the project. E.D.K.

N81-15564# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
A PRELIMINARY SCREENING OF THERMAL STORAGE CONCEPTS FOR WATER/STEAM AND ORGANIC FLUID SOLAR THERMAL RECEIVER SYSTEMS
R. J. Copeland, M. E. Karpuk, and J. L. Ullman Apr. 1980 60 p refs
(Contract EG-77-C-01-4042)
(SERI/TR-631-647) Avail: NTIS HC A04/MF A01

Alternate thermal storage concepts were compared for both collector/receiver systems in electric power and cogeneration applications. A baseline thermal system design was selected for both applications. Detailed design information is presented for these systems. Both designs included a storage system; a dual media oil/rock thermocline system for the water/steam plant and a trickle charge oil/taconite system for the organic fluid receiver. Costs for the baseline and alternate thermal storage systems were calculated with a consistent set of cost algorithms. T.M.

N81-15572# National Technical Information Service, Springfield, Va.
THERMAL ENERGY STORAGE. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1978 - Aug. 1980
Diane M. Cavagnaro Sep. 1980 118 p Supersedes NTIS/PS-79/0952
(PB80-815756; NTIS/PS-79/0952) Avail: NTIS HC $30.00/MF $30.00 CSCL 10C

The cited reports of federally-funded research concern thermal energy storage. The citations cover the design of equipment, performance evaluation, theory, materials used, and experimental design. This updated bibliography contains 240 citations, 128 of which are new entries to the previous edition. GRA

N81-15903# Escher Technology Associates, St. Johns, Mich.
AN ASSESSMENT OF THE STATUS OF FUEL CELL/BATTERY VEHICLE POWER SYSTEMS
William J. D. Escher, Richard W. Foster, and Raymond R. Tison Feb. 1980 135 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51210) Avail: NTIS HC A07/MF A01

An assessment of the status of the integrated fuel cell/battery power system concept for electric vehicle propulsion is reported. The fuel cell, operating on hydrogen or methanol (indirectly), acts as a very high capacity energy battery for vehicle sustaining operation, while a special power battery provides over-capacity transient power on demand, being recharged by the fuel cell, e.g., during cruising. A focused literature search and a set of industrial and Government contacts were carried out to establish views, outlooks, and general status concerning the concept. Computer simulated driving cycle results indicate that the concept can provide needed range capabilities and general operating flexibility to electric vehicles. In view of these potential benefits, and the absence of any comprehensive research, development, and demonstration activities which are supportive of the fuel cell/battery system concept, the initiation of an appropriate effort is recommended. This general recommendation is supported by applicable findings, observations, and conclusions. M.G.

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GENERAL

A81-10589 # **Coal, air pollution, and forests.** *Energy and Technology Review,* Sept. 1980, p. 30-35.

A conifer forest computer model (SILVA) is developed that simulates growth and succession patterns in a western area over periods of up to 500 years. The model simulates competitive interactions that occur between individual members of the forest stand and such varied environmental influences as altitude, soil, weather, fires, and air pollution. According to model predictions, a pollution level (sulfur dioxide from coal-fired power plants) that reduces the growth rate of ponderosa pines by 10% will result in their being gradually replaced by the more tolerant and less valuable white fir. S.S.

A81-10590 # **Portable instrumentation for environmental field studies.** *Energy and Technology Review,* Sept. 1980, p. 36-41.

Low-power, portable instruments have been developed for measuring gas exchange on individual plant leaves, the aggregate carbon uptake and release of vast jungle and forest areas, and methane concentrations in and around the dense fog resulting from a liquefied-natural-gas (LNG) spill. The group includes a battery powered carbon dioxide sensor and three specialized instruments that incorporate it in various ways: a minicuvette gas-exchange monitor, a rapid-response carbon-dioxide-flux sensor with a high-speed, cooled IR detector, a response time of 10 ms and a sensitivity of about 0.03 ppm CO_2, and a methane monitor with the optical path shortened to 5 cm and with a quadrupled IR output. S.S.

A81-11211 **Basic research needs on high temperature ceramics for energy applications.** H. K. Bowen (MIT, Cambridge, Mass.). *Materials Science and Engineering,* vol. 44, June 1980, p. 1-56. 249 refs.

Research and development in ceramic materials is reviewed with emphasis on high-temperature structural ceramics for use in advanced energy-related systems. Consideration is given to the development and control of microstructure as well as behavior and properties, including crack growth mechanisms, creep rupture, chemical and electrochemical stability, and deformation mechanisms in multiphase ceramics. Particular attention is given to the problem of reliability and reproducibility. Research recommendations are given with reference to specific applications. V.L.

A81-14103 # **Why bother with basic research.** H. Elliot (Imperial College of Science and Technology, London, England). *ESA Bulletin,* no. 23, Aug. 1980, p. 7-9.

The rapid growth in expenditure on basic research in the past two or three decades has raised the question whether such levels of expenditure on this type of activity can be justified in the present socio-economic context. Several arguments in support of basic research are presented. B.J.

A81-14226 **Energy alternatives: An assessment; Proceedings of the Sixth Annual UMR-DNR Conference on Energy, University of Missouri-Rolla, Rolla, Mo., October 16-18, 1979. Volume 6.** Conference sponsored by the Missouri Department of Natural Resources, University of Missouri-Rolla, Ralston-Purina Co., Fruin-Colnon Co., and Associated Electric Cooperatives. Edited by J. D. Morgan (Missouri-Rolla, University, Rolla, Mo.). Rolla, Mo., University of Missouri-Rolla, 1980. 530 p.

The conference focused on fuel economy in transportation, energy alternatives, solar energy, nuclear power plant safety, energy management, biomass resources, energy storage, environmental problems, economics of energy, and political/social implications of energy. Papers were presented on thermochemical conversion of biomass energy, waste heat utilization, building energy usage, fusion and nuclear energy, wind energy, inelasticity of oil supply and oil price deregulation, fuel economy of freight pipeline for transporting coal, estimation of residential electricity demand, energy analysis of a solar assisted heat pump, and direct gas fired air heating. A.T.

A81-16101 **Horizons of optics; European Optics Conference, Pont-à-Mousson, Moselle, France, April 22-25, 1980, Proceedings (Horizons de l'optique; Conférence Européenne d'Optique, Pont-à-Mousson, Moselle, France, April 22-25, 1980, Proceedings).** Conference sponsored by the Centre National de la Recherche Scientifique, Centre National d'Etudes Spatiales, Délégation Générale à la Recherche Scientifique et Technique, and Direction des Recherches, Etudes et Techniques. *Journal of Optics,* vol. 11, Nov.-Dec. 1980. 131 p. In French and English.

Topics discussed include optics in space research, biological and medical applications of lasers, high-power lasers, and optical techniques of industrial testing. Also considered are the future prospects of solar energy and new trends in infrared technology. B.J.

A81-17477 **Reflections on the survey of energy problems at the last World Energy Conference /Munich, September 8-13, 1980/ (Réflexions sur la revue des problèmes d'énergie par la dernière Conférence Mondiale de l'Energie /Munich, 8-13 Septembre 1980/).** P. Ailleret. *Revue de l'Energie,* vol. 31, Nov. 1980, p. 390-394. In French.

A81-18746 **New lubricating oils by graphite treatments of petroleum distillates.** A. J. Groszek (British Petroleum Co., Ltd., Research Centre, Sunbury-on-Thames, Middx., England). *American Society of Lubrication Engineers and American Society of Mechanical Engineers, International Lubrication Conference, San Francisco, Calif., Aug. 18-21, 1980, ASLE Preprint 80-LC-8A-4.* 7 p. 5 refs.

The paper examines several applications of graphite adsorbents to selective adsorption of n-paraffins and aromatic compounds from mineral oil in which unadsorbed fractions usually constitute refined oils representing high-quality lubricating oil basestocks. It is shown that graphite refining can produce oils similar to those obtained by super-refining treatment, i.e. high-pressure hydrogenation and deep dewaxing. Otherwise, the process can be used to prepare good quality base oils in one step, thus eliminating furfural extraction, dewaxing, and ferrofining or clay contacting. (Author)

N81-10223# Joint Publications Research Service, Arlington, Va.

WEST EUROPE REPORT: SCIENCE AND TECHNOLOGY NO. 3

14 Nov. 1979 85 p Transl. into ENGLISH from various European articles

(JPRS-74565) Avail: NTIS HC A05/MF A01

Information on national level science policies, technology strategies, and research and development programs in West European science and technology in general and specifically in civil technology is presented. Particular attention is given to transportation, energy, chemical manufacturing, industrial automation and technology transfer.

N81-10894 Societe Nationale Industrielle Aerospatiale, Les Mureaux (France). Div. Systemes Balistiques et Spatiaux.

EXAMPLE OF A POLICY FOR DEVELOPING SPACE TECHNOLOGY SPIN-OFFS IN OTHER FIELDS [EXEMPLE D'UNE POLITIQUE DE VALORISATION DE RETOMBEES TECHNOLOGIQUES SPATIALES DANS D'AUTRES DOMAINES]

Didier G. Compard Paris 1980 35 p In FRENCH Presented at Intern. Colloq. on Econ. Effects of Space and Other Adv. Technol., Strasbourg, Apr. 1980

(SNIAS-801-422-108) Avail: NTIS HC A03

Spin-offs fall into two categories: direct products available when satellites are put into orbit with applications in such areas as Earth communication stations, computer terminals, television stations and indirect products with specific applications in special industrial or commercial sectors. Spin-offs related to the oil, nuclear, and solar energy industries are presented together with other applications in medicine, heavy load braking systems (airplanes, tanks, etc.), chemical products, vehicle shielding, gas storage, magnetic bearings, gyroscopic energy storage systems, safety systems, and special materials. Author (ESA)

A81-11001 **Plane steady problem of heat-conduction theory for a hyperbolic cylinder with boundary conditions of the third kind.** B. A. Vasil'ev (Leningradskii Institut Sovetskoi Torgovli, Leningrad, USSR). *(Inzhenerno-Fizicheskii Zhurnal,* vol. 38, Jan. 1980, p. 150-153.) *Journal of Engineering Physics,* vol. 38, no. 1, July 1980, p. 107-109. 5 refs. Translation.

The paper examines the two-dimensional problem of heat conduction for a hyperbolic cylinder, whose surface is heated according to the Newton law. Fredholm equations of the second kind are obtained for temperature distribution on the cylinder. The equations can be efficiently solved by numerical methods and by the method of successive approximations at low values of the Biot criterion. B.J.

N81-11475# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.

ENERGY TECHNOLOGY PROGRAMS: PROGRAM SUMMARIES FOR 1979

B. Manowitz and T. E. OHare Dec. 1979 48 p

(Contract DE-AC02-76CH-00016)

(BNL-51167) Avail: NTIS HC A03/MF A01

The Energy Technology Programs in the Brookhaven National Laboratory Department of Energy and Environment cover a broad range of activities, namely: electrochemical research, chemical energy storage, chemical heat pumps, solar technology, fossil technology, catalytic systems development, space conditioning technology, and technical support/program management. Summaries of the individual tasks associated with these activities along with publications, significant accomplishments, and program funding levels are presented. DOE

N81-11476# Department of Energy, Washington, D. C. Office of Basic Energy Sciences.

BASIC RESEARCH NEEDS IN SEVEN ENERGY RELATED TECHNOLOGIES, CONSERVATION, CONVERSION, TRANSMISSION AND STORAGE, ENVIRONMENTAL FISSIONS, FOSSIL, GEOTHERMAL, AND SOLAR

Jul. 1980 209 p refs

(DOE/ER-0060) Avail: NTIS HC A10/MF A01

Seven studies performed by seven groups at seven national laboratories are presented. The laboratories were selected because of their assigned lead roles in research pertaining to the respective technologies. Researchers were requested to solicit views of other workers in the fields. DOE

N81-11953*# AiResearch Mfg. Co., Phoenix, Ariz.

COST/BENEFIT ANALYSIS OF ADVANCED MATERIALS TECHNOLOGY CANDIDATES FOR THE 1980'S, PART 2 Final Report

R. E. Dennis and H. F. Maertins Aug. 1980 106 p refs

(Contract NAS3-20073)

(NASA-CR-165176; AIRESEARCH-21-3663-PT-2) Avail: NTIS HC A06/MF A01 CSCL 05A

Cost/benefit analyses to evaluate advanced material technologies projects considered for general aviation and turboprop commuter aircraft through estimated life-cycle costs, direct operating costs, and development costs are discussed. Specifically addressed is the selection of technologies to be evaluated; development of property goals; assessment of candidate technologies on typical engines and aircraft; sensitivity analysis of the changes in property goals on performance and economics, cost, and risk analysis for each technology; and ranking of each technology by relative value. The cost/benefit analysis was applied to a domestic, nonrevenue producing, business-type jet aircraft configured with two TFE731-3 turbofan engines, and to a domestic, nonrevenue producing, business type turboprop aircraft configured with two TPE331-10 turboprop engines. In addition, a cost/benefit analysis was applied to a commercial turboprop aircraft configured with a growth version of the TPE331-10. M.G.

N81-11956# Department of Energy, Washington, D. C.

ELECTRIC AND HYBRID VEHICLE SELF-CERTIFICATION AND VERIFICATION PROCEDURES: MARKET DEMONSTRATION PROGRAM

Mar. 1980 17 p Revised

(DOE/CS-0178-Rev-1) Avail: NTIS HC A02/MF A01

The process by which a manufacturer of an electric or hybrid vehicle certifies that his vehicle meets the DOE Performance Standards for Demonstration is described. Such certification is required for any vehicles to be purchased under the Market *Demonstration Program. The verification testing process followed* by DOE for testing to verify compliance is described. Manufacturer responsibilities are outlined and procedures for recertification of vehicles that have failed verification testing are presented. DOE

N81-12978*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

IMPACT FOR THE 80'S: PROCEEDINGS OF A CONFERENCE ON SELECTED TECHNOLOGY FOR BUSINESS AND INDUSTRY

Nov. 1980 238 p Conf. held in Cleveland, 14-15 May 1980

(NASA-CP-2149; E-489) Avail: NTIS HC A11/MF A01 CSCL 05A

Various aspects of advanced energy technology are discussed. Specific emphasis is given to: aircraft propulsion; wind power commercialization; materials and structures, lubrication and bearings; Stirling and gas turbine engines; and electric and hybrid vehicles.

N81-12979*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ENERGY OVERVIEW

Henry O. Slone *In its* Impact for the 80's: Proc. of a Conf. on Selected Technol. for Business and Ind. Nov. 1980 p 1-9

Avail: NTIS HC A11/MF A01 CSCL 10A

The experience, capabilities, and facilities being utilized at NASA Lewis in support of energy programs conducted by the Department of Energy and other agencies are discussed. Background information is given regarding NASA's involvement in solving energy problems. R.C.T.

N81-13064# Battelle Columbus Labs., Ohio.

MECHANICAL PROPERTY IMPROVEMENT OF PROTECTIVE COATINGS FOR TURBINE ENGINES USING COAL-DERIVED FUELS Final Report

H. A. Beale 1 Sep. 1980 21 p refs

(Contract DE-AC03-78ET-12293)

(DOE/ET-12293/T1) Avail: NTIS HC A02/MF A01

Nb-NbC and Nb-NbB2 coatings were studied to determine how thermal expansion differences between a metal matrix and a dispersed phase affect the coating properties. The Nb-NbC and Nb-Nb-NB2 coatings were deposited by dual source electron beam evaporation. Transmission electron microscopic (TEM) examination of the deposited coatings revealed that the NbC and NbB2 in the coating was randomly dispersed with particle size of less than 50 A. The effect of such finely dispersed particles on the Peierls stress in the coating was found to have negligible impact on the coating properties. DOE

N81-13074* National Aeronautics and Space Administration, Washington, D. C.
HIGHLIGHTS OF 1980 ACTIVITIES
24 Dec. 1980 18 p
(NASA-News-Release-80-199; P80-10206) Avail: NASA Scientific and Technical Information Facility, P. O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22A

Progress in the Space Transportation System is reported. A review of the Voyager 1 mission is presented along with a summary of facts gathered on its Saturn encounter. Research and development in energy technology, space tracking, and data systems is described. T.M.

N81-13170# Ames Lab., Iowa. Dept. of Chemical Engineering.
POWER PLANT FLY ASH AS A RESOURCE FOR ALUMINA AND CEMENT
M. J. Murtha and George Burnet 1980 21 p refs Presented at the 89th Ann. Meeting of the AIChE, Portland, Oreg., 17 Aug. 1980
(Contract W-7405-eng-82)
(IS-M-289; CONF-800802-15) Avail: NTIS HC A02/MF A01

A sinter process developed to form soluble aluminate compounds from mixtures of fly ash, limestone, and soda ash is discussed. The aluminates are extracted, treated to remove silicates, and precipitated; the precipitate is calcined to metallurgical grade alumina. The extract residue shows promise as a raw material for the production of Portland cement. Process economics are presented, and the effects of alumina and silica contents of the fly ash, sintering temperatures and time, and sales credits for by-products are discussed. DOE

N81-13577# Northrop Services, Inc., Huntsville, Ala.
SITE INSOLATION AND WIND POWER CHARACTERISTICS, NORTHEAST REGION, VOL. 2
Roger E. Bray Aug. 1980 104 p refs
(Contracts DE-AC01-77ET-20160; EG-77-C-01-4016)
(DOE/CS-20160/01) Avail: NTIS HC A06/MF A01

Historic data (SOLMIET), at 8 National Weather Service stations with hourly solar insolation and collateral meteorological information, were interrogated to provide an estimate of future trends. Solar data are global radiation incident on a horizontal surface, and wind data represent wind power normal to the air flow. Selected insolation and wind power conditions were investigated for their occurrences and persistance for defined periods of time, on a monthly basis. Global horizontal insolation are related to inclined surfaces at each site. Ratios are provided, monthly, for multiplying global insolation to obtain insolation estimates on southfacing surfaces inclined at different angles with respect to the horizontal. DOE

N81-13957*# New Mexico Univ., Albuquerque. Technology Application Center.
TECHNOLOGICAL FORECASTING--AIRCRAFT DESIGN. CITATIONS FROM THE INTERNATIONAL AEROSPACE ABSTRACTS DATA BASE Progress Report, 1974 - Aug. 1980
Gerald F. Zollars and Mary K. Gallagher Sep. 1980 45 p Supersedes NTIS/PS-79/1017 Sponsored in part by NASA and NTIS
(NASA-CR-163833; PB80-815970; NTIS/PS-79/1017) Avail: NTIS HC $30.00/MF $30.00 CSCL 01C

Technological forecasts of aircraft design are discussed in approximately 162 citations. Forecasts dealing with the configuration of both civil and military aircraft are included. Specific topics stressed are fuel consumption, avionics, and cost and noise reduction. GRA

N81-14045# Massachusetts Univ., Amherst. Dept. of Chemistry.
AN ANALYTICAL CHEMICAL SYSTEM FOR THE DETERMINATION OF HEAVY METALS AND ORGANIC COMPOUNDS Annual Progress Report, 1 Dec. 1979 - 30 Nov. 1980
Sidney Siggia and Ramon M. Barnes 15 Aug. 1980 38 p refs
(Contract DE-AC02-77EV-04320)
(DOE/EV-04320/1) Avail: NTIS HC A03/MF A01

The synthesis, characterization, and application of sequestering resins for the measurement of inorganic and organic compounds at trace and ultratrace levels found in energy related materials are described. The major synthesis effort was directed toward creation of resins for inorganic and organic compounds. Although a number of new resins were created, only a few provided the quality required for extended analytical applications. In particular, the poly(dithiocarbonate) resin was extended to 59 elements and continues under investigation for metal sequester, and a new poly(acrylamidoxide) resin was found to complex 17 elements with strong possibility for more and was applied in the trace metal analysis of seawater and fresh pond water. Both resins exhibit the capability to sequester specific oxidation states selectively which introduces the possibilities for chemical speculation. S.F.

N81-14082*# General Electric Co., Philadelphia, Pa. Advanced Energy Programs Dept.
IMPROVED CERAMIC HEAT EXCHANGER MATERIALS Final Report
Harry W. Rauch Dec. 1980 39 p refs
(Contracts NAS3-19698 EC-77-A-31-1011; DE-AI01-77CS-51040)
(NASA-CR-159678; DOE/NASA/9698-2) Avail: NTIS HC A03/MF A01 CSCL 07C

The development and evaluation of materials for potential application as heat exchanger structures in automotive gas turbine engines is discussed. Test specimens in the form of small monolithic bars were evaluated for thermal expansion and dimensional stability before and after exposure to sea salt and sulfuric acid, followed by short and long term cycling at temperatures up to 1200 C. The material finally selected, GE-7808, consists of the oxides, ZrO_2-MgO-Al_2O_3-SiO_2; and is described generically as ZrMAS. The original version was based on a commercially available cordierite (MAS) frit. However, a clay/talc mixture was demonstrated to be a satisfactory very low cost source of the cordierite (MAS) phase. Several full size honeycomb regenerator cores, about 10.2 cm thick and 55 cm diameter were fabricated from both the frit and mineral versions of GE-7808. The honeycomb cells in these cores had rectangular dimensions of about 0.5 mm x 2.5 mm and a wall thickness of approximately 0.2 mm. The test data show that GE-7808 is significantly more stable at 1100 C in the presence of sodium than the aluminosilicate reference materials. In addition, thermal exposure up to 1100 C, with and without sodium present, results in essentially no change in thermal expansion of GE-7808. M.G.

N81-14262# National Technical Information Service, Springfield, Va.
SUPERCONDUCTING MAGNETS. CITATIONS FROM NTIS DATA BASE Progress Report, Sep. 1978 - Sep. 1980
George W. Reimherr Oct. 1980 225 p Supersedes NTIS/PS-78/1063
(PB80-816028; NTIS/PS-79/1063) Copyright. Avail: NTIS HC $30.00/MF $30.00 CSCL 09C

The cited reports discuss research on materials studies, theory, design and applications of superconducting magnets. Examples of applications include particle accelerators, MHD power generation, superconducting generators, nuclear fusion research devices, energy storage systems, and magnetic levitation. This updated bibliography contains 218 citations, 88 of which are new entries to the previous edition. GRA

08 GENERAL

N81-14341# Los Alamos Scientific Lab., N. Mex.
BICYCLE: A COMPUTER CODE FOR CALCULATING LEVELIZED LIFE-CYCLE COSTS
R. W. Hardie Aug. 1980 38 p ref
(Contract W-7405-eng-36)
(LA-8493-MS) Avail: NTIS HC A03/MF A01

This report serves as a user's manual for the BICYCLE computer code. BICYCLE was specifically designed to calculate levelized life cycle costs for plants that produce electricity, heat, gaseous fuels, or liquid fuels. Included are (1) derivations of the equations used by BICYCLE, (2) input instructions, (3) sample case input, and (4) sample case output. DOE

N81-15116# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
TECHNOLOGY ASSESSMENT OF CERAMIC JOINING APPLICABLE TO HEAT EXCHANGERS
G. W. Brassell and V. J. Tennery Jul. 1980 31 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7306) Avail: NTIS HC A03/MF A01

The joining-bonding technology applicable to high temperature heat exchangers was assessed to identify the status of ceramic materials joining technology and to determine needs for future research and development. This was accomplished through meetings and discussions with personnel in ceramic and electronic films and an extensive review of the literature. L.F.M.

N81-15746# Aerospace Corp., El Segundo, Calif.
THE INFLUENCE FUNCTION METHOD APPLIED TO ENERGY TIME SERIES DATA
Michael R. Chernick and Darryl J. Downing (ORNL) 1980 24 p refs
(Contract W-7405-eng-26)
(CONF-801045-3) Avail: NTIS HC A02/MF A01

The use of the influence function matrix for the auto correlation function of a time series is proposed as a method for detecting outliers in energy time series data. The method is proved to be effective in detecting errors in data from a monthly power plant report. The technique is also applicable to the safeguards problem of detecting losses of nuclear materials. A summary statistic, the average square influence function, is proposed for a hypothesis test for outliers. Asymptotic distribution theory for this summary statistic is presented. M.G.

ENERGY/*A Continuing Bibliography (Issue 29)* APRIL 1981

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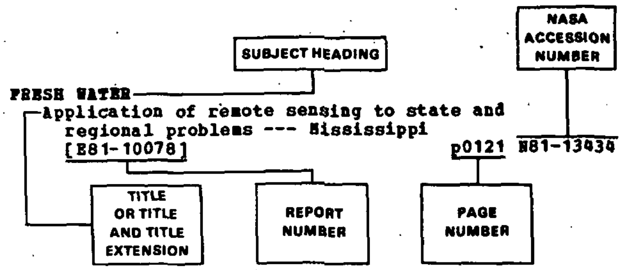

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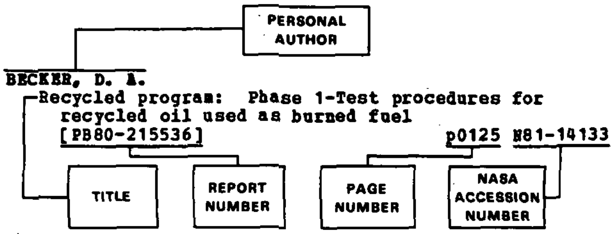

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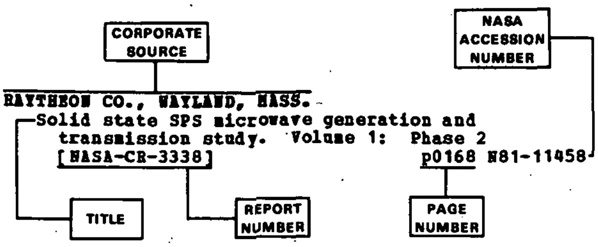

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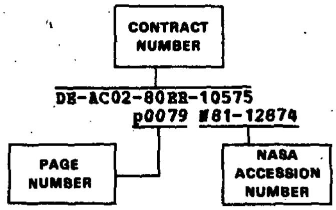

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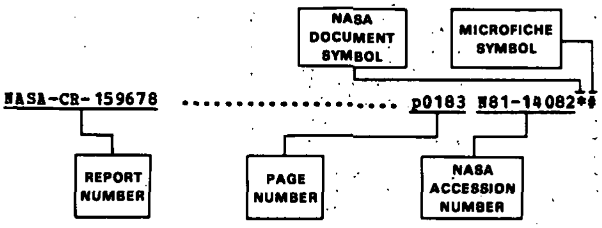

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