Energy
A Continuing
Bibliography
with Indexes

NASA SP-7043(32)
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NASA SP-7043(32)

ENERGY

A Continuing Bibliography

With Indexes

Issue 32

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 October 1 through December 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(32)) lists 1316 reports, journal articles, and other documents announced between October 1, 1981 and December 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.

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

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

Five indexes -- subject, personal author, corporate source, contract number, and report number -- are included.

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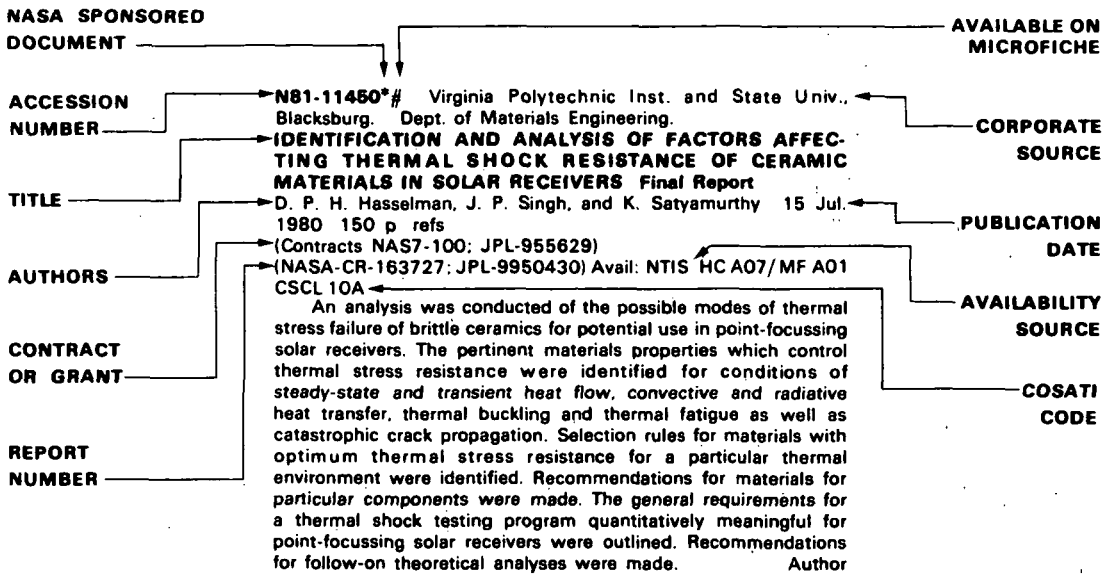

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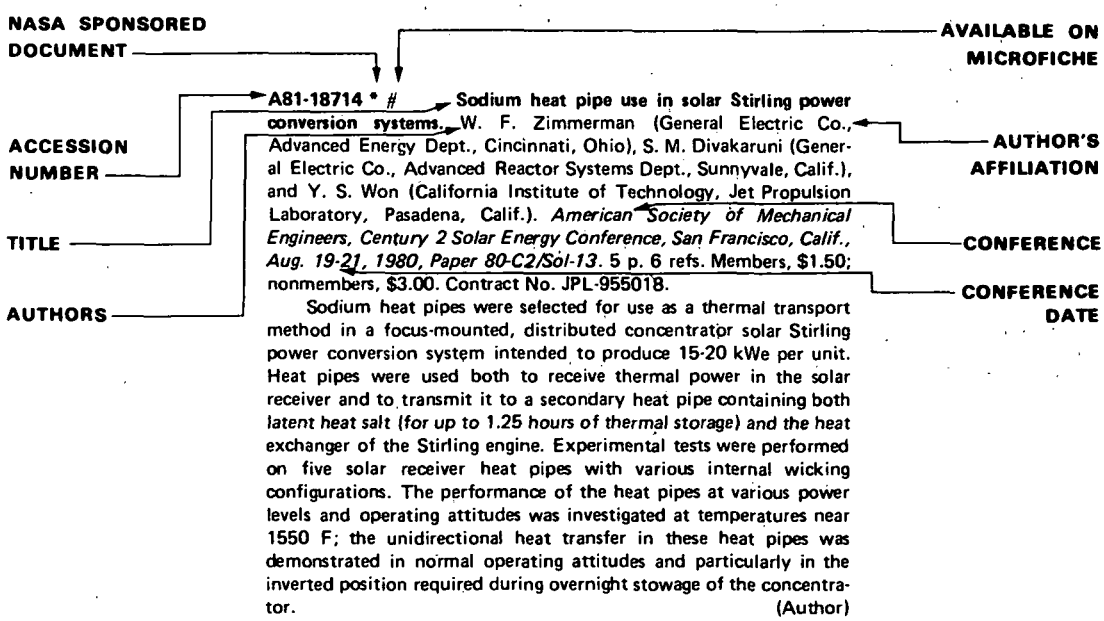

A Listing of Energy Bibliographies Contained In This Publication:

ENERGY

A Continuing Bibliography (Issue 32)

JANUARY 1982

01
ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

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

A81-41874 **Legal aspects of solar energy.** Edited by J. H. Minan (San Diego, University, San Diego, CA) and W. H. Lawrence. Lexington, MA, Lexington Books, 1981. 245 p. $23.95.

The objective of this book is to facilitate the realization of solar energy's potential through an analysis of the fundamental legal barriers that presently impede its widespread use. An overview of solar energy is provided and aspects of solar technology are examined, taking into account the sun, active solar-energy system, distribution, storage, applications, passive systems, the costs of solar systems, and the generation of electricity. Common-law doctrines and solar energy are considered along with a legislative approach concerned with questions of access to the sunlight, state and federal tax incentives to promote solar use, public and private methods of financing solar-energy devices, the relationship between utilities and solar energy, the limited role of warranties, and relations between oil companies and solar energy. An analysis is conducted of product standards, which hold great promise for overcoming user resistance, taking into account institutional barriers to solar commercialization, current solar standards development, and an evaluation of the significance of standards for solar-energy equipment. G.R.

A81-41875 **Synthetic fuels technology overview with health and environmental impacts.** E. J. Bentz, Jr. and E. J. Salmon. Research sponsored by the U.S. Environmental Protection Agency. Ann Arbor, MI, Ann Arbor Science Publishers, Inc., 1981. 136 p. 66 refs. $19.95.

An introduction is presented to the following synthetic fuels technologies: (1) the Lurgi gasification of coal; (2) the Fischer-Tropsch liquefaction of coal; (3) coal-methanol conversion; (4) donor solvent gas liquefaction; (5) Tosco surface shale retorting; ethanol production from coal; and (6) the coal-methanol-gasoline conversion process. After establishing the system characteristics of these six technologies, consideration is given to their potential major health, safety, environmental and socio-economic impacts at the global, regional and local levels. It is determined that the main global consequence of synfuels development is climate modification, to which may be added the regional impact of dry and wet deposition of gaseous and particulate pollutants, and land and water quality deterioration due to soil erosion at the local level. O.C.

A81-41904 **Geothermal energy projects - Planning and management.** Edited by L. J. Goodman (East-West Center, Honolulu, HI) and R. N. Love (Massey University, Palmerston North, New Zealand). New York and Oxford, Pergamon Press, 1980. 244 p. $33.

A presentation is made of management requirements for the development of geothermal resources by citing three major, and successful, projects: the Wairakei geothermal power project of New Zealand, the Hawaii geothermal project of the United States, and the Tiwi geothermal project of the Philippines. The three case studies are presented according to a format in which the history of each project falls into four phases: (1) planning, appraisal and design; (2) section, approval and activation; (3) operation, control and handover; and (4) evaluation and refinement. Each case study furnishes extensive performance and economic figures, along with consideration of such related issues as geothermal effluent chemical content, infrastructural requirements, and environmental impact. O.C.

A81-41905 **An introduction to geothermal energy.** L. J. Goodman (East-West Center, Honolulu, HI) and R. N. Love (Massey University, Palmerston North, New Zealand). In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 1-23. 7 refs.

A wide ranging introduction is given to the known resources and potential applications of geothermal energy. The discussion covers (1) the geological bases for the existence of heat flow and geothermal gradients in crustal plate boundaries; (2) the classification of resources into hydrothermal convection, hot igneous and conductive environment systems; (3) the approximate temperature requirements of geothermal fluids for various applications; (4) an inventory of residential, commercial, agricultural, food-processing and industrial users; (5) present and estimated electrical geneneration capacity for such rich geothermal resources as those of the U.S., Mexico, Turkey, Japan and Indonesia; and the four phases of the Integrated Project Planning and Management Cycle (IPPMC): comprising (1) planning, appraisal, and design; (2) selection, approval and activation; (3) operation, control and 'handover'; and (4) evaluation and refinement. O.C.

A81-41906 **Wairakei geothermal power project - New Zealand.** R. N. Love (Massey University, Palmerston North, New Zealand) and R. Bolton (Ministry of Works and Development, New Zealand). In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 24-94. 7 refs.

A comprehensive account is given to the development history of New Zealand's Wairakei geothermal power project. The project site was chosen because: (1) the area contained streams which could provide water needed for drilling operations; (2) the nearby Waikato River could provide an ample source of cooling water when electrical generation operations began; (3) the lands belonged to the government and no private interests would be affected; (4) the area was made up of unproductive wasteland; and (5) the location was isolated and would not detract from scenic attractions that are a major tourist resource in nearby areas. An extensive analysis is given of the capital costs factors influencing the project during its planning and design phase, and emphasis is put on the decision making relationships among government agencies with responsibility in the management of the program. O.C.

A81-41907 **Hawaii geothermal project - United States.** L. J. Goodman, B. Yount (East-West Center, Honolulu, HI), and T. Miyabara. In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 95-167. 21 refs.

An historical account is presented of the conduct of a major geothermal energy project on the island of Hawaii. Attention is given to the geophysical surveys and engineering and environmental-socioeconomic studies conducted at the outset, the mechanical principles of the vapor flashing and binary flashing plant design alternatives considered, the choice of plant locations, the design and construction of the geothermal well casing, and the extensive test program conducted upon the well's completion. Also detailed are the geothermal research test facility's estimated plant equipment costs, well performance figures, geothermal fluid chemical content, operation noise levels, and financial summary for the project over the period 1973-78. O.C.

A81-41908 Tiwi geothermal project - The Philippines. R. Aquino (De La Salle University, Manila, Philippines), S. Aquino (Philippine National Oil Co., Manila, Philippines), and A. Alcaraz. In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 168-205. 5 refs.

An account is given of the Philippines' Tiwi geothermal field development and related research projects. Among the topics covered are: (1) preliminary research studies throughout the Philippine archipelago, considering such potential sites as direct volcanic exhalations, shallow volcanic sources, deep-seated plutonic sources, and deep faulting in regions of high geothermal gradient; (2) fault systems detected by aerial photographic surveys, such as the plug-dome fault systems, radial fault systems, and arcuate fault systems; (3) performance figures on test drill holes at six different locations; (4) mechanical details of the Tiwi steam-gathering system; (5) the National Power Corporation's organization of responsibilities; and (6) detailed comparisons of energy demand, sources and their costs in the Philippines as seen by the Ten-Year Energy Program for the period 1979-88. O.C.

A81-41909 Policies of geothermal development. L. J. Goodman (East-West Center, Honolulu, HI) and R. N. Love (Massey University, Palmerston North, New Zealand). In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 206-222. 5 refs.

The case histories of (1) the Wairakei geothermal power project of New Zealand, (2) the Hawaii Geothermal project of the U.S., and (3) the Tiwi geothermal project of the Philippines are examined. It is argued that geothermal energy managers must be capable of accomplishing the following tasks: (1) coordination of resource exploration and evaluation, and the establishment of an optimum plant location; (2) the determination of the size of the resource and its hydrothermal and chemical characteristics; (3) designation of the site's civil improvements and plant module foundations; (4) design of the collection and reinjection system pipelines; (5) management of the procurement and detailed design of all modules and their interconnections; and (6) management of construction, activation, and training activities. O.C.

A81-42694 Southern California Edison bets on energy alternatives. W. B. Riley. *IEEE Spectrum*, vol. 18, Aug. 1981, p. 40-45. 5 refs.

A 10-MW solar-thermal generating plant and a 100-MW integrated coal-gasification combined cycle (IGCC) power facility are being built to develop a wide range of renewable, alternative power sources by 1990. The solar-thermal generating plant will use steam at 500 C and 100 kg/sq cm to produce 10 MW of electricity. It consists of a 1818 heliostat array, each weighing 1155 kg and having 12 mirrors which are rotated at either 0.25 deg/min (for sun following) or 22.5 deg/min (for major focusing and defocusing). A master control system allows both fully automatic and manual operation, and a beam-characterization system permits the operator to check the alignment of each heliostat individually. A central receiver, consisting of 24 panels of tubing, produces steam at 500 C and 100 kg/sq cm. The thermal storage unit uses crushed granite to absorb 50 kWht/cu m, allowing the plant to operate after sundown. The IGCC plant integrates the coal-gasification plant and the combined-cycle unit, demonstrating operational flexibility and reliability, load-following capability, and compliance with environmental regulations. The gasifier produces 79,300 cu m/h of a mixture of 51% CO and 36% H at 1370 C,and the gas turbine regenerates 65 MW through its own generator. J.F.

A81-42720 Topical problems of guideline editing with regard to emission control - Results and conclusions of a 1980 informative symposium by the VDI commission for clean air (Aktuelle Probleme der Richtlinienarbeit zur Emissionsbegrenzung - Ergebnisse und Folgerungen des Informationssymposiums 1980 der VDI-Kommission Reinhaltung der Luft). J. Kölble. *Staub - Reinhaltung der Luft*, vol. 41, July 1981, p. 237-239. In German.

A81-42785 * Development of simplified airborne computations for fuel conservative descents in a time-based metered air traffic environment. C. E. Knox (NASA, Washington, DC). *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 7-10, 1981, Paper 810642.* 18 p. 9 refs.

The NASA has developed and flight-tested a simple flight management descent algorithm designed to improve the accuracy of delivering an airplane in a fuel-conservative manner to a metering fix at a time designated by air traffic control. This algorithm provides a three-dimensional path with terminal area time constraints (four-dimensional) for an airplane to make an idle-thrust, clean-configured (landing gear up, flaps zero, and speed brakes retracted) descent to arrive at the metering fix at a predetermined time, altitude, and airspeed. The descent path is calculated for a constant Mach/airspeed schedule from linear approximations of airplane performance with considerations given for gross weight, wind, and nonstandard pressure and temperature effects. Applications of the four-dimensional and descent planning capabilities of the algorithm to conventional airplanes is being investigated. This report describes the flight management descent algorithm and presents the results of the flight tests flown with the Terminal Configured Vehicle airplane. (Author)

A81-42948 The economics of synthetic fuels and chemicals production from nuclear power and from coal. S. P. S. Andrew (Imperial Chemical Industries, Ltd., Agricultural Div., Billingham, Middx., England). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1653-1660.

The relative costs of production and likely prices for a number of important energy sources and basic chemicals are analysed in terms of future coal, oil and natural gas prices. It is concluded that Europe and Japan will be in a particularly difficult economic situation which can only be partially alleviated by a rapid expansion of nuclear power. The use of biomass as an energy source is not a practical solution in developed countries. (Author)

A81-43045 Effects of synfuel use. M. Ghassemi, R. Iyer, R. Scofield (TRW Energy Systems Group, Redondo Beach, CA), and J. McSorley (U.S. Environmental Protection Agency, Research Triangle Park, NC). *Environmental Science and Technology*, vol. 15, Aug. 1981, p. 866-873. U.S. Environmental Protection Agency Contract No. 68-02-3174.

The EPA sponsored an effort to investigate the environmental implications of a large-scale use of synfuel products. In forecasting the future of the synfuel product industry, it was shown that shale oil is more nearly cost-competitive and closer to commercialization than are high-Btu gasification and coal liquefaction, and will probably be used by 35% of all refinery feed and 48% of all middle distillate in the north-western region of the U.S.A by the year 2000. For the next two decades, environmental impacts will be confined primarily to synfuel production regions. Current environmental data are characterized in terms of gross properties, which do not provide an adequate basis for assessing environmental significance. Known differences in chemical, combustion, and health effects between synfuel products and their petroleum analogues are presented, showing the former to be more hazardous due to greater mutagenic, tumorigenic, and cytotoxic properties. Various synfuel products are also compared and ranked on their potential for exposure, emission, toxic hazard, cost of control, and adequacy of existing regulations. J.F.

A81-43157 # **Wright Field turboprop study.** R. C. Lorenzetti and P. P. Dull (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1685.* 6 p.

The considered investigation was conducted as part of an effort to reduce aircraft fuel costs. Turboprops are very fuel efficient at speeds below Mach 0.6. One of the most promising approaches to reduce fuel consumption in the speed range from Mach 0.6 to 0.8 is related to an employment of the swept eight to ten blade propeller (propfan) being developed by NASA. All studies to date indicate that turboshaft engines with propfans might save 15% or more of the fuel used by a turbofan engine of comparable technology. Attention is given to a turboprop status review, contractor studies, the NASA propfan program, an in-house performance study, specific problems which have to be solved to make a twin-turboprop, 100-150 passenger transport a viable possibility for the early 1990s, and turboprop dilemmas. G.R.

A81-43949 # **A synopsis of the Navy A-7 Aircraft Fuel Conservation program.** W. E. Mallett (Vought Corp., Dallas, TX) and M. Herskovitz (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1681.* 8 p. 8 refs.

A description is given of the Navy Aircraft Fuel Conservation program, with emphasis on fuel conservation methods devised for the A-7 aircraft. The fundamental elements of the program are reductions in (1) aircraft weight; (2) aerodynamic drag; (3) engine specific fuel consumption; and (4) fuel losses. Weight reduction is implemented through comprehensive use of plastic composite and titanium alloy secondary structures and accessories, and the incorporation of lighter subsystems (generator, radar, armor, etc.). Aerodynamic improvements include the application of fairings and fillets to various portions of the fuselage and wing. In addition, the efficiency of peripheral pneumatic and hydraulic systems' power extraction from the engine is increased through redesign. A description is given of the onboard Flight Performance Advisory System. O.C.

A81-44042 **Boeing 767 - The new fuel saver.** J. Marsden. *Flight International,* vol. 120, Aug. 8, 1981, p. 436-440, 442-448, 453.

A detailed introduction is given for the 767 airliner, which is intended to yield an 8.5% fuel reduction in 100-2000 n. mi. flights by comparison with the A310. Attention is given to such aspects of the aircraft as passenger accommodations, the extensive use of CRT displays for both electronic flight instrumentation and engine indication/crew alerting systems in the cockpit, advanced hydraulic, environmental control and electrical systems, the use of carbon and Kevlar-reinforced plastics, the airframe assembly sequence, and engine performance characteristics. Detailed dimensional data are presented, and a tentative list of airline orders and options is given showing a total of 173 orders and 138 options. Airline orders will differ in their choice of JT9D or CF6-80 engines. A cut-away section of the aircraft is included. O.C.

A81-44164 **Contribution to the study of sulphur dioxide transformation in power plant plumes - Tests in laboratory and on flue gases of an oil-fired power plant.** J. C. Sabroux, D. Vigla, G. Madelaine (Commissariat à l'Energie Atomique, Laboratoire de Physique de l'Atmosphère, Fontenay-aux-Roses, Hauts-de-Seine, France), G. Maffiolo, and J. Dubois (Electricité de France, Département Environnement Aquatique et Atmosphérique, Chatou, Yvelines, France). *Atmospheric Environment,* vol. 15, no. 9, 1981, p. 1605-1613. 18 refs.

The reported study has the objective to determine the nature and speed of the transformations which take place in the exhaust gases of oil-fired power plants. An investigation was conducted of the reactions which take place in the plume shortly after emission (dilution factor less than 100), giving particular attention to the point of water vapor condensation. Laboratory experiments were conducted to study two distinct types of chemical reactions, including reactions in the homogeneous gaseous phase (with and without ultraviolet light) and reactions in the heterogeneous phase. A semidynamic simulation device was used for the experiment. The device consists of three elements, including an injection pipe, a smog chamber, and an exhaust stack. On the basis of the study results, it appears that a transformation of SO2 to SO3 must occur. G.R.

A81-44166 **Particulate sulfate in Lexington, Kentucky and its relation to major surrounding SO2 sources.** A. M. Hazrati and L. K. Peters (Kentucky, University, Lexington, KY). *Atmospheric Environment,* vol. 15, no. 9, 1981, p. 1623-1631. 25 refs.

An experimental study was conducted during 1979 and 1980 to establish the chemical composition and size distribution of the atmospheric aerosol in Lexington, Kentucky. The sulfate, nitrate, metal and acid co:.tents of the total suspended particulate captured on Hi-Vol filters were measured. The daily average particulate sulfate concentration was relatively high (10-40 microgram/cu m), even though there are no substantial sources of either SO2 or sulfate in the immediate Lexington area. Eighty per cent or more of the sulfate was contained in particles having an aerodynamic equivalent diameter of less than 1 micron. The results of air trajectory calculations were empirically correlated to relate the measured sulfate and total sulfur to the emissions from the 23 largest coal burning power plants in Kentucky, distance and time of transport, and relative humidity. The sulfate levels were proportional to the SO2 emissions from these sources and showed a strong inverse dependence on the plume travel distance. These factors are consistent with the formation of SO4(2-) in the atmosphere during transport. (Author)

A81-44174 **Benzene, toluene and xylene concentrations in car exhausts and in city air.** E. Hasanen, V. Karlsson, E. Leppamaki (Technical Research Centre of Finland, Esbo, Finland), and M. Juhala (Helsinki University of Technology, Helsinki, Finland). *Atmospheric Environment,* vol. 15, no. 9, 1981, p. 1755-1757. 10 refs. Research supported by the Academy of Finland.

A81-44278 # **Air pollution control practices in large thermal power plants in India.** N. C. Debnath (National Thermal Power Corp., Ltd., Operation Services Div., New Delhi, India). *Indian Journal of Environmental Protection,* vol. 1, Apr. 1981, p. 97-102.

The status of Indian thermal power plants, their emissions and health aspects, current practices in controlling the emissions of various air pollutants and difficulties encountered in maintaining the 'clean air' drive are briefly described. The NTPC-Super thermal power projects (STPP) and its role in this context have also been highlighted. With the current trend of accelerated development of coal fired STPP, it is apprehended that present control technology in India would far outweigh the demands, unless stringent control guidelines are legalized. (Author)

A81-44279 # **Stack gas desulphurization recovery processes in thermal power plants of the world. II - Processes based on adsorption of SO2 on activated carbon.** S. Kumar (Banaras Hindu University, Varanasi, India). *Indian Journal of Environmental Protection,* vol. 1, Apr. 1981, p. 103-109. 22 refs.

Processes in use at thermal power plants for the recovery of SO2 adsorbed on activated carbon in flue gas desulfurization are discussed. Attention is given to methods for adsorbent regeneration by heating to induce a reaction between the carbon and sulfuric acid to produce SO2 (the Chemiebau or Reinluft and Bergbau-Forschung/Foster Wheeler processes), by washing with water to produce sulfuric acid solutions (the Lurgi or Sulfacid and Hitichi processes) and by the reaction with a reducing gas to produce elemental sulfur (the Westvaco process). A.L.W.

A81-44501 **The temporal and spatial distribution of tropospheric nitrous oxide.** R. F. Weiss (California, University, La Jolla, CA). *Journal of Geophysical Research,* vol. 86, Aug. 20, 1981, p. 7185-7195. 34 refs. NSF-supported research.

Nitrous oxide concentration measurements made in 1976-1980 aboard oceanographic vessels in the major world oceans show that the tropospheric nitrous oxide concentration is increasing by about 0.2% per year, with higher concentrations being detected in the northern rather than in the southern hemisphere. These data are well represented by a box model relating the tropospheric rate of increase to an exponentially increasing source function. According to the model projections, the concentration of tropospheric nitrous oxide in the year 2000 will be 5 to 7% above present values. The observed rate of tropospheric increase directly affects the production of stratospheric nitric oxide, playing a role in the earth's radiation balance that has been estimated conservatively as 10-15% of the effect due to increasing carbon dioxide. A substantial fraction of nitrous oxide production is attributable to the combustion of fossil fuels. O.C.

A81-44628 * **Review of NASA programs in applying aerospace technology to energy.** F. C. Schwenk (NASA, Office of Aeronautics and Space Technology, Washington, DC). In: Space - Enhancing technological leadership; Proceedings of the Twenty-seventh Annual Meeting, Boston, MA, October 20-23, 1980. San Diego, CA, American Astronautical Society; Univelt, Inc., 1981, p. 161-181. (AAS 80-218)

NASA's role in energy research and development, with the aid of aerospace technology, is reviewed. A brief history, which began in 1974 with studies of solar energy systems on earth, is presented, and the major energy programs, consisting of over 60 different projects, are described, and include solar terrestrial systems, conservation and fossil energy systems, and space utilization systems. Special attention is given to the Satellite Power System and the isolation of nuclear wastes in space. Emerging prospects for NASA programs in energy technology include bioenergy, and ocean thermal energy conversion, coal extraction and conversion technologies, and support to the nuclear industry in power plant systems safety. K.S.

A81-44635 **Commercial operations in space - 1980-2000; Proceedings of the Eighteenth Goddard Memorial Symposium, Washington, DC, March 27, 28, 1980.** Symposium sponsored by AAS, AIAA, AMA, et al. Edited by J. L. McLucas (Communications Satellite Corp., Washington, DC) and C. Sheffield (Earth Satellite Corp., Washington, DC). San Diego, CA, American Astronautical Society (Science and Technology Series, Volume 51); Univelt, Inc., 1981. 211 p. $30.

The need to revitalize American industry is considered along with questions of space industrialization, materials science and engineering in space, materials engineering in space, space power systems, earth resources, commercial launch operations, research opportunities, and international opportunities. Attention is given to the Space Shuttle power extension package, the orbital transfer of large space structures with nuclear electric rockets, a satellite power system overview of system studies and critical technology, electric orbit transfer vehicles, the mixed-mode principle and advanced chemical rocket engine concepts, crop reporting from space, the Space Industrialization Act and the government role in the commercialization of space, the airlines in the 80's and 90's, approaches to private sector involvement with government in technology development, innovation of space technology through joint endeavors between NASA and private industry, and the economic and political climate for exploitation of space riches. G.R.

A81-44668 * # **Results from conceptual design study of potential early commercial MHD/steam power plants.** F. Hals, R. Kessler, D. Swallom, L. Westra, J. Zar (Avco Everett Research Laboratory, Inc., Everett, MA), W. Morgan (Charles T. Main, Inc., Boston, MA), and C. Bozzuto (Combustion Engineering, Inc., Windsor, CT). *Magnetohydrodynamics Symposium, 19th, University of Tennessee, Tullahoma, TN, June 15-17, 1981, Paper.* 11 p. 5 refs. Research supported by the U.S. Department of Energy; Contract No. DEN3-51.

This paper presents conceptual design information for a potential early MHD power plant developed in the second phase of a joint study of such plants. Conceptual designs of plant components and equipment with performance, operational characteristics and costs are reported on. Plant economics and overall performance including full and part load operation are reviewed. Environmental aspects and the methods incorporated in plant design for emission control of sulfur and nitrogen oxides are reviewed. Results from reliability/availability analysis conducted are also included. (Author)

A81-44729 # **Electric vehicle energy use simulation model.** K. A. Stafford and A. R. DeWispelare (USAF, Institute of Technology, Wright-Patterson AFB, OH). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 544-548. 8 refs.

Electric vehicle propulsion systems are modeled in a driving cycle computer simulation. A very comprehensive vehicle model is used which includes aerodynamic drag, tire rolling resistance, rotational and translational inertia effects, and complete component by component power train efficiencies for varying load and speed. Battery discharge performance is tracked by a fractional-utilization method corrected for short-term prior discharge effects. The Federal Urban Driving Cycle was selected over the less rigorous SAE J227a electric vehicle test cycle to more accurately reproduce actual urban vehicle requirements and predict performance closer to actual vehicle user experience. The computer simulation outputs are used to determine optimized designs for minimum energy usage. An application for a typical suburban passenger vehicle is included. (Author)

A81-45274 **Laser-radar signature-processing system.** G. A. Bundell (Western Australia, University, Nedlands, Australia). *IEE Proceedings, Part F - Communications, Radar and Signal Processing,* vol. 128, pt. F, no. 4, Aug. 1981, p. 215-221. 11 refs. Research supported by the Western Australian Department of Conservation and Environment.

The analysis and presentation of ruby-laser-radar signatures in a particular application is examined. A complete system has been developed for this purpose, from acquisition of the return signal to contour presentation of target structures. In this case the target considered is an industrial plume emanating from a coal-fired power station. (Author)

A81-45904 **Numerical study of local/regional atmospheric changes caused by a large solar central receiver power plant.** C. M. Bhumralkar, A. J. Slemmons, and K. C. Nitz (SRI International, Menlo Park, CA). *Journal of Applied Meteorology,* vol. 20, June 1981, p. 660-677. 8 refs. Contract No. DE-AC03-78ET-20537.

A two-dimensional numerical atmospheric mesoscale model with a vertical cross section is applied to study the potential local/regional atmospheric effects of the installation of a 100 MWe solar thermal central receiver power plant in California. The plant comprises heliostats (mirrors) covering a portion of ground surface and reflecting sunlight onto a central receiving tower. The model is able to simulate the changes in surface characteristics associated with the installation of heliostats and other power plant ancillaries and can also simulate the effects of waste heat from cooling towers. The model equations are integrated to simulate typical summer and atypical summer. The results for typical summer conditions at the site and in the surrounding region demonstrate 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 atypical summer conditions show that the solar power plant is potentially able to increase the wind circulation and form clouds and rain. It is noted, however, that the life cycle of such formations is only 2-3 h. C.R.

A81-45925 **Synfuels and the energy transition.** R. E. Balzhiser (Electric Power Research Institute, Golden, CO). *EPRI Journal,* vol. 6, July-Aug. 1981, p. 21-27.

Various synfuel options and their impact on the electric utility industry are discussed. The energy transition for the U.S.A. is seen as moving from natural fluid fuels to solid fuels and renewable energy resources. The key to this transition is electrification, which can encompass both nuclear and renewable resources, centralized and dispersed technologies. It is shown that the fraction of total energy converted to electricity has risen steadily for the past 30 years, reaching 33% last year. The abundance and cost of production of the various fossil energy resources, including natural gas, heavy oil, oil shale, and coal are considered. EPRI analyses indicate that an integrated-combined-cycle power plant could be competitive with conventional coal plant technology. These plants would use only half the water of current coal-fired plants, would meet tighter sulfur emission standards, and would produce a vitreous ash that is less leachable than the ash from today's coal plants. Solvent-refined coal processes, currently being developed in the U.S.A. are a second approach to converting coal to liquid fuels. It is pointed out, however, that synfuels will complement, not replace, other sources of energy in the continued electrification of the U.S.A. J.F.

A81-46465 **Assessment of contemporary carbon combustion source contributions to urban air particulate levels using carbon-14 measurements.** J. A. Cooper (Oregon Graduate Center, Beaverton, OR), L. A. Currie, and G. A. Klouda (National Bureau of Standards, Washington, DC). *Environmental Science and Technology,* vol. 15, Sept. 1981, p. 1045-1050. 23 refs. Research supported by the Oregon Dept. of Environmental Quality and NBS; U.S. Environmental Protection Agency Contract No. IAG-D6-E684.

The reported study had the objective to evaluate the use of carbon-14 as a unique tracer of emissions from burning vegetative material and to establish an upper limit to the contribution of residential wood burning and slash and field burning to air particulate levels in the Portland and Eugene airsheds. The use of C-14 as a unique tracer for vegetative emissions (natural emissions, forest fires, and field and slash burning) depends upon the absence of radiocarbon in fossil fuel and the presence of radiocarbon activity in the biosphere. Attention is given to measurement procedures, sample collection and selection, vegetative burn source apportionment, and residential wood combustion. The obtained results demonstrate for the first time the utility of radiocarbon as a unique tracer for emissions from burning vegetation. A consistent relationship has been developed between the fine-particle radiocarbon concentration and known source impacts such as field and slash burning and residential wood combustion. G.R.

A81-46466 **Elemental composition of size-fractionated aerosols associated with a coal-fired power plant plume and background.** L. E. Wangen (California, University, Los Alamos, NM). *Environmental Science and Technology,* vol. 15, Sept. 1981, p. 1080-1088. 11 refs. Research supported by the U.S. Department of Energy; U.S. Environmental Protection Agency Contract No. IAG-D5-0681.

A81-46467 **Polychlorinated biphenyls in effluents from combustion of coal/refuse.** J. J. Richard and G. A. Junk (U.S. Department of Energy, Ames Laboratory, Ames, IA). *Environmental Science and Technology,* vol. 15, Sept. 1981, p. 1095-1100. 24 refs. Contract No. W-7405-eng-82.

Polychlorinated biphenyls (PCBs) were observed in all of the effluents from an electrical power plant equipped to burn coal and mixtures of coal and refuse-derived fuel (RDF). Test combustions

with and without refuse were made, and no correlation could be established between the PCB content of any of the effluents and the fuel being combusted. The effluents studied were grate ash, fly ash, stack ash, stack gas, sluice water, and sluice sediment. The PCB content of the coal and RDF fuels and the air used to support the combustion were also measured. The fate of the average low PCB level of 0.1 microgram/cu m in this air could only be approximated. However, the appreciable amounts of PCBs which averaged 8500 micrograms/kg in the RDF were almost completely destroyed, leaving less than 1% to be distributed in the environment via stack emissions and disposal of grate and fly ash. The PCBs present in these ash effluents averaged less than 5 micrograms/kg. (Author)

A81-46476 **Life cycle problems and environmental technology; Proceedings of the Twenty-sixth Annual Technical Meeting, Philadelphia, PA, May 12-14, 1980.** Meeting sponsored by the Institute of Environmental Sciences. Mt. Prospect, IL, Institute of Environmental Sciences, 1980. 475 p. $25.

The conference focuses on the following key life cycle issues: specification, design and test in environmental integration; environmental test tailoring for electronic hardware; emerging technology in environmental testing and measurement; and contamination control in industry and bioscience. Other major issues discussed are: environmental strategy and economic balance, and the growing conflict between energy demands and environmental regulation. V.L.

A81-46786 **Comparison of prospective energy sources with those in use.** B. V. Voitsekhovskii. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Sept.-Oct. 1980, p. 118-125.) *Journal of Applied Mechanics and Technical Physics,* vol. 21, no. 5, Mar. 1981, p. 673-678. 17 refs. Translation.

The comparative physical-technical and economic characteristics of renewable energy sources are analyzed. The significant advantages of wind energy for future use over oil, gas, and coal are demonstrated. Costs of wind electrical energy are compared in the U.S., Denmark, and the U.S.S.R. A.T.

A81-47237 **Analysis and comparison of solar systems, heat pumps, and total-energy systems for low-temperature heat supply (Analyse und Vergleich von Solarsystemen, Wärmepumpen und Totalenergiesystemen zur Niedertemperaturwärmeversorgung).** D. Orth (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 127-136. In German.

An analysis is conducted of the conditions concerning the low-temperature heat supply in West Germany, taking into account a comparison of alternative heating systems with conventional approaches. It is found that, for an alleviation of energy-supply problems, energy-saving systems must become competitive in the area of one-family and two-family houses. However, only the electrical heat pump is currently competitive, and it is only competitive in comparison to oil heating. The use of solar energy systems is still not economical compared to an employment of heat pumps, if space-heating applications are considered. The competitive position of the new energy-saving systems is more favorable for multifamily houses. However, these houses can be supplied economically with heat by pipeline systems which transport heat over large distances. G.R.

A81-47246 **The Swedish wind energy program.** S. Hugosson. In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 399-405.

The National Swedish Board for Energy Source Development has implemented a program for wind energy research. Off-shore and sea coast conditions in Sweden offer a great potential for using wind energy; this potential is based on a totally integrated and highly balanced electrical supply system with a large proportion of hydropower. A large-scale, horizontal-axis wind turbine, equipped with two to three rotor blades will be used to demonstrate the technical and economic feasibility of wind energy. Full-scale prototypes of 2-10 MW size will be designed to produce reliable engineering data for future use. The design variations will be guided by criteria of high, slender tower; horizontal axis; two to three blades; and blade pitch control. A two-bladed, horizontal wind turbine with a rated power of 3 MW, a turbine diameter of 78 m, and cut-in and cut-out wind speeds of 6 m/sec and 21 m/sec, respectively, is one model already planned for in southern Sweden. J.F.

A81-47313 **A nuclear waste depot as a large platform in earth orbit.** H. O. Ruppe and D. Hayn (München, Technische Universität, Munich, West Germany). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-47.* 15 p. 6 refs.

The storing and disposal of high-activity nuclear wastes (HAW) in large structures at high earth orbit is considered to the end of the century and beyond. Among the topics discussed are: (1) the rate of accumulation of HAW on earth and at the space disposal station; (2) the projected growth of those rates of accumulation; (3) HAW payload launch schemes; (4) alternative nuclear waste disposal platform configurations; (5) lifetime mapping of long-lifetime orbits based on the 11-year mean solar cycle; and (6) the ultimate destination of nuclear waste disposal platforms. It is concluded that the additional cost to nuclear electricity consumers incurred by the implementation of a 1000-km altitude orbit platform scheme is 0.04 cents/kWh(e). The concept of the mass-driver is briefly covered, and various statistics concerning nuclear waste loads are given. O.C.

A81-47397 **Preliminary study results on possible space contribution to the solution of the world energy problems.** C. Poher (Centre National d'Etudes Spatiales, Paris, France). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-187.* 10 p.

The use of launch vehicles of the Ariane family for the long-term management of nuclear wastes is discussed. It is noted that because solar power satellites will not be economical in the near future, nuclear power will play a larger role. It is thought that the risks attendant upon space disposal will be reduced by advances in technology over the next 20 years, the period that will elapse before such disposal is attempted. C.R.

A81-47399 **Compact SPS - Environmental considerations.** M. Pospisil (Ceskoslovenska Akademie Ved, Astronomicky Ustav, Ondrejov, Czechoslovakia). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-194.* 7 p. 10 refs.

The effect on the environment of the production, transportation into orbit, and operation of space power stations (SPSs) is discussed. Methods are proposed for countering the effects seen as deleterious. For example, with regard to the operation of SPSs, it is suggested that more satellites be designated for each rectenna. With regard to the production of SPSs, it is noted that manufacture in space would not only preserve the environment but would also lower the costs of transporting the SPS into orbit. The harmful effects caused by the microwave transfer of energy from orbit to earth can be reduced by a proper choice of frequency, beam shape, power density, and time dependency of power during the day. C.R.

A81-47504 **EVC EXPO 80; Proceedings of the Third International Electric Vehicle Conference, St. Louis, MO, May 20-22, 1980.** Conference sponsored by the Electric Vehicle Council and European Electric Road Vehicle Association. Edited by L. Andrews (Electric Vehicle Council, Washington, DC). Washington, DC, Electric Vehicle Council, 1980. 605 p. $75.

Issues and trends in the case of electric vehicles are considered along with vehicle systems, EV fleet user experience, batteries, aspects of vehicle testing, EV commercial market and vehicle potentials, EV cost considerations, the effective utilization of EVs, and modeling, mission analysis, and impact assessment. Attention is given to EV component reliability, automatic gearshift control for an efficient battery vehicle drive system, a brushless DC motor-power conditioner unit designed and built for propulsion of electric passenger vehicles, a roadway powered electric vehicle system, inductively coupled power systems for electric vehicles, a fuel-cell-powered golf cart, electric vehicles in telephone service, electric vehicle use in the U.S. Postal Service, high performance electric commercial vehicles, nickel iron battery design and performance, the development of the nickel-iron-battery system for electric vehicle propulsion, the advancing performance threshold of the lead-acid

electric vehicle battery, advances in zinc bromine batteries for motive power, some aspects of battery vehicle evaluation with particular attention to a battery model, and a generic battery model for electric and hybrid vehicle simulation performance prediction. G.R.

A81-47843 **The relation between aircraft fuel reserves and navigation.** V. W. Attwooll (Civil Aviation Authority, London, England). *(Royal Institute of Navigation, Meeting, London, England, Jan. 21, 1981.) Journal of Navigation,* vol. 34, Sept. 1981, p. 437-449; Discussion, p. 450, 451.

A rational basis is presented for the determination of fuel uplift quantities in commercial operations, in relation to safety and regularity of services. Numerical models are devised as aids in estimating such factors as the regularity of service to be expected from a given fuel quantity uplifted at take-off, assuming that in-flight decisions about fuel usage are made in a rigid, automatic way. Navigation figures as an important element because all in-flight decisions demand exact knowledge of aircraft position. Attention is given the possible effects on fuel uplift policies of various changes and developments in aircraft equipment and air traffic control (ATC) systems; for instance: (1) the use of blind landing equipment of high reliability can influence a pilot's decision to continue holding or divert to an alternative landing site; and (2) airborne flight management systems are being developed to help the pilot implement fuel conservation through automatic estimates of the best speed and altitude to fly under given conditions, reducing fuel consumption by an estimated 1.6%. O.C.

A81-48117 ***Turning to the wind.*** B. Sorensen (Roskilde Universitetscenter, Roskilde, Denmark). *American Scientist,* vol. 69, Sept.-Oct. 1981, p. 500-508. 26 refs.

Consideration is given the economic and technological aspects of both free-stream (horizontal-axis) and cross-wind (vertical-axis) wind energy conversion systems, with attention to operational devices ranging in rotor diameter from 10 to 40 m and in output from 22 to 630 kW. After a historical survey of wind turbine design and applications development, the near-term technical feasibility and economic attractiveness of combined wind/fossil-fueled generator and wind/hydroelectric systems are assessed. Also presented are estimates of wind energy potential extraction in the U.S. and Denmark, the industrial requirements of large-scale implementation, energy storage possibilities such as pumped hydro and flywheels, and cost comparisons of electrical generation by large and small wind systems, coal-fired plants, and light-water fission reactors. O.C.

A81-48317 # **Possibilities of utilizing renewable energy sources.** I. Benko (Budapesti Muszaki Egyetem, Budapest, Hungary). *Periodica Polytechnica, Mechanical Engineering,* vol. 25, no. 1, 1981, p. 67-86. 7 refs.

Attention is given to the quantitative and structural changes that have occurred in man's consumption of energy. It is pointed out that today 90% of the energy used comes from nonrenewable sources. In considering renewable energy sources, such as the sun, winds, tides, river currents, and earth's heat, attention is given to their geographical distribution. It is noted that supplying energy to isolated settlements that do not possess sources of renewable energy will pose a challenge. C.R.

A81-48477 ***Power in the year 2000 - Some reminiscences and forecasts.*** T. E. Allibone. *Contemporary Physics,* vol. 22, Sept.-Oct. 1981, p. 545-558.

The forecasting of future electrical energy demands in Great Britain by the Central Electricity Generating Board, which is necessary in view of the long time needed to build a large power station, is discussed. Unexpected factors which invalidate electricity forecasts, such as the sudden fourfold increase in the price of oil in 1973 and the discovery of nuclear fission, are pointed out. Options for planning in 1981 are then considered, with attention given to the place of energy savings, a second generation of nuclear power plants, fusion power, district heating from generator steam, pumped storage, wind power, wave power, geothermal energy and magnetohydrodynamics. A tentative prediction is made that in 50 years, coal will no longer be burned, but extracted for use in the chemical industry. A.L.W.

A81-49630 **Energy from space - An imperative for international cooperation.** S. Gorove. *(Symposium on Space Law in Perspective, University of Mississippi, University, MS, Apr. 21, 1980.) Journal of Space Law,* vol. 9, Spring-Fall 1981, p. 41-44. 9 refs.

Problems associated with the internationalization of research and development regarding the solar power satellite program are examined. It is suggested that a careful assessment must be made of the pros and cons of internationalization with regard to the totality of the basic value and institutional processes rather than on the basis of a single value or institutional alternative. B.J.

A81-49876 **National Powder Metallurgy Conference Proceedings 1978-1979.** Edited by J. Hoffman (Cincinnati, Inc., Cincinnati, OH), W. Cebulak (Aluminum Company of America, Pittsburgh, PA), and E. Klar. Princeton, NJ, Metal Powder Industries Federation; American Powder Metallurgy Institute (Progress in Powder Metallurgy. Volumes 34 & 35), 1980. 439 p.

A status report on energy consumption and distribution in the P/M industry is presented and energy-saving applications of industrial gases are examined. Attention is given to designing sintering furnaces and atmospheres for energy savings, the use and application of miniature P/M parts, hot isostatic pressing of maraging steels, cold isostatic pressing of complex P/M shapes in the case of titanium and other special metals, the forming of P/M parts by consolidation at atmospheric pressure, and the preparation of binary and ternary alloys from mixed oxide ceramic preforms. The effects of particle size and density on the mechanical properties of sintered iron and iron/phosphorus alloys are considered along with predicting DC properties of P/M materials, P/M plates of hard-to-work materials, the characterization and processibility of high speed tool steel powders, and the graphite influence on P/M steel processing parameters. Other topics discussed are related to powders for plasma spray coatings, warm pressed alloys of copper with tin and tin-lead, a comparison of endothermic (generated) and nitrogen-based sintering atmospheres, and an advanced P/M material for high tensile, impact, and hardware applications. A description is provided of the surface porosity in P/M steel forgings, and the development and applications of heat-treated P/M steels containing manganese, chromium, vanadium, and molybdenum. G.R.

N81-28290# R and D Associates, Marina Del Rey, Calif.
RECOMMENDED RESEARCH ON LNG SAFETY Final Report, 1 Mar. 1979 - 31 Dec. 1980
H. J. Carpenter and F. R. Gilmore Mar. 1981 304 p refs
(Contract DE-AC03-79EV-10024)
(DOE/EV-10024/1; RDA-TR-111000-001) Avail: NTIS HC A14/MF A01

Although the modern liquefied natural gas (LNG) industry has enjoyed excellent success in providing for safe operations, significant questions remain on the part of many, the expressions of which were intensified with the addition of marine-based LNG import terminals. Public safety with regard to large scale importation of this fuel has received widespread attention in the U.S. Congress, state legislatures, county and city governments, and from various individuals and public groups, with coverage in all the news media, including books published on the subject. The safety concerns have centered around the consequences to the public of a large spill of the cryogenic liquid from an ocean tanker or a larger storage tank, either of which might hold as much as 125,000 cu m of LNG. DOE

N81-28291# Fluor Engineers and Constructors, Inc., Irvine, Calif.
ECONOMIC EVALUATION OF COAL GASIFICATION FOR ELECTRIC POWER GENERATION (AN UPDATE) Final Report
R. Beckman, W. Hsu, and J. Joiner Feb. 1981 188 p refs
Sponsored by EPRI
(EPRI Proj. 239-2)
(EPRI-AP-1725) Avail: NTIS HC A09/MF A01

This is an economic update of previous evaluations of various coal gasification and power generation systems. Capital and operating costs of all the systems were escalated to mid 1978 dollars from their original mid 1976 basis. The processes studied included the Lurgi dry ash gasifier; the British Gas Corporation's Slagger; the Texaco entrained system; Combustion Engineering's two stage entrained atmospheric pressure gasifier; Foster-Wheeler's two stage entrained pressurized system; and the Tosco/HRI Tosco-Dyne process. For comparative purposes, a coal fired steam electric generating station with stack gas desulfuriza-

tion in subcritical and supercritical designs is also developd. The plant sizes used in all of the screening studies are in the capacity range of 1000 MW to 1200 MW. These plants feed a constant coal rate equivalent to 10,000 tons/day of Illinois No. 6 coal. Results indicate that the installed plant costs have escalated by elevent to 19 percent from mid 1976 plant investment costs. DOE

N81-28292# TRW Energy Systems Group, Morgantown, W. Va.

ECONOMIC ANALYSIS OF VERTICAL WELLS FOR COAL-BED METHANE RECOVERY

Arnold Snygg and William Fox Apr. 1981 62 p refs
(Contract DE-AC21-78MC-08089)
(DOE/MC-08089/107) Avail: NTIS HC A04/MF A01

Previous economic studies of the recovery and utilization of methane from coalbeds using vertical wells were based on drainage in advance of mining where a single seam is drained with well spacing designed for rapid predrainage. This study extends the earlier work and shows that methane recovery costs can be reduced significantly by increasing well spacing and draining multiple coalbeds. A favorable return on investment can be realized in many geologic settings using this method. Sensitivity of recovery economics to certain development costs and parametric variations are also examined as are the economics of three methane utilization options. DOE

N81-28303# Argonne National Lab., Ill. Energy and Environmental Systems Div.

IMPLEMENTATION PLANNING FOR INDUSTRIAL ENERGY CONVERSATION: APPROACH AND METHODOLOGY

T. G. Alston, G. Falk, P. J. Grogan, D. Katz, and J. Tatar Jan. 1981 46 p refs
(Contract W-7405-eng-38)
(ANL/CNSV-TM-55) Avail: NTIS HC A03/MF A01

Details of an industry-specific Conservation Technology Implementation Branch implemenation plan is described in detail. CTIB has conducted implementation planning in the steel, pulp/paper, and agriculture/food processing industries, but in FY 1981, CTIB plans to conduct planning for the chemicals, petroleum refining, aluminum, glass, cement, and textile industries. Guidelines are presented for each contractor for each industry toward a common methodology in terms of approach, areas of analysis, assumptions, and reporting. The major parts of the CTIB plan are: an implementation study consisting of technology selection, market demand analysis, and policy analysis, and a plan consisting of a detailed description and schedule of future CTIB actions, followed by a recommended system for monitoring market results when the plan is implemented. DOE

N81-28494 California Univ., Los Angeles.

THE FEASIBILITY OF USING SILVICULTURAL BIOMASS AS AN ALTERNATE FUEL: THE HANFORD RESERVATION CASE STUDY Ph.D. Thesis

John Isaac Baum 1981 153 p
Avail: Univ. Microfilms Order No. 8113815

An integrated silvicultural biomass plantation and infrastructure capable of producing a renewable supply of wood pellets. The capacity of the system is intended to replace the 78,000 metric tons per year (86,000 short tons per year) of coal currently used at the U.S. Department of Energy Richland Operation site (Hanford Reservation). The proposed 4,860 hectare (12,000 acre) plantation is located on the Hanford Reservation, adjacent to the Columbia River. The biomass plantation would be used for producing rapid growing hybrid Poplar trees, which would be intensely managed and harvested on a six year rotation cycle. Research, storage, transportation, and pelletizing facilities are also included in this concept. Results of the study indicate that it is technically feasible to design an integrated silvicultural/wood pelletizing facility at Hanford. As proposed, the plantation would require a large capital-intensive irrigation system. Based on a discounted cummulative net benefit analysis, the project will show a positive cash flow after 18 years. The net energy analysis indicate that six times more energy is produced than is utilized by the silvicultural plantation (i.e., 84 percent efficiency), which includes direct and indirect energy inputs. The environmental impact analysis indicates that there will be minimal adverse impacts. The major impact will be from the emission of small particulate matter from burning the wood (i.e., less than 10 microns). Overall, the net environmental impacts will be less than the coal, which is currently being used. Dissert. Abstr.

N81-28500# Texas Univ. at Arlington. Center for Energy Studies.

EASTERN EUROPE'S RESOURCE CRISIS, WITH SPECIAL EMPHASIS ON ENERGY RESOURCES: DEPENDENCE AND POLICY OPTIONS

George W. Hoffman Jan. 1981 66 p refs
(Policy-Study-14) Avail: NTIS HC A04/MF A01

The impact of Eastern Europe's energy resource shortages on its future economic and political development and its dependence on the Soviet Union as its main source of supply is examined. Tables show domestic production, imports, exports, and consumption for Bulgaria, Czechoslovakia, the GDR, Hungary, Poland, and Romania. A.R.H.

N81-28502# Texas Univ. at Arlington.

THE BANKING OF LIGNITE LEASES IN BASTROP COUNTY, TEXAS: 1954 - 1979

Christopher S. Davies and R. Wyatt Dietrich Aug. 1980 63 p refs
(Policy-Study-12) Avail: NTIS HC A04/MF A01

The forces that produce the pattern of lignite leasing and the effects of these contracts on the landowners and energy companies of Bastrop County are described. Disparities extraction costs, selling price, and the profits of companies and landowners are examined, as well as in the amounts allocated for aesthetic and functional rehabilitation of the landscape despoiled by strip mining. The attitude of landowners towards lignite mining were obtained by questionnaire and are analyzed using two- and three-stage models. The data presented attests to the unbalanced nature of the gains distribution resulting from lignite extraction and lend support to the idea that the energy companies should make a greater contribution to the rehabilitation of the land. A.R.H.

N81-28505# California Univ., Los Angeles. Lab. of Biomedical and Environmental Sciences.

VEGETATION MANAGEMENT AND RECOVERY AT SITES DISTURBED FOR SOLAR THERMAL POWER SYSTEMS DEVELOPMENT Progress Report

E. M. Romney, R. B. Hunter, and A. Wallace Feb. 1981 25 p refs
(Contract DE-AC03-76SF-00012)
(UCLA-12-1281) Avail: NTIS HC A02/MF A01

Disturbing land to develop energy producing technologies in Mojave Desert areas usually destroys existing shrub vegetation that cannot be repaired by natural restoration processes within the time frame required by environmental protection legislation. The primary effort of the vegetation management project during FY 1980 was directed toward the development of cost effective methods of restoring native vegetation on disturbed Mojave Desert land. Emphasis was placed upon improving techniques for producing transplanting stocks of native shrub species, investigating different ways to protect and encourage regrowth from crown sprouting and new seedling germination, developing improved transplanting methods, and searching for more practical means of conserving seasonal soil moisture necessary for the survival of new plant seedlings and transplanted specimens. DOE

N81-28522*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF INTEGRATED GASIFIER-COMBINED CYCLE AND AFB-STEAM TURBINE SYSTEMS FOR INDUSTRIAL COGENERATION

Joseph J. Nainiger, John M. Abbott, and Raymond K. Burns 1981 27 p refs Presented at 16th Intersoc. Energy Conversion Engl. Conf., Atlanta, 9-14 Aug. 1981; sponsored by ASME
(NASA-TM-82648; E-906) Avail: NTIS HC A03/MF A01 CSCL 10B

In the cogeneration technology alternatives study (CTAS) a number of advanced coal fired systems were examined and systems using a integrated coal gasifier IGCC or a fluid bed combustor AFB were found to yield attractive cogeneration results in industrial cogeneration applications. A range of site requirements and cogeneration sizing strategies using ground rules based on CTAS were used in comparing an IGCC and an AFB. The effect of time variations in site requirements and the sensitivity to fuel and electricity price assumptions are examined. The economic alternatives of industrial or utility ownership are also considered. The results indicate that the IGCC system has potentially higher fuel and emission savings and could be an attractive option for utility ownership. The AFB steam turbine system has a potentially higher return on investment and could be attractive assuming industrial ownership. A.R.H.

N81-28557# Oak Ridge National Lab., Tenn. Energy Div.
POTENTIAL FOR DISTRICT HEATING: AN HISTORICAL OVERVIEW
Martin A. Broders Mar. 1981 25 p Presented at the District Heating Tech. Training Workshop, Washington, D.C., 1-3 Apr. 1981
(Contract W-7405-eng-26)
(CONF-810435-1) Avail: NTIS HC A02/MF A01

An introduction to district heating is outlined. Attention is focused on the potential of district heating to meet the nation's energy conservation, environmental and social objectives. Basic terms are defined and the principal of district heating operation is described. District heating thermal energy sources, transport and distribution piping, and consumer secondary heating systems are discussed in general terms. A brief historical overview is presented. The history and status of district heating in Europe are also summarized. The advantages of district heating are outlined, and the primary factors that impeded the implementation of district heating in the US are discussed. DOE

N81-28558# Oak Ridge National Lab., Tenn. Energy Div.
ENERGY ISSUES RELEVANT TO DOMED CITIES. WINOOSKI, VERMONT: A CASE STUDY
Robert E. Gant 1980 15 p refs Presented at 1st Intern. Dome Symp., Winooski, Vt., 27 Mar. 1980
(Contract W-7405-eng-26)
(CONF-8003107-2) Avail: NTIS HC A02/MF A01

Enclosing all or a significant portion of a small urban community within a large secondary building envelope (dome) was examined as a potential alternative energy strategy. The concept of secondary envelopes as a community level energy strategy is discussed. Five alternative energy strategies are presented which might be less costly and technically complex than an urban envelope. The alternatives focused upon local options and resources to affect reductions in total energy consumption and scarce fuels. Insulation and use of efficient appliances, hydroelectric development, installation of cogeneration/district heating systems, use of solar technologies, and combinations of technologies are discussed. The alternatives represent examples of the opportunities available to local governments to exercise a degree of control over the community's energy future. DOE

N81-28572# Argonne National Lab., Ill.
COMPARATIVE HEALTH AND SAFETY ASSESSMENT OF ALTERNATIVE FUTURE ELECTRICAL GENERATION SYSTEMS
L. J. Habegger, J. R. Casper, and C. D. Brown 1980 7 p refs Presented at the Intern. Symp. on Alternative Energy Sources and Technol., Montreal, 28-30 May 1980
(Contract W-31-109-eng-38)
(CONF-800567-6) Avail: NTIS HC A02/MF A01

An analysis is made of health and safety risks of seven alternative electrical generation systems, all of which have potential for commercial availability in the post 2000 timeframe. The systems are compared on the basis of expected public and occupational deaths and lost workdays per year associated with 1000 MWe average unit generation. Risks and their uncertainties are estimated for all phases of the energy production cycle; including fuel and raw material extraction and processing, direct and indirect component manufacture, on site construction, and system operation and maintenance. DOE

N81-28576# Southwest Research and Development Co., Las Cruces, N. Mex.
ECONOMICS OF WIND ENERGY FOR IRRIGATION PUMPING Final Report
R. R. Lansford, R. J. Supalla, J. R. Gilley, and D. L. Martin 14 Jul. 1980 89 p refs Sponsored in part by Dept. of Agriculture
(Contracts DE-A101-76ET-20319; EX-76-A-29-1026)
(DOE/SEA-7315-2074/81/2) Avail: NTIS HC A05/MF A01

The economic questions associated with wind power as an energy source for irrigation under different situations with seven regions of the nation were studied. Target investment costs for wind turbines used for irrigation pumping and policy makers with bases for adjusting taxes to make alternative sources of energy investments more attractive are analyzed. Three types of wind systems are considered for each of the seven regions. The three types of wind powered irrigation systems evaluated for each region are: (1) wind assist combustion engines (diesel, natural gas, propane panel); (2) wind assist electric engines, with or without sale of surplus electricity; and (3) stand alone reservoir systems with gravity flow reservoirs. DOE

N81-28579# California Univ., Livermore. Lawrence Livermore Lab.
CALIFORNIA ENERGY FLOW IN 1979
C. K. Briggs and I. Y. Borg 31 Mar. 1981 18 p refs
(Contract W-7405-eng-48)
(UCID-18991) Avail: NTIS HC A02/MF A01

Energy use in California during 1979 differed significantly from 1978. Overall use of natural gas in the state increased substantially (14.3%) due principally to greater use for electrical power production; 4% more gas was used for electrical power generation in 1979 than in 1978 and 21% more than in 1977. Use of fuel oil for electrical generation remained at the 1978 level but below the high 1977 level, which reflected substitution of oil for hydroelectric power during the 1976 to 1977 drought. Together, oil and gas accounted for 80% of the fuels used to generate electricity. Crude-oil imports principally from Indonesia fell substantially; however, use of Alaskan North Slope oil increased so that the net increase in crude oil use was up about 4%. The transportation end-use sector consumed about as much as in 1978 despite shortages in early 1979 associated with the Iranian revolution. While sales fell slightly, sales of high-sulfur residual oils (Bunker C) increased markedly. Transportation represents 38% of total energy consumption in California. DOE

N81-28582# Stanford Univ., Calif. Dept. of Operations Research.
ETA-MACRO: A USER'S GUIDE
A. S. Manne Feb. 1981 138 p
(EPRI Proj. 1014)
(EPRI-EA-1724) Avail: NTIS HC A07/MF A01

The ETA-MACRO model is designed to estimate the extent of two way linkage between the energy sector and the balance of the economy. It represents a merger between ETA (a process analysis for energy technology assessment) together with a macroeconomic growth model providing for substitution between capital, labor, and energy inputs. The ETA-MACRO allows explicitly for: (1) energy economy interactions; (2) cost effective conservation; (3) interfuel substitution, and (4) new supply technologies, each with its own difficulties and uncertainties on dates and rates of introduction. This user's guide includes an overview of the model, an illustrative application to long term US energy projections, and technical descriptions of the macro and ETA submodels. It also includes an analysis of how market penetration rates may be related to the profitability of new technologies. Finally, the appendices provide a detailed guide to the computer implementation. DOE

N81-28590# Public Technology, Inc., Washington, D. C.
LOCAL GOVERNMENT GUIDE TO THE EMERGING TECHNOLOGIES OF COGENERATION AND PHOTOVOLTAICS. ENERGY TECHNOLOGY REPORT OF THE ENERGY TASK FORCE OF THE URBAN CONSORTIUM
1980 44 p refs Prepared in cooperation with Planning and Management Associates of Greater Washington, Inc., Washington, D.C.
(Contract DE-FG02-78IR-05106)
(DOE/IR-05106/T24) Avail: NTIS HC A03/MF A01

An overview of cogeneration and photovoltaic systems is presented to provide local government managers a basic understanding of the technologies. Issues and considerations associated with applications are presented. Discussions cover installation and maintenance requirements, equipment availability, costs, and risks/benefits. Data describing demonstration sites and contacts for further information are provided. DOE

N81-28596# Massachusetts Building Code Commission, Boston.
ENERGY-CONSERVATION OPPORTUNITIES IN LIGHTING
Apr. 1981 34 p
(Contract DE-FG01-79CS-60467)
(DOE/CE-60467-02) Avail: NTIS HC A03/MF A01

Technologies and techniques employed to reduce lighting costs by as much as 70 percent are discussed. Four basic steps to reduce energy costs and improve the effectiveness of the lighting system discussed are: (1) acquaintance with some of the basic terminology and energy efficient lamps and fixtures which are on the market; (2) conducting a survey of the building to determine where and how much energy and money can be saved; (3) implementation of the simple, low cost or no cost measures; and (4) calculation of the payback period for capital investment, modifications, and implementation. DOE

N81-28622# Greater Caribbean Energy and Environment Foundation, Inc., Key Biscayne, Fla.
GREATER CARIBBEAN ENERGY AND ENVIRONMENT FUTURE. AD HOC WORKING GROUP REPORT
Anitra Thorhaug, ed. 1980 20 p refs Presented at Key Biscayne, Fla., 26-28 Oct. 1980; sponsored in part by Florida International Univ.
(Contract FG-01-80EV-10454)
(DOE/EV-10454/T1) Avail: NTIS HC A02/MF A01

The process by which environmental assessments by tropical experts can be successfully integrated into energy decisions is by: international loan institutions requiring or strongly recommending excellent assessments; engineering awareness of total effects of energy projects; governmental environmental consciousness-raising with regard to natural resource value and potential inadvertent and unnecessary resource losses during energy development; and media participation. Research tasks for today and twenty years hence, needed research, demonstration and information dissemination projects to get knowledge about Caribbean energy-environment used, and recommendation are presented. DOE

N81-29031# Texas Univ. at Arlington. Center for Energy Studies.
AN ANALYSIS OF FINANCIAL AND REGULATORY MODELS OF ELECTRIC UTILITIES
Alicia Torre Apr. 1981 62 p refs
(RR-12) Avail: NTIS HC A04/MF A01

Five financial and regulatory models were analyzed in terms of their use in a larger modelling project to measure conservation impact on utilities (CIUS). The five models are the Over/Under Capacity Planning Model (Over/Under), the Regulatory Analysis Model (RAM), the Electric Utility Policy and Planning Analysis Model (EPPAM), the Regionalized Electricity Model (REM), and the electric and Gas Utility Financial Simulation Model (ELFIN). No matter which model is used, certain modifications are necessary for use with CIUS. T.M.

N81-29032# Texas Univ. at Arlington. Center for Energy Studies.
A PRELIMINARY ANALYSIS OF THE NATURAL GAS MARKET-ORDERING PROBLEM
Robert C. Means Feb. 1981 133 p refs
(Policy-Study-15) Avail: NTIS HC A07/MF A01

Application of microeconomic analysis to the provisions of the Natural Gas Policy Act predict that partial deregulation of natural gas in 1985 will result in price discontinuity, misdirected benefits, and market raiding. The principal factual issues that must be resolved in any full assessment of this market ordering problem are considered. A.R.H.

N81-29035*# Cleveland State Univ., Ohio. Dept. of Electrical Engineering.
MINIMUM FUEL CONTROL OF A VEHICLE WITH A CONTINUOUSLY VARIABLE TRANSMISSION Final Technical Report, 1 Oct. 1978 - 30 Jun. 1980
James H. Burghart and John F. Donoghue 30 Jun. 1980 94 p refs
(Grant NsG-3223)
(NASA-CR-164587) Avail: NTIS HC A05/MF A01 CSCL 13F

The design and evaluation of a control system for a sedan with a heat engine and a continuously variable transmission, is considered in a effort to minimize fuel consumption and achieve satisfactory dynamic response of vehicle variables as the vehicle is driven over a standard driving cycle. Even though the vehicle system was highly nonlinear, attention was restricted to linear control algorithms which could be easily understood and implemented demonstrated by simulation. Simulation results also revealed that the vehicle could exhibit unexpected dynamic behavior which must be taken into account in any control system design. A.R.H.

N81-29039# California Univ., Livermore. Lawrence Livermore Lab.
ESTIMATES OF THE COST AND ENERGY CONSUMPTION OF ALUMINUM-AIR ELECTRIC VEHICLES
J. F. Cooper Nov. 1980 85 p refs Presented at the Fall Meeting of the Electrochem. Soc., Hollywood, Fla., 5 Oct. 1980
(Contract W-7405-eng-48)
(UCRL-84445; CONF-8010159-1) Avail: NTIS HC A05/MF A01

Economic costs and primary energy consumption are estimated for general purpose electric vehicles using aluminum-air propulsion batteries within the time frame of the 1990's (earliest possible date of introduction). The results show that for a 40 kW, 70 kWh battery used in a vehicle traveling 16,000 km/y, the total capital investment in electricity and aluminum production plants and fuels distribution system was 2250 dollars or 32 dollar sq/kWh. Of this, the aluminum plants contributed 60 percent, and the fuels disribution system, 3 percent (less than 1 dollar/kWh). The introduction of 1,000,000 vehicles per year in 1995 would increase domestic aluminum demand by below 5 percent per year, and electricity demand by less than 0.2 percent per year. DOE

N81-29217# Massachusetts Inst. of Tech., Cambridge.
ASSESSMENT OF THE MAGNESIUM PRIMARY PRODUCTION TECHNOLOGY Final Report
Merton C. Flemings, George B. Kenney, D. R. Sadoway, Joel P. Clark, and Julian Szekely 1 Feb. 1981 180 p refs
(Contracts DE-AC01-76CS-40284; EX-76-A-01-2295)
(DOE/CS-40284/T1) Avail: NTIS HC A09/MF A01

At current production levels, direct energy savings achievable in primary magnesium production are 1.2 milliquads of energy per annum. Were magnesium to penetrate the automotive market to an average level of 50 pounds per vehicle, the resultant energy savings at the production stage would be somewhat larger, but the resulting savings in gasoline would conserve an estimated 325 milliquads of energy per year. The principal barrier to more widespread use of magnesium in the immediate future is its price. A price reduction of magnesium of 10% would lead to widespread conversion of aluminum die and permanent mold castings to magnesium. This report addressed the technology of electrolytic and thermic magnesium production and the economics of expanded magnesium production and use. DOE

N81-29242# Department of Energy, Bartlesville, Okla. Energy Technology Center.
DESIGN AND TESTING OF A PROCEDURE FOR EVALUATING FUEL-EFFICIENT CRANKCASE LUBRICANTS
T. M. Naman Apr. 1981 15 p refs
(DOE/BETC/RI-81/2) Avail: NTIS HC A02/MF A01

Experiments were conducted to design a procedure for evaluating the fuel efficiency characteristics of crankcase lubricants using the driving cycles of the 1975 Federal Test Procedure and the Highway Fuel Economy Test. Three crankcase lubricants and five oil supplements, as well as a baseline lubricant, were used in eight 1980 model year vehicles of identical make. The vehicles were operated at 750 F in closely controlled chassis dynamometer tests designed to detect small changes in fuel efficiency. Results from these tests showed measurable increases in fuel economy of 0 to 6 percent with the test lubricants when compared to a common SAE 30 grade oil. These results are not definitive because of lack of quantification of mileage accumulation effects. The test protocol did reduce measurement variability greately; this procedure can be applied to evaluatin of fuel efficient oils using larger test fleets. A good potential exists for improving the fuel economy of the U.S. automotive fleet. GRA

N81-29265# Decision Analysis Corp., Annandale, Va.
ALTERNATIVE-FUEL PRICE TRAJECTORIES: PREPARATION OF MFBI SIZE/USAGE OVERLAYS AND NEW BOILER ORDER ANALYSIS. SUBTASK 3.3 Final Report
15 Jun. 1981 253 p Sponsored in part by JWK International Corp.
(Contract DE-AC01-80RG-10446)
(DOE/RG-10446/T2) Avail: NTIS HC A12/MF A01

Results of a detailed statistical analysis of boiler unit size and capacity factor distributions by standard industrial classification (SIC) code and fuel type are presented. This analysis is based on data from the 1975 Survey of major fuel-burning installations (MFBI's). A comparative analysis of new boiler orders are also presented. The purpose of the comparative analysis is to identify emerging trends in boiler unit size distributions by fuel type relative to the MFBI data for 1974. The principal findings of the MFBI analysis are discussed. The results of analysis of the new boiler order data are discussed, and some conclusions, relevant to implementation of provisions of the Fuel Use Act of 1978 concerning boiler conversions to coal are presented. DOE

N81-29299# Battelle Pacific Northwest Labs., Richland, Wash.
CONSERVING ENERGY IN NEW BUILDINGS: ANALYSIS OF NONREGULATORY POLICIES
R. M. Scheer, L. A. Nieves, and R. P. Mazzucchi May 1981 70 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3820) Avail: NTIS HC A04/MF A01

Nonregulatory program alternatives identified are: information and education programs, tax incentives and disincentives, and mortage and finance programs. Surveys data to assess present public awareness of energy issues and energy-efficient building design were reviewed. Homebuyer and homebuilder surveys were reviewed and conservation motivations are discussed. The provision of technical and economic information to various factors affecting building design decisions were examined. This approach assumes that the economic incentives and technical means to achieve energy conservation goals already exist but that critical information is lacking. DOE

N81-29457# Environmental Protection Agency, Ann Arbor, Mich. Test and Evaluation Branch.
EMISSIONS AND FUEL ECONOMY OF THE AUTOMOTIVE CYLINDER DEACTIVATOR SYSTEM (ACDS)
Edward Anthony Barth Oct. 1980 40 p refs
(PB81-177958; EPA-AA-TEB-81-7) Avail: NTIS HC A03/MF A01 CSCL 13F

By operating an engine on a reduced number of cylinders and operating these at high power levels, throttling losses are appreciably reduced. The operating cylinders are run at a high brake-mean-effective pressure (BMEP) and, therefore, potentially more efficiently. Test results showing both emissions and fuel economy are presented for a cylinder deactivator. GRA

N81-29539# Centec Consultants, Inc., Reston, Va.
ENERGY CONSERVATION IN ETHANOL PRODUCTION FROM RENEWABLE RESOURCES AND NON-PETROLEUM ENERGY SOURCES
Mar. 1981 63 p refs Sponsored in part by A. Smith Bowman Distillery
(Contract DE-AC01-80CS-40352)
(DOE/CS-40352/T2) Avail: NTIS HC A04/MF A01

The dry milling process for the conversion of grain to fuel ethanol is reviewed for the application of energy conservation technology, which will reduce the energy consumption to 70,000 Btu per gallon, a reduction of 42 percent from a distilled spirits process. Specific energy conservation technology applications are outlined and guidelines for the owner/engineer for fuel ethanol plants to consider in the selection on the basis of energy conservation economics of processing steps and equipment are provided. Steps discussed are mash preparation and cooking, fermentation, distillation, and distillers dried grains processing. The economics of cogeneration of fuel ethanol plants is also studied. DOE

N81-29545# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
THIN FILM BATTERY/FUEL CELL POWER GENERATION SYSTEM. TOPICAL REPORT COVERING TASK 5: THE DESIGN, COST AND BENEFIT OF AN INDUSTRIAL COGENERATION SYSTEM, USING A HIGH TEMPERATURE SOLID OXIDE ELECTROLYTE (HTSOE) FUEL CELL GENERATOR
E. F. Federmann, A. O. Isenberg, W. A. Summers, and E. J. Vidt 25 Feb. 1981 59 p refs
(Contracts DE-AC02-76ET-11305; EY-76-03-1197)
(DOE/ET-11305/T8) Avail: NTIS HC A04/MF A01

A literature search and review of the studies analyzing the relationship between thermal and electrical energy demand for various industries and applications resulted in several applications affording reasonable correlation to the thermal and electrical output of the HTSOE fuel cell. One of the best matches was in the aluminum industry, specifically, the Reynolds Aluminum Production Complex near Corpus Christi, Texas. Therefore, a preliminary design of three variations or a cogeneration system for this plant was effected. The designs were developed to the extent necessary to determine technical practicality and economic viability, when compared with alternate conventional fuel (gas and electric) prices in the year 1990. DOE

N81-29546*# Argonne National Lab., Ill.
ASSESSMENT OF A SATELLITE POWER SYSTEM AND SIX ALTERNATIVE TECHNOLOGIES
T. Wolsko, R. Whitfield, M. Samsa, L. S. Habegger, E. Levine, and E. Tanzman Apr. 1981 230 p refs
(Contract W-31-109-eng-38)
(NASA-CR-164598; DOE/ER-0099) Avail: NTIS HC A11/MF A01 CSCL 10A

The satellite power system is assessed in comparison to six alternative technologies. The alternatives are: central-station terrestrial photovoltaic systems, conventional coal-fired power plants, coal-gasification/combined-cycle power plants, light water reactor power plants, liquid-metal fast-breeder reactors, and fusion. The comparison is made regarding issues of cost and performance, health and safety, environmental effects, resources, socio-economic factors, and institutional issues. The criteria for selecting the issues and the alternative technologies are given, and the methodology of the comparison is discussed. Brief descriptions of each of the technologies considered are included. DOE

N81-29551# Department of Energy, Washington, D. C. Assistant Secretary for International Affairs.
INTERNATIONAL ENERGY INDICATORS
R. M. Weiss, ed. May 1981 30 p
(DOE/IA-0010/11) Avail: NTIS HC A03/MF A01

Tabulated data and graphic displays are presented for: world crude oil production for each year since 1974; OPEC crude oil production capacity; world crude oil and refined product inventory level for each year since 1975; oil consumption in CECD Countries for each year since 1975; USSR crude oil production for each year since 1975; and the free World and US nuclear electricity generation for 1973 and the current capacity. Also, tabulated data and graphic displays are included on: US domestic oil supply for each year since 1977; US gross imports of crude oil and products for each year since 1973; landed cost of Saudi crude in current and 1974 dollars; US coal trade for each year since 1975; US natural gas trade for each year since 1975; a summary of US merchandise trade for each year since 1977; and the US energy/GNP ratio in 1972 dollars. DOE

N81-29554# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Engineering.
DIRECT EFFICIENCY MEASUREMENT AND CHARACTERIZATION OF RESIDENTIAL HEATING EQUIPMENT Annual Report, fiscal year 1979
R. F. Krajewski, R. J. McDonald, and J. S. Milau May 1980 77 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51242) Avail: NTIS HC A05/MF A01

Preliminary characterization results for hydronic (hot water) oil fired systems are presented. Results from the fully operational warm air furnace test facility and a description of the equipment and the technique used in measuring furnace efficiencies are included. Laboratory data were used to determine annual fuel consumption and fuel weighted seasonal efficiency for each heating unit based on typical operating parametes (size of residence, geographic location, and usage). A range of hydronic burner boiler systems are evaluated. The combination of direct, accurate efficiency measurement and calculation of annual fuel use provides a standard method for comparison of individual heating units and retrofit modifications on a common and realistic basis. DOE

N81-29560# Wilson-Hill Associates, Inc., Washington, D.C.
METHODS FOR EVALUATING AND RANKING TRANSPORTATION ENERGY CONSERVATION PROGRAMS Final Report
Louis C. Santone 30 Apr. 1981 111 p refs
(Contract DE-AC01-80CS-50226)
(DOE/CS-50226/1) Avail: NTIS HC A06/MF A01

The energy conservation programs are assessed in terms of petroleum savings, incremental costs to consumers probability of technical and market success, and external impacts due to environmental, economic, and social factors. Three ranking functions and a policy matrix are used to evaluate the programs. The net present value measure which computes the present worth of petroleum savings less the present worth of costs is modified by dividing by the present value of DOE funding to obtain a net present value per program dollar. The comprehensive ranking function takes external impacts into account. Procedures

are described for making computations of the ranking functions and the attributes that require computation. Computations are made for the electric vehicle, Stirling engine, gas turbine, and MPG mileage guide program. DOE

N81-29561# Oak Ridge National Lab., Tenn. Engineering Technology Div.
US INDUSTRIAL THERMAL ENERGY STORAGE PROGRAM
Mitchell Olszewski 1981 14 p refs Presented at Intern. Symp. on Energy Storage, Brighton, England, 29 Apr. 1981
(Contract W-7405-eng-26)
(CONF-810463-1) Avail: NTIS HC A02/MF A01

Three major programs to reduce oil and gas consumption in industry are described. The programs include in-plant reuse of industrial reject heat, external reuse of industrial reject heat, and the use of alternate fuels. Projects, the organization of the US Industrial Thermal Energy Storage Program, and future program directions are described with some specifics cited in the food processing and paper industries. DOE

N81-29570# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY FUTURES TO PROVIDE A CONTEXT FOR ENERGY R AND D
Glenn C. Werth, Barney Rubin, Richard A. Heckman, David W. Dorn, Carl J. Anderson, and Robert B. Bell 21 Apr. 1981 55 p refs
(Contract W-7405-eng-48)
(UCRL-53140) Avail: NTIS HC A04/MF A01

The constant evolution of energy which poses concerns for organizations carrying out energy R and D is discussed. Managers of such organizations need a context for assessing the evolution to judge the possible roles for research. The need to develop strategic plans was examined for research implications of three different scenarios: (1) low productivity and economic growth; (2) oil disruption; and (3) an optimistic future in which the U.S. restores its economic strength and leadership. DOE

N81-29580# Biphase Energy Systems, Inc., Santa Monica, Calif.
GENERATION OF USEFUL ENERGY FROM PROCESS FLUIDS USING THE BIPHASE TURBINE Final Report
N. L. Helgeson Jan. 1981 213 p refs
(Contract DE-AC07-76ET-15350)
(DOE/ET-15350/1) Avail: NTIS HC A11/MF A01

The six largest energy consuming industries in the United States were surveyed to determine the energy savings that could result from applying the Biphase turbine to industrial process streams. A national potential energy savings of 58 million barrels of oil per year (technical market) was identified. This energy is recoverable from flashing gas liquid process streams and is separate and distinct from exhaust gas waste heat recovery. The industries surveyed in this program were the petroleum chemical, primary metals, paper and pulp, stone-clay-glass, and food. It was required to determine the applicability of the Biphase turbine to flashing operations connected with process streams, to determine the energy changes associated with these flashes if carried out in a Biphase turbine, and to determine the suitability (technical and economical feasibility) of applying the Biphase turbine to these processes. DOE

N81-29588# Argonne National Lab., Ill.
HEAT-PUMP-CENTERED INTEGRATED COMMUNITY ENERGY SYSTEMS: SYSTEM DEVELOPMENT ASSESSMENT
J. M. Calm, G. R. Sapienza, and N. P. Biederman Mar. 1981 287 p refs
(Contract W-32-109-eng-38)
(ANL/CNSV-18) Avail: NTIS HC A13/MF A01

An assessment of district heating systems employing heat pumps to enable use of low-temperature energy sources is presented. These systems operate as thermal utilities to provide space heating and may also supply space cooling, service-water heating, and other thermal services. Natural sources including solar and geothermal heat, heat stored on an annual cycle from summer cooling, and otherwise-wasted heat from industrial and commercial processes may be effectively used by the systems described. Fifteen system analyses are examined. The assessment concludes that district heating with heat pumps can conserve energy resources, and particularly scarce fuels, in an environmental and economically attractive way. The application potential is believed to be broad, and the energy savings of widespread implementation would be substantial. No one system is universally applicable, but many system options exist. Market forces are already promoting many of the required technologies, but further research, development, and demonstration could accelerate implementation. DOE

N81-29593# Argonne National Lab., Ill. Energy and Environmental Systems Div.
COST COMPARISON OF THE SATELLITE POWER SYSTEM (SPS) AND SIX ALTERNATIVE TECHNOLOGIES
T. Wolsko and M. Samsa Apr. 1981 119 p refs
(Contract W-31-109-eng-38)
(ANL/EES/TM-133) Avail: NTIS HC A06/MF A01

A method to compare the Satellite Power System (SPS) with various projected alternative energy sources on the basis of technical possibility, economic viability, and social and environmental acceptability is described. The following energy sources are briefly described: conventional coal, light water reactor, coal gasification/combined cycle, liquid metal fast breeder reactor, central station terrestrial photovoltaic, fusion, and the SPS. DOE

N81-29618# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
LAND-USE IMPLICATIONS OF WIND-ENERGY-CONVERSION SYSTEMS
R. J. Noun Feb. 1981 7 p Presented at the Conf. and Exposition-Wind Power: Energy Alternatives for the Upper Midwest, Rochester, Minn., 3-4 Apr. 1981; sponsored by Alternative Sources of Energy, Inc. and the Rochester Energy Information Center
(Contract EG-77-C-01-4042)
(SERI/TP-744-1099; CONF-810447-1) Avail: NTIS HC A02/MF A01

An estimated 20 utilities in the United States are now investigating potential wind machine sites in their areas. Identifying sites for wind machine clusters (wind farms) involves more than just finding a location with a suitable wind resource. Consideration must also be given to the proximity of sites to existing transmission lines, environmental impacts, aesthetics, and legal concerns as well as the availability of and alternative uses for the land. These issues have made it increasingly difficult for utilities to bring conventional power plants on-line quickly. Utilities are now required, however, to give careful consideration to specific legal, social, and environmental questions raised by the siting of wind energy conversion systems. DOE

N81-29620# Argonne National Lab., Ill.
OVERVIEW OF DEPARTMENT OF ENERGY PROGRAMS TO STIMULATE NEW INDUSTRIAL TECHNIQUES
A. R. Evans 1980 8 p refs Presented at 2nd Ann. Industrial Program Grantee Conf., Hot Springs, Ariz., 14 May 1980
(Contract W-31-109-eng-38)
(CONF-8005155-1) Avail: NTIS HC A02/MF A01

With the objectives of the U.S. DOE to provide for the orderly and adequate supply of fuels to the nation's industry and the efficient use of the fuels by industry, a review is presented of DOE programs related to these objectives. The objective of the programs is to accelerate the availability and adoption of existing and new industrial techniques for increased energy efficiency or fuel substitution. Also described are some of the ways in which academic researchers cooperate with industry and DOE in carrying out these programs. Several topics for further research are suggested. DOE

N81-29622# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
IMPACTS OF THE RESIDENTIAL CONSERVATION SERVICE PROGRAM ON RESIDENTIAL SOLAR DEVELOPMENTS
Tom Potter and Tad L. Bircher Apr. 1981 6 p refs Presented at the AS/ISES Conf. and Exposition, Philadelphia, 26-30 May 1981
(Contract EG-77-C-01-4042)
(SERI/TP-722-1169; CONF-810509-16) Avail: NTIS HC A02/MF A01

The roles of the various participants in the Residential Conservation Service (RCS) program were examined, with special attention to their potential influence on the program's effectiveness in accelerating solar commercialization. Cooperation and support

of the participants will be necessary for the information and implementation assistance goals of the program to be achieved, but resistance and obstructions are noted. DOE

N81-29663# Energy Resources Co., Inc., Walnut Creek, Calif.
ENVIRONMENTAL ASPECTS OF ALTERNATIVE WET TECHNOLOGIES FOR PRODUCING ENERGY/FUEL FROM PEAT Final Report
R. T. Smith 1 May 1981 142 p refs
(Contract DE-PR18-80FC-10169)
(DOE/FC-10169/T1) Avail: NTIS HC A07/MF A01

Peat in situ contains up to 90 percent moisture, with about 90 percent of this moisture trapped as a colloidal gel. This colloidal moisture cannot be removed by conventional dewatering methods (filter presses, etc.) and must be removed by thermal drying, solvent extraction, or solar drying before the peat can be utilized as a fuel feedstock for direct combustion or gasification. To circumvent the drying problem, alternative technologies such as wet oxidation, wet carbonization, and biogasification are possible for producing energy or enhanced fuel from peat. These three alternative technologies are described and the material balances for given raw peat feed rates of 1000 tph were calculated and the environmental consequences of all process effluent discharges were evaluated. DOE

N81-29668# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
SUBMICRON PARTICULATES FROM PULVERIZED-COAL COMBUSTION
J. Pennucci, R. Greif, G. Parsons, F. Robben, and P. Sheman Mar. 1981 8 p refs Presented at the Western States Section/The Combust. Inst. Spring Meeting, Pullman, Wash., 13-14 Apr. 1981
(Contract W-7405-eng-48)
(LBL-12485; CONF-810466-2) Avail: NTIS HC A02/MF A01

The effect of heat transfer and combustion parameters on the number and size distribution of particles in the submicron range, including consideration of practical methods of their control was studied. The flame temperature, cooling rate and oxygen concentration in the fuel lean range are investigated. Peak temperatures varied from 1900 K to 2500 K. It is shown that there is competition between homogeneous and heterogeneous nucleation of vaporized material, in various models of pulverized coal fly ash formation. It is indicated that there are possibilities to control the smallest prticles by varying the cooling rates in the post flame region. DOE

N81-29670# Oak Ridge National Lab., Tenn. Energy Div.
ENVIRONMENTAL IMPLICATIONS OF SMALL FIXED-BED GASIFIERS FOR INDUSTRY
Jerome E. Dobson, Robert M. Cushman, Phillip J. Walsh, Garland A. Samuels, David P. Vogt, John B. Mills, Suman P. Singh, Peter A. Dauzvardis (Argonne National Lab.), Charles M. Macal (Argonne National Lab.), and Roger L. Kroodsma May 1981 167 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7361) Avail: NTIS HC A08/MF A01

The assessment focuses on the industrial utilization of low energy gas (often called low Btu gas) in the range of 3708 to 7416 kJ/cu cm manufactured on site or nearby in a coal air steam reaction process. The major risk is in occupational health, due to potential exposure to toxic substances. This risk to workers is considerably greater than the risk to the public at large. The major sources of occupational exposure will be process steam leaks, accidental spills, and maintenance operations. DOE

N81-29673# Mitre Corp., McLean, Va.
HEALTH AND ENVIRONMENTAL EFFECTS OF SYNTHETIC FUEL TECHNOLOGIES: RESEARCH PRIORITIES. REPORT TO THE FEDERAL INTERAGENCY COMMITTEE ON THE HEALTH AND ENVIRONMENTAL EFFECTS OF ENERGY TECHNOLOGIES
R. D. Brown Apr. 1981 229 p
(Contract DE-AC01-79EV-10018)
(MTR-80W348) Avail: NTIS HC A11/MF A01

An assessment of the health and environmental effects of research priorities related to coal gasification and liquefaction and oil shale development is presented. It reflects the subjective judgments of well chosen research scientists in relevant disciplines. These scientists reviewed the resuls of workshops conducted in 1978 on coal gasification and liquefaction and oil shale, background informaion on related federal research, and comments by relevant federal agencies. The scientists prepared a listing of current research needs according to major areas of concern. These were categorized as to generic, region specific, or process specific research. For the latter category, various scales of development were addressed for two exemplary processes: SRC (solvent refined coal) II and above ground oil shale retorting. Subjective judgments were used to prioritize the research tasks and assess the adequacy of current research. DOE

N81-29677# California Univ., Livermore. Lawrence Livermore Lab.
ENVIRONMENTAL IMPACTS OF THE PRODUCTION AND UTILIZATION OF CARBONACEOUS FUELS: A BRIEF OVERVIEW
D. H. Stuermer and M. A. Tompkins 1980 10 p refs Presented at DOE Workshop on Basic Res. in Organic Geochem., Appl. to Natl. Energy Needs, St. Petersburg, Fla., 15 Dec. 1980 Sponsored by DOE
(UCRL-85599; CONF-801249-1) Avail: NTIS HC A02/MF A01

The projected increased future use of fossil fuels over the next several decades will intensify many of the current environmental concerns. These concerns include the following: contamination of water resources; consequences of various solid and liquid waste disposal alternatives; atmospheric input of organic emissions, SO sub x, NO sub x, particulates, smog forming products, and associated acid rain; increased global atmospheric CO2 concentrations; and, spills of crude and synthetic oils and their refined products. The development of oil shale, coal, tar sands, and enhanced oil recovery (EOR) resources will have regional impacts related to the distribution of the resources. DOE

N81-29687# Operations Research, Inc., Silver Spring, Md.
THE POTENTIAL FOR COAL USE AND RELATED ECONOMIC AND AIR QUALITY IMPLICATIONS OF FUTURE ENERGY SCENARIOS Final Report
Mar. 1981 325 p refs
(Contract NCAQ-24A-AQ-7744)
(PB81-179475; AQ-7744-24A) Avail: NTIS HC A14/MF A01 CSCL 13B

The air quality changes total costs associated with different national energy policies and related supply and demand scenarios were examined. The key issues examined are: the potential for coal use in the near and long-term under present air pollution control requirements and under related policy options; and the effect on air quality and total energy user costs as the energy supply mix of coal, oil, gas, nuclear, and solar is altered by air pollution policy options, energy demand forecasts, and energy production plans. GRA

N81-29691# TRW, Inc., Redondo Beach, Calif.
ENVIRONMENTAL ASPECTS OF SYNFUEL UTILIZATION Final Report, Mar. 1980 - Feb. 1981
M. Ghassemi and R. S. Lyer Mar. 1981 404 p refs
(Contract EPA-68-02-3174)
(PB81-175937; EPA-600/7-81-025) Avail: NTIS HC A18/MF A01 CSCL 13B

Environmental concerns about the distribution, handling, and end use of synfuel products are discussed. Available data on the physical, chemical, and health effects characteristics of synfuel products and the environmental significance of such characteristics are reviewed; the potential environmental impacts and regional implications associated with the production and end use are analyzed; and the products from the standpoint of environmental concerns and mitigation requirements are reported. Results indicate that: (1) widescale transportation, distribution, and end use of certain synfuel products present significant threats to the environment and the public health; (2) synfuel products appear to be similar to petroleum products; and (3) synfuel test and evaluation programs provide opportunities for the collection of some of the required environmental data. GRA

N81-29701# Edaw, Inc., Palo Alto, Calif.
PROBLEM DEFINITION STUDY OF SUBSIDENCE CAUSED BY GEOPRESSURED GEOTHERMAL RESOURCE DEVELOPMENT Rept., 1 Oct. 1979 - 30 Sep. 1980
Dec. 1980 196 p refs Prepared in cooperation with Earth

Sciences Associates, Palo Alto, Calif.
(Contract W-7405-eng-48)
(LBL-12392; GSRMP-10) Avail: NTIS HC A09/MF A01

The environmental and socio-economic settings of four environmentally representative Gulf Coast geopressured geothermal fairways were inventoried. Subsidence predictions were prepared using feasible development scenarios for the four representative subsidence sites. Based on the results of the subsidence estimates, an assessment of the associated potential environmental and socioeconomic impacts was prepared. An inventory of mitigation measures was also compiled. Results of the subsidence estimates and impact assessments are presented, as well as conclusions as to what are the major uncertainties, problems, and issues concerning the future study of geopressured geothermal subsidence. DOE

N81-29777# Environmental Protection Agency, Cincinnati, Ohio. Health Effects Research Lab.
HEALTH EFFECTS OF DIESEL ENGINE EMISSIONS: PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM HELD AT CINCINNATI, OHIO ON DECEMBER 3-5, 1979, VOLUME 1
W. E. Pepelko, ed., R. M. Danner, ed., and N. A. Clarke, ed. Nov. 1980 591 p refs Proceedings of Conf. held in Cincinnati, Ohio, 3-5 Dec. 1979 2 Vol.
(PB81-173809; EPA-600/9-80-057A) Avail: NTIS HC A25/MF A01 CSCL 06T

The purpose of this Symposium was to bring together scientists and engineers from the public and private sectors to discuss their research findings on the health effects of diesel engine emissions and to conclude with a discussion of health risk assessment of diesel exhaust. The Proceedings are organized into eight main sections corresponding to the format of the Symposium and addressing physical and chemical characteristics of diesel effects of diesel emissions and components, and biochemical and metabolic effectsj GRA

N81-29778# Environmental Protection Agency, Cincinnati, Ohio. Health Effects Research Lab.
HEALTH EFFECTS OF DIESEL ENGINE EMISSIONS: PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM
W. E. Pepelko, ed., R. M. Danner, ed., and N. A. Clarke, ed. Nov. 1980 632 p refs Proceedings of Conf. held in Cincinnati, Ohio, 3-5 Dec. 1979 2 Vol.
(PB81-173817; EPA-600/9-80-057B) Avail: NTIS HC A99/MF A01 CSCL 06T

The Proceedings are organized into sections corresponding to the format of the Symposium and addressing toxicological effects of inhaled diesel emissions, mutagenic and carcinogenic potency of extracts of diesel and related environmental emissions, mutagenicity of inhaled diesel emissions, carcinogenic effects of exposure to diesel emissions, and epidemiological studies. A panel discussion on health risk assessment of diesel emissions is included. GRA

N81-30046# Battelle Pacific Northwest Labs., Richland, Wash.
ANALYSIS OF FEDERAL INCENTIVES USED TO STIMULATE ENERGY CONSUMPTION
R. J. Cole, B. W. Cone, J. C. Emery, M. Huelshoff, D. E. Lenerz, A. Marcus, F. A. Morris, W. J. Sheppard; and P. Sommers Apr. 1981 14 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3558-EX-Summ) Avail: NTIS HC A02/MF A01.

Data on estimated cost of incentives used to stimulate energy consumption by incentive type and energy source are tabulated for coal, oil, gas, and electricity. It is suggested that the examination of past incentives can be useful in developing guidelines and limits for the use of incentives to stimulate consumption of solar energy. DOE

N81-30050# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY-STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION. VOLUME 1: OVERVIEW AND FINDINGS Final Report
L. G. OConnell, C. J. Anderson, E. Behrin, W. Cliff (Battelle Pacific Northwest Lab., Seattle, Wash.), R. Crisp (Arkansas Univ. Fayetteville), H. C. Forsberg, C. L. Hudson (Interplan Corp.), J. S Payne, R. Renner, M. D. Schrot et al 15 Dec. 1980 67 p refs 4 Vol.
(Contract W-7405-eng-48)
(UCRL-53053-80-Vol-1) Avail: NTIS HC A04/MF A01

Results of a national multilaboratory study of energy storage propulsion systems for automobiles are presented. The findings of the five participating panels are given, including a technical and cost analysis for the energy storage devices and resulting vehicles, as well as a discussion of national impact issues. Information on electrochemical, mechanical, chemical, and thermal energy storage devices is presented. The feasibility of developing each type of system for use in automobiles; the effects of such usage on vehicle design, safety, performance, cost, and marketability; and the impact on US petroleum consumption of the commercialization of vehicles with energy storage equipment are addressed. DOE

N81-30053# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY-STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION. VOLUME 4: NATIONAL IMPACT ISSUES Final Report
L. G. OConnell, C. J. Anderson, E. Behrin, W. Cliff (Battelle Pacific Notthwest Labs., Wash.), R. Crisp (Arkansas Univ., Fayetteville), H. C. Forsberg, C. L. Hudson (Interplane Corp.), J. S. Payne, R. Renner, M. D. Schrot et al 15 Dec. 1980 255 p refs 4 Vol.
(Contract W-7405-eng-48)
(UCRL-53053-80-Vol-4) Avail: NTIS HC A12/MF A01

Information on the social, economic, environmental, health, and energy impacts predicted as the result of marketing advanced automobiles with energy storage systems, are presented. The effects of manufacturing and service infrastructure for ESV's, and specialty markets for ESV's are addressed. DOE

N81-30222# Oak Ridge National Lab., Tenn. Environmental Sciences Div.
COAL CONVERSION SOLID WASTES: CHARACTERIZATION FOR ENVIRONMENTAL ASSESSMENT
S. Y. Lee and W. J. Boegly, Jr. Jun. 1981 43 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7533) Avail: NTIS HC A03/MF A01

Physicochemical and leaching properties of coal conversion solid wastes produced by British Gas-Lurgi, Cogas, and Texaco gasification pilot plants were measured in order to assess the potential environmental impact caused by disposal of these wastes. The British Gas-Lurgi waste was composed of homogeneous calcic aluminosilicate glass with less than 1 percent of metallic iron particles. Major and trace elements were diluted by the influx of limestone added during the slagging process. The Cogas waste was partially vitrified ferruginous aluminosilicate with a surface occasionally covered by iron oxide coatings. Immiscible iron oxide and iron sulfide phases in the aluminosilicate matrix of ferromagnetic particles were detected. The Texaco gasification waste was composed of sulfur rich ferruginous aluminosilicate particles, and the surface of the particles was extensively coated by amorphous iron sulfide and occasionally by lepidocrocite. Pyrrhotite mineral was dominant in the ferromagnetic fraction. DOE

N81-30226# Battelle Pacific Northwest Labs., Richland, Wash.
CHEMICAL PRODUCTION FROM INDUSTRIAL BY-PRODUCT GASES Final Report
S. E. Lyke and R. H. Moore Apr. 1981 128 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3753) Avail: NTIS HC A07/MF A01

The potential for conservation of natural gas is studied and the technical and economic feasibility and the implementation of ventures to produce such chemicals using carbon monoxide and hydrogen from byproduct gases are determined. A survey was performed of potential chemical products and byproduct gas sources. By-product gases from the elemental phosphorus and the iron and steel industries were selected for detailed study. Gas sampling, preliminary design, market surveys, and economic analyses were performed for specific sources in the selected industries. The study showed that production of methanol or ammonia from byproduct gas at the sites studied in the elemental phosphorus and the iron and steel industries is technically feasible but not economically viable under current conditions. Several other applications are identified as having the potential for better economics. DOE

N81-30278# Falcon Research and Development Co., Buffalo, N. Y.

EVALUATION OF STATISTICAL PROCEDURES FOR GRADING FUEL EFFICIENT ENGINE OILS Final Report
S. Kaufman, H. T. McAdams, and N. Morse Nov. 1980 78 p refs
(Contract EPA-68-03-2835)
(PB81-188930; EPA-460/3-81-012; Rept-3520-2/BUF-40) Avail: NTIS HC A05/MF A01 CSCL 11H

In March 1980 the EPA distributed for industry comment at draft 'EPA Recommended Practice for Evaluating, Grading, and Labeling the Fuel Efficiency of Motor Vehicle Engine Oils'. The EPA request Falcon Research and and Development Co. to 'analyze comments received...with regard to the recommended statistical procedure'. As a follow up effort, Falcon was requested to provide an independent assessment of certain aspects of the proposed statistical procedure. Particular areas identified for consideration were: (1) comparative accuracy of carryover and non-carryover effect procedures; (2) means for encouraging (rewarding) accurate testing; (3) dealing with outliers in fuel economy test data; and (4) the impact of variability in oil effects across car models on the meaningful grading of oils. An investigation of these areas, and cursory examination of some additional topics form the subject of this report. GRA

N81-30313# Oak Ridge National Lab., Tenn.
A MATRIX APPROACH TO BIOLOGICAL INVESTIGATION OF SYNTHETIC FUELS
David L. Coffin Mar. 1981 79 p refs Conf. held at Research Triangle Park, N.C., 26 Apr. 1979; sponsored by EPA and DOE
(PB81-183477; EPA-600/9-81-009) Avail: NTIS HC A05/MF A01 CSCL 06T

Documentation is provided for a conference on toxicological assessment of health effects from the rapidly developing synthetic fuels industry. The discussions focus on the Paraho crude shale oil produced and refined into diesel and jet fuels. Summaries of both operations are presented. Also discussed is the collection, storage, and distribution to toxicologists of sample materials from these operations. GRA

N81-30319# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
AIR INFILTRATION IN BUILDINGS Ph.D. Thesis
Max Howard Sherman Oct. 1980 125 p refs
(Contract W-7405-eng-48)
(LBL-10712) Avail: NTIS HC A06/MF A01

A physical model of infiltration in buildings that can be used to predict the infiltration for a wide range of construction types and climate regions is presented. The problems associated with commonly used tracer gas methods for measuring infiltration were examined in detail so that results obtained from the model could be properly compared with actual measurements. In addition, a simple model of the hydrodynamics of typical leaks in the building envelope was devised in order to study the physical processes of infiltration (i.e., the flow of air through cracks in the structure of the building). Finally, a method for quantifying the leakage of the building envelope (the quantity analogous to envelope thermal conductance) was developed. The name given to this measurement technique is AC pressurization. Although other methods exist for measuring the leakage of a building envelope, AC pressurization is far more accurate and can be used at lower pressures than any existing methods. The model, based on the determination of the effective leakage area, was used to predict the infiltration at 15 separate sites. DOE

N81-30394# Midwest Research Inst., Golden, Colo. Building Systems Development Branch.
ANALYSIS OF THE PERFORMANCE AND SPACE-CONDITIONING IMPACTS OF DEDICATED HEAT-PUMP WATER HEATERS
L. Morrison and J. Swisher Dec. 1980 15 p refs Presented at 3rd Ann. Systems Simulation Econ. Analysis/Solar Heating and Cooling Operational Results Conf., Reno, Nev., 27 Apr. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-721-1014; CONF-810405-15) Avail: NTIS HC A02/MF A01

The operation of a newly marketed dedicated heat pump water heater (HPWH) which utilizes an air to water heat pump, costs about $1000 installed, and obtains a coefficient of performance (COP) of about 2.0 in laboratory and field tests, is a space conditioning benefit if an air conditioning load exists and a penalty if a space heating load exists. A simulation was developed to model the thermal performance of a residence with resistance baseboard heat, air conditioning, and either heat pump or resistance water heating. The building characteristics were adapted (Madison, Wisconsin; Washington, DC; and Ft. Worth, Texas) and the system was simulated for a year with typical weather data. For each city, HPWH COPs are calculated monthly and yearly. The water heating and space conditioning energy requirements of HPWH operation are compared with those of resistance water heater operation to determine the relative performance ratio of the HPWH. DOE

N81-30512 International Institute for Applied Systems Analysis, Laxenburg (Austria).
THE IIASA SET OF ENERGY MODELS: ITS DESIGN AND APPLICATION
Paul S. Basile, M. Agnew, A. Holzl, Yu. Kononov, A. Papin, H.-H. Rogner, and L. Schrattenholzer Dec. 1980 67 p refs
(IIASA-RR-80-31) Avail: Issuing Activity

The models studied include an accounting framework type energy demand model, a dynamic linear programming energy supply and conversion system model, an input-output model, a macroeconomic model, and an oil trade gaming model. They are incorporated in an integrated set for long-term, global analyses. This set makes use of a highly iterative process for energy scenario projections and analyses. Each model is quite simple and straightforward in structure; a great deal of human judgement is necessary in applying the set. The models are applied to study two alternative energy scenarios for a coming fifty year period. Examples are presented revealing the wealth of information that can be obtained from multimodel techniques. Details are given for several models (equations employed, assumptions made, data used). Author (ESA)

N81-30524*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE SYSGEN USER PACKAGE
C. R. Carlson 15 Mar. 1981 119 p refs
(Contracts NAS7-100; DE-AT04-81AL-16228)
(NASA-CR-164706; JPL-Pub-81-47; DOE/JPL-1060-47) Avail: NTIS HC A06/MF A01 CSCL 10B

The user documentation of the SYSGEN model and its links with other simulations is described. The SYSGEN is a production costing and reliability model of electric utility systems. Hydroelectric, storage, and time dependent generating units are modeled in addition to conventional generating plants. Input variables, modeling options, output variables, and reports formats are explained. SYSGEN also can be run interactively by using a program called FEPS (Front End Program for SYSGEN). A format for SYSGEN input variables which is designed for use with FEPS is presented. E.A.K.

N81-30551*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MARKET ASSESSMENT OVERVIEW
Hamid Habib-agahi *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 241-246 (For primary document see N81-30525 21-44)
Avail: NTIS HC A13/MF A01 CSCL 05C

Market assessment, refined with analysis disaggregated from a national level to the regional level and to specific market applications, resulted in more accurate and detailed market estimates. The development of an integrated set of computer simulations, coupled with refined market data, allowed progress in the ability to evaluate the worth of solar thermal parabolic dish systems. In-depth analyses of both electric and thermal market applications of these systems are described. The following market assessment studies were undertaken: (1) regional analysis of the near term market for parabolic dish systems; (2) potential early market estimate for electric applications; (3) potential early market estimate for industrial process heat/cogeneration applications; and (4) selection of thermal and electric application case studies for fiscal year 1981. S.F.

N81-30559*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REGIONAL CHARACTERISTICS RELEVANT TO ADVANCED TECHNOLOGY COGENERATION DEVELOPMENT
Ram Manvi Jul. 1981 155 p refs Sponsored in part by DOE
(Contract NAS7-100)

(NASA-CR-164697; JPL-Pub-81-61) Avail: NTIS HC A08/MF A01 CSCL 10B

To assist DOE in establishing research and development funding priorities in the area of advanced energy conversion technoloy, researchers at the Jet Propulsion Laboratory studied those specific factors within various regions of the country that may influence cogeneration with advanced energy conversion systems. Regional characteristics of advanced technology cogeneration possibilities are discussed, with primary emphasis given to coal derived fuels. Factors considered for the study were regional industry concentration, purchased fuel and electricity prices, environmental constraints, and other data of interest to industrial cogeneration. A.R.H.

N81-30560*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CONCEPTS FOR DESIGN OF AN ENERGY MANAGEMENT SYSTEM INCORPORATING DISPERSED STORAGE AND GENERATION

H. Kirkham, T. Koerner, and D. Nightingale 15 Apr. 1981 135 p refs

(Contracts NAS7-100; Contract DE-AI01-79ET-29372)

(NASA-CR-164700; JPL-Pub-81-20; DOE/ET-29372/1) Avail: NTIS HC A07/MF A01 CSCL 10B

New forms of generation based on renewable resources must be managed as part of existing power systems in order to be utilized with maximum effectiveness. Many of these generators are by their very nature dispersed or small, so that they will be connected to the distribution part of the power system. This situation poses new questions of control and protection, and the intermittent nature of some of the energy sources poses problems of scheduling and dispatch. Under the assumption that the general objectives of energy management will remain unchanged, the impact of dispersed storage and generation on some of the specific functions of power system control and its hardware are discussed. A.R.H.

N81-30582# Hawaii Community Design Center, Honolulu.

HOME ENERGY SAVER'S HANDBOOK Final Report

Noreen N. Koga, ed. Sep. 1980 43 p refs

(Contracts DE-FG03-78SF-01910; EM-78-G-03-1910)

(DOE/SF-01910/T1) Avail: NTIS HC A03/MF A01

Energy is described and how much energy a household consumes is discussed. The saving of energy is recommended and measures to save energy when operating hot water heaters, air conditioners, lighting systems refrigerators, freezers, stoves, microwave ovens, washing machines, clothes dryers, dishwashers, television sets, and portable appliances are summarized. DOE

N81-30585# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.

REGIONAL ANALYSIS OF ENERGY FACILITY SITING

F. W. Lipfert, P. M. Meier, and L. I. Kleinman 1980 37 p refs Presented at the SOGESTA Workshop on Energy Policy Analysis, Urbino, Italy, 3-6 Nov. 1980

(Contract DE-AC02-76CH-00016)

(BNL-29324; CONF-801137-5) Avail: NTIS HC A03/MF A01

Some of the regional environmental parameters of energy facility siting with emphasis on air quality impacts were examined. An example of a siting optimization study is presented, and it is shown how difficult it presently is to specify an environmental objective function that is universally applicable. The importance of regional background effects are discussed, and long range transport models are used to analyze the relative importance of local and long range impacts. DOE

N81-30619# Oak Ridge National Lab., Tenn. Energy Div.

LINK BETWEEN TRADITIONAL PLANNING AND ENERGY MANAGEMENT

M. Schweizer 1981 13 p refs Presented at the Community Energy Planning Conf., Gatlinburg, Tenn., 21-20 Jan. 1981; sponsored by the Tennessee Chapter of the American Planning Association and Tennessee Univ.

(Contract W-7405-eng-26)

(CONF-810140-1) Avail: NTIS HC A02/MF A01

Community energy planning is the process of envisioning a desired future state of energy supply and consumption for a local area and designing the appropriate measures to implement that future. While energy planning can be distinguished from other specialized concerns, such as housing or transportation planning, there are also major similarities which bind all these elements together. These similarities and differences are discussed. Community level energy planning represents a natural extension of the comprehensive planning process. As the comprehensive plan has grown in the past to reflect new subjects of public concern such as environmental quality and economic development, so it can evolve further to address society's growing interest in energy use. DOE

N81-30620# Oak Ridge National Lab., Tenn. Energy Div.

APPROPRIATE ENERGY TECHNOLOGY FOR URBAN AREAS

W. R. Mixon 1981 9 p refs Presented at Workshop on Status of Res. and Methods of Evaluation Interaction, Gainesville, Fla., 14-16 May 1981

(Contract W-7405-eng-26)

(CONF-810565-1) Avail: NTIS HC A02/MF A01

Some of the unique characteristics of high density urban areas as they affect the potential use of energy conservation measures and more efficient and renewable energy sources are addressed. Energy related problems of urban areas are presented and the inner city is characterized as an environment with limited potential for applying conservation measures and innovative energy sources of the level of individual buildings. District heating and cooling is presented as one technology, uniquely appropriate for urban areas, that can collect thermal energy from efficient cogeneration plants, municipal incinerators, industrial processes, and renewable natural energy resources and distribute that energy throughout a community to its ultimate consumers. Through district heating, the urban communities can conserve energy and scarce fuels, improve environmental quality, and participate in achieving a more harmonious interface between humanity and the natural environment. DOE

N81-30630# Department of Energy, Washington, D. C. Office of Industrial Programs.

INDUSTRIAL ENERGY-EFFICIENCY IMPROVEMENT PROGRAM Annual Report to the Congress and the President, 1979

1 Dec. 1980 83 p

(DOE/CE-0001) Avail: NTIS HC A05/MF A01

The industrial energy efficiency improvement program to accelerate market penetration of new and emerging industrial technologies is described. Practices which will improve energy efficiency, encourage substitution of more plentiful domestic fuels, and enhance recovery of energy and materials from industrial waste streams are enumerated. Specific reports from the chemicals and allied products; primary metals; petroleum and coal products; stone, clay, and glass, paper and allied products; food and kindred products; fabricated metals; transportation equipment; machinery (except electrical); textile mill products; rubber and miscellaneous plastics; electrical and electronic equipment; lumber and wood; and tobacco products are discussed. A summary on progress in the utilization of recovered materials, and an analysis of industrial fuel mix is presented. DOE

N81-30631# Los Alamos Scientific Lab., N. Mex.

CHARACTERIZATION OF HOT DRY ROCK GEOTHERMAL ENERGY EXTRACTION SYSTEMS

James N. Albright and Carl A. Newton 1981 7 p refs Presented at the SQUID Applications to Geophys. Workshop, Los Alamos, N. Mex., 2-4 Jun. 1980

(Contract W-7405-eng-36)

(LA-UR-81-1620; CONF-810660-1) Avail: NTIS HC A02/MF A01

The engineering of heat exchange systems by which geothermal heat can be efficiently extracted from hot impermeable rocks is studied. The system currently under investigation at Fenton Hill, New Mexico consists of a network of large fractures created through the hydraulic pressurization of a well penetrating hot basement rocks and subsequently intersected by a second well drilled to form a flow-thru system. Cool water pumped into the fractures through one well, once heated in the reservoir, returns to the surface through the second well, is cooled, and then recirculated. While much is known about the performance parameters of the fracture network from short-term flow tests, little is understood concerning the spatial dimensions and geometrical relationship of individual fractures comprising the network. Ultimately, the success one has in estimating the long-term performance of such a system where commercialization

is an issue, and in engineering future systems with optimal performance, depends on the success in characterizing the flow-thru fracture networks. DOE

N81-30637# Oak Ridge National Lab., Tenn. Energy Div.
COMMUNITY-BASED ASSESSMENT AND PLANNING OF ENERGY FUTURES
Sam A. Carnes 1981 17 p refs Presented at the Community Energy Planning Conf., Gatlinburg, Tenn., 29-30 Jan. 1981; sponsored by the Tennessee Chapter of the American Planning Association and Tennessee Univ.
(Contract W-7405-eng-26)
(CONF-810140-2) Avail: NTIS HC A02/MF A01

The decentralized solar energy technology assessment program is discussed. Four communities were involved in an assessment of the compatibility of diverse conservation and renewable energy supply technologies and community values and goals and in community planning for the implementation of compatible energy demand and supply alternatives. The community approach has several basic components: (1) recruiting and organizing for the assessment planning process; (2) collection and analysis of data related to community energy use and indigenous renewable energy resources; (3) creation and maintenance of a community education and information program; (4) development of policies favorable to the development of preferred community futures; and (5) development of implementation or action strategies. The role of public participation, group decision making techniques, the role of technical information in citizen and group decision making, and linkage between assessment planning and the relevant policy process are emphasized. DOE

N81-30638# Battelle Columbus Labs., Ohio.
TECHNOLOGY FOR THE DEVELOPMENT OF HIGH EFFICIENCY OIL-FIRED RESIDENTIAL HEATING EQUIPMENT Final Report
D. W. Locklin and H. R. Hazard Jun. 1980 264 p refs 80066127 Prepared for Brookhaven National Lab., Upton, N.Y.
(Contract DE-AC02-76CH-00016)
(BNL-51325) Avail: NTIS HC A12/MF A01

The development of efficient residential oil burning equipment with capability for reliable, low capacity operation is assessed. Technical approaches with potential application to unconventional types of oil burners and to efficient heat exchangers, including those that operate partially in the mode of condensing moisture from the flue gases to regain the latent heat of vaporization are reviewed. The following concepts are recommended for further investigation in the development of efficient oil fired heating equipment: (1) modified high pressure atomizing systems; (2) alternative methods of atomization; (3) blue flame burners; (4) pulse combustion systems; and (5) condensing-type heat exchangers. DOE

N81-30639# Department of Energy, Washington, D. C. Office of Consumption Data System.
RESIDENTIAL ENERGY-CONSUMPTION SURVEY: CONSUMPTION AND EXPENDITURES. PART 1: NATIONAL DATA INCLUDING CONSERVATION
Apr. 1981 160 p refs
(DOE/EIA-0262/1) Avail: NTIS HC A08/MF A01

The results of the second residential energy consumption survey are presented. Data on consumption and expenditures are presented for the year April 1979 through March 1980. Tables are also presented which indicate the cost and incidence of major insulation added to US households in 1978 and 1979. The tables are from the final data file that contains imputations for missing data and includes information from the mail questionnaires. The report contains selected tabulations for each of the four Census regions for the period 1978-1980. Included are: a summary of findings showing comparisions in residential energy consumption between the 1978 to 1979 and 1979 to 1980 time periods a description of how the survey was conducted, a statement about the limitations of the data including relative standard errors, a copy of the survey forms, and a glossary.DOE

N81-30640# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ECONOMIC ANALYSIS OF INDUSTRIAL WASTE-HEAT RECOVERY: FLUIDIZED-BED TECHNOLOGY VERSUS THREE CONVENTIONAL ALTERNATIVES
Paul J. Grogan, Harry L. Brown, Michael J. Koluch, and Bernard B. Hamel Apr. 1981 40 p refs
(Contract W-31-103-eng-38)
(ANL/CNSV/TM-66) Avail: NTIS HC A03/MF A01

The performance parameters and costs of these technologies were based upon existing information. Data on available waste energy in industry, and the temperatures and operating sources of that energy were based upon the Industrial Plant Energy Profile (IPEP). This data base contains plant-energy information from approximately 400,000 industrial plant sites in the country. These sites represent the bulk of the nation's industrial manufacturing capacity. Based on this information, the available waste energy from each of the industrial sectors was determined by process-unit operation. Waste energy was determined as a function of plant size. Each of the competing heat-recovery technologies, both conventional and fluidized-bed, was applied to the waste streams. Energy savings and payback were determined on the bases of waste-heat source and plant size. Conventional heat exchangers showed a significant number of applications with paybacks of less than one year. DOE

N81-30642# California Univ., Livermore. Lawrence Livermore Lab.
CANADA'S NEW NATIONAL ENERGY PROGRAM ON OIL AND GAS: WHAT ARE THE MAIN PROVISIONS? WHAT ARE THE REACTIONS SO FAR?
K. K. Burr Apr. 1981 73 p refs
(Contract W-7405-eng-48)
(UCID-19052) Avail: NTIS HC A04/MF A01

The Canadian federal government announced a National Energy Program (NEP) for oil and natural gas to achieve energy self sufficiency. The program deals with two major political and economic influences in Canadian energy: provincial ownership of natural resources and 70% of foreign ownership in the Canadian petroleum industry. The objectives to achieve national energy security, create opportunities for Canadian participation, and share resource benefits among the provinces. The major provisions include: a 80% federal tax on oil and gas production; a natural gas federal excise tax; a pricing scheme which holds conventional oil prices down but gives incentives for oil sands, heavy oil, and tertiary recovery production; a gas pricing scheme which encourages substitution of gas for oil; a 25% carried interest for the government on federal leases; and a Canadianization incentives grant system which replace the depletion allowance system. DOE

N81-30648# Research Inst. of National Defence, Stockholm (Sweden).
FACTOR DEMAND IN SWEDISH MANUFACTURING INDUSTRY WITH SPECIAL REFERENCE TO THE DEMAND FOR ENERGY. INSTANTANEOUS ADJUSTMENT MODELS; SOME RESULTS
Kent Rune Sjoeholm Feb. 1981 141 p refs
(FOA-C-10175-M5) Avail: NTIS HC A07/MF A01

The dual approach to the theory of production is used to estimate factor demand functions of the Swedish manufacturing industry. Two approximations of the cost function, the translog and the generalized Leontief models, are used. The price elasticities of the factor demand do not seem to depend on the choice of model. This is at least true as to the sign pattern and as to the inputs capital, labor, total energy and other materials. Total energy is separated into solid fuels, gasoline, fuel oil, electricity and a residual. Fuel oil and electricity are found to be substitutes by both models. Capital and energy are shown to be substitutes. This implies that Swedish industry will save more energy if the capital cost can be reduced. Both models are, in the best versions, able to detect an inappropriate variable. The assumption of perfect competition on the product market, is shown to be inadequate by both models. When this assumption is relaxed, the normal substitution pattern among the inputs is resumed. Author (ESA)

N81-30651# Rhode Island Univ., Kingston.
WATER, ENERGY, AND ECONOMIC DEVELOPMENT TOWARDS AN INTEGRATED REGIONAL POLICY ANALYSIS SYSTEM
Rudolph W. Hardy Feb. 1981 63 p refs Sponsored by Dept. of Interior
(PB81-184111; W81-02430; OWRT-C-90071; G/C-00191; G(9412)(1)) Avail: NTIS HC A04/MF A01 CSCL 10A

An integrated methodological approach in the economic development of water resources and preservation and energy

production and consumption was examined. The implications are explored, and potential solutions are sought. It is concluded that the nature of institutions and how they function require highly compartmentalized decision making/planning, and incentives for coordination appear weak. GRA

N81-30654# Pratt Inst., Brooklyn, N. Y.
ENERGY CONSERVATION POTENTIAL IN LOW-RISE, HIGH-DENSITY HOUSING Final Report, Sep. 1979 - Sep. 1980
Ron DiDonno New York New York State Energy Research and Development Authority Sep. 1980 221 p Sponsored by New York State Energy Research and Development Authority (PB81-194664; NYSERDA-80-9) Avail: NTIS HC A10/MF A01 CSCL 13A

Results of a year-long study of energy consumption in New York Housing Authority projects and of the design analysis for row house type buildings are reported. Computer simulations and economic analyses were made of 113 design options, and the most cost effective and energy efficient options were selected. GRA

N81-30661# Argonne National Lab., Ill. Energy and Environmental Systems Div.
IN PURSUIT OF CLEAN AIR: A DATA BOOK OF PROBLEMS AND STRATEGIES AT THE STATE LEVEL, SUPPLEMENT
D. B. Garvey, S. B. Moser, and D. G. Streets Aug. 1980 288 p refs
(Contract W-31-109-eng-38)
(ANL/EES/TM-129) Avail: NTIS HC A13/MF A01

The Clean Air Act Amendments of 1977 and EPA regulations set stringent requirements for the control of emissions in areas where the National Ambient Air Quality Standards were exceeded. A previous five volume summary of nonattainment area designations and attainment strategies of the states as of July 1, 1980 is updated. Maps of PSD Class 1 areas and additional information on coal production, coal reserves, and coal quality are also included. DOE

N81-30665# Argonne National Lab., Ill.
ENVIRONMENTAL EFFECTS OF SPACE SYSTEMS
D. M. Rote 1980 13 p refs Presented at the AIAA Intern. Meeting and Tech. Display Global Technol. 2000, Baltimore, 6-8 May 1980
(Contract W-31-109-eng-38)
(CONF-800590-2) Avail: NTIS HC A02/MF A01

The potential effects of large space systems, primarily the Satellie Power System (SPS), on the upper atmosphere, were reviewed. From 56 to 500 km, the major contaminant sources are SPS microwave transmissions and rocket effluents. Deposition of rocket effluens causes compositional changes, most of which appear to be associated with the release of large amounts of water. The formation of ionospheric holes is an example of a modification resulting from the injection of propellant exhaust in the F-region. From 500 to 36,000 km, rocket effluents and ion engine contaminants could alter magnetospheric and plasmaspheric structure and dynamics. One of the major impacts of these alterations could be perturbation of Van Allen radiation belt stability, leading to changed radiation hazards to materials and personnel. DOE

N81-30668# Argonne National Lab., Ill. Energy and Environmental Systems Div.
TECHNOLOGY ASSESSMENT OF SOLAR ENERGY SYSTEMS: AIR-QUALITY EFFECTS OF DIRECT-SOLAR AND BIOMASS SYSTEMS IN HIGH AND LOW DEPLOYMENT SCENARIOS
L. Habegger, P. Dauzvardis, M. Snider, P. Michel, and W. Gasper Jan. 1981 85 p refs
(Contract W-31-109-eng-38)
(ANL/EES/TM-140) Avail: NTIS HC A05/MF A01

The potential benefits and damages to air quality that are related to utilization of solar and biomass technologies as alternatives to more conventional energy producing technologies are evaluated. A compilation of emission levels from various biomass technologies is included. Secondly, it evaluates and compares national and regional cumulative emissions for two solar and biomass growth scenarios in the year 2000: a low growth scenario of 6 quad; and a high growth scenario of 14.2 quad. For the high growth solar scenario, both the national sulfur dioxide and nitrogen oxide emissions were projected to be approximately 5 percent lower than for the low growth scenario. In contrast, particulate emissions were estimated to be approximately 10 percent larger for the high growth scenario, primarily due to emissions from direct combustion of forest and agricultural residues in small, poorly controlled units. Both scenarios project an increase from 1975 national levels of sulfur dioxide and nitrogen dioxide emissions, and both project a decrease from 1975 national levels of particulate emissions. Air pollutant implications of the solar and biomass scenarios for the ten federal regions are also discussed. This indicates significant regional differences in technology mix and the relation of emission changes to attainment and maintenance of air quality standards within the regions. DOE

N81-30691# Mound Lab., Miamisburg, Ohio.
AIR QUALITY AND THE ENVIRONMENTAL EFFECTS FROM AN UNDERGROUND COAL-GASIFICATION TEST
P. W. Seabaugh, R. E. Zielinski, A. K. Agarwal, J. W. Martin (DOE, Morgantown, W. Va.), and A. J. Liberatore (DOE, Morgantown, W. Va.) 1981 9 p refs Presented at the Symp. on Instrumentation and Control for Fossil Energy Processes, San Francisco, 8 Jun. 1981
(Contract DE-AC04-76DP-00053)
(MLM-2837(OP); CONF-810607-4) Avail: NTIS HC A02/MF A01

Using fast response analytical systems and real-time data acquisition, a high density data base was acquired for 17 gaseous components of the product gas stream, including SO2, H2S, COS, and HCN. The data show that almost all gaseous sulfur from the bituminous coal was emitted as H2S. The SO2 and COS values rarely exceeded the background of the instruments although the COS values did rise to abut 100 ppM during the gasification phase. Except for one short period when values rose to 60 ppM, the HCN similarly stayed at the instrument background level of about 1 ppM. Because proven technology to clean H2S from gas streams is available, the test indicates that in-situ gasification of high sulfur bituminous coal on a commercial scale should not contribute to deterioration in air quality. DOE

N81-30692# Battelle Pacific Northwest Labs., Richland, Wash.
REVIEW OF PACIFIC NORTHWEST LABORATORY RESEARCH ON AQUATIC EFFECTS OF HYDROELECTRIC GENERATION AND ASSESSMENT OF RESEARCH NEEDS
D. H. Fickeisen, C. D. Becker, and D. A. Neitzel May 1981 32 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3816) Avail: NTIS HC A03/MF A01

The effect of hydroelectric generation on aquatic biota and environments is discussed. The research goals are to: (1) identify impacts of hydroelectric generation; (2) provide guidance in allocating scarce water resources; and (3) develop techniques to avoid or reduce the impacts on aquatic communities or to compensate for unavoidable impacts. The generic impacts of hydrogeneration is studied. The impacts studied result from a particular system of dams and operating procedures and occur within a specific ecosystem, however, the results have application at hydroelectric generating facilities throughout the United States. DOE

N81-30693# Argonne National Lab., Ill.
TRADEOFFS OF ENERGY CONSERVATION AND ENVIRONMENTAL QUALITY
Allan R. Evans 1980 6 p refs Presented at the 3rd World Energy Congr., Atlanta, 13-16 Oct. 1980
(Contract W-31-109-eng-38)
(CONF-801076-3) Avail: NTIS HC A02/MF A01

Studies performed on industrial energy conservation and pollution control are summarized. The primary purpose of the summary paper is to present the problem for the consideration of others, particularly those from industrial firms who must make the choices in selection of technologies. The paper is also presented as an appeal for more and better analyses of the energy costs of industrial pollution control equipment and new technologies related to energy efficiency improvement or fuel substitution. Industrial emissions and control costs, energy required for industrial pollution control, and effects of energy cost increase are discussed. DOE

N81-30702# Radian Corp., Austin, Tex.
SELECTIVE CATALYTIC REDUCTION AND NOx CONTROL IN JAPAN Final Report, Mar. 1980 - Jan. 1981

Gary D. Jones Mar. 1981 269 p
(Contract EPA-68-02-3171)
(PB81-191116; RAD-81-203-001-27-07; EPA-600/7-81-030)
Avail: NTIS HC A12/MF A01 CSCL 13B

Overall goals of the study were to obtain new information on curent issues concerning application of FGT technology and to update information previously published. A total of 28 equipment vendors, process operators, government agencies, and industry groups were contacted. Substantial recent progress was discovered with regard to commercial applications of selective catalytic reduction (SCR) technology to gas and oil fired boilers. There are several applications where SCR systems are operated continuously and are successfully removing 80% of the NOx from the flue gas stream. GRA

N81-30728# Argonne National Lab., Ill. Energy and Environmental Systems Div.
TROPOSPHERIC EFFECTS OF SATELLITE POWER SYSTEMS
K. L. Brubaker and J. Lee 1980 10 p refs Presented at the AIAA Intern. Meeting and Tech. Display Global Technol. 2000, Baltimore, 6-8 May 1980
(Contract W-31-109-eng-38)
(CONF-800590-4) Avail: NTIS HC A02/MF A01

The construction and operation of a system of solar power satellites is expected to have a variety of effects on the troposphere. The launching of large space vehicles affects the air quality in the vicinity of the launch site, and the ground cloud associated with such a launch is known to stimulate the growth of water clouds under some circumstances. The transmission of power from satellite to the Earth's surface may affect certain meteorological parameters in the vicinity of the rectenna site. These and other effects are discussed in reference to the proposed solar power satellite system. DOE

N81-30763# National Oceanic and Atmospheric Administration, Boulder, Colo. Center for Environmental Assessment Services.
CLIMATIC DEGREE DAYS FOR ENERGY DEMAND ASSESSMENT
Henry E. Warren, Sharon K. LeDuc, and Mary S. Joshua Nov. 1980 146 p refs
(PB81-193880; NOAA-81021901) Avail: NTIS HC A07/MF A01 CSCL 04B

The development and procedures for the use of real time heating and cooling degree days information for States is presented. These State data are determined by population weighting heating and cooling degree days data from major National Weather Service stations. The concept of a degree day index is a result of the need to monitor temperature sensitive energy consumption on a disaggregated basis. Climatological normals and ranges of heating and cooling degree days are calculated for each State and presented in tabular and graphic form to facilitate the use of operational information. GRA

N81-30793# Environmental Protection Agency, Research Triangle Park, N.C. Health Effects Research Lab.
TUMORIGENESIS OF DIESEL EXHAUST, GASOLINE EXHAUST, AND RELATED EMISSION EXTRACTS ON SENCAR MOUSE SKIN
Stephen Nesnow, Larry L. Triplett (ORNL), and Thomas J. Slaga 1980 25 p refs Presented at the EPA 2nd Symp. on Application of Short Term Bioassays in the Analysis of Complex Environ. Mixtures, Williamsburg, Va., 4-7 Mar. 1980
(Contracts W-7405-eng-26; EPA-79-D-X0526; DOE-40-728-78)
(CONF-800323-4) Avail: NTIS HC A02/MF A01

The SENCAR mouse skin tumorigenisis bioassay for tumor initiation, a quantitative short term in vivo rodent carcinogenesis system which detects a variety of structurally diverse chemical carcinogens was examined. This bioassay system is utilized in evaluating complex environmental mixtures for tumorigenic potential. It provides dose responses with both substances and complex mixtures and is utilized for comparative potency analysis. The tumorigenicity of diesel exhaust particulate emissions was examined using SENCAR mouse skin. The tumorigenic potency of particulate emissions from diesel, gasoline, and related emission sources are compared and the tumorigenic potential of the materials is clearly indicated. E.A.K.

N81-30956# Argonne National Lab., Ill.
NORTHEAST REGIONAL ENVIRONMENTAL IMPACT STUDY: WASTE DISPOSAL TECHNICAL REPORT
J. L. S. Saguinsin Apr. 1981 243 p refs
(Contract W-31-109-eng-38)
(DOE/RG-0058) Avail: NTIS HC A11/MF A01

The potential for cumulative and interactive environmental impacts associated with the conversion of multiple generating stations in the Northeast is assessed. The estimated quantities and composition of wastes resulting from coal conversion, including ash and SO2 scrubber sludge, are presented. Regulations governing the use of ash and scrubber sludge are identified. Currently available waste disposal schemes are described. The location, capacity, and projected life of present and potential disposal sites in the region are identified. Waste disposal problems, both hazardous and nonhazardous, are evaluated. Environmental regulations within the region as they pertain to coal conversion and as they affect the choice of conversion alternatives are discussed. A regional waste management strategy for solid waste disposal is developed. DOE

N81-31016# Midwest Research Inst., Golden, Colo. Planning, Applications, and Impacts Div.
ORGANIZATIONAL PRECEDENTS FOR OWNERSHIP AND MANAGEMENT OF DECENTRALIZED RENEWABLE-ENERGY SYSTEMS
Richard Meunier and Jo Ann Silversmith Mar. 1981 62 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-744-312) Avail: NTIS HC A04/MF A01

Three existing organizational types that meet the decentralization criteria of local consumer ownership and control - cooperatives, Rural Electric Cooperatives, and municipal utilities - are examined. These three organizational precedents are analyzed in terms of their histories, structures, legal powers, sources of capital, and social and political aspects. Examples of related experiments with renewable energy technologies are given, and inferences are drawn regarding the organizations' suitability as vehicles for future implementation of decentralized renewable energy systems. DOE

N81-31025# Oak Ridge National Lab., Tenn. Engineering Physics Div.
INPUT PARAMETERS FOR LEAP AND ANALYSIS OF THE MODEL 22C DATA BASE
L. Stewart and Moshe Goldstein May 1981 226 p refs
(Contract W-7405-eng-26)
(ORNL-5746) Avail: NTIS HC A11/MF A01

The structure of the data base is briefly outlined and an attempt made to categorize the parameters according to the methods employed for estimating the numerical values. Due to incomplete documentation and/or lack of specific parameter definitions, few of the input values could be traced and uniquely interpreted using the information provided in the primary and secondary sources. Input parameter choices were noted which led to output projections which are somewhat suspect. Other data problems encountered are summarized. Some of the input data were corrected and a revised base case was constructed. The output projections for this revised case are compared with the Model 22C output for the year 2020, for the transportation sector. DOE

N81-31026# PEDCo-Environmental, Inc., Cincinnati, Ohio.
FLUE GAS DESULFURIZATION INFORMATION SYSTEM (FGDIS) DATA BASE USER'S MANUAL
M. Smith Mar. 1981 127 p Sponsored in part by EPA
(PB81-162505) Avail: NTIS HC A07/MF A01 CSCL 05B

A guide is provided for the use of the Flue Gas Desulfurization Information System (FGDIS) data base which is a collection of data files consisting of information pertaining to the design and performance of flue gas desulfurization (FGD) systems. GRA

N81-31032*# Mechanical Technology, Inc., Latham, N. Y. Engine Systems Div.
AUTOMOTIVE STIRLING REFERENCE ENGINE DESIGN REPORT
Jun. 1981 134 p
(Contracts DEN3-32; EC-77-A-31-10040)
(NASA-CR-165381; DOE/NASA/0032-12; MTI-81-ASE-164DR-2) Avail: NTIS HC A07/MF A01 CSCL 13F

The reference Stirling engine system is described which

provides the best possible fuel economy while meeting or exceeding all other program objectives. The system was designed to meet the requirements of a 1984 Pontiac Phoenix (X-body). This design utilizes all new technology that can reasonably be expected to be developed by 1984 and that is judged to provide significant improvement, relative to development risk and cost. Topics covered include: (1) external heat system; (2) hot engine system; (3) cold engine system; (4) engine drive system; (5) power control system and auxiliaries; (6) engine instalation; (7) optimization and vehicle simulation; (8) engine materials; and (9) production cost analysis. A.R.H.

N81-31035*# University of Southern California, Los Angeles. NASA Industrial Application Center.
ADVANCED TECHNOLOGY DISPLAY HOUSE. VOLUME 1: PROJECT SUMMARY AND PROCEDURES
D. H. Maund [1981] 54 p refs 4 Vol.
(Contract NAS2-10794)
(NASA-CR-166238-Vol-1; DRB-320-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 13B

The Advanced Technology Display House (ATDH) project is described. Tasks are defined in the areas of energy demand, water demand, sewage treatment, electric power, plumbing, lighting, heating, and air conditioning. Energy, water, and sewage systems are defined. S.F.

N81-31036*# University of Southern California, Los Angeles. NASA Industrial Application Center.
ADVANCED TECHNOLOGY DISPLAY HOUSE. VOLUME 2: ENERGY SYSTEM DESIGN CONCEPTS
D. H. Maund [1981] 62 p refs 4 Vol.
(Contract NAS2-10794)
(NASA-CR-166238-Vol-2; DRB-320-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 13B

The preliminary design concept for the energy systems in the Advanced Technology Display House is analyzed. Residential energy demand, energy conservation, and energy concepts are included. Photovoltaic arrays and REDOX (reduction oxidation) sizes are discussed. S.F.

N81-31040# Argonne National Lab., Ill.
STUDY DESCRIPTION: AN ENVIRONMENTAL COMPARISON OF FUTURE URBAN-TRANSPORTATION ALTERNATIVES
D. O. Moses (DOE, Washington, D.C.) and Sarah J. LaBelle 1980 26 p refs Presented at the 3rd World Energy Congr., Atlanta, 14-16 Oct. 1980
(Contract W-31-109-eng-38)
(CONF-801076-5) Avail: NTIS HC A03/MF A01

The transportation sector directly consumes one quarter of the energy used in this country with auto passenger travel accounting for half of the transport sector's energy supply. Due to rapidly rising fuel prices and intermittent supply shortages, Federal, state, and local government have begun to introduce various strategies (combinations of policies and technologies) designed to conserve urban transportation energy while maintaining a productive economy. The environmental consequences of many of the conservation strategies have not been adequately assessed. As a result, a technology assessment project is underway. The project will concentrate on the effects of alternative conservation strategies for the efficient movement of people in urban areas. The goals of the project are to provide: a description of several alternative strategies promoting energy conservation in the urban passenger transportation sector; a better understanding of the environmental impacts of such strategies; and an identification of the constraints to the implementation of such strategies. DOE

N81-31184*# Kentron International, Inc., Hampton, Va.
DESIGN AND ANALYSIS OF A FUEL-EFFICIENT SINGLE-ENGINE, TURBOPROP-POWERED, BUSINESS AIRPLANE
G. L. Martin, D. E. Everest, Jr., W. A. Lovell, J. E. Price, K. B. Walkley, and G. F. Washburn Hampton, Va. NASA. Langley Research Center Aug. 1981 37 p refs
(Contract NAS1-16000)
(NASA-CR-165768) Avail: NTIS HC A03/MF A01 CSCL 01C

The speed, range, payload, and fuel efficiency of a general aviation airplane powered by one turboprop engine was determined and compared to a twin engine turboprop aircraft. An airplane configuration was developed which can carry six people for a noreserve range of 2,408 km at a cruise speed above 154 m/s, and a cruise altitude of about 9,144 m. The cruise speed is comparable to that of the fastest of the current twin turboprop powered airplanes. It is found that the airplane has a cruise specific range greater than all twin turboprop engine airplanes flying in its speed range and most twin piston engine airplanes flying at considerably slower cruise airspeeds. E.A.K.

N81-31195*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADVANCED SUBSONIC TRANSPORT PROPULSION
Donald L. Nored, Carl C. Ciepluch, Roger Chamberlain, Edward T. Meleason, and Gerald A. Kraft 1981 32 p refs Presented at the Intern. Air Transportation Conf., Atlantic City, N.J. 26-28 May 1981; sponsored by AIAA and SAE
(NASA-TM-82696; E-979) Avail: NTIS HC A03/MF A01 CSCL 21E

A brief review of the current NASA Energy Efficient Engine (E(3)) Project is presented. Included in this review are the factors that influenced the design of these turbofan engines and the advanced technology incorporated in them to reduce fuel consumption and improve environmental characteristics. In addition, factors such as the continuing spiral in fuel cost, that could influence future aircraft propulsion systems beyond those represented by the E(3) engines, are also discussed. Advanced technologies that will address these influencing factors and provide viable future propulsion systems are described. The potential importance of other propulsion system types, such as geared fans and turboshaft engines, is presented. T.M.

N81-31309# Committee on Science and Technology (U. S. House).
ADVANCED COAL COMBUSTION SYSTEMS
Washington GPO 1980 337 p refs Hearings before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 162, 16-17 Sep. 1980
(GPO-69-289) Avail: Subcomm. on Energy Development and Applications

An overview of clean coal technologies is given taking into consideration the concerns of the environmental and industrial sectors. Coal alternatives that can be made available to satisfy policies for increased coal utilization and environmental protection are discussed. These include: advanced pulverized coal plants in which the environmental control is integrated to minimize both its complexity and lack of reliability, atmospheric fluidized bed combustion, pressurized fluidized bed combined cycle plants, and gasification combined cycles. Factors which effect the selection of a particular advanced technology are addressed. J.M.S.

N81-31381# Committee on Commerce, Science, and Transportation (U. S. Senate).
METHANE TRANSPORTATION RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT OF 1980
Washington GPO 1980 165 p refs Joint Hearing on H.R. 6889 before the Subcomm. on Energy Res. and Develop. of the Comm. on Energy and Nat. Resources and the Subcomm. on Sci., Technol., and Space of the Comm. on Com. Sci., and Transportation, 96th Congr., 2nd Sess., 23 Sep. 1980
(Publ-96-126; GPO-70-504) Avail: NTIS Avail: Subcommittee on Energy Research and Development

A bill is presented which would provide a program for advanced and accelerated research into methane vehicle design, methane distribution systems, and methane storage facilities. It would also demonstrate the economic and technological practicalities of methane fueled vehicles for fleet use and onfarm operations. The Department of Energy would be the lead agency to conduct this research, development, and demonstration program. The bill would result in the initiation of 50 fleet demonstrations, of no less than 50 vehicles each, over the next 3 years. R.C.T.

N81-31382# Committee on Banking, Finance and Urban Affairs (U. S. House).
SYNTHETIC FUEL OVERSIGHT HEARING
Washington GPO 1981 99 p Hearing before the Subcomm. on Econ. Stabilization of the Comm. on Banking, Finance and Urban Affairs, 97th Congr., 1st Sess., 3 Mar. 1981
(GPO-76-079) Avail: Subcommittee on Economic Stabilization

Current programs in the development of synthetic fuel technology and supplies are described. Emphasis is placed on rapid development to ensure greater independence from foreign energy supplies. Progress in coal liquefaction, coal gasification, and oil recovery, is discussed in relationship to the synthetic fuels programs. T.M.

N81-31383# Committee on Commerce, Science, and Transportation (U. S. Senate).
ENERGY FROM OPEN OCEAN KELP FARMS
Washington GPO 1980 87 p refs Presented to the Comm. on Com., Sci., and Transportation, 96th Congr., 1st Sess., Sep. 1980 Prepared by Office of Technology Assessments
(GPO-51-285) Avail: Committee on Commerce, Science, and Transportation

The problems and opportunities associated with developing ocean farms which would use giant kelp as a biomass source of energy are described. The possibilities of kelp are examined in terms of the status of the technology in general, its potential, the problems involved, and the Federal role in this segment of altenative energy research. R.C.T.

N81-31384# Committee on Agriculture (U. S. House).
ALCOHOL FUELS
Washington GPO 1980 109 p refs Joint hearings before the Comm. on Sci. and Technol. and the Comm. on Agr., 96th Congr., 2nd Sess., No. 176, 2 Oct. 1980
(GPO-70-454) Avail: Committee on Science and Technology

The plans of DOE and USDA to implement a major program for the production of alcohol fuels from biomass energy resources are examined. Emphasis is placed on the effect of such conversion technology on the food supply. Specific factors considered include regional feedstocks based on surpluses and/or wastes, cogeneration projects, and cellulosic conversion and utilization of agricultural wastes and residues for methane production. J.M.S.

N81-31385# Committee on Energy and Natural Resources (U.S. Senate).
SYNFUELS FROM COAL AND THE NATIONAL SYNFUELS PRODUCTION PROGRAM: TECHNICAL, ENVIRONMENTAL, AND ECONOMIC ASPECTS
Paul F. Rothberg, John R. Justus, James E. Mielke, F. Angelyn Wells, Judith A. Katzoff, Robert E. Trumbule, Malcolm M. Simmons, Alvin Kaufman, and Susan J. Bodilly Washington GPO 1981 312 p refs Presented to the Comm. on Energy and Nat. Resources, 9th Congr., 1st Sess., Jan. 1981 Prepared by the Congressional Research Service, Library of Congress
(GPO-71-047; Publ-97-3) Avail: SOD HC

The regulatory framework associated with the emerging coal-based synthetic fuels (synfuels) industry was examined. Federal programs affecting the commercialization of this industry were reviewed and analyzed, and areas for possible congressional oversight and additional action are indicated. The Federal programs are an interim program and a long range program. The interim program can be divided into the Department of Energy's (DOE) Alternative Fuels Production Program, and a joint DOE-Department of Defense (DOD) program which allows funding for synfuels projects under amendments to the Defense Production Act. The *long range program will be conducted by the United States* Synthetic Fuels Corporation (SFC), an independent Federal entity which will function primarily as an investment bank to accelerate the commercialization of synfuels. DOE

N81-31555# Corporate-Tech Planning, Inc., Waltham, Mass.
REVIEW OF ALTERNATE AUTOMOTIVE ENGINE FUEL ECONOMY Final Report, Jan. - Oct. 1978
David Cole, Jay A. Bolt, Paul Huber, and Theodore Taylor, Jr. Nov. 1980 72 p refs
(Contract DOT-HS-7-01789)
(PB81-186652; DOT-HS-805810) Avail: NTIS HC A04/MF A01 CSCL 13F

The potential of alternate automotive engines to meet the fuel economy goals and emission levels of the 1980-1990 period is assessed. Those developments offering viable substitutes fo the current spark ignition engine systems are reviewed. Categories assessed included stratified charge, diesels, turbo charging, rotary/Wankel engines, and the developmental gas turbine and Stirling cycle engines. GRA

N81-31608# Committee on Energy and Natural Resources (U.S. Senate).
WORLD PETROLEUM OUTLOOK, 1981
Washington GPO 1981 155 p refs Hearing before the Comm. on Energy and Nat. Resources, 97th Congr., 1st Sess., 22 Jan. 1981
(Publ-97-4; GPO-74-059) Avail: Committee on Energy and Natural Resources

The impact of the Iraq/Iran conflict and the resultant decrease in OPEC oil production on stocks of crude oil and distillates in the United Staes is considered as well as causes of fuel shortages in New England. Methods are proposed for assuring that holders of petroleum stocks, utilities, and industries use current supplies to act as a buffer against possible shortages. A.R.H.

N81-31635# Joint Economic Committee (U. S. Congress).
ENERGY CONSERVATION: EMERGING CONSENSUS, DIVERGING COMMITMENT
Washington GPO 1980 43 p refs Presented to the Subcomm. on Energy of the Joint Econ. Comm., 96th Congr., 2nd Sess., 31 Dec. 1980
(GPO-72-109) Avail: SOD HC

The role of energy conservation in national energy policy is considered. Energy conservation is defined. The level of Federal financial incentives for energy conservation and energy production is examined. It is concluded that the financial incentives for energy production are seven times greater than those for energy conservation. The impact of the bias against energy conservation on national energy security is discussed. J.D.H.

N81-31637# *Committee on Science and Technology* (U. S. House).
FLORIDA'S RENEWABLE ENERGY POTENTIAL
Washington GPO 1980 229 p refs Hearing before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., No. 166, 16 May 1980
(GPO-68-757) Avail: Subcommittee on Energy Development and Applicatons

Developments in the commercialization of biomass, solar energy conversion, and other renewable energy sources are considered. The role and performance of the Southern Solar Energy Center are reviewed, and solar energy conversion projects surveyed. The production of fuel alcohol from biomass is discussed. The use of forest biomass and tree farming for biomass is considered for cogeneration and for thermal energy production. Sources of waste biomass are identified. J.D.H.

N81-31638# Committee on Science and Technology (U. S. House).
COGENERATION
Washington GPO 1980 608 p refs Hearings before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., No. 155, 22-23 Jul. 1980
(GPO-68-746) Avail: NTIS · Avail: Subcommittee on Energy Development and Applications

Portions of the National Gas Policy Act the Fuel Use Act, and the Public Utility Regulatory Policies Act all offer financial and regulatory breaks for cogeneration. Some of these incentives, however, work at cross purposes, creating confusion about Federal intentions and national goals for conservation and primary fuel use. The nature and scope of the conflicts and what the Government needs to do to increase use of cogenerations systems are discussed especially since direct coal combustion technologies, novel heat engines, solar thermal power systems, and other technologies under development are made more economically attractive when cogeneration applications are considered. A.R.H.

N81-31640# Oak Ridge National Lab., Tenn. Health and Safety Research Div.
RELATIVE ENERGY RISK: IS SOLAR ENERGY RISKIER THAN NUCLEAR
Herbert Inhaber 1981 19 p refs
(Contract W-7405-eng-26)
(CONF-810542-3) Avail: NTIS HC A02/MF A01

The discussion of risk analysis is divided into three parts: (1) a discussion of the methodology which can be used; (2) a listing of some of the major assumptions; and (3) the results of a comparison of eleven energy systems. The energy systems considered are divided into two groups: conventional, i.e., those in fairly widespread use, like coal or nuclear, and nonconventional, i.e., all others, like solar and wind. Compared to some conventional systems like natural gas and nuclear, technologies like solar and windpower have relatively high risk. Because of the dilute nature of the energy they handle, solar and wind systems, when compared on the quality of their energy production, require a considerable amount of apparatus as compared to other systems. In turn, this apparatus requires a large amount of material and construction labor to build and install. Associated with each ton of material and hour of labor is a definite number of accidents, diseases and deaths, according to labor statistics. DOE

N81-31642# Westat Research, Inc., Rockville, Md.
NONRESIDENTIAL BUILDING ENERGY CONSUMPTION SURVEY Final Report
Mar. 1981 223 p refs
(Contracts DE-AC01-78EI-06389; EI-78-C-016389)
(DOE/EIA-0288) Avail: NTIS HC A10/MF A01

A building survey designed to provide data on the characteristic of a building's structure, activities inside the building, heating and air conditioning equipment, and the types and uses of energy, consumed, is described. The sample selection plan is included. A total of 7322 nonresidential buildings were selected and 6222 interviews were completed. The tasks performed in order to select the samples and interview appropriate respondents knowledgeable about their building's characteristics, operations, and energy use are detailed. DOE

N81-31644# Barton-Aschmann Association, Inc., Evanston, Ill.
OVERVIEW OF ENERGY-CONSERVING DEVELOPMENT PLANNING AND DESIGN TECHNIQUES BASED ON FIVE CASE STUDIES
Jun. 1980 229 p refs
(Contract W-31-109-eng-38)
(ANL/CNSV-TM-59) Avail: NTIS HC A11/MF A01

Ways to conserve energy through development planning and site design in five old, new, and planned communities are presented. Two approaches were used: (1) a conventional, preexisting plan was analyzed to determine potential energy use; (2) energy conservation options were independently identified and evaluated. DOE

N81-31646# Center for Research on the Acts of Man, Philadelphia, Pa.
MODELING ENERGY AND SOCIETY: THEORY AND METHOD IN ASSESSING THE SOCIAL EFFECTS OF ENERGY POLICIES. VOLUME 1: EXECUTIVE SUMMARY Final Report
Samuel Z. Klausner and Robert H. Edelstein Dec. 1980 15 p 3 Vol.
(Contract FEA-CO-04-60588-00)
(DOE/TIC-1022359) Avail: NTIS HC A02/MF A01

A positive correlation is found between unemployment and per-capita energy use. The social theory upon which the study model is based anticipates this otherwise counterintuitive finding. It is not the number of men or machines at work but the number of social roles and the intensity of activity in those roles which determine the level of energy consumption. The feasibility is assessed of a society/energy model which, when completed, may be used to monitor and to forecast the social effects of energy policies. Such is found to be feasible. DOE

N81-31648# Center for Research on the Acts of Man, Philadelphia, Pa.
MODELLING ENERGY AND SOCIETY: THEORY AND METHOD IN ASSESSING THE SOCIAL EFFECTS OF ENERGY POLICIES. VOLUME 3: THE MEASUREMENT MODEL Final Report
Samuel Z. Klausner and Robert H. Edelstein Dec. 1980 146 p refs 3 Vol.
(Contract FEA-CO-04-60588-00)
(DOE/TIC-1022361) Avail: NTIS HC A07/MF A01

A mathematical statement is presented of typical equations expressing causal relations between measures of physical energy consumption and both the attributes of various social institutions and the behavior of actors in those institutions. A way of testing the proposed model with empirical data is demonstrated. National, annualized time-series data from published sources for the period from 1960 to 1974 were used, and empirical tests of the model were limited to three strategic types of energy policies: those involving fuel price controls; changes in employment rates; and changes in economic output. DOE

N81-31660# Colorado School of Mines, Golden. Research Inst.
STATE ENERGY MODELING. VOLUME 1: AN ANALYSIS OF STATE ENERGY MODELING
Albert G. Melcher 30 May 1981 85 p 2 Vol.
(Contract DE-AC02-79CS-10046)
(DOE/CS-10046/2-Vol-1) Avail: NTIS HC A05/MF A01

An inventory and analysis of state energy models were made. The inventory identified 69 models developed or used at the state government level. Most of these deal with energy demand and area mix as regards the sectors modeled and the fuel types included. Nearly all of these are econometric or econometric engineering end use models. Fewer models deal with energy supply, and several address both supply and demand. The most common types of models are econometric, engineering and use, linear programming, and input-output. Purposes of models include: forecasting; policy analysis; impact analysis; and scenario analysis. Uses include short term emergency management, long term strategic assessment, and specific applications in decisions on facility siting, utility capacity expansion and rate increases proposed legislation, and analysis of federal policy. DOE

N81-31661# Colorado School of Mines, Golden. Research Inst.
ENERGY MODELING. VOLUME 2: INVENTORY AND DETAILS OF STATE ENERGY MODELS
Albert G. Melcher, Robert G. Underwood, Joseph C. Weber, Ronald L. Gist, Roger P. Holman, and Dennis W. Donald 30 May 1981 295 p refs 2 Vol.
(DOE/CS-10046/2-Vol-2) Avail: NTIS HC A13/MF A01

An inventory of energy models developed by or for state governments is presented, and certain models are discussed in depth. These models address a variety of purposes such as: supply or demand of energy or of certain types of energy; emergency management of energy; and energy economics. Ten models are described. The purpose, use, and history of the model is discussed, and information is given on the outputs, inputs, and mathematical structure of the model. The models include five models dealing with energy demand, one of which is econometric and four of which are econometric-engineering end-use models. DOE

N81-31674# New England Council of Water Center Directors, Boston, Mass.
WATER, ENERGY, AND ECONOMIC DEVELOPMENT TOWARDS AN INTEGRATED REGIONAL POLICY ANALYSIS SYSTEM: SELECTED BACKGROUND ESSAYS
Rudolph W. Hardy, ed. Dec. 1980 46 p refs
(Contract DI-14-34-0001-9412)
(PB81-184129; W81-02431;
OWRT-C-90071-G/C-00191-G9412-3) Avail: NTIS HC A03/MF A01 CSCL 10A

Background essays for the project: water, energy, and economic development towards an integrated regional policy analysis system are reported. A write up for a preliminary systems dynamic model is included. The following topics are addressed: (1) planning theory; (2) institutional impacts of energy systems (the problem of scale); (3) regional incidence of investment and welfare; (4) innovation in the public sector; and (5) description of a preliminary model for the study of interactions among water, energy, and economic development. GRA

N81-31683# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
DISTRICT HEATING: AIR QUALITY CONSIDERATIONS AND THE CLEAN AIR ACT

P. D. Moskowitz, T. Carney, and F. W. Lipfert Jan. 1981 24 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51361) Avail: NTIS HC A02/MF A01

The advantages of a district heating facility arise from increases in overall energy utilization efficiency and the ability to use coal or nuclear fuels as energy sources and thus reduce dependence on more limited energy resources such as oil or natural gas. It is suggested that commercialization of the district heating concept is likely to reduce regional production of environmental residuals, even though local burdens could increase. Although site specific production of emissions could increase, it is shown that local air quality will not be degraded. It is concluded that although air quality benefits could be accrued nonattainment requirements of the Clean Air Act may present a barrier to implementation. DOE

N81-31685# Aerospace Corp., Germantown, Md.
OIL SHALE SURFACE RETORTING: ENVIRONMENTAL CHARACTERIZATION INFORMATION REPORT
Jan. 1981 68 p refs
(Contract DE-AT03-76EV-74010)
(DOE/EP-0015) Avail: NTIS HC A04/MF A01

Environmental Characterization Information Report for Oil Shale, Surface Retorting: Paraho Process (Direct Mode) is described. The plant chose for characterization is a syncrude equivalent facility using the Paraho Process (Direct Mode). The process, assumed plant operating parameters, resources needed, and the environmental residuals and products associated with the plant are presented. Annual resource usage and pollutant discharges are shown in English and metric units, assuming an annual plant capacity factor of 90 percent. Twenty-one environmental points of interest are discussed individually. DOE

N81-31691# Jacobs Engineering Co., Pasadena, Calif.
ENVIRONMENTAL PERSPECTIVE ON THE EMERGING OIL SHALE INDUSTRY. VOLUME 2: APPENDICES
Edward R. Bates, ed. and Terry L. Thoem, ed. Denver EPA Apr. 1981 442 p refs
(Contract EPA-68-03-2569)
(PB81-196602; EPA-600/2-80-205B) Avail: NTIS HC A19/MF A01 CSCL 13B

The following appendices are included: status and development of the oil shale industry; procedures for ambient air monitoring; environmental monitoring activities; applicable Federal, state and local legislation, standards and regulations; quality assurance bibliography; Federal and state permits required for operation of an oil shale facility. GRA

N81-31692# Pennsylvania State Univ., University Park.
FIELD TESTS OF INDUSTRIAL STOKER COAL-FIRED BOILERS FOR EMISSIONS CONTROL AND EFFICIENCY IMPROVEMENT, SITES L1-L7 Final Report, Feb. 1978 - May 1979
J. W. Davis and H. K. Owens Feb. 1981 67 p Sponsored in part by the American Boiler Manufacturers Assn.
(Contracts EPA-IAG-D7-E681FZ; DOE-EF-77-C-01-2609)
(PB81-196628; EPA-600/7-81-020A) Avail: NTIS HC A04/MF A01 CSCL 13B

Results of field measurements to determine particulate emission rate and particle size distribution for seven institutional type stoker fired boilers firing bituminous coals are given. Operational data were recorded during the tests to provide information for evaluating boiler emission as a function of boiler load, heat release rates, coal size and characteristics, percent excess combustion air, and flue gas temperature. All boilers were tested under normal operating conditions at loads of 50-75 percent of maximum boiler capacity. The types of stokers tested included single retort underfeed, multiple retort underfeed, traveling grate overfeed, and vibrating grate overfeed. GRA

N81-31695# Environmental Sciences Research Lab., Research Triangle Park, N.C.
FILTER MEDIA FOR COLLECTING DIESEL PARTICULATE MATTER
Frank Black and Lisa Doberstein May 1981 37 p refs
(PB81-197774; EPA-600/2-81-017) Avail: NTIS HC A03/MF A01 CSCL 13B

Certification of particulate emissions from diesel motor vehicles involves filtration of measured aliquots of the total air diluted exhaust. Seven commercially available filter media were examined for this purpose. The media included a variety of PTFE membrane filters, glass fiber filters, and PTFE coated glass fiber filters. Relative flow resistance (pressure drop), collection efficiency, and gas phase adsorption were examined. The results obtained indicate that under the defined test conditions the membrane filters yield low gram per mile emissions rates due to difficulties with collection of Federal Test Procedure phase 1 emissions, and the Gelman A-E glass fiber filter high rates due to adsorption of gas phase emissions. GRA

N81-31696# Battelle Columbus Labs., Ohio.
EVALUATION OF EMISSIONS AND CONTROL TECHNOLOGY FOR INDUSTRIAL STOKER BOILERS Final Report, Oct. 1977 - Oct. 1980
Robert D. Giammar, Russell H. Barnes, David R. Hopper, Paul R. Webb, and Albert E. Weller May 1981 266 p refs
(Contract EPA-68-02-2627)
(PB81-197873; EPA-600/7-81-090; IERL-RTP-1187) Avail: NTIS HC A11/MF A01 CSCL 13B

Emission characteristics were determined for a variety of coals fired in a 200-kW stoker boiler. It was observed that significant amounts of sulfur were retained in the lignite and western subbituminous coals. Fuel nitrogen conversion to NO was found to be between 10 and 20%. In addition, a limestone/coal fuel pellet was developed and found effective in capturing 80% of the fuel sulfur. Using an 8-MW spreader stoker boiler, it was found that improved control of combustion air (i.e., underfire and overfire air) resulted in lower excess air operation (improved efficiency), reduced particular loading, smoke, CO and NO emissions and no effect on SO2 levels. The limestone/coal pellet (Ca/S=7) was successfully fired, achieving 75% SO2 reduction. GRA

N81-31697# Missouri Univ. -Columbia. Dept. of Chemistry.
INTERCHANGE OF POLLUTANTS BETWEEN GROUNDWATER AND MINERAL STRATA AS APPLIED TO WASTE CHEMICAL DUMPS AND IN SITU COAL GASIFICATION SITES Completion Report, 1 Oct. 1979 - 30 Sep. 1980
Stanley E. Manahan, Paul Tobben, Robert Gale, Steven Hoeffner, and Darryl Bornhop 15 Mar. 1981 19 p refs
(Contract DI-14-34-0001-0127)
(PB81-198335; W81-02714; OWRT-A-117-MO(1)) Avail: NTIS HC A02/MF A01 CSCL 13B

Particular emphasis was placed upon the development of methods to evaluate the chemical interaction between contaminated groundwaters and specific solids so that these methods could be applied to specific situations which other investigators might need to study. Of particular importance was the development of methods to obtain chemical data which in turn can be used to provide meaningful bases for modelling groundwater contamination. Water contaminated by vapor from laboratory-simulated in situ coal gasification was employed as a model polluted water. The solids used to sorb organics from this waster were subbituminous coal, non-activated coal char, activated coal char, and coal ash. GRA

N81-31822# *Oak Ridge National Lab., Tenn.*
DOING A RISK ANALYSIS
H. Inhaber 1981 18 p Presented at the 2nd Ann. Eastern Reg. Safety Congr., Philadelphia, 30 Apr. 1981
(Contract W-7405-eng-26)
(CONF-810480-1) Avail: NTIS HC A02/MF A01

The methodologies which can be used to determine the overall risk of any energy system are outlined. Termed risk accounting, it is calculated in analogy to energy accounting, which attempts to determine all the energy inputs into a system in comparison to the net output. The most important conclusion of this analysis is that the risk from non-conventional energy sources can be as high as, or even higher than that of conventional sources. In particular, it tends to be considerably higher than that of nuclear power, the newest of the conventional sources. The ratio is, in some cases, as high as 10 or 100. The results can be divided into occupational risk, borne by those who construct, fabricate and maintain the energy sources, and danger to members of the public. The total risk of a system is then the sum of occupational and public risk. The occupational man-days lost per unit energy averaged over the system lifetime are given. DOE

N81-32077# Midwest Research Inst., Golden, Colo. . Solar Energy Research Inst.
TRANSFER OF INFORMATION FROM RESEARCHER TO CONSUMER: CHOOSING THE APPROPRIATE MEDIA
Dan Halacy May 1981 5 p refs Presented at the AS/ISES Special Interest Group on Energy and Environ. Inform. Conf., Denver, 11 May 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-513-1193; CONF-810560-1) Avail: NTIS HC A02/MF A01

The diffusion of solar innovations is discussed. The objectivity, timeliness, comprehensiveness, and clarity of marketing and commercial messages are reviewed. DOE

N81-32088*# Transportation Systems Center, Cambridge, Mass.
FUEL ECONOMY AND EXHAUST EMISSIONS CHARACTERISTICS OF DIESEL VEHICLES: TEST RESULTS OF A PROTOTYPE FIAT 131 NA 2.4 LITER AUTOMOBILE
S. S. Quayle, M. M. Davis, and R. A. Walter May 1981 82 p refs
(NASA Order C-32817-D; Contract DE-AI01-80CS-50194)
(NASA-CR-165281; DOE/NASA/281751; DOT-TSC-NASA-81-1) Avail: NTIS HC A05/MF A01 CSCL 13B

The vehicle was tested on a chassis dynamometer over selected drive cycles and steady-state conditions. Two fuels were used, a U.S. no. 2 diesel and a European diesel fuel. The vehicle was tested with retarded timing and with and without an oxidation catalyst. Particulate emission rates were calculated from dilution tunnel measurements and large volume particulate samples were collected for biological and chemical analysis. It was determined that while the catalyst was generally effective in reducing hydrocarbon and carbon monoxide levels, it was also a factor in increasing particulate emissions. Increased particulate emission rates were particularly evident when the vehicle was operated on the European fuel which has a high sulfur content. T.M.

N81-32092# Falcon Research and Development Co., Buffalo, N. Y.
DYNAMOMETER AND TRACK MEASUREMENT OF PASSENGER CAR FUEL ECONOMY Final Report
Jeffrey Bernard and Sol Kaufman Mar. 1981 137 p refs
(Contract EPA-68-03-2835)
(PB81-196446; EPA-460/3-81-002) Avail: NTIS HC A01/MF A01 CSCL 13F

The factors contributing to differences in fuel economy measured on a road in consumer service as compared to EPA estimates using a dynamometer are considered. The relationship between the fuel economy of production cars tested on dynamometer equipment and the fuel economy they achieve when operated over the same driving sequence on a test track is analyzed. The test track simulates a subset of driving conditions that might be encountered in actual driving. GRA

N81-32299# Water Resources Council, Washington, D.C.
SYNTHETIC FUEL DEVELOPMENT FOR THE UPPER MISSOURI RIVER BASIN. SECTION 13A: WATER ASSESSMENT REPORT
Apr. 1981 124 p refs
(Contract DE-AI01-76EV-03201)
(DOE/EV-03201/T4) Avail: NTIS HC A06/MF A01

The availability of water to support synfuel development for three types of coal conversion technologies and to identify major effects that synfuel development could have on the water resources of the region were assessed. Surface water is generally available in the Upper Missouri River basin to support coal conversion development. Approximately 700,000 acre-feet of surface water are available annually in the Boysen and Yellowtail Reservoirs on the Brighorn River, pending completion of environmental impact statement and water availability studies by the US Water and Power Resources Service. Existing single- and multiple-purpose water supply systems in the Upper Missouri would require major modification and expansion to enable the use of water supplies for regional coal conversion development. Possible considerations to provide water at desired plant locations include new storage, interbasin transfers, changes to present water use, and groundwater development. The operations of some reservoirs in the Yellowstone River Basin may need to be altered to assure sufficient flows for energy needs during dry years. DOE

N81-32611# Committee on Interstate and Foreign Commerce (U. S. House).
POTENTIAL DISPLACEMENT OF OIL BY NUCLEAR ENERGY AND COAL IN ELECTRIC UTILITIES
Washington GPO 1981 397 p refs Hearing before the Subcomm. on Oversight and Invest. of the Comm. on Interstate and Foreign Com., 96th Congr., 2nd Sess., 9 Dec. 1980
(GPO-72-081) Avail: Subcommittee on Oversight and Investigations

Discrepancies exist between estimates of the amount of oil displaced by nuclear fuels or coal in 1979 as determined by DOE and other researchers. Future trends in utility fuel use are discussed from the point of view of construction, replacement, energy costs to consumer, availability of fossil fuels (other than oil), and site selection. A.R.H.

N81-32618# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany).
HEAT RECOVERY FROM WASTE WATER BY ENERGY-SAVING HEAT PUMP SYSTEMS IN CONNECTION WITH WATER TREATMENT PLANTS
U. Wiedmann and Rudolf Flohrschuetz Apr. 1980 287 p refs In GERMAN; ENGLISH summary Sponsored by Budesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-022) (US Sales Only) HC A13/MF A01; DOE Depository Libraries

The advantages of waste water recovery as an energy source were investigated. It was found that heat pump systems reach the highest performance coefficients and their primary energy ratios are competitive with conventional heating systems. It is concluded that the utilization of waste water treatment plants by large heat pump systems provides a considerable annual energy saving of light oil. Transl. by E.A.K.

N81-32638# Department of Energy, Washington, D. C.
SECURING AMERICA'S ENERGY FUTURE: THE NATIONAL ENERGY POLICY PLAN
Jul. 1981 37 p
(DOE/S-0008) Avail: NTIS HC A03/MF A01

Energy policy guidelines within the context of the overall economic recovery program were reformulated. The new national energy policy continues to develop and to be refined; it will not be tied to a static and unresponsive plan. The approach for reformulation of policy energy is defined, and the current energy outlook of the Nation is presented. DOE

N81-32649# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ENVIRONMENTAL AND ECONOMIC COMPARISONS OF THE SATELLITE POWER SYSTEM AND SIX ALTERNATIVE ENERGY TECHNOLOGIES
R. G. Whitfield, L. J. Habegger, E. P. Levine, and E. A. Tanzman Apr. 1981 129 p refs
(Contract W-31-109-eng-38)
(ANL/EES-TM-136) Avail: NTIS HC A07/MF A01

The satellite power system (SPS) was compared with alternative systems on life cycle cost and environmental impacts. Environmental and economic effects are evaluated and subdivided into the following issue areas: human health and safety, environmental welfare, resources (land, materials, energy, water, labor), macroeconomics, socioeconomics, and institutional. These evaluations are based on technology characterization data and alternative futures scenarios, developed as part of CDEP. The technologies and the scenarios are described. The cost and performance of the SPS and the alternative technologies provide the basis of the macroeconomic analyses. DOE

N81-32658# National Center for Appropriate Technology, Butte, Mont.
USA: LIVING WITH THE SUN
K. Collins, Edwin Kepler, John McBride, Cindi Rucker, and Jon Sesso Jul. 1981 31 p Sponsored in part by Dept. of State and US Community Services Administration
(Contract DE-AP01-811A-10191)
(DE81-027832; DOE/CE-0017) Avail: NTIS HC A03/MF A01

This illustrated brochure describes and shows renewable energy demonstration projects across the country. Solar energy, biomass, windpower, and waterpower projects are included. L.F.M.

N81-32686# Argonne National Lab., Ill.
PLANNING FOR ENERGY CONSERVATION: THE COMMUNITY IS THE KEY
Isiah Sewell and Kevin Croke (Illinois Univ., Chicago) 1981 7 p refs Presented at the Intersoc. Energy Conversion Conf., Seattle, 17-22 Aug. 1981
(Contract W-31-109-eng-38)
(DE81-023118; CONF-810822-1) Avail: NTIS HC A02/MF A01

The concept of viewing a community as a related set of energy demands and supplies in an effort to develop more-effective energy-planning procedures in the United States is explored. Integrated energy planning programs in Sweden and Germany were examined, as well as several projects being sponsored in the United States. Impediments to adopting an integrated planning approach are also discussed. Energy efficiency and conservation are attained mainly through the efficient planning and cost-effective delivery of each separate energy form. An alternate view of the community is to conceive of it as a group of inter-related, end-use markets which generate demands for usable energy. This latter concept of usable energy emphasizes not its form as electricity, oil, or natural gas but rather to its quality (temperature) and its location. DOE

N81-32691# Argonne National Lab., Ill.
OCEAN ENERGY RESOURCES: THE IMPACT OF OTEC
John D. Ditmars 1980 10 p refs Presented at the Conf. on Climate and Offshore Energy Resources, London, 21-23 Oct. 1980
(Contract W-31-109-eng-38)
(DE81-023916; CONF-8010198-1) Avail: NTIS HC A02/MF A01

The status ocean thermal energy conversion (OTEC) technological development is summarized. The potential impacts of OTEC power production on the ocean environment, including implications for impacts on climate is emphasized. DOE

N81-32700# Energy and Environmental Analysis, Inc., Arlington, Va.
INDUSTRIAL ENERGY USE PROJECT Annual Report, 1979 - 1980
M. Lerner, A. Sarin, D. Hauth, and V. S. Kothari Oct. 1980 138 p refs
(Contract GRI-5014-342-0185)
(PB81-201899; GRI-79/0076) Avail: NTIS HC A07/MF A01 CSCL 10A

The industrial energy use project was studied. The following objectives were outlined: (1) to determine energy use data disaggregated to the process level for all industries; (2) identify technological options to improve efficiency of gas consuming furnaces; and (3) recommend research priorities for improving the efficiency of industrial gas use. Furnaces used in the glass and iron and steel industries are examined. A detail mathematical model for heat transfer processes inside a glass regenerative melting furnace is presented. The model simulates effects of various energy conservation options on furnace operation and performance. Major inefficiencies in furnaces in the glass and iron and steel industries are discussed and available energy conservation and fuel switching options are identified GRA

N81-32702# Battelle Columbus Labs., Ohio.
ENERGY RECOVERY IN NATURAL GAS DEPRESSURIZING STATIONS Final Report, Jun. - Dec. 1980
John M. Corliss and David E. Jones 9 Apr. 1981 50 p refs
(Contract GRI-5015-310-0281)
(PB81-201972; GRI-79/0107) Avail: NTIS HC A03/MF A01 CSCL 10B

Thermodynamic and economic analyses to determine the potential cost worthiness of depressurizing natural gas from transmission pressure to distribution pressure via turboexpansion as opposed to throttling are presented. The use of turboexpanders to generate electricity or provide shaft power for use on site is considered. Site selection criteria and regulatory impediments are discussed. GRA

N81-32705# Old West Regional Commission, Billings, Mont.
ENERGY RESEARCH INFORMATION SYSTEM PROJECTS REPORT, VOLUME 5, NUMBER 1 Progress Report, Jun. 1979 - Jul. 1980
Judith Johnson, comp. and Laura Schillinger, comp. Jul. 1980 104 p
(PB81-204992; OWRC/ERIS-8001) Avail: NTIS HC A06/MF A01 CSCL 08I

The system (ERIS) provides an inventory of the energy related programs and research activities from 1974 to the present in the states of Montana, Nebraska, North Dakota, South Dakota and Wyoming. Areas of research covered include coal, reclamation, water resources, environmental impacts, socioeconomic impacts, energy conversion, mining methodology, petroleum, natural gas, oilshale, renewable energy resources, nuclear energy, energy conservation and land use. Each project description lists title, investigator(s), research institution, sponsor, funding, time frame, location, a descriptive abstract of the research and title reports and/or publications generated by the research. All projects are indexed by location, personal names, organizations and subject keywords. GRA

N81-32706# Old West Regional Commission, Billings, Mont.
ENERGY RESEARCH INFORMATION SYSTEM PROJECTS REPORT, VOLUME 5, NUMBER 2 Report, Aug. - Dec. 1980
Judith Johnson, comp. Dec. 1980 102 p
(PB81-205007; OWRC/ERIS-8002) Avail: NTIS HC A06/MF A01 CSCL 08I

The system (ERIS) is a service administered by the Old West Regional Commission in response to the need for current information on research activities in the region's rapidly growing and changing field of energy. The ERIS compiles and makes available to the users in the Region an up to date inventory of ongoing and recently completed energy related research projects. The subject areas covered are: reclamation, energy conversion, and land use research, socioeconomic impact and renewable energy development which do not necessarily involve research. GRA

N81-32710# West Virginia Univ., Morgantown.
NO SUB x EMISSION FROM COMBUSTORS: A STATE-OF-THE-ART REVIEW
G. T. Chen, J. Y. Shang, and C. Y. Wen May 1981 95 p refs
(Contract DE-AM21-79MC-11284)
(DOE/MC-11284/166) Avail: NTIS HC A05/MF A01

The state-of-the-art of the theory and control of NOx emissions from combustors of thermal gases, and NOx emissions control technology and mathematical modeling of fluidized bed combustors are also discussed. DOE

N81-32711# *Electric Power Research Inst., Palo Alto, Calif.* Coal Combustion Systems Div.
PROCEEDINGS OF THE JOINT SYMPOSIUM ON STATIONARY COMBUSTION NO SUB x CONTROL, VOLUME 2
May 1981 368 p refs Symp. held at Denver, 6-9 Oct. 1980
(DE81-903302; EPRI-WS-79-220-Vol-2) Avail: NTIS HC A16/MF A01

For pulverized coal-fired utility boilers, postcombustion control, and emissions characterization of other combustion-generated species. Specifically selective catalytic reduction, commercial fuel gas treatment systems, and environmental assessment of NOx emissions from utility power plants and conventional combustion sources are discussed. J.M.S.

N81-32712# Mitre Corp., McLean, Va. METREK Div.
ENVIRONMENTAL EFFECTS OF COAL TECHNOLOGIES RESEARCH NEEDS
R. Brown Jun. 1981 234 p refs
(Contract DE-AC01-79EV-10018)
(MTR-79W-159-03) Avail: NTIS HC A11/MF A01

Environmental problems associated with conventional coal mining, storage, transportation, and combustion, and with chemical coal cleaning, in situ gasification, fluidized bed combustion, cocombustion of coal-oil mixtures, and cocombustion of coal with municipal solid waste are addressed. Recommended research required to address the identified problems is presented. The findings relate primarily to effects related research. DOE

N81-32713# Argonne National Lab., Ill. Engineering Div.
COMPARISON OF ANALYTICAL AND EXPERIMENTAL STUDIES OF NOx KINETICS IN MHD SYSTEMS
A. J. Sistino Feb. 1981 29 p refs
(Contract W-31-109-eng-38)
(ANL/MHD-80-17) Avail: NTIS HC A03/MF A01

In an open cycle MHD-steam system, the high temperature (2800 to 3000 K) in the coal/air combustor tends to produce high NO x levels (approx. 10,000 ppM) in the combustion products. These levels must be reduced to 550 ppM for stack emission acceptable under Environmental Protection Agency regulations. In order to meet the EPA requirement, the NOx concentration in the various system components must be determined, and certain of those components must be of new special design. In particular, the NOx composition in the MHD-steam system has been determined by modeling the chemical kinetics in the diffuser, the radiant boiler and the secondary combustor. A detailed description of the formulation of the chemical kinetics model is first given, which should aid understanding of NOx formation/decomposition in an MHD-steam system; then the results of studies using the chemical kinetics model are compared with available experimental results. DOE

N81-32714# Argonne National Lab., Ill. Engineering Div.
NITRIC OXIDE FORMATION IN MULTI-PARALLEL JET SECONDARY COMBUSTOR FOR MHD SYSTEM
P. M. Chung (Illinois Univ. at Chicago Circle), R. Scott Smith, John Haydweiller (Syracuse Univ., N.Y.), and Z. ElDerini Oct. 1980 54 p refs
(Contract W-31-109-eng-38)
(ANL/MHD-80-9) Avail: NTIS HC A04/MF A01

The minimum combustor length required for mixing and complete combustion in the limit of fast chemical kinetics was determined. This length is shorter than that required for uniform mixing. It is a moderate function of the jet spacing and is rather strongly dependent upon the stoichiometric air ratio. In the usual operating temperature range of 1600 to 2000 K and for the lengths up to about 5m, the NO sub X reactions in the secondary combustors are found to be nearly frozen. Therefore, ignition and combustion, rather than the nitric oxide formation, should be the secondary combustor design criterion. DOE

N81-32715# International Power Technology, Inc., Sunnyvale, Calif.
DESIGN AND TEST OF AN EXHAUST GAS CLEAN-UP SYSTEM FOR POWER PLANTS USING HIGH SULPHUR CONTENT FUELS Final Report
C. N. Chang 10 Oct. 1980 140 p refs
(Contract DE-AC03-79ET-12442)
(DE81-026513; DOE/ET-12442/T2) Avail: NTIS HC A07/MF A01

This experimental program, initially designated to study an exhaust gas cleanup and water recovery system for a Cheng Cycle Dual-Fluid (CCDF) turbine power plant using sulfur rich fuels, has shown the potential of a general flue Gas Desulfurization (FGD) system applicable to utility and industrial boilers as well. The process was studied both theoretically and experimentally. Experiments were performed using a bench scale (25k equivalent) apparatus and a pilot scale (1Mw equivalent) apparatus. Data obtained indicated the process potentially can out-perform the conventional process with significant cost savings. DOE

N81-32717# Acurex Corp., Mountain View, Calif.
SURVEY AND EVALUATION OF MODERN ELECTROSTATIC CONCEPTS APPLIED TO HIGH-RESISIVITY FLY ASH
Clyde L. Stanley Dec. 1980 115 p refs
(Contract DE-AC18-80FC-10226)
(DE81-026204; DOE/FC-10226/T1) Avail: NTIS HC A06/MF A01

The ineffectiveness of conventional electrostatic precipitators on high resistivity fly ash has different, though interrelated, causes. A versatile multiple-concept pilot precipitator would allow GFETC to develop the optimum: combination of novel concepts. Acurex is recommmending a precipitator with component interchangeability in three sections: (1) the main precipitator section (one or more cells) should be designed to accept either conventional electrodes or a few tri-electrode configurations. Versatile pulse-charged power supplies will be needed to accommodate the various electrode configurations. The best method of suppressing back-corona in the precipitator itself can thus be developed; (2) a precharger section should be installed ahead of the main precipitator to optimize precharger design; and (3) a downstream collector section would test the effectiveness of concepts which lend themselves to effective collection of low-load, high-resisivity, small particles. These include wet precipitators, fabric filters, and bed filters. DOE

N81-32721# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ENVIRONMENTAL IMPLICATIONS OF THE LARGE-SCALE UTILIZATION OF ALCOHOL FUELS IN THE UNITED STATES
Oreste H. Bevilacqua (OMB Associates), Martin J. Bernard, III, and Daniel P. Maxfield (DOE) Oct. 1980 9 p ref Presented at the 4th Intern. Symp. on Alcohol Fuels Technol., Guaruja, Brazil, Oct. 1980
(Contract W-31-109-eng-38)
(DE81-023906; CONF-8010194-1) Avail: NTIS HC A02/MF A01

In this assessment, the environment is considered to include natural resource, ecological, physical environment, health and safety, and social-economic systems. The environmental assessment was based on the extrapolation and systematic analysis of existing data as to the characteristics of alcohol fuels and their performance in conventional engines. The major results and implications of this assessment are presented. DOE

N81-32722# Oak Ridge National Lab., Tenn. Industrial Safety and Applied Health Physics Div.
DESIGN OF THE OAK RIDGE NATIONAL LABORATORY STEAM PLANT AIR-QUALITY NETWORK IN COMPLEX TERRAIN
Eric S. Hougland (Tennessee Univ., Knoxville) and Thomas W. Oakes 1981 15 p refs Presented at the 74th Ann. Meeting of the Air Pollution Control Assoc., Philadelphia, 21 Jun. 1981
(Contract W-7405-eng-26)
(DE81-024087; CONF-810631-4) Avail: NTIS HC A02/MF A01

The conversion of the steam plant from oil and gas to coal fired operation is researched. The determination of the environmental impact of this coal burning on air pollution levels in the vicinity of the laboratory was studied. A model for the optimal design of an air quality monitoring system was used for the development of a network of samplers to monitor the air quality impacts of the fuel conversion. The extension of the system design project to include other major air pollution sources in the vicinity of Oak Ridge, more representative meteorologica data, and the exploit consideration of the complex terrain in the Oak Ridge area are discussed. DOE

N81-32726# Argonne National Lab., Ill.
ENVIRONMENTAL EFFECTS OF THE SATELLITE POWER SYSTEM MICROWAVE POWER TRANSMISSION SYSTEM
A. R. Valentino and M. M. Abromavage (Illinois Inst. of Technology, Chicago) 1980 6 p refs Presented at the Natl. Telecommun. Conf., Houston, Tex., 3 Dec. 1980
(Contract W-31-109-eng-38)
(DE81-023811; CONF-801261-1) Avail: NTIS HC A02/MF A01

The potential environmental effects of the satellite power system (SPS) microwave power transmission system were studied. Issues were identified including: (1) health effects due to microwave exposure for the public as well as the SPS worker; (2) effects on telecommunications due to ionospheric changes caused by the passage of the microwave beam; and (3) electromagnetic compatibility with military systems, radio astronomy, satellite systems, and electronic systems in general. DOE

N81-32727# Department of Energy, Washington, D. C. Geothermal Energy Div.
ENVIRONMENTAL ASSESSMENTAL, GEOTHERMAL ENERGY, HEBER GEOTHERMAL BINARY-CYCLE DEMONSTRATION PROJECT: IMPERIAL COUNTY, CALIFORNIA
Oct. 1980 310 p refs
(DOE/EA-0119) Avail: NTIS HC A14/MF A01

The proposed design, construction, and operation of a commecial scale (45 MWe net) binary cycle geothermal demonstration power plant, are described using the liquid dominated geothermal resources at Heber, Imperial County, California. The following are included in the environmental assessment: a description of the affected environment, potential environmental consequences of the proposed action, mitigation measures and monitoring plans, possible future development activities at the Heber anomaly, and regulations and permit requirements. DOE

N81-32736# Fish and Wildlife Service, Washington, D. C. Office of Biological Services.

NATIONAL COASTAL ECOLOGICAL RESEARCH: EXISTING AND PROPOSED ENERGY DEVELOPMENT
Sharon L. Gordon, Herbert L. Lundblad, and Carol A. Westcott Jan. 1981 174 p refs Prepared in cooperation with Aerospace Corp., El Segundo, Calif.
(Contract DI-14-16-0009-78-981)
(PB81-203192; FWS/OBS-81/11) Avail: NTIS HC A08/MF A01 CSCL 13B

An initial information base is provided for the U.S. Fish and Wildlife Service in allocating their resources when dealing with the impacts of coastal energy development of fish and wildlife resources. Included is a survey of the locations of existing and projected coastal energy development and an independent evaluation of energy development problems facing coastal resouces of concern to the Service. Trends and outlook for energy developments are discussed for power generation, oil and gas production, refineries, transportation, strategic petroleum reserve, liquefied natural gas, geothermal, and synthetic fuels. GRA

N81-32738# National Oceanic and Atmospheric Administration, Washington, D. C.
ACID PRECIPITATION
Feb. 1981 16 p refs
(PB81-202673; CIO-81-1; NOAA-81040201) Avail: NTIS HC A02/MF A01 CSCL 04A

A comprehensive 10 year acid precipitation research plan to study environmental and atmospheric effects and to monitor precipitation acidity is described. Current issues relate to: the establishment of networks and standards for long term monitoring and measurement of acid precipitation; the promotion of research on the environmental effects of acid precipitation; and the assessment of the financial costs of acid precipitation and the economic benefits of acid precipitation control programs, weighed with other pollution control programs and the national need for increased coal utilization. GRA

N81-32740# Council for Scientific and Industrial Research, Pretoria (South Africa).
INTERNATIONAL CONFERENCE ON AIR POLLUTION, VOLUME 2
Oct. 1979 308 p refs In ENGLISH and AFRIKAANS Conf. held in Pretoria, 22-25 Oct. 1979 4 Vol.
(PB81-205064) Avail: NTIS HC A14/MF A01 CSCL 13B

Papers on methods of reducing air pollution in the metallurgical and chemical industries and in power generation plants are presented. The prevention of dust emissions, fluidized bed combustion for pollution control, processing of smelter off gasses, reduction of pollution from steel plants, and related energy considerations are discussed. GRA

N81-32741# Council for Scientific and Industrial Research, Pretoria (South Africa).
INTERNATIONAL CONFERENCE ON AIR POLLUTION, VOLUME 3
Oct. 1979 382 p refs In ENGLISH and AFRIKAANS Conf. held in Pretoria, 22-25 Oct. 1979 4 Vol.
(PB81-205072) Avail: NTIS HC A17/MF A01 CSCL 13B

Methods of measuring air pollution, modeling pollution transport, and energy conservation and waste utilization for energy production are discussed. GRA

N81-32745# Aerospace Corp., Los Angeles, Calif. Energy and Resources Div.
DISPOSAL OF FLUE GAS DESULFURIZATION WASTES: EPA SHAWNEE FIELD EVALUATION Final Report, Sep. 1974 - Sep. 1980
P. R. Hurt, P. P. Leo, J. Rossoff, and J. R. Witz Jun. 1981 289 p refs
(Contract EPA-68-02-2633)
(PB81-212482; EPA-600/7-81-103; IERL-RTP-1199) Avail: NTIS HC A13/MF A01 CSCL 13B

Methods and costs for disposing of wastes produced from wet non-regenerable scrubbing of SO2 from coal-fired utility-boiler flue gases were evaluated. The environmental effects of various disposal techniques were studied, including evaluations of untreated, chemically treated, and oxidized wastes utilizing lime or limestone scrubber absorbents. Because water quality and land reclamation are to principal interest, leachate, supernate, runoff, and ground water were analyzed, and physical properties of the wastes were evaluated. No measurable effect on ground water quality at the disposal site was detected during the program. Chemical treatment and underdrainage of untreated waste yielded structurally sound materials. GRA

N81-32816# Tompkins (Daryl), Friendly, Md.
WIND ENERGY IN MARYLAND
Daryl Tompkins Jul. 1980 37 p refs Sponsored by Dept. of National Resources, Annapolis, Md.
(PB81-199937; PPSP/PPRP-41) Avail: NTIS HC A03/MF A01 CSCL 10A

This report marks one of the first steps in defining the wind energy option in Maryland. In the following sections, the state of the art is reviewed, applications, economic, and environmental issues were introduced, the results of a preliminary wind energy resource assessment completed in April of 1979 are discussed, and recommendations are made for further resource definition. GRA

N81-32956*# California Univ., Los Angeles. School of Engineering and Applied Science.
FORECAST OF FUTURE AVIATION FUELS: THE MODEL Final Report
M. B Ayati, C. Y. Liu, and J. M. English Sep. 1981 192 p refs
(Contract NsG-3116)
(NASA-CR-165486; UCLA-eng-8037) Avail: NTIS HC A09/MF A01 CSCL 12B

A conceptual models of the commercial air transportation industry is developed which can be used to predict trends in economics, demand, and consumption. The methodology is based on digraph theory, which considers the interaction of variables and propagation of changes. Air transportation economics are treated by examination of major variables, their relationships, historic trends, and calculation of regression coefficients. A description of the modeling technique and a compilation of historic airline industry statistics used to determine interaction coefficients are included. Results of model validations show negligible difference between actual and projected values over the twenty-eight year period of 1959 to 1976. A limited application of the method presents forecasts of air transportation industry demand, growth, revenue, costs, and fuel consumption to 2020 for two scenarios of future economic growth and energy consumption. Author

N81-33098# Committee on Science and Technology (U. S. House).
HELIUM: ENERGY ACT OF 1980
Washington GPO 1981 387 p refs Hearing on H. R. 7336 before the Subcomm. on Energy Res. and Production, the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., No. 170, 17 Jun. 1980 (GPO-71-077) Avail: Subcommittee on Energy Research and Production

Legislation developing a helium gas conservation program is discussed. A national helium reserve of 85 billion cu ft by 1990 is sought. The Secretary of Energy is required to acquire and store helium offered for purchase, bearing all transportation and storage costs. Taxes are removed, and royalty assessment of helium gas is delayed until it is repurchased. The Government is granted the power of eminent domain to acquire helium and to operate helium extraction facilities. The Government is required to buy the helium it uses from the private market. The sale of federally owned helium is permitted only when the cost approaches the cost of extracting helium from the air. J.D.H.

N81-33102# Transportation Research Board, Washington, D.C.
URBAN SYSTEMS AND TRAFFIC EVALUATIONS
William H. Dietrich, Michael A. Kennedy, Jon Twichell, Janis M. Gross, Peter M. Lima, Yacov Zahavi, Gabriel Roth, William D. Glauz, D. J. Migletz, and J. S. Ludwick, Jr. 1980 43 p refs
(PB81-204679; TRB/TRR-770; ISBN-0-309-03114-1; ISSN-0361-1981) Avail: NTIS HC A03/MF A01 CSCL 13B

Contents include: a joint institutional tranportation systems management program; Forecasting energy impacts of TSM actions; an evaluation of transportation system management strategies; and measuring the effectiveness of priority schemes for high-occupancy vehicles. Traffic conflicts techniques for use at intersections are discussed. Comparison of three loran position-determination techniques in the Los Angeles area are presented. GRA

N81-33158*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS OF THE PERFORMANCE OF THE DRIVE SYSTEM AND DIFFUSER OF THE LANGLEY UNITARY PLAN WIND TUNNEL
Robert L. Stallings and Lowell E. Hasel Oct. 1981 67 p refs (NASA-TM-83168; L-14543) Avail: NTIS HC A04/MF A01 CSCL 01A

A broad program was initiated at the Langley Research Center in 1973 to reduce the energy consumption of the laboratory. As a part of this program, the performance characteristics of the Unitary Plan Wind Tunnel were reexamined to determine if potential methods for incresing the operating efficiencies of the tunnel could be formulated. The results of that study are summarized. The performance characteristics of the drive system components and the variable-geometry diffuser system of the tunnel are documented and analyzed. Several potential methods for reducing the energy requirements of the facility are discussed. T.M.

N81-33184# Federal Aviation Administration, Washington, D.C. Air Traffic Service.
OPERATION FREE FLIGHT: AN OPERATIONAL EVALUATION OF DIRECT ROUTE FLIGHT PLAN FILING IN TODAY'S NATIONAL AEROSPACE SYSTEM Final Report
Wayne Minnick Jul. 1981 87 p
(AD-A104150; FAA-AT-81-1) Avail: NTIS HC A05/MF A01 CSCL 17/7

This report presents the results of an operational evaluation concerning the feasibility of permitting the filing of direct route flight plans, without route definition, between departure and arrival area fixes serving selected city-pairs. The evaluation was conducted with the voluntary participation of Eastern, United, and Pan American Airlines during the period June 1 through December 31, 1980. Objectives of Operation Free Flight were to obtain factual information about air traffic control (ATC) handling of test aircraft on direct routings, system prohibitions to the concept, general pilot attitude regarding the utility of their RNAV equipment, potential fuel savings, and ATC system impact. The evaluation was conducted throughout the contiguous United States between 27 city-pairs. The primary conclusions were: the operational concept of filing direct, great circle routes between departure and arrival area fixes, at altitudes above Flight Level 290, in a radar environment; incompatibility with traffic arrival flow at destination airports was determined to be the most significant system prohibition; pilot attitude was skewed in a positive direction; potential fuel savings are projected to be in excess of 40,000,000 gallons per year, and, there was no adverse impact to the ATC system. Author (GRA)

N81-33201# Peat, Marwick, Mitchell and Co., San Francisco, Calif.
RESPONSES TO COMMENTS OF AIR TRANSPORT ASSOCIATION OF AMERICA ON AIRCRAFT TOWING FEASIBILITY STUDY
Jun. 1981 112 p refs
(Contract DE-AC01-79CS-50069)
(DE81-029834; DOE/CS-50069/T1) Avail: NTIS HC A06/MF A01

A preliminary assessment of the constraints on and feasibility of extended aircraft towing between airport runways and terminal gate areas with engines shutdown is made. Past aircraft towing experience and the state of the art in towing equipment are reviewed. Safety and operational concerns associated with aircraft towing are identified, and the benefits and costs of implementing aircraft towing at 20 major US airports are analyzed. It was concluded that extended aircraft towing is technically feasible and that substantial reductions in aircraft fuel consumption and air pollutant emissions can be achieved through its implementation. It was also concluded that, although capital and operating costs associated with towing would be increased, net savings could generally be attained at these airports. Because of the lack of past experience and the necessity of proving the cost effectiveness of towing concept, a demonstration of the feasibility of large scale aircraft towing is necessary. DOE

N81-33316# Oak Ridge National Lab., Tenn.
IMPACT OF ENVIRONMENTAL CONTROL COSTS ON AN INDIRECT COAL LIQUEFACTION
P. J. Johnson, R. M. Wham, S. P. N. Singh, and J. F. Fisher Aug. 1981 218 p refs
(Contract W-7405-eng-26)
(DE81-026541; ORNL-5722) Avail: NTIS HC A10/MF A01

The effect on product price of three different scenarios for the control of emissions to the environment by a conceptual, commercial indirect coal liquefaction facility is examined. The plant design utilizes Lurgi dry-ash gasifiers operating on western, subbituminous coal to provide synthesis gas for low pressure methanol synthesis and subsequent conversion of the methanol to gasoline. Levels of emission control, which are based as much as possible on existing regulations for analogous processes, range from minimal control to more stringent control than that currently in effect. The use of several emission control options and the reduction of plant size are also examined in regard to their effects on product price. Environmental control to current levels would account for 12% of the product price for the facility assumed here. More stringent emission standards would produce an additional price. Two unpredictable factors having the greatest impacts on product price, however, are inflation and the method of financing. DOE

N81-33332# Stuttgart Univ. (West Germany).
SAAR: TRANSPORT SYSTEM FOR DISTRICT HEATING [FERNWAERMESCHIENE SAAR]
W. Hochreuther (Saarberg-Fernwaerme GmbH., Saarbruecken, West Germany) *In its* Commemoration of 60th Anniv. of Professor Dr. Jakob Wachter Jan. 1980 p 221-250 In GERMAN

Avail: NTIS HC A16/MF A01

The Saar transport system for the utilization of waste heat from power stations and industrial processes for district heating is discussed. Construction of a regional compound system for district heating was demonstrated in the Voelkingen district. Author (ESA)

N81-33489# Energy and Environmental Analysis, Inc., Arlington, Va.
HEAVY-DUTY ENGINES ANALYSIS, STUDY 2: ANALYSIS OF EMISSION REGULATIONS AND TEST PROCEDURES FOR THE GAS TURBINE ENGINE
K. G. Duleep Jun. 1981 117 p refs Prepared for Argonne National Lab.
(Contract W-31-109-eng-38)
(DE81-029990; ANL/CNSV-TM-74) Avail: NTIS HC A06/MF A01

There is considerable interest in heavy duty gas turbines (HDGT) suitable for use in trucks and buses because of their potential for reduced maintenance, improved fuel economy, better overall reliability, and cleaner exhaust emissions relative to existing (gasoline and diesel) heavy duty engines. This analysis focuses on the application of current and expected emissions measurement techniques to heavy duty gas turbines. The purposes of this report are to: identify emission requirements for heavy duty engines applicable during and after completion of the DOE demonstration program, i.e., 1985; provide an understanding of current steady state test procedures and applicability to the HDGT; describe the development and methodology of the test procedures and sampling techniques to measuring emissions from the HDGT; and assess the limitations and problems of current sampling techniques for regulated pollutants and identify promising methods of sampling that are applicable to the HDGT. This information should serve as a comprehensive guide to emissions testing requirements and test procedures for the HDGT. DOE

N81-33538 International Institute for Applied Systems Analysis, Laxenburg (Austria).
[SYSTEMS ANALYSIS AND WORLD RESOURCES] Annual Report, 1980
H. J. Miser, ed. and D. Delves, ed. 1981 87 p refs
Avail: Issuing Activity

Research on energy systems and on food and agriculture programs is outlined. Progress in the resources and environment, human settlements and services, management and technology, system and decision sciences, general research, and education areas was reviewed. The conclusions of a seven year study of the global energy problem are presented. Optimization research, including large scale structured linear programming and stochastic optimization was conducted. Global and regional economic modelling efforts are described. Author (ESA)

N81-33576*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

REPORT OF ACTIVITIES OF THE ADVANCED COAL EXTRACTION SYSTEMS DEFINITION PROJECT, 1979 - 1980

Milton L. Lavin and Lionel Isenberg 1 Aug. 1981 222 p refs
(Contract NAS7-100; Contract DE-AI01-76ET-12548)
(NASA-CR-164852; JPL-Pub-81-69; DOE/ET-12548/7) Avail: NTIS HC A10/MF A01 CSCL 08I

During this period effort was devoted to: formulation of system performance goals in the areas of production cost, miner safety, miner health, environmental impact, and coal conservation, survey and in depth assessment of promising technology, and characterization of potential resource targets. Primary system performance goals are to achieve a return on incremental investment of 150% of the value required for a low risk capital improvement project and to reduce deaths and disability injuires per million man-hour by 50%. Although these performance goals were developed to be immediately applicable to the Central Appalachian coal resources, they were also designed to be readily adaptable to other coals by appending a geological description of the new resource. The work done on technology assessment was concerned with the performance of the slurry haulage system. T.M.

N81-33622# Midwest Research Inst., Golden, Colo. Planning, Applications, and Impacts Div.

ENVIRONMENTAL, HEALTH, SAFETY, AND REGULATORY REVIEW OF SELECTED PHOTOVOLTAIC OPTIONS: COPPER SULFIDE/CADMIUM SULFIDE AND POLYCRYSTALLINE SILICON

Kathryn Lawrence, Sue Morgan, David Schaller, and Thomas Wilczak Jun. 1981 240 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-027294; SERI/TR-743-799) Avail: NTIS HC A11/MF A01

Emissions, effluents and solid wastes from the fabrication of both polycrystalline silicon and front-wall copper sulfide/cadmium sulfide photovoltaic cells are summarized. Environmental, health, and safety characteristics of cell fabrication material inputs and by products are listed. Candidate waste stream treatment methods and resultant effluents are reviewed. Environmental, health, and safety effects of photovoltaic cell/module/array installation, operation, maintenance, and decommission are summarized. Federal legislation is addressed and future regulatory trends under these laws as they may affect each cell process are discussed. Water quality, solid waste disposal, and occupational health and safety regulations will likely be those most applicable to commercial scale PV production. Currently available control technology appears sufficient to treat cell fabrication wastes. DOE

N81-33632# Hittman Associates, Inc., Columbia, Md.

EVALUATION OF HYBRID SOLAR/FOSSIL RANKINE-COOLING CONCEPT

H. M. Curran Nov. 1980 29 p refs
(Contract DE-AC03-79CS-30202)
(DOE/CS-30202/T3; H-C1007/010-80-990) Avail: NTIS HC A03/MF A01

The hybrid solar/fossil Rankine cycle is analyzed thermodynamically to determine fuel use and efficiency. The hybrid system is briefly compared with solar organic Rankine systems with a fossil fuel auxiliary mode, and with geothermal resources. The economic evaluation compares the present value of the superheater fuel cost over the system lifetime with the first cost reduction obtained by substituting a hybrid solar/fossil Rankine engine. The economics analysis indicates that even if the hybrid solar/fossil Rankine cooling system were developed to the point of being a commercial product with an economic advantage over an otherwise equivalent solar organic Rankine cooling system, it would gradually lose that advantage with rising fuel costs and decreasing collector costs. From the standpoint of national fossil fuel conservation, the hybrid concept would be preferable only in applications where the operating duration in the solar/fossil mode would be substantially greater than in the fossil fuel only auxiliary mode. DOE

N81-33669# Illinois Inst. of Natural Resources, Springfield.

ILLINOIS RESIDENTIAL ENERGY EFFICIENCY INDEX

Walter Zyznieuski Jan. 1981 28 p refs
(Contract DE-F646-80CS-69095)
(PB81-211021; ILLDOE-81S/02) Avail: NTIS HC A03/MF A01 CSCL 10A

The index (EEI) measures the amount of natural gas and electricity used for heating in Illinois homes during a four year period (1976-1980). The four year EEI results based on data received from the utilities involved in the study were reviewed. GRA

N81-33670# Illinois Inst. of Natural Resources, Springfield.

ILLINOIS ENERGY PLAN: STAFF WORKING PAPER. VOLUME 1: ILLINOIS ENERGY CONSUMPTION TRENDS, 1960-2000

May 1981 297 p refs
(PB81-211245; ILLDOE-81S/13-Vol-1) Avail: NTIS HC A13/MF A01 CSCL 10A

An analysis of historical state energy consumption patterns for five different economic sectors: residential, transportation, commercial, agricultural and industrial is presented. Future energy consumption and costs in Illinois are projected. GRA

N81-33671# Charles River Associates, Inc., Boston, Mass.

ENERGY REQUIREMENTS FOR METALS PRODUCTION: COMPARISON BETWEEN OCEAN NODULES AND LAND-BASED RESOURCES Final Report

Sep. 1980 100 p refs
(PB81-211351; NOAA-81040602; CRA-492) Avail: NTIS HC A05/MF A01 CSCL 10A

The energy requirements for production of copper, nickel, cobalt, and manganese from ocean nodules are based on an ocean mining operation of 3 million tons per year of dry nodules. A linear relationship exists between the amount of nodules processed and the total energy so that the energy can be easily converted to other processing rates if desired. GRA

N81-33676# National Bureau of Standards, Washington, D.C. Building Equipment Div.

CONTROL STRATEGIES FOR ENERGY CONSERVATION. A CASE STUDY OF THE MATERIALS BUILDING, NATIONAL BUREAU OF STANDARDS Final Report

James Y. Kao and E. Thomas Pierce Jun. 1981 48 p refs
(PB81-217804; NBSIR-81-2277) Avail: NTIS HC A03/MF A01 CSCL 13A

The BLAST-2 computer program was used to investigate various heating, ventilating and air conditioning control strategies and their combinations to reduce the energy consumption of a laboratory building. The techniques of modeling the building load and air system performance are explained. The results are presented and discussed. Control strategies investigated include dry-bulb and enthalpy economizer cycles, resetting supply air tempratures by outside temperature and zone demand, shutdown of fan systems selectively, and converting interior systems to VAV systems. By combining the various control strategies, eight percent, twenty-nine percent and eight percent of heating, cooling and fan energy respectively may be saved. GRA

N81-33677# National Bureau of Standards, Washington, D.C.

RESEARCH AND INNOVATION IN THE BUILDING REGULATORY PROCESS: PROCEEDINGS OF THE 5TH ANNUAL NBS/NCSBCS JOINT CONFERENCE. TECHNICAL SEMINAR ON SOLAR ENERGY CONSERVATION Final Report

Sandra A. Berry May 1981 211 p refs Proc. held at Denver, 6 Aug. 1980
(PB81-219321; NBS/SP-608) Avail: NTIS HC A10/MF A01 CSCL 13A

Topics in solar energy and energy conservation are addressed. These proceedings include: (1) energy programs in the state of Colorado; (2) building energy performance standards concepts (3) state energy audits; (4) energy and building systems services; (5) solar energy and building codes. GRA

N81-33680# Battelle Pacific Northwest Labs., Richland, Wash.

EVALUATION OF FLYASH SURFACE PHENOMENA AND THE APPLICATION OF SURFACE ANALYSIS TECHNOLOGY, PHASE 1 Summary Report

R. D. Smith Jun. 1981 66 p refs
(Contract DE-AC06-76RL-01830)
(DE81-029106; PNL-3842) Avail: NTIS HC A04/MF A01

The factors governing the formation of flyash surfaces during and following coal combustion were reviewed. The competing chemical and physical processes during the evolution of inorganic material in coal during combustion into flyash are described with respect to various surface segregation processes. Two mechanisms leading to surface enrichment are volatilization-condensation

processes and diffusion processes within individual flyash particles. The experimental evidence for each of these processes was reviewed. It is shown that the volatilization-condensation process is the major factor leading to trace element enrichment in smaller flyash particles. DOE

N81-33681# Department of Energy, Washington, D. C.
ENVIRONMENTAL TRENDS TO THE YEAR 2000
Jul. 1981 23 p refs
(DE81-027695; DOE/EP-0021) Avail: NTIS HC A02/MF A01

This analysis focuses on the environmental impacts of the National Energy Policy Plan and emphasizes those pollutants for which energy development and use play a significant role. The increase in relative contributions of the energy sector to emissions during the study period is within a range of zero to 15% for all selected pollutants with the exception of ash, captured particulates, and oil-shale waste. For the group, the energy sector contribution increases from 58% to 89%, primarily because of the production of oil from shale. If the oil-shale wastes were not included in these totals, energy-process wastes would be 62% of the national total of 250 million tons. Even though these figures represent total net emissions to the environment, rather than ambient concentrations, the assessment offers a sound basis for an important overall conclusion. The significant economic growth projected by the National Energy Policy Plan, and continuing free-market efforts to ensure the wise and efficient application of energy resources by the nation, can be achieved without foresaking reasonable environmental quality. DOE

N81-33686# Acurex Corp., Mountain View, Calif. Energy and Environmental Div.
ADVANCED PULVERIZED-COAL COMBUSTOR FOR CONTROL OF NO/SUB X/ EMISSIONS Quarterly Report, 1 Apr. - 30 Jun. 1981
R. L. Pam, S. T. Suttmann, J. T. Kelly, and E. K. Chu 31 Jul. 1981 20 p
(Contract DE-AC22-80PC-30296)
(DE81-029124; DOE/PC-30296/T1; QR-3) Avail: NTIS HC A02/MF A01

A dimensional combustor, incorporating fuel staging for control of NO/sub x emissions was examined. A comprehensive computer model is developed to allow NO mechanisms and rates to be extracted from the experimental data. Initial PROF code runs led to extensive debugging efforts. A simplified radiation model formulation and devolatization model are described. Combustor installation was completed. Work utilizing fuel staging concepts is summarized in terms of its NO/sub x/ reduction potential. DOE

N81-33687# Ames Lab., Iowa.
ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF POWER PLANT FLY ASH
M. J. Murtha 1980 17 p refs Presented at 3rd Miami Intern. Conf. on Alternative Energy Sources, Bal Harbour, Fla., 15-17 Dec. 1980
(Contract W-7405-eng-82)
(DE81-023777; IS-M-309; CONF-801210-28) Avail: NTIS HC A02/MF A01

The environmental impact of coal combustion and fly ash disposal, the current status of relevant legislation and regulations, and ash utilization process development are discussed. A process being developed for metals recovery from fly ash is described. DOE

N81-33703# Gilbert Associates, Inc., Reading, Pa.
COMPATIBILITY OF SOURCE SEPARATION AND MIXED-WASTE PROCESSING FOR RESOURCE RECOVERY Final Report
M. G. Klett, W. H. Fischer, B. N. Murthy, H. H. Fiedler, L. M. Oliva (Resource Planning Associates, Washington, D. C.), and R. Crystal (Crystal Planning and Commun., Inc.) Jun. 1981 194 p refs
(Contract EPA-68-02-2645)
(PB81-216046; EPA-600/2-81-097) Avail: NTIS HC A09/MF A01 CSCL 13B

Existing source separation programs and mixed-waste processing facilities were analyzed four broad areas of concern, energy and materials conservation, environmental impacts institutional and technological impacts, and economic impacts are considered. Issues most important for each viewpoint are assessed for each combination of options and alternatives. The issues addressed are: changes in production of useful energy from a mixed waste processing facility, air, land, and water pollution emissions, contractors employment, operator profitability, total solid waste collection costs, and quantities of recycled materials. GRA

N81-33704# GCA Corp., Bedford, Mass. Technology Div.
ENVIRONMENTAL ASPECTS OF FLUIDIZED-BED COMBUSTION Final Report
J. M. Robinson, R. J. Kindya, C. W. Young, R. R. Hall, and P. Fennelly Apr. 1981 80 p refs
(Contract EPA-68-02-2693)
(PB81-217630; GCA-TR-80-108-G; EPA-600/7-81-075) Avail: NTIS HC A05/MF A01 CSCL 13B

Emissions data indicate that FBC technology is a viable alternative to conventional coal combustion. Adverse impacts on health or the environment appear to be minimal; at worst, they are no different than for conventional coal combustion systems. To support this conclusion, specific results of FBC sampling and analysis from work performed through late 1979 are discussed. GRA

N81-33705# Research Triangle Inst., Research Triangle Park, N. C.
EVALUATION OF RELATIVE ENVIRONMENTAL HAZARDS FROM A COAL GASIFIER Final Report, Nov. 1976 - Apr. 1981
S. K. Gangwal, J. G. Cleland, and R. S. Truesdale Jun. 1981 108 p refs
(Grant EPA-R-804979)
(PB81-217648; EPA-600/7-81-100; RTI/1934/00-02F) Avail: NTIS HC A06/MF A01 CSCL 13B

Environmental hazards from a laboratory scale coal gasifier were evaluated. Relative environmental hazards were determined by the multimedia environmental goals methodology. Toxicity and mutagenicity were assessed. It is found that environmentally, the most significant effluent stream is aqueous condensate, followed by tar, product gas, and ash. However, on an equivalent weight basis, the tar stream is more toxic and mutagenic than aqueous condensate. Polycyclic aromatic hydrocarbons and organic bases are the most mutagenic fractions of the tar. Coal pyrolysis and gasificaion at higher tempratures leads to reduced tar mutagenicity. GRA

N81-34100# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
THE ELECTRIC VEHICLE ALTERNATIVE M.S. Thesis
David E. Swanson and Michael R. VanHouse Jun. 1981 145 p refs
(AD-A103810; AFIT-LSSR-35-81) Avail: NTIS HC A07/MF A01 CSCL 13/6

This thesis discusses three basic concepts of economic analysis: the time value of money, life cycle cost, and reliability theory. Using these concepts, a method of economic analysis is developed to be used in evaluating the possible replacement of internal combustion engine (ICE) vehicles with electric vehicles (EVs). This methodology is then demonstrated by comparing two possible alternatives for replacement of the existing fleet of pickup trucks assigned to the 4950th Test Wing Aircraft Maintenance Complex at Wright-Patterson AFB, Ohio. One alternative is to replace the existing pickup fleet with new ICE pickups, the other is to replace the existing fleet with EVs. In this research effort the ICE pickup fleet is found to be the low cost alternative. Recommendations for further research and additional considerations are provided to the reader. This thesis contains an extensive bibliography on EV technology and principles of economic analysis. Author (GRA)

N81-34102# Argonne National Lab., Ill.
PROJECTION OF US TRANSPORTATION NEEDS FOR BEYOND 1990: A MARKET FOR ADVANCED VEHICLES?
Martin J. Bernard, III 8 Dec. 1980 18 p refs Presented at the Elec. and Hybrid Vehicle Advan. Technol. Seminar, Pasadena, Calif., 8 Dec. 1980
(Contract W-31-109-eng-38)
(DE81-023820; CONF-801242-7) Avail: NTIS HC A02/MF A01

Forecasts of the advanced vehicle (AV) market to the year 2000 are made considering petroleum supplies, electric power demand, economics, and environmental impacts. It is concluded

that there are markets for AVs, but the competition in the market place from other technologies will be substantial. Utilities should have sufficient capacity for two or more decades to handle offpeak charging of electric hybrid vehicles but acid rain from coal power plant emissions will remain a major environmental problem, which can only raise the cost of electricity and thus AV operation. All this will tax the creativity of the AV innovator. DOE

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02

SOLAR ENERGY

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

A81-41221 Surface recombination effects on the performance of n/+/p step and diffused junction silicon solar cells. J. D. Arora, P. C. Mathur (Delhi, University, Delhi, India), and S. N. Singh (Delhi, University, Delhi; National Physical Laboratory of India, New Delhi, India). *Solid State Electronics,* vol. 24, Aug. 1981, p. 739-747. 18 refs.

A81-41223 Solar cell fill factors - General graph and empirical expressions. M. A. Green (New South Wales, University, Kensington, Australia). *Solid State Electronics,* vol. 24, Aug. 1981, p. 788, 789. Research supported by the Australian Research Grants Committee.

Two techniques for evaluating solar cell fill factors (FF) are discussed. One is a graph which allows FF to be determined for any combination of parameters used to characterize cell performance, while the second consists of empirical expressions by which FF under similar general conditions can be described. Results confirm that a high degree of accuracy can be obtained by the two techniques, showing 0.54 for the graph, and 0.547 using the empirical expressions, as compared to the exact value of 0.556. E.B.

A81-41332 Photovoltaic solar arrays - Unlimited power for our space vehicles. L. G. Chidester (Lockheed Missiles and Space Co., Inc., Space Systems Div., Sunnyvale, CA). *Lockheed Horizons,* Summer 1981. p. 2-10.

Solar cell technology is reviewed with reference to the high-efficiency cells, ultra-thin cells, GaAs cells and wrap-around cells. Performance characteristics are presented noting the advantages of GaAs cells over silicon cells. A number of solar array configurations are illustrated including large flexible arrays and curved graphite panels. Attention is given to the NASA Solar Electric Propulsion Stage program which would use ion engines to propel spacecraft in interplanetary missions. Applications of solar cell technology to the Space Shuttle program are discussed, including the Power Extension Package, lightweight arrays and solar energy concentrators. S.C.S.

A81-41692 * A solar simulator-pumped atomic iodine laser. J. H. Lee (Vanderbilt University, Nashville, TN) and W. R. Weaver (NASA, Langley Research Center, Hampton, VA). *Applied Physics Letters,* vol. 39, July 15, 1981, p. 137-139. 9 refs. Grant No. NCC1-8.

An atomic iodine laser, a candidate for the direct solar-pumped gas laser, was excited with a 4-kW beam from a xenon arc solar simulator. Continuous lasing at 1.315 micron for over 10 ms was obtained for static filling of n-C3F7I vapor. By momentarily flowing the lasant, a 30-Hz pulsed output was obtained for about 200 ms. The peak laser power observed was 4 W for which the system efficiency reached 0.1%. These results indicate that direct solar pumping of a gas laser for power conversion in space is indeed feasible. (Author)

A81-41801 Reflector satellites for solar power. T. F. Rogers. *IEEE Spectrum,* vol. 18, July 1981, p. 38-43. 9 refs.

A global photovoltaic power distribution system is conceptualized in the paper. GW sized solar cell arrays constructed in sunny, arid regions of the world would convert sunlight to dc, dc to microwaves in mm length, then beam the power to passively reflecting geostationary satellites, which in turn redirect the beams to rectennas on the earth for reconversion to dc for immediate use or adjustment to ac and transmission. The system is projected to have lower costs for space equipment than SPS because the cells would be based earth-side, and could be constructed in areas where the populations are poorest and land is least valuable. Cost estimates are in the range of $20 billion for 10,000 sq km collectors and converters and a 600 sq mm reflector in orbit. A global distribution of the photovoltaic clusters would provide base-load electricity because some areas would always be in sunlight. Techniques for compensation for atmospheric attenuation are reviewed, noting a final system efficiency of 1-8% is attainable, with costs similar to those now associated with fusion power development. D.H.K.

A81-41824 Factors influencing solar energy collector efficiency. P. K. C. Pillai and R. C. Agarwal (Indian Institute of Technology, New Delhi, India). *Applied Energy,* vol. 8, July 1981, p. 205-213. 7 refs.

The effects of glazing, solar flux, emissivity and absorptivity of the absorber surface on collector performance have been predicted for different plate temperatures (60 C and 100 C). At low solar flux levels (200-600 W/sq m) double- or triple-glazed collectors are superior to single-glazed collectors. For collectors with selective absorber coatings, the optimal number of glazing planes is two. Higher values of absorptivity and lower values of emissivity are more effective for single-glazed than for double-glazed collectors. (Author)

A81-41970 Solar thermal engineering: Space heating and hot water systems. P. J. Lunde (Hartford Graduate Center, Hartford, CT). New York, John Wiley and Sons, Inc., 1980. 635 p. 108 refs. $30.

Heat transfer fundamentals are considered along with solar radiation, flat plate collectors, optically concentrating collectors and reflectors, the transfer of the collected heat, the storage of the collected heat, long-term system performance, parametric studies, economic evaluation, solar systems design, passive heating systems, solar radiation tables, and solar radiation data on inclined surfaces for selected U.S. locations for use with the base-temperature methods for performance prediction. Attention is given to the thermal characteristics of buildings, collector plate surfaces, collector performance, collector improvement, the effect of incident angle, heat transfer to fluids, freeze protection, heat exchanger analysis, the heat exchanger factor, stratified storage, well-mixed storage, annual heat storage, fundamentals of economic analysis, system optimizations, swimming pool heaters, hot water heating, pumps and fans, and sizing pipe and ductwork. G.R.

A81-42150 New ion implant technique for low-cost solar cell fabrication. K. Tokiguchi, H. Itoh, N. Sakudo, H. Koike, I. Kanomata, and T. Tokuyama (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Tokyo, Japan). *Review of Scientific Instruments,* vol. 52, July 1981, p. 1110, 1111. Research supported by the Ministry of International Trade and Industry.

A new implant technique, in which a single magnet carries out mass separation and ion beam scanning, is described. Dose uniformity and energy conversion efficiency of a solar cell fabricated using this technique are investigated. (Author)

A81-42451 * Dispersed solar thermal generation employing parabolic dish-electric transport with field modulated generator systems. R. Ramakumar (Oklahoma State University, Stillwater, OK) and K. Bahrami (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Solar Energy,* vol. 27, no. 1, 1981, p. 7-11. 6 refs. Research sponsored by the U.S. Department of Energy and NASA.

This paper discusses the application of field modulated generator systems (FMGS) to dispersed solar-thermal-electric generation from a parabolic dish field with electric transport. Each solar generation unit is rated at 15 kWe and the power generated by an array of such units is electrically collected for insertion into an existing utility grid. Such an approach appears to be most suitable when the heat engine rotational speeds are high (greater than 6000 r/min) and, in particular, if they are operated in the variable speed mode and if utility-grade a.c. is required for direct insertion into the grid without an intermediate electric energy storage and reconversion system. Predictions of overall efficiencies based on conservative efficiency figures for the FMGS are in the range of 25 per cent and should be encouraging to those involved in the development of cost-effective dispersed solar thermal power systems. (Author)

A81-42452 **A fixed Fresnel lens with tracking collector.** E. M. Kritchman, A. A. Friesem, and G. Yekutieli (Weizmann Institute of Science, Rehovot, Israel). *Solar Energy*, vol. 27, no. 1, 1981, p. 13-17. 20 refs.

The application of a wide angle concentrating Fresnel lens to a linear solar energy system, in which the optical concentration is stationary while the absorber follows the locus of best foci, is investigated. The two substantial direction possibilities of the linear axis, east-west and polar, are compared to each other. It is shown that such a concentrator may operate about six hours a day throughout the year with an average effective concentration exceeding 10. Specifically, a polar installation, including a fixed lens and a fixed assembly of separate absorbers behind it, may enable sufficient concentration for residential heating and airconditioning without any moving parts. (Author)

A81-42453 **Thermal analysis of CPC collectors.** C. K. Hsieh (Florida, University, Gainesville, FL). *Solar Energy*, vol. 27, no. 1, 1981, p. 19-29. 36 refs. Contract No. W-31-109-eng-38.

Mathematical formulations were developed to study thermal processes in a compound-parabolic-concentrator (CPC) collector. The system under investigation consists of a CPC cusp fitted with a concentric, evacuated double pipe to serve as a heat absorber. Heat is transmitted to the circulating fluid flowing inside a U-tube via the heat getter slipped inside the inner pipe. The collector has a cover for dust protection. Four nonlinear, simultaneous equations were derived to predict heat exchange among various components in the system. Collector efficiency equations were also developed following the Hottel-Whillier-Woertz-Bliss formalism. These equations were subsequently used in a computer program to test the collector performance under varied operating conditions. Test results indicate that, because of the high thermal resistance between the receiver jacket and the envelope, the collector performance is quite stable and is nearly independent of many parameters tested. The efficiency of the collector is high and shows only a very slight drop at high operating temperatures. The predicted results were also compared with experiments. (Author)

A81-42454 **Numerical evaluation of radiation absorption by a fluid confined in a semi-transparent circular cylinder.** M. Sokolov and C. Saltiel (Tel Aviv University, Tel Aviv, Israel). *Solar Energy*, vol. 27, no. 1, 1981, p. 31-35. 6 refs.

Solar energy absorbed by a fluid contained in a circular cylindrical vessel is calculated with consideration given to energy losses due to reflection and energy absorption of the cover. A computer simulated specular radiation for various cover thicknesses, coefficients of extinction, and cover diameters and concentrations, including all ray cascades. A comparison was made of the energy absorbed, for circular and flat geometries. Also obtained was an optimum fluid diameter for a given cover thickness with respect to the amount of energy absorbed by the fluid per unit aperture. D.L.G.

A81-42455 **Calculation of the top loss coefficient of a flat-plate collector.** V. K. Agarwal and D. C. Larson (Drexel University, Philadelphia, PA). *Solar Energy*, vol. 27, 1981, p. 69-71. 7 refs.

The useful energy gain of a flat plate collector depends strongly on energy losses due to convective and radiative heat transfer processes from the top surface of the collector. Klein's (1975) empirical equations are given, discussed, and compared at different plate temperatures for calculations of a simpler equation for a top loss coefficient. Results show Klein's approach as satisfactory, although discrepancies arose when testing for the coefficient's dependence on collector tilt. In addition, the new equation proved simpler to manipulate, and provided an enhanced accuracy in the calculations over a wide range of different parameters. D.L.G.

A81-42458 **Enhanced air flow over cooling fins in solar energy convertors.** J. W. Cochrane and H. J. Goldsmid (New South Wales, University, Kensington, Australia). *Solar Energy*, vol. 27, no. 1, 1981, p. 89, 90. Research supported by the National Energy Research, Development and Demonstration Council of Australia.

A81-42489 **The physics of heavily doped n/+/-p junction solar cells.** H. P. D. Lanyon (Solar Energy Research Institute, Golden, CO; Worcester Polytechnic Institute, Worcester, MA). *Solar Cells*, vol. 3, July 1981, p. 289-311. 18 refs.

Current-voltage characteristics of a p-n junction in terms of the diffusion of minority carriers in the neutral regions on either side of the junction space charge region were first considered by Shockley (1949). Early in the 1970s it became obvious that large deviations from this theory were occurring in solar cells which had a heavily doped emitter region on low-resistivity base layers. The mechanisms proposed to account for these discrepancies are related to band gap reduction and a position-dependent recombination rate. In the considered investigation, a review is provided of the involved physical relations, taking into account minority carrier mobility, minority carrier lifetime, minority carrier diffusion length, band gap narrowing, and Fermi-Dirac statistics. A comparison is conducted between theory and experiment, giving attention to device structure and experimental results, the base current component, the emitter current component, and short-wavelength quantum efficiency. G.R.

A81-42491 **Module and solar cell values as a function of efficiency.** M. Wolf (Pennsylvania, University, Philadelphia, PA). *Solar Cells*, vol. 3, July 1981, p. 327-336. 5 refs.

The determination of solar cell value as a function of efficiency provides a valuable tool for the selection of modules for a given system or for the assessment of the cost effectiveness of solar cell and module fabrication processes. This value-efficiency relationship is dominated by the area-related balance-of-system costs (ARBOS). Their future magnitude, however, is rather uncertain. An assumption of this magnitude will radically influence the direction of photovoltaic module research and development to be undertaken. To illustrate the effect of array installation costs, a graph presents four curves of module value as a function of efficiency with ARBOS costs as parameter. G.R.

A81-42492 **High efficiency bifacial back surface field solar cells.** A. Cuevas, A. Luque, J. Eguren, and J. del Alamo (Madrid, Universidad Politécnica, Madrid, Spain). *Solar Cells*, vol. 3, July 1981, p. 337-340. 6 refs.

The first high efficiency p(plus)-n-n(plus) bifacial solar cells are presented. Efficiencies of 15.7 percent and 13.6 percent were measured under front and back air mass 1 illumination, respectively, at 28 C. At 7 air mass 1 illumination and 28 C, the front efficiency increases to 16.5 percent. A pilot production of 200 cells was made following a fabrication process as simple as that for conventional back surface field cells. Mean efficiencies of 13.4 percent and 10.7 percent were obtained under front and back illumination, respectively. The production yield is higher than 80 percent. (Author)

A81-42493 **Growth patterns of chemiplated Cu/2-x/S layers in CdS/Cu2S thin film solar cells.** S. Salkalachen, S. Jatar, A. C. Rastogi, and V. G. Bhide (National Physical Laboratory, New Delhi, India). *Solar Cells*, vol. 3, July 1981, p. 341-353. 20 refs. Research supported by the Tata Energy Research Institute.

An investigation is conducted of the kinetics of growth of chemiplated Cu(2-x)S films on thermally deposited and chemically etched CdS layers. Efficient CdS/Cu2S thin film solar cells are generally prepared by chemically plating vacuum-deposited CdS layers in CuCl solution. Before chemiplating, the CdS film surface is texturized to enhance its light absorption properties and to increase the active junction area. It is found that the texturizing step preceding chemical plating alters the growth mechanisms of the Cu(2-x)S layer considerably, since both the morphology and the composition of the host CdS layer are affected. The Cu(2-x)S growth equations and variations in the deposit angle with the grain boundary edge are discussed on the basis of a pyramidal grain model. G.R.

A81-42494 **Theoretical bases of photovoltaic concentrators for extended light sources.** A. Luque (Madrid, Universidad Politécnica, Madrid, Spain). *Solar Cells*, vol. 3, July 1981, p. 355-368. 10 refs.

The theoretical bases for casting maximum energy on a cell placed in a static concentrator of minimum entry aperture are derived. Several concentrators are analyzed according to this theory and the gain achievable with each is obtained. When practical materials are used the maximum gain is about 9 for the direct beam source and about 4.5 for diffuse radiation. One of the concentrators analyzed allows for reaching these figures. (Author)

A81-42495 Application of electrochemical methods in Ga/1-x/Al/x/As/GaAs solar cell fabrication. J. Przyluski, J. Mendyk, and N. Druto (Warszawa, Politechnika, Warsaw, Poland). *Solar Cells,* vol. 3, July 1981, p. 369-374.

The discussed investigation had the objective to produce a Ga(1-x)Al(x)As/GaAs heterojunction model solar cell with an antireflection (AR) coating. An n(+) Te-doped (100)-oriented GaAs single crystal with a carrier concentration of 10 to the 18th per cc was used as substrate. Three successive layers n/p/p(+) were grown on the substrate by liquid phase epitaxy. Anodic oxidation was carried out by a galvanostatic method. An ellipsometric method with an He-Ne laser was employed to measure the thickness of the anodic layer. Ohmic contacts were prepared with the aid of standard photolithographic techniques. The investigation demonstrated the possibility to employ electrochemical methods in solar cell production of the considered type. G.R.

A81-42516 Space Shuttle and solar power satellite systems. G. M. Hanley (Rockwell International Corp., Pittsburgh, PA). In: Update on space. Volume 1. Granada Hills, CA, National Behavior Systems, 1981, p. 106-125.

The most significant fact about the Shuttle is that it makes it possible to place men and materials into orbit in a routine manner. Solar power satellites use solar cells to convert solar energy on orbit into electrical energy which is transmitted down to the ground using radio frequency waves which are received by a ground antenna and turned into direct current electrical energy. The satellite is in geosynchronous orbit. At this altitude sunlight is present approximately 98% of the time. A typical satellite is roughly 10 miles long and about 2-1/2 miles wide. It is assembled on orbit, with the materials brought up from earth. Each satellite produces 5 gigawatts of power. Plans are to start construction on solar power satellites around the year 2000. Energy-providing space systems which have been rejected after an evaluation include a nuclear reactor in space and a solar thermal system. The selected photovoltaic system will possibly use gallium aluminum arsenide cells instead of silicon cells. Attention is also given to problems of microwave energy transmission, details of satellite construction, and aspects of cost. G.R.

A81-42533 # Some aspects of the choice and design of antenna systems for satellite solar power stations (Nekotorye aspekty vybora i postroeniia antennykh sistem solnechnykh kosmicheskikh elektrostantsii). N. A. Armand, A. N. Lomakin, and B. M. Paramonov. *Radiotekhnika i Elektronika,* vol. 26, July 1981, p. 1479-1487. 7 refs. In Russian.

Various aspects of the design of microwave power transmitting and receiving antennas in satellite solar power systems are discussed. Particular consideration is given to problems of receiving-antenna design in Eastern European countries, where safety norms specify lower levels of microwave intensity than in the United States. Attention is also given to problems of sidelobe reduction in phased arrays consisting of a chain of a large number of nonlinear amplifiers series-connected by waveguides with slot radiators. Conditions for the damping of amplitude-modulated and phase-modulated oscillations in the chain are established, and the value of the suppression coefficient is determined. B.J.

A81-42638 Determination of the maximum efficiency solar cell structure. H. Pauwels and A. De Vos (Gent, Rijksuniversiteit, Ghent, Belgium). *Solid-State Electronics,* vol. 24, Sept. 1981, p. 835-843. 13 refs.

A very general formulation of a semiconducting photovoltaic device is given. The efficiency of this device is maximized with respect to its structural parameters. In this way it is shown that no solar cell structure can achieve a larger efficiency than an infinite tandem cell, with bandgaps monotonically decreasing from infinity to zero, and of which each individual cell is a selective black body with its own appropriate bias voltage. This maximum efficiency is numerically calculated for various cell- and sun temperatures and concentration factors. (Author)

A81-42640 Barrier height enhancement of the Schottky barrier diode using a thin uniformly-doped surface layer. C.-Y. Wu (National Chiao Tung University, Hsinchu, Nationalist China). *Solid-State Electronics,* vol. 24, Sept. 1981, p. 857-862. 13 refs. Research supported by the National Science Council of Nationalist China.

An analytic model for the barrier height enhancement of the Schottky barrier diode with the Mnp (or Mpn) structure, which considers the uniformly doped surface layer and the surface properties of the metal-semiconductor system, is presented. The maximum potential barrier and its precise location including the effect of the image-force potential have been calculated, which shows that the effective barrier height for the majority carriers without considering the image-force lowering will give erroneous predictions if the doped surface layer is very shallow or lightly doped. The built-in voltage of the Mnp structure based on the interfacial layer theory has also been calculated, which gives the exact dependence of the built-in voltage on the interface properties of the metal-semiconductor contact and the dose of the doped surface layer. Numerical results of the developed model have been computed and discussed, which may serve as the guide for the fabrication of the Schottky barrier (SB) and MIS solar cells with higher barrier height. (Author)

A81-42641 Silicon nitride for the improvement of silicon inversion layer solar cells. R. Hezel (Erlangen-Nürnberg, Universität, Erlangen, West Germany). *Solid-State Electronics,* vol. 24, Sept. 1981, p. 863-868. 29 refs.

An experiment is presented which demonstrates the use of CVD Si-nitride films as a transparent dielectric, and which results in high-efficiency, long-term stability MIS/inversion layer (IL) solar cells. The film is deposited on single crystalline silicon by the SiH4/NH3 reaction at a significantly lower temperature than usual (600-650 C), and fixed positive interface charge densities of up to 7 x 10 to the 12th/sq cm, with excellent stability, are obtained. Utilizing the Si-nitride charge storage effect, the charge density is further increased up to greater than 10 to the 13th/sq cm, a value far above those achieved in MIS/IL solar cells up to now. The charge distribution is discussed, and an energy band diagram, modified according to new analytical results, is presented. It is concluded that because of its low deposition temperature, cell fabrication could be reduced to a simple one mask process. The process could also be used for AR coatings on diffused junction solar cells. K.S.

A81-42650 * # Photoproduction of I2, Br2, and Cl2 on n-semiconducting powder. B. Reichman (Christopher Newport College, Newport News, VA; Energy Conversion Devices, Inc., Troy, MI) and C. E. Byvik (NASA, Langley Research Center, Hampton, VA). *Journal of Physical Chemistry,* vol. 85, July 23, 1981, p. 2255-2258.

The photosynthetic production of Br2 and Cl2 and the photocatalytic production of I2 from aqueous solutions of the respective halide ions in the presence of platinized semiconducting n-TiO2 powder are reported. Reactions were produced in 2-3 M oxygen-saturated aqueous solutions of KI, KBr or NaCl containing Pt-TiO2 powder which were irradiated by a high-pressure mercury lamp at a power of 400 mW/sq cm. Halogens are found to be produced in greater quantities when platinized TiO2 powders are used rather than pure TiO2, and rates of halogen production are observed to increase from Cl2 to Br2 to I2. The presence of the synthetic reactions producing Br2 and Cl2 with a net influx of energy indicates that an effective separation of the photoproduced electron-hole pair occurs in the semiconductor. Quantum efficiencies of the reaction, which increase with decreasing solution pH, are found to be as high as 30%, implying a solar-to-chemical energy conversion efficiency between 0.03% and 3% for the case of chlorine production. It is concluded that the photoproduction of halogens may be of practical value if product halogens are efficiently removed from the reaction cell. A.L.W.

A81-42698 The potential for thin-film photovoltaic cells. T. W. F. Russell and V. L. Dalal (Delaware, University, Wilmington, DE). *IEEE Transactions on Education,* vol. E-24, Aug. 1981, p. 239-242. 10 refs.

In this paper the potential for photovoltaic power generation is considered in terms of the photovoltaic generation facilities and the facilities for manufacturing the cell material. Significant quantities of electricity require very-large-scale manufacturing facilities and the

need for new innovative technology to design such facilities is discussed. (Author)

A81-42851 Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volumes 1, 2, 3 & 4. Conference sponsored by the U.S. Department of Energy, Ministry of Education, Science and Culture of Japan, Ministry of International Trade and Industry of Japan, et al. Edited by T. N. Veziroglu (Miami, University, Coral Gables, FL), K. Fueki (Tokyo, University, Tokyo, Japan), and T. Ohta (Yokohama National University, Yokohama, Kanagawa, Japan). Oxford and New York, Pergamon Press (Advances in Hydrogen Energy 2), 1981. Vol. 1, 594 p.; vol. 2, 707 p.; vol. 3, 510 p.; vol. 4, 745 p. Price of four volumes, $300.

Papers are presented in the areas of electrolytic hydrogen production, thermochemical and hybrid hydrogen production, innovative hydrogen production, hydrogen storage and transmission, vehicles and hydrogen combustion, chemical and metallurgical usage of hydrogen, overall systems, environmental and materials aspects of hydrogen energy, and industrial aspects of hydrogen energy. Specific topics include advanced alkaline water electrolysis plants, polyethylene-based solid polymer electrolytes, the sulfur-iodine thermochemical water-splitting cycle, hydrogen, carbon monoxide, and char production by flash coal carbonization, photoassisted water electrolysis by Si electrodes, hydrogen production by a thermophilic blue-green alga, the hydrogen storage properties of Fe(1-x)Nb(x)Ti alloys, and hydrogen-fueled compression-ignition engines. Attention is also given to ammonia as an energy vector for the hydrogen economy, a solar hydrogen energy system for an isolated island, a photovoltaic electrolysis system, and the economics of synthetic fuel and chemical production from nuclear power and coal. A.L.W.

A81-42907 Solar heat storage by metal hydrides. M. Yamaguchi, I. Yamamoto, and T. Ohta (Yokohama National University, Yokohama, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2.
Oxford and New York, Pergamon Press, 1981, p. 931-936.

A theoretical and experimental study is presented of a solar heat storage system using metal hydrides, in an effort to overcome the problem of intermittent insolation. A numerical system analysis is performed, with consideration given to the dynamic characteristics of metal-hydrogen systems, the relative amounts of the hydrogen and the metal, and the reservoir volume. The experimental apparatus, which consists mainly of a hydrogen channel and a water channel, is described. Heat storage experiments using sintered FeTi alloy are compared with the system analysis, and the heat of reaction is estimated (from the dependence of the hydrogen flow rate on the thermal output) to be -6.9 kcal/mole H2. Examples are given of the time variation of pressure, hydrogen flow rate, and other variables in the heat storing and using cycle. The construction and operation of a solar heat storage system is described. K.S.

A81-42945 Performance of photovoltaic electrolysis system. D. Estève, C. Ganibal (CNRS, Laboratoire d'Automatique et de ses Applications Spatiales, Toulouse, France), D. Steinmetz, and A. Vialaron (CNRS, Toulouse, France). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3.
Oxford and New York, Pergamon Press, 1981, p. 1593-1603. 7 refs.

A photovoltaic generator with concentrated light is combined with a water electrolysis cell in an effort to further the development of solar energy utilization. SOPHOCLE, a photovoltaic generator with limited concentration of energy, is a heliostat of the altazimuth type, consisting of an optical device to focus the sunlight on the photocells, a tracking device to follow the position of the sun, and a cooling device to allow dissipation of thermal energy. The combined cost and performance of SOPHOCLE gives an overall efficiency of 9 percent (for direct solar radiation). A power conditioning device matches the generator photocell characteristics with the electrolysis cell to give maximum hydrogen production. Hydrogen can be produced by this method with an overall efficiency of 7 percent. J.F.

A81-42966 Reversible photovoltaic-electrochemical solar cell. M. Sharon and A. Sinha (Indian Institute of Technology, Bombay, India). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2047-2053. 5 refs. Research supported by the Tata Energy Research Institute.

The development of a novel solar electrochemical rechargeable battery is reported. The device uses n-BaTiO3 as photo-anode for charging by sunlight, and Pt electrodes for the dark, reverse reaction. The electrolyte is Ce(3+)/Ce(4+) solution, which behaves like a cathode during charging. The cell has a potential of 0.62 V and a current on the order of 0.20 mA/sq cm. The photo-current, photo-voltage and stability of the semiconductor electrode were measured, and the flat-band potential and carrier concentration were calculated from Mott-Schottky plots. In addition, the effect of pH and additives were studied at a frequency of 1 KHz. O.C.

A81-43024 A high performance solar powered thermoelectric generator. D. M. Rowe (University of Wales Institute of Science and Technology, Cardiff, Wales). *Applied Energy*, vol. 8, Aug. 1981, p. 269-273. 7 refs. Research supported by the British Gas Corp.

The efficiency of a single couple solar powered thermoelectric generator utilizing fine-grained Si-Ge alloy thermoelements and a selective solar absorbing coating is investigated as a function of operating temperature and solar concentration factor. Optical losses and heat losses are taken into account. Under optimal operating conditions, the overall efficiency of the device is computed to be in excess of 12 per cent when operating between room temperature and 1000 K. (Author)

A81-43025 The coefficient of performance for a solar absorption dual cycle. H. M. Sofrata, A. E. Nasser, and M. R. Megahed (Riyadh, University, Riyadh, Saudi Arabia). *Applied Energy*, vol. 8, Aug. 1981, p. 275-280.

A new selection criterion for solar powered dual absorption systems is presented, and a multidimensional definition for the coefficient of performance is suggested. The traditional definition, which does not define the heat input base, is found to create misleading results with respect to machine selection, causing the dual cycle to often be ignored. A lithium bromide dual absorption cycle is also presented, and is found appropriate for places where solar energy is available but water is scarce, thus eliminating the need for a cooling tower. D.L.G.

A81-43286 a-SiC:H/a-Si:H heterojunction solar cell having more than 7.1% conversion efficiency. Y. Tawada, H. Okamoto, and Y. Hamakawa (Osaka University, Toyonaka, Japan). *Applied Physics Letters*, vol. 39, Aug. 1, 1981, p. 237-239. 19 refs.

A81-43290 Submicron polycrystal silicon film solar cells. P. H. Fang, C. C. Schubert, J. H. Kinnier (Boston College, Chestnut Hill, MA), and D. Pang (Boston College, Chestnut Hill, MA; Beijing Polytechnic University, Beijing, Communist China). *Applied Physics Letters*, vol. 39, Aug. 1, 1981, p. 256-258. 17 refs. Research supported by the U.S. Department of Energy.

A silicon polycrystal thin-film solar cell with a present efficiency of 1% is reported. The process involves depositing a silicon film by electron beam evaporation on metal layers with steel as the substrate. The thickness of the p-i-n structure is about 5 microns. The grain size is of the order of several hundred angstroms. Some similarities of this submicron silicon with amorphous silicon are discussed. (Author)

A81-43293 Observation of grain boundary hydrogen in polycrystalline silicon with Fourier transform infrared spectroscopy. D. S. Ginley and D. M. Haaland (Sandia Laboratories, Albuquerque, NM). *Applied Physics Letters*, vol. 39, Aug. 1, 1981, p. 271-273. 17 refs. Contract No. DE-AC04-76DP-00789.

A81-43400 HTE visits - An overview of SERI solar thermal research facilities. II. F. Kreith (Solar Energy Research

Institute, Golden, CO). *Heat Transfer Engineering*, vol. 2, Jan.-June 1981, p. 16, 17, 19-21, 134-137.

The objectives of investigations conducted in the Heat and Mass Transfer Research Laboratory are related to the study and the improvement of methods of transferring heat and mass under the small driving forces which often exist when the sun is the energy source for the process. The primary method under consideration is direct contact between the working fluid and the reservoirs, but other methods such as enhanced contact area may be studied. The near-term objective of laboratory research is to investigate the heat and mass transfer phenomena relevant to various open-cycle ocean thermal energy conversion systems. The objectives of the Advanced Component Research Facility include the development and evaluation of innovative concepts to improve high-temperature solar energy collection and conversion devices. The Mid-Temperature Collector Research Facility is dedicated to the investigation of a variety of research issues relating to the thermal performance of concentrating of solar collectors. Capability and equipment of the three facilities are described. G.R.

A81-43514 Tunneling solar cell under concentrated light illumination. A. Myszkowski, L. E. Sansores, and J. Tagüena-Martinez (Universidad Nacional Autónoma de México, Villa Obregon, Mexico). *Journal of Applied Physics*, vol. 52, June 1981, p. 4288-4296. 36 refs.

The behavior of ITO-SiO(x)-pSi tunneling solar cell (MIS type) under concentrated light illumination is analyzed theoretically. Conversion efficiency as high as 22.7 percent is predicted at 75 x AM1 illumination. At still higher light concentration the efficiency drops mainly owing to the resistance of the SiO(x) layer. The numerical calculations show the important role of the interface states in the tunneling process, electrical charge storage, and carrier recombination. Large current flowing through the diode can induce significant quasi-Fermi level drop across the insulator layer and electric charge storage in the depletion region. The operation of the diode cannot be explained by the standard MIS theory of low current densities. Therefore a more general treatment is presented. (Author)

A81-43518 Optimum design for window layer thickness of GaAlAs-GaAs heteroface solar cell regarding the effect of reflection loss. A. Yoshikawa and H. Kasai (Chiba University, Chiba, Japan). *Journal of Applied Physics*, vol. 52, June 1981, p. 4345-4347. 9 refs.

Optimum design for a window layer thickness of GaAlAs-GaAs heteroface solar cell has been performed regarding the effect of reflection loss. It is shown that the GaAlAs layer thickness greatly affects the reflection characteristics of the cell and that there is an optimum thickness for the GaAlAs layer. Thus the GaAlAs layer thickness must be designed so as to minimize the reflection loss as well as the absorption loss by the window. Optimum thickness for the GaAlAs layer is about 0.03 microns, and the power reflection loss for the cell with optimized double antireflection (AR) coatings is as low as 1.09% for AM0 solar radiation. (Author)

A81-43717 CdS based solar cells - Review and present status. L. C. Burton (Virginia Polytechnic Institute and State University, Blacksburg, VA). In: SOUTHEASTCON '80; Proceedings of the Region 3 Conference and Exhibit, Nashville, TN, April 13-16, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 116-118. 7 refs.

The CdS/Cu2S solar cell - the highest efficiency thin film solar cell yet reported - is reviewed. Limiting mechanisms that result in a reduction of open circuit voltage are discussed. Recent measurements made on a modified structure (CdZnS/Cu2S) are reviewed, and a modified model that can account for differences between CdS and (Cd,Zn)S based solar cells is presented. The potential and high priority research areas related to (Cd,Zn) based cells are also discussed. (Author)

A81-43718 * Second quadrant effects in silicon solar cells. R. A. Hartman, J. L. Prince, and J. W. Lathrop (Clemson University, Clemson, SC). In: SOUTHEASTCON '80; Proceedings of the Region 3 Conference and Exhibit, Nashville, TN, April 13-16, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 119-122. Research sponsored by the U.S. Department of Energy and NASA.

A simple model describing the behavior of a solar cell in the second quadrant of the I-V curve is described. In this mode of operation appreciable power is dissipated in the cell leading to thermal breakdown and the formation of hot spots. These hot spots will be stable in a current limited mode of operation. In addition a simple method is described to locate the hot spots. (Author)

A81-43719 * Direct solar-pumped lasers. J. H. Lee (Vanderbilt University, Nashville, TN), Y. J. Shiu (Hampton Institute, Hampton, VA), and W. R. Weaver (NASA, Langley Research Center, Hampton, VA). In: SOUTHEASTCON '80; Proceedings of the Region 3 Conference and Exhibit, Nashville, TN, April 13-16, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 126-131. Grants No. NCC1-8; No. NsG-1595.

The feasibility of direct solar pumping of an iodine photodissociation laser at lambda = 1.315 microns was investigated. Threshold inversion density and effect of elevated temperature (up to 670 K) on the laser output were measured. These results and the concentration of solar radiation required for the solar pumped iodine laser are discussed. (Author)

A81-43725 Solar energy and energy management microcomputer controller evolution. T. M. Murray, Jr. (Louisville, University, Louisville, KY). In: SOUTHEASTCON '80; Proceedings of the Region 3 Conference and Exhibit, Nashville, TN, April 13-16, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 289-292.

The design and development of six microprocessor-based systems for the control of energy systems including those utilizing solar energy are summarized with particular emphasis on data sensors and the interface circuitry required for communication between the sensors and the microprocessors. The initial system collects data from 14 sensors and a clock with date information in order to control the solar heating and cooling system of an 1800-sq ft building; it is based on an Intel 8080 CPU. The next system, currently under implementation, was designed to control the lighting and HVAC systems of medium-sized buildings based on the use of a Z-80 CPU. The third system was built for the control of a domestic solar water heating system and employs an Intel 8748 chip. A fourth system, a low-cost microcomputer solar energy control and monitoring system for a private home with an air solar heating system, uses an Intel 8035 chip. A further system is used to control a fractional distillation column for the one-pass production of 160-187 proof ethanol, based on a Z80 microprocessor. The final system is a portable power factor meter based on an Intel 8748 microprocessor chip. A.L.W.

A81-43800 Financial transactions between the electric utility and the solar photovoltaic system owner. Z. A. Yamayee and J. Peschon (Systems Control, Inc., Palo Alto, CA). *(Institute of Electrical and Electronics Engineers, Winter Meeting, Atlanta, GA, Feb. 1-6, 1981.) IEEE Transactions on Power Apparatus and Systems*, vol. PAS-100, Aug. 1981, p. 3950-3957; Discussion, p. 3958. 17 refs.

Residential customers with surplus solar photovoltaic (SPV) energy in excess of their load have the option of either selling that energy or storing it in batteries and consuming it later. Their choice of the option depends on the financial transaction contract between such households and the electric utility. The buy-back ratio can be used to characterize the financial transactions between the utility and the SPV owner. This paper addresses the issue of buy-back ratio and its implications. It describes how the buy-back ratio is going to affect the transaction between the SPV owner and the utility. Many components that affect the buy-back ratio are discussed from the electric utility perspective. A range of buy-back ratio is determined from the utility point of view. (Author)

A81-43809 Radiative heating and cooling with spectrally selective surfaces. C. G. Granqvist (Chalmers Tekniska Hogskola, Goteborg, Sweden). *Applied Optics*, vol. 20, Aug. 1, 1981, p. 2606-2615. 349 refs.

Ambient radiative properties are examined. For the temperatures of interest in connection with natural heating and cooling, the Planck spectrum is confined to the wavelength range from 3 to 50

micrometers. Solar radiation is limited to the range from 0.25 to 3 micrometers. A surface may, therefore, have different properties with respect to solar and thermal radiation. Attention is given to surfaces with high solar absorptance and low thermal emittance, surfaces for radiative cooling to low temperatures, transparent heat mirrors, and green leaves. An extensive list of literature references concerning the different surface types is provided. The importance of spectral selectivity for efficient photothermal conversion of solar energy was pointed out several decades ago. Recently the interest in solar energy applications had led to an active development of selective surfaces. Practical solar energy collectors use surfaces consisting of black chrome, black nickel, electrolytically colored anodic alumina, and copper oxide. G.R.

A81-44045 Transient analysis of solar air heaters using a finite difference technique. H. P. Garg, R. Chandra, and U. Rani (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research,* vol. 5, July-Sept. 1981, p. 243-252. 7 refs.

The transient heat transfer model of a solar air heater is developed and the resulting system is solved by using an explicit finite difference technique. The solar radiation data and the ambient temperature have been represented by a Fourier series in the numerical calculations. The effects of various design parameters of the heater on its performance are studied. (Author)

A81-44046 Influence of errors of trough pointing and fin alignment on the geometrical concentration ratio of focusing parabolic concentrators. S. S. Mathur, T. C. Kandpal, R. N. Singh, and A. K. Singhal (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research,* vol. 5, July-Sept. 1981, p. 277-287. 7 refs.

Geometrical behavior of a focusing parabolic trough with a fin receiver has been studied in detail keeping in view the interesting application of this system for photovoltaic conversion of solar energy through double-sided and multiple-junction edge illuminated solar cells. Results regarding the influence of the pointing errors of the trough and alignment errors of the fin on the geometrical concentration ratio of the system are presented. (Author)

A81-44149 Electrochemical solar cells with layer-type semiconductor anodes - Performance of n-MoSe2 cells. G. Razzini, M. Lazzari, L. P. Bicelli (CNR, Centro Studio Processi Elettrodici, Milan, Italy), F. Levy (Lausanne, Ecole Polytechnique Fédérale, Lausanne, Switzerland), L. de Angelis, F. Galluzzi, E. Scafè (Laboratori di Ricerche di Base, Monterotondo, Italy), L. Fornarini, and B. Scrosati (Roma, Università, Rome, Italy). *Journal of Power Sources,* vol. 6, Oct. 1981, p. 371-382. 11 refs.

Output characteristics and long-term performances of n-MoSe2 (I-, I2) electrochemical solar cells are investigated, and the role of the surface state of the semiconductor with layer-type, d-band transition metal dichalcogenide systems is established. Fill factor values of 0.6 and efficiency values of 6 percent are obtained under AM1 illumination using smooth crystal samples, with values significantly reduced using irregular crystal samples. Chemical treatments specific to the unsaturated transition metal atoms exposed to the electrolyte at edge sites are used in an attempt to control surface state effects. Finally, the stability of the MoSe2 (I-, I2) cells under long time operation is evaluated, and long-term stability was achieved, delivering a continuous output of 10 mA/sq cm without appreciable degradation. D.L.G.

A81-44150 Thermal damage in luminescent solar concentrators /LSC/ for photovoltaic systems. F. J. Meseguer Rico, F. Jaque (Consejo Superior de Investigaciones Científicas, Instituto de Física del Estado Sólido; Madrid, Universidad Autónoma, Madrid, Spain), and F. Cussó (Madrid, Universidad Autónoma, Madrid, Spain). *Journal of Power Sources,* vol. 6, Oct. 1981, p. 383-388. 8 refs. Research supported by PLEXI, S.A. and Comisión Asesora de Investigación Científica y Técnica.

The dependence of optical efficiency on temperature in luminescent solar concentrators (LSC) is studied. It is found that for temperatures in the range of 20 to 100 C the LSC experiences significant thermal degradation and a decrease in the efficiency of conversion of the solar spectrum. Damage is also found to depend on the nature of the dye, and can reach values up to 37 percent, as observed with Rhodamine B. A partial recovery of damage is obtained when LSC is cooled to room temperature range, and the origin of the damage is discussed. D.L.G.

A81-44316 The THEK program - Perspectives on development (Le programme THEK - Perspectives de développement). G. Peri (Aix-Marseille I, Université, Marseille, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique,* 1st Semester, 1981, p. 4-7. In French.

The status of work carried out within the framework of the THEK program for the development of solar thermal energy conversion units is reviewed. The first phase of the program, begun in 1975, has confirmed the theoretical feasibility of using distributed solar thermal conversion modules with operating temperature up to 320 C, instantaneous global efficiencies greater than 0.72 and daily energy efficiencies of approximately 0.70, leading to an annual heat production of 50 to 55 MWh for a 50-sq m module in the Marseille region. The second stage of the program has resulted in the construction of two experimental installations: a unit to be coupled to a thermodynamic conversion loop operating at about 275 C which is based on a thermal oil as a working fluid, and a unit for the direct production of industrial steam. The second installation uses pressurized water both at the storage medium and the heat transfer medium, with an optimum arrangement of collectors, automatic control of collector pointing and the pumping of pressurized water through the collectors and heat exchanger, and steam production by the expansion of gas in a reservoir. A.L.W.

A81-44317 Optical properties of linear parabolic concentrators of large area - Experimental results. C. Bellecci, A. Bonanno, M. Camarca, M. Conti, G. Garofalo, S. Racalbuto, and R. Visentin (Calabria, Università, Cosenza, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique,* 1st Semester, 1981, p. 8-10.

A parabolic trough solar concentrator with a 2.5-m aperture has been developed which may be used with both a thermodynamic receiver and a photovoltaic array. The present paper presents results of the measurement of the optical properties of the modular concentrator, which limit its performance in photovoltaic applications. The concentration of the collected energy in the focal zone was monitored by the use of a laser beam to illuminate sections of the trough reflecting surface at various angles of incidence and collector inclinations. A new concentration factor defined as the product of the geometric concentration factor with the cosine of the incidence angle at which the radiation strikes the photocell array was then determined for various sections of the trough as a function of trough aperture. These tests have allowed the definition of the size and shape of a prototype photovoltaic converter currently under construction. A.L.W.

A81-44318 Development and future prospect of gravity-controlled solar concentrators. C. Pontiggia, G. A. Rottigni (Genova, Università, Genoa, Italy), and C. Bellecci (Calabria, Università, Cosenza, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique,* 1st Semester, 1981, p. 11-14. 8 refs.

The theoretical development of the gravity-controlled solar concentrator is reviewed, and results of an experimental study of model concentrator characteristics are presented. The advantages and potential applications of a gravitationally deformed lamina used as the reflecting surface of a solar concentrator are discussed, and the evolution of the concept from that of a reflector surface deformed solely by the force of gravity into a catenary curve to that of a variable-density lamina with one mobile end which is tracked with solar position to produce a parabolic reflector with a constant focus is examined. Experimental measurements of the concentration factors obtained with a model concentrator composed of a 3-m long, 0.2-mm thick reflecting lamina with two mobile ends mounted on a frame are then presented as a function of the number of small chains hung from each side of the lamina for the purpose of varying laminar density with end height. The results obtained are noted to confirm the theoretical possibility of building solar concentrators with heretofore unattainably large apertures, and verify the feasibility of the use of hanging chains to vary reflector density. A.L.W.

A81-44319 **Multipass air solar collectors (Les insolateurs à air multipasses).** P. Granier and M. Daguenet (Perpignan, Université, Perpignan, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique,* 1st Semester, 1981, p. 21-25. 5 refs. In French.

Instantaneous thermal efficiencies are calculated for flat-plate solar collectors of various configurations which use air exposed to solar radiation or the solar absorber one or many times as the heat transport medium. The efficiencies of 18 potential models are obtained from numerical calculations of air flow and thermal loss distribution in the collector channels, incident solar radiation, solar radiation absorption, and the energy balance and air temperature increase following each pass through the collector. Plots of the instantaneous thermal efficiency as a function of inlet air temperature under standard operating conditions reveal that, if nonselective materials are used for the collector, models utilizing one or two covers with air flow only behind the solar absorber are most suitable, with only a few models with one cover and one selective surface having higher performance than the most efficient two-cover model with nonselective materials. For relatively high air inlet temperatures, a model with two covers and one selective surface having air flow only behind the absorber is also found to be superior. In the case of models with two selective covers, highest performance was obtained for models with parallel air flow in front of and behind the absorber, and flow only behind the absorber. It is noted that the use of two selective surfaces is, however, not justified at low inlet temperatures. A.L.W.

A81-44320 **A simplified non-linear model leading to full range valid calibration test of thermal solar collectors through simple experimental procedure.** G. Y. Saunier (Asian Institute of Technology, Bangkok, Thailand). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique,* 1st Semester, 1981, p. 26-34. 8 refs.

A simple, nonlinear model of the thermal characteristics of a solar collector is presented which is intended for use in the evaluation of the performances of various solar collectors at a given site based on a few simple experimental measurements. The model relies on a simplified equivalent network representing the thermal properties of the collector under various assumptions concerning the heat loss from the plate. The useful energy gain of the collector can be determined according to the model and measurements of collector performance, including the thermal loss coefficient through the back and sides of the collector, the stagnation temperature, and first- and second-order heat transfer coefficients through the front of the collector. Comparison of model predictions with those of an accurate simulation computer program for a single-glass cover flat plate thermal collector with a selective coating on the absorber and a doubly glazed flat plate collector with black paint on the absorber indicates that the model is capable of predicting accurately the performance of solar collectors working under conditions very different from those prevailing during the determination of collector intrinsic parameters. A.L.W.

A81-44321 **A study of the mirror coupling of solar photocells in concentrated sunlight (Etude sous concentration du couplage par miroir de photopiles solaires).** J.-R. Leguerre (Rabat, Faculté des Sciences, Rabat, Morocco; Laboratoire d'Automatique et de ses Applications Spatiales, Toulouse, France), A. Chave, and M. Leroy (Rabat, Faculté des Sciences, Rabat, Morocco). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique,* 1st Semester, 1981, p. 47-55. 16 refs. In French.

A study is presented of the photovoltaic characteristics of solar cells with complementary band gaps coupled by a dichroic mirror in concentrated sunlight. The photocurrents and cell efficiencies were determined based on an analytical model of photovoltaic cell operation taking into account series resistances and shading rates for the case of a p(plus)-n junction GaAs cell coupled to an n(plus)-p Ge cell. By a suitable choice of the surface recombination rates and junction depths of the materials and the inclination and cut-off wavelength of the mirror, a peak efficiency of 28.5 percent is obtained under a concentration factor of 600 and AM 1 illumination with an optimum collection grid profile. A.L.W.

A81-44333 **A low-cost efficient and durable low-temperature solar collector.** T. P. O'Donnell (Solar Materials, Inc., Altadena, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 101-107.

The considered collector utilizes a material made of ethylene-propylene-diene-monomer (EPDM). This material has been used in solar systems to heat domestic water, pools, spas, and homes by radiant energy. EPDM or ethylene propylene rubber compounds are synthetic elastomers. EPDM elastomers combine superior ozone, good heat and oxygen resistance, and very good low temperature properties to produce a compound with excellent overall age resistance. The material is extruded into 4.4 inch wide mats. Each mat has six small tubes alternating with thin webbing. The absorber mat will adhere to any clean building surface with the use of thermosetting construction-grade mastic adhesive. Carbon black contained in the mat material acts to increase the solar absorptivity. Their low cost makes the elastomers commercially very attractive. The efficiency and durability of the material are discussed. G.R.

A81-44335 * **Molybdenum-tin as a solar cell metallization system.** D. W. Boyd and C. Radics (California Institute of Technology, *Jet Propulsion Laboratory, Pasadena, CA*). *In: Material and* process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 119-124. Research sponsored by the U.S. Department of Energy and NASA.

The operations of solar cell manufacture are briefly examined. The formation of reliable, ohmic, low-loss, and low-cost metal contacts on solar cells is a critical process step in cell manufacturing. In a commonly used process, low-cost metallization is achieved by screen printing a metal powder-glass frit ink on the surface of the Si surface and the conductive metal powder. A technique utilizing a molybdenum-tin alloy for the metal contacts appears to lower the cost of materials and to reduce process complexity. The ink used in this system is formulated from MoO3 with Sn powder and a trace amount of titanium resonate. Resistive losses of the resulting contacts are low because the ink contains no frit. The MoO3 is finally melted and reduced in forming gas (N2+H2) to Mo metal. The resulting Mo is highly reactive which facilitates the Mo-Si bonding. G.R.

A81-44629 **Space manufacturing studies for SPS.** D. B. S. Smith (MIT, Cambridge, MA). In: Space - Enhancing technological leadership; Proceedings of the Twenty-seventh Annual Meeting, Boston, MA, October 20-23, 1980. San Diego, CA, American Astronautical Society; Univelt, Inc., 1981, p. 229-246. 8 refs. (AAS 80-223)

Two aspects of the production of Solar Power Satellites (SPS), i.e., manufacture of components, and assembly in space of large structures for an SPS, are reviewed. A solar cell factory design is presented by describing a reference in-space facility, which receives beneficiated raw materials from the moon, logistics and some raw materials from the earth, and energy from the sun; it produces components of one 10-gigawatt SPS per year. A cost summary of the reference system is also given. Research is conducted on underwater simulation of human assembly of large space structures in zero-g, and simulation of a truss-structure assembly is described. It is concluded that although automation is desirable for repetitive manufacturing operations and special situations, replacing personnel by machinery will not yield significant reductions in program costs. K.S.

A81-44702 **Evaluation of heat transfer enhancement in air-heating collectors.** D. L. Mattox (Northrop Services, Inc., Huntsville, AL). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 330-332.

Results of a study of means for improving the heat transfer coefficient between the solar energy absorbers and the air stream in an air-heating solar collector are outlined. Efforts undertaken in the study included the identification and evaluation of techniques for enhancing heat transfer; the development of a thermal model for the determination of the required conductance area product, the determination of the optimum flow Reynolds number ranges, the

evaluation of various fin designs, and the development of empirical heat and momentum transfer relationships for scaling the state-of-the-art high conductance fin designs. Future activities proposed would include futher theoretical analysis and and an absorber heat exchanger test program to validate fin performance and establish an optimum configuration. A.L.W.

A81-44703 Residential load profiles for photovoltaic simulation studies. J. F. Rudisill and J. W. Lathrop (Clemson University, Clemson, SC). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 333-338. 6 refs. Research supported by the U.S. Department of Energy.

In order to analyze the performance of photovoltaic (PV) systems in residential applications, it is necessary to consider the load characteristics. This paper describes a computer based model which simulates the demand of a 'typical' residential customer. Input parameters allow the model to be customized for different lifestyles and different geographical locations. Previous research has utilized hourly intervals of the time domain, based on utility averages. Since the electrical demand (and solar supply) can change instantaneously, the continuous time feature is necessary in order to accurately analyze the effect of various load management strategies. The residential load was divided into heating-ventilating-air conditioning, water heating, and diversified components. The model incorporates the interactive effects of the three components as well as temporal, meteorological, and geographic effects. (Author)

A81-44843 Substrate heating and emitter dopant effects in laser-annealed solar cells. R. T. Young, R. F. Wood, W. H. Christie, and G. E. Jellison, Jr. (Oak Ridge National Laboratory, Oak Ridge, TN). *Applied Physics Letters*, vol. 39, Aug. 15, 1981, p. 313-315. 12 refs. Contract No. W-7405-ENG-26.

Experimental evidence is presented to demonstrate that substrate heating during pulsed-laser annealing (PLA) of ion-implanted silicon can significantly improve the electrical properties of the laser-recrystallized region, due to regrowth velocity reduction. Use of the optimum PLA condition shows qualitative agreement with theoretical predictions in that (1) the open-circuit voltage and fill factor of ion-implanted, laser-annealed solar cells are improved by the increase of emitter dopant concentrations, while (2) the short-circuit current remains fairly constant. O.C.

A81-44845 Image force effects on carrier collection in a-Si:H solar cells. M.-K. Han, W. A. Anderson, R. Lahri (New York, State University, Amherst, NY), and J. Coleman (Plasma Physics Corp., Locust Valley, NY). *Applied Physics Letters*, vol. 39, Aug. 15, 1981, p. 325-327. 12 refs. Contract No. XS9-8041-9.

A modified carrier collection model is proposed to account for the falloff of short wavelength carrier collection efficiency in a-Si:H Schottky-barrier solar cells. It is argued that the potential distribution near the metal-semiconductor interface is altered by Schottky-barrier lowering due to image force effects, lowering carrier collection in solar cells of the present type by as much as 30%. Design considerations for the improvement of carrier collection efficiency are proposed. O.C.

A81-45090 Photocurrent conversion efficiency in a Schottky barrier. H. S. Jarrett (Du Pont de Nemours and Co., Central Research and Development Dept., Wilmington, DE). *Journal of Applied Physics*, vol. 52, July 1981, p. 4681-4689. 18 refs.

The diffusion equation for an illuminated Schottky barrier is solved for a finite lifetime of photoinjected minority carriers within the barrier. The general solutions are related to parabolic cylinder functions when diffusivity and mobility are constant. These solutions are subject to the usual boundary conditions that at the surface the minority carrier current is proportional to the carrier density and that at the barrier/bulk interface the carrier density and its gradient are continuous. The photoconversion efficiency for a given impurity concentration is completely defined by three parameters: the charge transfer rate at the surface, the optical absorptivity, and the carrier lifetime. These calculations are applicable to many of the oxide semiconductors used as anodes in photoelectrolysis. (Author)

A81-45092 Strains and photovoltaic response in Ta-sputtered Si metal-insulator-semiconductor solar cells. B. Lalevic, K. Murty, T. Ito, Z. H. Kalman, and S. Weissmann (Rutgers University, Piscataway, NJ). *Journal of Applied Physics*, vol. 52, July 1981, p. 4808-4817. 16 refs. NSF Grant No. DMR-78-05930.

Deformation by bending of Si or Si-SiO2 wafers is achieved by sputter deposition of tantalum films. Strains induced at Si-SiO2 interface and in Ta films are investigated using a combination of X-ray diffraction, electron diffraction, and transmission electron microscopy. Thin Ta film deposits are found to have predominantly a fcc structure, while thicker films have the normal bcc structure with certain admixture of fcc. Film strains generated by the coexistence of the polymorph structure are accommodated by formation of misfit dislocations at the film-Si substrate interface. The effect of the induced stress on the electronic parameters characterizing the Si-SiO2 interface is studied in the metal-oxide-semiconductor structure, and for the effect on photovoltaic response a metal-insulator-semiconductor solar cell configuration is used. Large changes with increasing stress are observed in the values of recombination time, capture cross section, and diffusion length and in sharply decreased conversion efficiency, fill factor, open-circuit voltage, and short-circuit current. C.R.

A81-45094 Fabrication of P/+/-N-N/+/ silicon solar cells by simultaneous diffusion of boron and phosphorus into silicon through silicon dioxide. G. C. Jain, S. N. Singh, R. K. Kotnala, and N. K. Arora (National Physical Laboratory of India, New Delhi, India). *Journal of Applied Physics*, vol. 52, July 1981, p. 4821-4824. 12 refs. Research supported by the Ministry of Industrial Development.

A process of fabricating P(+)-N-N(+) silicon solar cells by simultaneous diffusion of boron and phosphorus into N-type silicon through a thermally grown silicon dioxide layer approximately 0.1 micron thick is described. The inherent problems of cross doping and the usefulness of silicon dioxide in minimizing them are briefly discussed. It is noted that the process is well suited for large-scale production of P(+)-N-N(+) back surface field silicon solar cells. Cells fabricated through this process from single-crystalline silicon wafers of 100 ohm-cm resistivity show open-circuit voltages of approximately 0.6 V at 28 C under 100 mW/sq cm (AM1) intensity, and cells fabricated from polycrystalline silicon wafers that are 1-2 mm in grain size and have 7-27 ohm-cm resistivity show conversion efficiencies between 10.4 and 11.4% (AM1) at 28 C. C.R.

A81-45166 # The determination of the optimal radiation concentration coefficients and concentrator parameters for solar batteries with radiative heat transfer (K opredeleniiu optimal'nykh koeffitsientov kontsentratsii izlucheniia i parametrov kontsentriruiushchikh sistem dlia solnechnykh batarei s radiatsionnym teplootvodom). V. A. Grilikhes, O. F. Zaitsev, and E. M. Men'shikov. *Geliotekhnika*, no. 3, 1981, p. 19-24. 12 refs. In Russian.

A81-45439 Solar thermochemistry and chemical engineering (Thermochimie et génie chimique solaires). J. Villermaux (CNRS, Laboratoire des Sciences du Génie Chimique, Nancy, France). *Entropie*, vol. 16, no. 96, 1980, p. 24-27. In French.

In 1978, the CNRS initiated a program designed to encourage French laboratories in the development of processes for the thermochemical conversion of solar energy and chemical processes employing solar energy. The present paper summarizes the results of 20 contracts concluded within this program between 1978 and 1980. Research was conducted in the areas of the chemical transfer and storage of solar energy, by means of reversible chemical reactions, the conversion of solar energy into chemical vectors by thermal or electrochemical processes resulting in hydrogen or fuel production, materials preparation processes by solar thermal methods, and solar chemical reactor development. A.L.W.

A81-45440 Photocell technologies (Les filières de photopiles). M. Rodot (CNRS, Meudon, Hauts-de-Seine, France). *Entropie*, vol. 16, no. 96, 1980, p. 28-40. 33 refs. In French.

Currently promising technologies for the fabrication of photovoltaic solar cells are examined and compared in relation to the efficiencies and costs of the cells produced. The primary effort has been in the preparation of crystalline silicon of purity less than that

required for electronic applications for directly exposed solar cells. The processes under investigation include those leading to ingots (Czochralski, heat exchange, Bridgman, vacuum casting), ribbons (edge-defined film growth, web dendrite, ribbon-to-ribbon) and thin films deposited on inexpensive substrates (ribbon against drop, silicon on ceramic, chemical vapor deposition). Other work has involved the development of cells based on polycrystalline thin films of alternative semiconductors such as GaAs, InP and CdTe or amorphous silicon, and the reduction of solar cell requirements by the use of solar concentrators. It is noted that although these parallel developments have little chance of producing economic devices in the short term when prices as low as $1/peak Watt are expected, they have the potential to contribute to long-range energy reserves. A.L.W.

A81-45441 The optimal utilization of photovoltaic generators (Utilisation optimale de générateurs photovoltaiques). J. P. Requier, M. Barlaud, G. Chaumain, and P. Rouan (Institut Universitaire de Technologie, Dakar, Senegal). *Entropie,* vol. 16, no. 96, 1980, p. 41-47. 7 refs. In French.

Methods used to ensure optimal coupling between the output of a photovoltaic generator and the mechanical system receiving this output are discussed. Although the first approach to the problem may be to design the receiver with static characteristics adapted to those of the generator, it is pointed out that a more economical approach would be the insertion of one or two static converters to effect the adaptation. The converters may be based on the principle that the voltage allowing maximum photocell yield is constant to a first approximation, or based on the view of the generator as a dipole. The receiver can then be optimized so that the usable power is maximal at the operating point. Apparatus developed to allow the optimization of a photovoltaic generator-receiver system is presented, including a measuring system for the determination of electrical and physical parameters, and a programmable generator. The application of the methods outlined to the optimization of a photovoltaic generator coupled to a water pump by the use of a microprocessor-controlled chopper circuit is illustrated. A.L.W.

A81-45442 Heat and electricity production by distributed concentrating solar collectors (La production de chaleur et d'électricité par des collecteurs solaires distribués à concentration). J. L. Boy-Marcotte (Société Bertin et Cie., Plaisir, Yvelines, France). *Entropie,* vol. 16, no. 96, 1980, p. 66-73. In French.

Technical and economic parameters with which to establish the best compromise between price and performance in the design of distributed concentrating solar collectors to provide industrial process heat at powers on the order of 1 MW thermal and temperatures from 100 to 300 C are presented. Factors influencing the optimization of a solar thermal electricity plant comprised of collector, heat storage and thermal-electric converter subsystems are considered, including heat source temperature. Attention is then given to the costs and performances of distributed concentrating collectors developed in France, including a cylindroparabolic collector, a line-focus collector with segmented mirrors and a point-focus collector, and to the possible realizations of Rankine cycles based on heavy organic fluids for the conversion of thermal to mechanical energy. It is noted that two such organic fluid converters are to be installed on the 100 kWe distributed collector solar power plant on Corsica. A.L.W.

A81-45443 The Thémis 2500-kW solar power station (La centrale solaire Thémis 2500 kW). J. Hillairet (Electricité de France, Marseille, France). *Entropie,* vol. 16, no. 96, 1980, p. 78-84. In French.

The Thémis 2500-kW solar power station is being constructed at Targassonne in the eastern Pyrenees. A 201-heliostat field collects the solar radiation to direct it into a collector located on a 100-m-high tower. A molten-salt circuit carries the thermal energy to a storage unit, a temperature of 450 C corresponding to a sunny day. A turboalternator produces 2500 kW for 11,170 kW of collected power. B.J.

A81-45444 The Thémis heliostat field (Le champ d'héliostats de Thémis). A. Collon (Electricité de France, Marseille, France), and A. Leclerc (CETHEL, Neully-sur-Seine, Hauts-de-Seine, France). *Entropie,* vol. 16, no. 96, 1980, p. 84-94. In French.

The focusing of direct solar radiation at the Thémis solar power station in the eastern Pyrenees is accomplished by a field of 210 focusing heliostats. Each of the heliostats has a 54-sq-m surface of focusing mirrors consisting of silver-plated composite glass, assembled on a wire netting structure. A central control system with a hierarchy of three logic levels ensures open-loop tracking of the sun and heliostat safety in the case of the failure of the collector or of the heliostats themselves. The further development of heliostats is discussed in the light of experience gained with the Thémis field. B.J.

A81-45445 The Thémis solar collector (Le récepteur solaire Thémis). J. M. Gravrand (Constructions Navales et Industrielles de la Méditerranée, La Seyne-sur-Mer, Var, France) and X. Pouget-Abadie (Electricité de France, Marseille, France). *Entropie,* vol. 16, no. 96, 1980, p. 94-103. 5 refs. In French.

The design of a solar collector for a tower-type power station has to satisfy several requirements, including very high solar-flux concentration, high efficiency, and the allowance for the physical limits of the materials used. This paper describes the design and operation of the solar collector for the Thémis solar power station in the eastern Pyrenees; considerations which have led to the choice of the cavity, the fluid, and the type of circulation are examined. B.J.

A81-45446 Applications of solar heat in agriculture and industry (Les applications de la chaleur solaire dans l'agriculture et l'industrie). J. Deflandre, F. Moisan, P. Matarasso, and F. Valette (CNRS, Paris, France). *Entropie,* vol. 16, no. 96, 1980, p. 104-127. In French.

A81-45447 Chemistry and the concentration of solar radiation (Chimie et concentration du rayonnement solaire). A. Vialaron (CNRS, Laboratoire d'Energétique Solaire, Toulouse, France). *Entropie,* vol. 17, no. 97, 1981, p. 134 138. 10 refs. In French.

Thermodynamic and technological parameters influencing the efficiency of concentrating solar thermal energy conversion are considered. Expressions for the theoretical thermal, thermodynamic, heat pump and energy efficiencies of the absorption of solar radiation by a black body are presented in terms of the operating temperatures, and it is pointed out that the elevation of the operating temperature of solar collectors results in greater collector efficiency. The designs of concentrating collectors intended to achieve a higher operating temperature are indicated. Consideration is then given to the design of a reactor capable of absorbing such concentrated solar fluxes, and the principal criteria of heat transfer at the interface between the incident flux and the material to be heated and of the reactor specific energy productivity are indicated. The economics of concentrating solar collector technology is finally discussed in terms of the internal profitability rate of the investment. A.L.W.

A81-45448 Thermodynamic power stations at low temperatures (Centrales thermodynamiques à basse température). J. Malherbe (Société Française d'Etudes Thermiques et d'Energie Solaire, Montargis, Loiret, France), R. Ployart, T. Alleau, P. Bandelier, and F. Lauro (Commissariat à l'Energie Atomique, Paris, France). *Entropie,* vol. 17, no. 97, 1981, p. 161-168. In French.

The development of low-temperature thermodynamic power stations using solar energy is considered, with special attention given to the choice of the thermodynamic cycle (Rankine), working fluids (frigorific halogen compounds), and heat exchangers. Thermomechanical conversion machines, such as ac motors and rotating volumetric motors are discussed. A system is recommended for the use of solar energy for irrigation and pumping in remote areas. Other applications include the production of cold of fresh water from brackish waters, and energy recovery from hot springs. K.S.

A81-45516 Optimal control of solar energy collection in Solar House II at Colorado State University. R. C. Winn and C. B. Winn (Colorado State University, Fort Collins, CO). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 2 p. (WA10-F). Contract No. EG77-S-02-4159.

An optimal controller of the second kind is one which

maximizes the difference between the useful energy collected by a solar heating system and the associated pumping costs. This paper describes a method of implementing the optimal control strategy on a microprocessor based controller. The optimal controller built for Solar House II at Colorado State University, which has an air solar heating system, is described. Significant increases in the difference between energy collected and fan energy used were realized using optimal control. These increases were the greatest on the least sunny days. (Author)

A81-45526 Field experience with solar concentrating collector control systems. H. J. Gerwin (Sandia Laboratories, Albuquerque, NM). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1.
New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 4 p. (WP3-A). Research supported by the U.S. Department of Energy.

Solar-concentrating collectors are tested and evaluated for performance of sun tracker system sensors, fluid control, and safety functions. Sun tracker system sensors which are tested include shadow-band, linear-concentrated flux, computer-driven (ephemeris), optical balance, and linear-flux integration. Safety circuits are tested to operate on signals such as over-temperature, insufficient fluid flow, and over-travel. Results are compared on the basis of field-test conditions, and component failures and corrective actions are discussed. The cost of a computer is found to be a disadvantage, although as sun tracking, fluid control and safety functions are integrated into a single unit, a central computer could amortize the cost over all the functions. D.L.G.

A81-45527 Analytical modeling of line focus solar collectors. J. D. Wright (Solar Energy Research Institute, Golden, CO). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 6 p. (WP3-C).

Solar thermal electric power generation systems and industrial process heat systems generating steam through flash vaporization require a constant outlet temperature from the collector field. This constant temperature is most efficiently maintained by adjusting the circulating fluid flow rate. Successful design of analog controllers for this regulation requires knowledge of system dynamics and the nonlinear nature of the system parameters. Simplified models relating deviations in outlet temperature to changes in inlet temperature, insolation, and fluid flow rate illustrate the basic responses and the distributed-parameter nature of line focus collectors. Detailed models are used to develop transfer functions and frequency response curves useful for design. (Author)

A81-45528 Fluid temperature control for parabolic trough solar collectors. R. Schindwolf (Sandia Laboratories, Albuquerque, NM). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1.
New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 9 p. (WP3-D). 7 refs.

Techniques for controlling the temperature of the heat-transfer fluid in parabolic-trough solar-collector fields were studied by computer simulation. In particular, the rather stringent 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 closed-loop control-system simulation. 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; time responses to startup transients and to partial and full collector cloud-shadowing transients were obtained. The results indicated that the temperature-control requirements can be satisfied using readily available components. (Author)

A81-45586 A microcomputer based control system for solar parabolic collectors. G. Cammarata, A. Faro, G. Messina, and O. Mirabella (Catania, Università, Catania, Italy). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 6 p. (FP8-F). 6 refs.

A81-45587 Parameter estimation in solar systems by the method of least squares. D. Pryor, P. Burns, and C. B. Winn (Colorado State University, Fort Collins, CO). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 5 p. (FP8-H).

It is shown that the least squares method is able to compete with the Kalman filter method in all areas of solar systems parameter determination except convergence rate. The least squares method is, however, easier to implement than the Kalman filter method in that no initialization is called for and no statistical properties of the system inputs need be known beforehand. A possible drawback is that the method is not able to filter data; it is seen by inspection of the least squares equations that all data points are weighed equally in the determination of the solution. O.C.

A81-45598 Response of Schottky barrier solar cells at higher temperatures. S. Srivastava, N. K. Swami, and G. P. Srivastava (Birla Institute of Technology and Science, Pilani, India). *Journal of Physics D - Applied Physics*, vol. 14, Aug. 14, 1981, p. 1495-1503. 20 refs.

In the present work, the responses of Cu/Cr-p-type silicon and Au-n-type silicon Schottky barrier solar cells at higher temperatures have been studied. The variations of different factors, such as intrinsic carrier density, energy gap, absorption coefficient, barrier height, effective number of photons etc, have been taken into account. The results show that in the temperature range 300-450 K, except for the short-circuit current, all other factors (e.g., open-circuit voltage, fill factor and conversion efficiency) decrease with increase in temperature. (Author)

A81-46210 Interfacial phenomena in solar materials. L. E. Murr (Oregon Graduate Center, Beaverton, OR). *Solar Energy Materials*, vol. 5, June-July 1981, p. 1-19. 19 refs. Contract No. DE-FG04-79AL-10887.

This paper provides a short review of the fundamental features of the general classes of interfaces and interfacial thermodynamics. The energetics and structures of interfaces are reviewed in the context of applications of current understanding of interfacial phenomena to specific materials in several solar technologies. Overviews are presented for interfacial energetics, compositional and chemical analysis of interfaces, and the structure of interfaces and representative illustrations are provided. Numerous examples of interfacial phenomena pertinent to solar materials interface problems are included, and solar materials interface problems are discussed and summarized in a general way. Problems or concerns are tabulated for interfaces in specific solar systems or components, e.g., reflectors, polymers, absorbers, collectors, PV cells, storage systems and heat transfer materials. (Author)

A81-46211 Efficiency of Ge solar cells designed for Ge-GaAs bicolor systems. B. Sautreuil and A. Laugier (Lyon, Institut National des Sciences Appliquées, Villeurbanne, Rhône, France). *Solar Energy Materials*, vol. 5, June-July 1981, p. 21-36. 16 refs. Research supported by the Commissariat à l'Energie Solaire and Centre National de la Recherche Scientifique.

This paper presents the results of a detailed theoretical analysis of Ge solar cells designed for the two-cell Ge-GaAs system. Spectrum splitting and tandem stacked concepts are considered. The maximum intrinsic limit efficiency for the two concepts are 38 and 33 percent, respectively (300 K, 300 AM 1.5 suns). The analysis of the Ge cell, taking into account published data of minority carrier lifetimes versus doping level is made as a function of temperature, solar concentration ratio, series resistance and air mass number. The intrinsic parameters of the device, xj (junction depth) and surface recombination velocity are not critical if xj is less than 1 micron. Efficiencies of 13.5 percent for the Ge solar cell and 5.8 percent for the Ge cell with solar spectrum limited to 1.4 eV are obtained at 300 K 300 AM 1.5 suns. With the state-of-art GaAs solar cell, a realistic efficiency of 30 percent can be obtained for the two-cell system. V.L.

A81-46212 **Materials issues in solar thermal energy systems.** R. W. Mar and J. C. Swearengen (Sandia Laboratories, Livermore, CA). *Solar Energy Materials,* vol. 5, June-July 1981, p. 37-53. 28 refs.

The solar central receiver concept for the production of electrical energy or industrial process heat has been the subject of recent system and conceptual design studies. This paper explores the materials issues likely to be associated with the development of this technology. The scope of this paper is limited to concepts using nitrate salts as the heat transfer and energy storage media. Heliostat, fluid and containment materials are discussed with regard to system requirements, candidate materials, performance under simulated and field test experiments, and areas of future research. The emphasis is on materials which are the leading candidates for use in near-term systems. (Author)

A81-46213 **Physical background of spectral selectivity.** M. Sikkens (Groningen, Rijksuniversiteit, Groningen, Netherlands). *Solar Energy Materials,* vol. 5, June-July 1981, p. 55-70. 13 refs.

A discussion of the restraints imposed by fundamental physical relations on the performance of spectrally selective solar energy materials is presented. It is shown, that three different classes of selective materials can be distinguished. The limitations to the performance of each of these 'ideal' classes are indicated. Some examples of physical mechanisms leading to spectral selectivity are discussed. (Author)

A81-46215 ***Phototransport parameters in InP single crystals.*** L. Gouskov, C. Llinares, A. Brenac, and M. Savelli (Montpellier II, Université, Montpellier, France). *Solar Energy Materials,* vol. 5, June-July 1981, p. 81-94. 17 refs.

A determination of diffusion length (L) and surface recombination carrier velocity (s) is presented for single crystals of n- and p-type InP using electron-beam induced current profile and photoconductivity spectra measurements. The s parameter is evaluated for various chemical etches and crystalline orientations. A low s value is observed in n-type InP and this significant result confirms that InP is a good candidate for solar cells. V.L.

A81-46217 **Electrochemical solar cells with layer-type semiconductor anodes - Performance of n-MoS2 cells.** L. Fornarini, F. Stirpe, B. Scrosati (Roma, Università, Rome, Italy), and G. Razzini (Milano, Politecnico, Milan, Italy). *Solar Energy Materials,* vol. 5, June-July 1981, p. 107-114. 11 refs. Research supported by the Università di Roma.

A81-46333 **Calorimetric determinations of bond conductances in pipe and fin type flat-plate solar collectors.** H. P. Garg and U. Rani (Indian Institute of Technology, New Delhi, India). *Applied Energy,* vol. 9, Sept. 1981, p. 77-82. 8 refs.

A81-46387 **Phthalocyanine organic solar cells - Indium/x-metal free phthalocyanine Schottky barriers.** R. O. Loutfy, J. H. Sharp, C. K. Hsiao, and R. Ho (Xerox Research Centre of Canada, Mississauga, Ontario, Canada). *Journal of Applied Physics,* vol. 52, Aug. 1981, p. 5218-5230. 27 refs. Research supported by the National Research Council of Canada.

Operation characteristics of NESA/x-metal free phthalocyanine/indium photovoltaic devices are described, and a film of polycrystalline particles of x-metal free phthalocyanine (x-H2Pc) are shown to exhibit strong photovoltaic effects when sandwiched between tin oxide and indium electrodes. The active region responsible for electric power generation is confined to the metal/semiconductor interface. A Schottky barrier built-in potential of 0.63 V is estimated from C-V measurements, and at a peak solar power of 135 mW/sq cm, a power conversion efficiency of 1.2 percent is obtained. The effects of pigment loading, cell thickness, light intensity, binder material, dye sensitization and the nature of barrier electrodes are also studied. The devices exhibit open-circuit voltages of 0.45 V, and the concept is considered a viable approach to constructing simple, economical photovoltaic devices which are significantly more efficient than evaporated film, although engineering efficiency is low due to low transmission of light through the indium barrier electrode. D.L.G.

A81-46388 **The superposition principle for semiconductor-electrolyte junction solar cells.** F. El Guibaly and K. Colbow (Simon Fraser University, Vancouver, Canada). *Journal of Applied Physics,* vol. 52, Aug. 1981, p. 5247-5249. 9 refs.

The superposition principle of currents in a solar cell states that the current in an illuminated device subject to a forward bias voltage (V) is given by the algebraic sum of the short circuit photocurrent and the current (J) flowing at bias V in the dark. A mathematical analysis is given of this principle as applied to semiconductor-electrolyte solar cells. The surface transfer velocity and the density of photoexcitable surface states are shown to be important in determining the validity of the principle and the J-V characteristics of the device. Little error results when applying the principle to cells with long minority carrier diffusion length and passivated or low density of surface states; and results are applicable to Schottky-barrier solar cells. D.L.G.

A81-46391 **On the carrier collection efficiency of amorphous silicon hydride Schottky barrier solar cells - Effects of recombination.** D. Gutkowicz-Krusin (Exxon Research and Engineering Co., Theoretical Sciences Group, Linden, NJ). *Journal of Applied Physics,* vol. 52, Aug. 1981, p. 5370-5376. 9 refs.

Solutions for the photogenerated carrier densities and the carrier collection efficiency are found for amorphous silicon hydride, alpha-SiH(x), Schottky barrier solar cells. The dependence of the collection efficiency on the nature of the contacts and on four characteristic length scales is determined. Strong dependencies of collection efficiency on the width of the depletion region at very short wavelengths and on the hole diffusion length at long wavelengths suggests that the theory can be used to determine these parameters from measurements of collection efficiency in solar cells. For thin films, the agreement between calculated and measured collection efficiency is excellent, and the theory can be used to obtain quantitative information about hole diffusion length, and consequently the hole lifetime if the diffusion coefficient is known. D.L.G.

A81-46457 **Small Solar Power Systems /SSPS/.** W. Grasse (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Cologne, West Germany). *Sunworld,* vol. 5, May 1981, p. 68-72.

A detailed description is given of the project organization, hardware, and projected performance of the distributed collector and central receiver solar thermal research facilities comprising the Small Power Systems (SSPS) plants in Almeria, Spain. The Distributed Collector System (DCS) is rated at 500 kWe and employs two fields of line-focusing parabolic trough collectors. The Central Receiver System (CRS) has the same rating and uses liquid sodium as a heat-transfer medium to circulate the 530 C heat yielded by a concentration factor of 450 from 4000 sq m of reflective surface. The purpose of the plant's dual configuration is the comparison of the two concentration methods under identical environmental conditions and the responsibility of a single operator/evaluator. O.C.

A81-46458 * **Parabolic dish collectors - A solar option.** V. C. Truscello (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Sunworld,* vol. 5, May 1981, p. 80-86. Research supported by the U.S. Department of Energy and NASA.

A description is given of several parabolic-dish high temperature solar thermal systems currently undergoing performance trials. A single parabolic dish has the potential for generating 20 to 30 kW of electricity with fluid temperatures from 300 to 1650 C. Each dish is a complete power-producing unit, and may function either independently or as part of a group of linked modules. The two dish designs under consideration are of 11 and 12 meter diameters, yielding receiver operating temperatures of 925 and 815 C, respectively. The receiver designs described include (1) an organic working fluid (toluene) Rankine cycle engine; (2) a Brayton open cycle unit incorporating a hybrid combustion chamber and nozzle and a shaft-coupled permanent magnet alternator; and (3) a modified Stirling cycle device originally designed for automotive use. Also considered are thermal buffer energy storage and thermochemical transport and storage. O.C.

A81-46459 * **Parabolic dish systems at work - Applying the concepts.** A. T. Marriott (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Sunworld,* vol. 5, May 1981,

p. 86-89. Research supported by the U.S. Department of Energy and NASA.

An overview is given of parabolic dish solar concentrator application experiments being conducted by the U.S. Department of Energy. The 'engineering experiments' comprise the testing of (1) a small-community powerplant system, in conjunction with a grid-connected utility; (2) stand-alone applications at remote sites such as military installations, radar stations and villages; and (3) dish modules that can deliver heat for direct use in industrial processes. Applicability projections are based on a dish and receiver that use a Brayton engine with an engine/generator efficiency of 25% and a production level of up to 25,000 units per year. Analyses indicate that parabolic-dish power systems can potentially replace small, oil-fired power plants in all regions of the U.S. between 1985 and 1991. O.C.

A81-46469 New heat transfer factors for flat plate solar collectors. P. J. Lunde (Center for the Environment and Man, Inc., Hartford, CT). *Solar Energy,* vol. 27, no. 2, 1981, p. 109-113. 5 refs.

It is shown that, for flat plate collectors operating in economically viable applications, three equations presented give suitable heat transfer factors for collector efficiency equations based on inlet, mean, and outlet fluid temperatures, respectively. The equations can be solved explicitly for any variable and do not become indeterminate as the flow approaches infinity. In addition, simple equations can be derived with which to convert any efficiency curve to one based on an alternate fluid temperature if (1) the flow rate is known, and (2) curves based on a particular fluid and flow rate can be adjusted to another flow rate without additional information. When a new heat transfer fluid is used, the heat transfer coefficient changes and the new heat transfer factor can be derived from the known transmissivity-absorptivity product and absorber plate fin efficiency. O.C.

A81-46470 Heat degradation studies of solar heat transfer fluids. T. R. Henderson, C. R. Clark, T. C. Marshall, R. L. Hanson, and C. H. Hobbs (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM). *Solar Energy,* vol. 27, no. 2, 1981, p. 121-128. 15 refs. Contract No. EY-76-C-04-1013.

A81-46471 Convex Fresnel lens with large grooves. E. M. Kritchman, A. A. Friesem, and G. Yekutieli (Weizman Institute of Science, Rehovot, Israel). *Solar Energy,* vol. 27, no. 2, 1981, p. 129-137. 29 refs.

Methods for the design of 'almost ideal' convex Fresnel lenses were extended to include lenses having grooves of finite size; where the choice of the groove size determines the best design. Emphasis is put on the case where a two-axis tracking solar system is represented. One of the resulting designs was found to yield a concentration factor of 34 almost independently of groove size, and to produce the highest concentration of all designs considered when the groove width/focal length ratio was equal to or greater than 0.023. The use of such relatively large grooves reduces the amount of radiation lost in blunt edges and from the diffraction of individual grooves. O.C.

A81-46502 Terrestrial solar energy systems - Test and evaluation. A. R. Lunde (Boeing Co., Seattle, WA). In: Life cycle problems and environmental technology; Proceedings of the Twenty-sixth Annual Technical Meeting, Philadelphia, PA, May 12-14, 1980. Mt. Prospect, IL, Institute of Environmental Sciences, 1980, p. 397-400.

The paper discusses various thermal-performance test and evaluation methods that are applied to solar collectors, such as flat-plate collectors, trough concentrators, parabolic concentrators, and central power-tower receivers. An indoor test facility for determining the thermal performance of solar collectors is described, along with the methods used to determine thermal performance and collection efficiency. The use of thermal models to evaluate materials, conceptual design, heat loss, and thermal efficiency is reviewed. The laser ray trace used to determine the surface contour accuracy of dish and trough concentrators is examined, and the facility's data acquisition system is outlined. F.G.M.

A81-46515 # Review, evaluation, and improvement of direct irradiance models. R. E. Bird and R. L. Hulstrom (Solar Energy Research Institute, Golden, CO). *ASME, Transactions, Journal of Solar Energy Engineering,* vol. 103, Aug. 1981, p. 182-192. 50 refs.

A study was performed to: (1) define the relative significance of the various atmospheric constituents to the depletion of the direct solar beam irradiance; (2) compare and evaluate several simple models versus a complex SOLTRAN-model; and (3) develop an improved, easy to use model. The results indicate that for a reasonable range of atmospheric conditions the broadband direct beam energy is attenuated by atmospheric constituents in the following order: aerosols attenuate the most; molecular scattering is next in importance; and water vapor absorption is third. Attenuation by O3, O2, and CO2 is minor. The total irradiance from various models agree to within + or - 10 percent at small zenith angles, but diverge significantly at large zenith angles. (Author)

A81-46516 # The effect of receiver optical properties on solar thermal electric systems. P. J. Call, G. J. Jorgensen, and J. R. Pitts (Solar Energy Research Institute, Boulder, CO). *ASME, Transactions, Journal of Solar Energy Engineering,* vol. 103, Aug. 1981, p. 207-212. 18 refs. Contract No. EG-77-C-01-4042.

The importance of reducing the thermal emittance of the receiver surface on the cost effective operation of intermediate and high temperature (not less than 400 C) solar thermal electric power plants is discussed. Computer codes for seven systems (point and line focus) are used to independently determine optimum operating conditions for selective (low emittance) and nonselective receiver surfaces. The detailed computer calculations show excellent agreement with numbers generated from a simplified analytical model indicating that system dynamics are a secondary effect in this sensitivity analysis. This study reveals that improvements in system cost effectiveness of 5 to 10 percent for desert environments can be produced by reducing receiver emittance from 0.95 to 0.3. The system operating temperature is determined not to be a critical parameter and little effect is observed on the system capacity factor. (Author)

A81-46518 # The interrelation between recurrent and capital costs in a solar thermal process heat system. L. L. Lukens and W. P. Schimmel, Jr. (Sandia Laboratories, Albuquerque, NM). *ASME, Transactions, Journal of Solar Energy Engineering,* vol. 103, Aug. 1981, p. 241-243. 5 refs. Research supported by the U.S. Department of Energy.

The effect of operation and maintenance (O & M) costs on energy produced by solar collector systems is crucial to the market penetration of solar process heat as an alternative energy source. In the present paper, a particular O & M operation, regular collector cleaning, is considered in order to determine its effect upon annualized life cycle energy cost. A first-order model of mirror reflectance degradation as a function of time is constructed from experimental data. This is used as input to a systems optimization model of a line-focus solar collector process heat installation. The energy cost variation is considered as a function of cleaning cost per unit of collector aperture and cleaning interval. Results are presented for a process heat temperature of 177 C. (Author)

A81-46519 # Analytical dynamic modeling of line-focus solar collectors. J. D. Wright (Solar Energy Research Institute, Golden, CO). *ASME, Transactions, Journal of Solar Energy Engineering,* vol. 103, Aug. 1981, p. 244-250. 8 refs.

Solar thermal electric power and industrial process heat systems may require a constant outlet temperature from the collector field. This constant temperature is most efficiently maintained by adjusting the circulating fluid flow rate. Successful tuning of analog or digital controllers requires a knowledge of system dynamics. Models relating deviations in outlet temperature to changes in inlet temperature, insolation, and fluid flow rate illustrate the basic responses and the distributed-parameter nature of line-focus collectors. When plotted in dimensionless form, the frequency response of a given collector is essentially independent of the operating conditions, suggesting that feedback controlled settings are directly related to such easily determined quantities as collector gain and fluid residence time. (Author)

A81-46520 # Theoretical and experimental study of an air solar collector with an evacuated tube cover. R. Alben and K. Hardcastle (General Electric Co., Schenectady, NY). *ASME, Trans-*

actions, Journal of Solar Energy Engineering, vol. 103, Aug. 1981, p. 251-257. 11 refs.

Theoretical calculations and experimental data on an evacuated tube solar collector with an air heat transfer medium are presented. The collector is a conventional flat plate design except that the front cover, instead of being made up of one or two sheets of flat glass, consists of a raft-like arrangement of evacuated glass tubes. The calculations indicate that an evacuated tube cover, together with a high heat transfer absorber, could give a solar collector with superior thermal performance. Experimental measurements are given for an air collector using uncoated evacuated tubes and a screen absorber. Results on internal temperatures are used to infer the effectiveness of the heat transfer between the absorber screen and the air flow. When account is taken of the measured absorber properties, the performance of the evacuated tube cover is in reasonable accord with the theory. (Author)

A81-46521 # Simulation of thermal performance of solar collector arrays. A. H. Fanney (National Bureau of Standards, Active Solar Systems Group, Washington, DC) and W. C. Thomas (Virginia Polytechnic Institute and State University, Blacksburg, VA). *(American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/SOL-1.) ASME, Transactions, Journal of Solar Energy Engineering,* vol. 103, Aug. 1981, p. 258-267. 13 refs. Research sponsored by the U.S. Department of Energy.

A method is described for simulating the thermal performance of solar collectors by using an in-line heat source to simulate absorbed solar energy and a nonirradiated array to simulate heat losses, during tests of solar water heating systems. The mathematical relationships needed to operate an electric heat source in series with a nonirradiated array are developed, and consideration is given to the location of the heat source and arrays with collectors connected in parallel and series combinations. An analysis is presented of the effects on thermal performance of the mixed indoor-outdoor collector test procedures. Analytical and experimental results are presented which show that the net power output from a nonirradiated collector array in series with an electric heat source is in good agreement with that from an irradiated array. Location of the heat source downstream from the nonirradiated array results in closer agreement with the irradiated array thermal output as compared to locating the heat source upstream from the nonirradiated collector array. Results of tests of a domestic solar hot water system are consistent with the theoretical results. K.S.

A81-46522 # The role of rear insulation in the performance of flat plate solar collectors. S. Satcunanathan and P. Gandhidasan (University of the West Indies, St. Augustine, Trinidad and Tobago). *ASME, Transactions, Journal of Solar Energy Engineering,* vol. 103, Aug. 1981, p. 282-284. 6 refs.

A81-47226 International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports (Internationales Sonnenforum, 3rd, Hamburg, West Germany, June 24-27, 1980, Tagungsberichte). Edited by H. Selzer (Deutsche Gesellschaft für Sonnenenergie, Bremen, West Germany). Munich, DGS-Sonnenenergie Verlags GmbH, 1980. 953 p. $39.50. In German and English.

Solar power systems are considered along with aspects of hydrogen technology, solar technology in sunny countries, wind energy, solar architecture, solar buildings, passive systems, the storage of energy, collector tests, legal aspects for solar systems, solar radiation, heat pump technology, and solar cooling. Attention is given to the practical use of solar technology, the layout of heliostat fields for solar thermal power stations, a comparison of solar tower plants with different cooling media, a 1-10 KWe solar power plant with modular cylindrical-parabolic concentrators, experience related to testing and operating concentrating collectors in small solar power plants, and economical aspects for large wind converters. Other subjects discussed are related to the construction and function of energy roofs, the efficiency of house heating in different climatic regions, principles of operation and design of energy-collecting roof systems, and an evaluation of Powersat. Other topics examined include hydrogen in large-scale solar energy utilization, the status and near term development goals of a hydrogen economy, and the storage of hydrogen by adsorption. G.R.

A81-47227 Eurelios - The 1 MW/el/ solar thermal power plant of the EEC (Eurelios - Das MW/el/ Sonnenkraftwerk der Europäischen Gemeinschaft). W. Palz, A. Strub, J. Gretz (Commission of the European Communities, Brussels, Belgium), H. Treiber, and J. Hofmann (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 3-20. 16 refs. In German.

Eurelios, the 1 MW(el) solar thermal power plant of the EEC, is a power tower plant. Its construction in Sicily is sponsored by the Federal Republic of Germany, France, and Italy. The employed technical concept involves the use of a water-cooled Francia-type cavity receiver and a heliostat field north of the tower. The heliostat field uses two types of heliostats. The energy produced by Eurelios will be delivered to the local grid. Attention is given to aspects of project organization and development, system requirements, system characteristics, energy balance data, details of heliostat design, aspects of receiver and tower construction, the thermal cycle, the thermal storage system, and the electrical system. G.R.

A81-47228 On-site versus centralized solar-electric systems (Solarelektrische Einzel- und Zentralsysteme im Vergleich). W. H. Thompson (San Diego State University, San Diego, CA). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 21-27. 9 refs.

Questions regarding solar energy in California are considered, taking into account the subsidy of solar installations by the State or the Federal government, and issues regarding the centralization or decentralization of solar systems. A centralized system would require a concentration of solar flux, while decentralization would permit the employment of low-priced photovoltaic panels, used without a concentrator, almost everywhere. The only other equipment besides a photovoltaic cell array the household would need would be some diodes to prevent the reversal of current, a voltage regulator, and a bank of batteries. If in the absence of an emergence of a more economical battery, lead-acid batteries had to be used, they would cost more than the solar cells. An alternative to using a large battery system is for the homeowner to become a seller of net energy to the power company. Attention is also given to the Space Satellite, the power tower, and the ocean thermal energy conversion unit. G.R.

A81-47229 The DCS solar power plant within IEA's SSPS project - Aspects of the final system layout and component selection (Das DCS-Sonnenkraftwerk in SSPS-Projekt der IEA - Gesichtspunkte der endgültigen Systemauslegung und der Komponentenwahl). A. C. Kalt (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Cologne, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 28-39. In German.

The SSPS project, which is financed by nine countries, has the objective to design, construct, and operate two solar power stations. The power stations will be located near Almeria in southern Spain. One of the two power stations utilizes the solar-tower principle, while the other represents a distributed collector system (DCS). In the DCS, the radiation energy is collected and transformed into heat with the aid of two collector fields, which operate in parallel. The heat is stored in a suitable medium. The heated medium can be stored in a tank. It is used to produce steam for the operation of a steam turbine, which is used to derive a three-phase generator. Attention is given to technical data, design criteria, the storage system, questions of collector selection, and the energy transformation system. G.R.

A81-47230 The layout of heliostat fields for solar thermal power stations (Die Auslegung von Heliostatfeldern für solarthermische Kraftwerke). V. Hartung, W. Mayer, and C. Kindermann (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 40-49. 5 refs. In German.

Solar thermal power stations which can provide power of 1 MW(el) and more can be optimally designed by making use of collectors based on the tower concept (heliostat). The description of

a heliostat field requires the use of a large number of parameters and a consideration of complex functional relations regarding these parameters. A system of computer programs has been developed for conducting the required calculations. The theoretical principles for the design of heliostat fields are presented and aspects of numerical processing are discussed. A description is given of two examples involving heliostat fields, taking into account Eurelios, a solar power station being built in Sicily and a power station which is currently in the planning and development stage. G.R.

A82-47231 Comparison of solar tower plants with different cooling media (Vergleich von Solar-Turm-Kraftwerken mit unterschiedlichen Kühlmedien). F. Boese, U. Leuchs, W. Meinecke, and D. Stahl (INTERATOM, Internationale Atomreaktorbau GmbH, Bergisch Gladbach, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 50-57. In German.

The characteristics of solar tower power stations are examined, taking into account the effect of these characteristics on the selection of the cooling medium. In connection with the high investment costs, a high efficiency regarding the entire system is more important than in the case of conventional power stations. An increase in the receiver costs of 5 percent can be quite acceptable, if it is accomplished by an enhancement of the system efficiency amounting to 5 percent. An optimum efficiency is obtained by minimizing the energy losses of the power station. Factors determining the selection of the cooling medium are related to conflicting objectives to obtain a high system efficiency on one side, and a long service life and a high level of availability for the receiver on the other. Cooling media considered in the comparison include sodium, gas, and water. G.R.

A81-47232 1-10 kWe solar power plant with modular cylindrical-parabolic concentrators of 100 sq m, oriented E-W. S. Petrescu, A. Danescu, and S. Bucurenciu (Bucuresti, Institutul Politehnic, Bucharest, Rumania). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 58-67. 16 refs.

A number of investigations have been conducted regarding the feasibility to design a solar power plant which employs cylindrical-parabolic concentrators. The subjects studied in the investigations are briefly considered and a description is presented of the current stage of development of such a plant. Attention is given to the solutions selected for the solar power plant to be implemented, taking into account the solar radiation collection system, the working fluid, the storage system, the thermal engine, the electric generator, and auxiliary services. The determination of the collection area, mounting system, and orientation system of the collectors is considered along with the sun-tracking system. It is found that the utilization of modular cylindrical-parabolic concentrators rotating about an E-W axis, flat receivers of concentrated radiation, and water as a working fluid leads to the best performance. G.R.

A81-47233 Experience related to testing and operating concentrating collectors in small solar power plants (Erfahrungen beim Test und Betrieb von konzentrierenden Kollektoren in Sonnenkleinkraftwerken). R. Köhne (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 68-77. 6 refs. In German.

Small-scale solar power stations with a power output in the range from ten to a few hundred KW are of particular interest for countries with a high level of insolation, particularly in the case of developing countries. The stations can provide electric power and process heat. A description is presented of four installations of the considered type. A heat-transfer fluid, such as water or oil, is heated in solar collectors to temperatures in the range from 150 to 290 C. The fluid is stored in a tank or pumped directly into a heat exchanger where the medium used for the operation of the heat engine is evaporated. This medium can be water or Freon. All four power stations use cylindrical-parabolic concentrators. Attention is given to the obtained levels of collector efficiency and the operational disturbances experienced. It was found that most failures occurred with conventional systems. However, there were also problems with collectors, which are mainly related to the entrance of dust. G.R.

A81-47234 Development and construction of ultra-light solar power stations (Entwicklung und Bau superleichter Sonnenkraftwerke). J. Kleinwächter and H. Kleinwächter (BOMIN-Solar GmbH, Lörrach, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 78-93. 9 refs. In German.

The concept of a solar power station of a novel type is compared with the concept of the conventional solar tower. The new concept makes use of large aerostatically deformed concentrators of very light weight. The concentrators, which consist of plastic films, are protected by being kept under transparent domes. The new approach makes it possible to improve important system parameter values compared to the values for the conventional design. These parameters include power-weight ratio and the required land-surface area. In addition, the severity of weather-related problems is significantly reduced. G.R.

A81-47239 Solar farm stations for industrial process heat (Solar-Farm-Anlagen für industrielle Prozesswärme). U. Wiedman and G. Isenberg (M.A.N. - Neue Technologie, Munich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 232-242. In German.

The most obvious application for solar farms is the generation of heat, which can be offered at maximum efficiency rates of 50-60 percent in the temperature range from 150 to 300 C. In connection with efficiency considerations, concentrating collector systems must be employed for the envisaged applications. For process heat supplied at temperatures above 150 C, the solar farm stations can only be used in regions with a yearly solar radiation energy per unit area of more than 1300 KWh/sq m a. A description is presented of the design and performance range of solar farms employing the concentrating collector module Helioman. The market potential of the technology is discussed, taking into account a study regarding the process-heat requirements of prospective consumers as well as questions regarding the anticipated economic feasibility. G.R.

A81-47241 The modular evacuable nonimaging concentrating-collector concept (Modulares, evakuierbares, nicht abbildendes Konzentrator-Kollektorkonzept). T. Nordmann, Ch. Gloor, and H. U. Bogatzki (ELCO, Ltd., Vilters, Switzerland). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 253-262. 6 refs. In German.

The design and implementation of the modular evacuable nonimaging concentrating-collector are described. This concept features: (1) glass as the material of the collector body, assuring maximum life expectancy; (2) modular glass elements that allow the optimal adjustment to structural features due to individual collector size; (3) elements that are individually tilted towards the path of the sun; (4) low manufacturing cost due to existing production facilities in the glass and metal industries; and (5) good potential for development as a special insulating gas collector, low pressure collector, and hybrid thermal-electric collector. B.J.

A81-47245 Solar energy in Brazil (Sonnenenergie in Brasilien). P. Gräff. In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 354-361. In German.

In response to economic difficulties related to the high prices for oil, the Brazilian government has sponsored a program, which has the objective to use in 1985 alcohol for 20 percent of the fuel needed for the operation of automobiles. The program also demonstrates the magnitude of the solar potential of Brazil. Various possibilities of solar utilization are discussed. Collectors of solar energy are considered, taking into account aspects of storage, the use of solar energy for drying applications in agriculture, the replacement of fans by solar collector systems which provide air currents, solar hot-water supply systems for high buildings, effects on national economy, and ecological aspects. Attention is given to the alcohol

program, the biopotential, biogas, the use of pyrolysis, the utilization of water hyacinth plants for biogasification, and ecological aspects. G.R.

A81-47254 Complete electrical power supply for small loads at remote sites with wind and solar energy (Elektrische Vollversorgung von abgelegenen Kleinverbrauchern mit Wind- und Sonnenenergie). F. Auer (Battelle-Institut, Frankfurt am Main, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 481-490. 6 refs. In German.

The combined use of wind and solar energy to supply solar electrical loads at remote sites will be of increasing importance in the near future. A computer program has been developed which can calculate for every site and for arbitrary loads a cost minimum for the wind energy converter and solar cells in conjunction with a battery storage unit. A plant thus optimized can provide a complete electrical power supply, e.g., for TV transmitters or weekend houses. B.J.

A81-47258 Standardized test procedures for solar collectors - Evaluation, status, and trends. H. D. Talarek and H. J. Stein (Kernforschungsanlage Jülich GmbH, Institut für Kernphysik, Jülich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 711-721. 13 refs.

It is noted that through round-robin testing of flat-plate collectors, the inherent uncertainties of test procedures in use become apparent. It is found that well-calibrated pyranometers and an integral calorimetric calibration of the test facility can markedly increase the accuracy of measurements. The range of variation for the environmental parameters allowed by the procedures is modeled and compared with experimental data. C.R.

A81-47259 A collector test method suitable to Swiss weather conditions. J. M. Suter, J. Keller, P. Kesselring, and F. Widder (Eidgenössische Technische Hochschule, Zürich, Wurenlingen, Switzerland). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 722-730. 5 refs.

A method for outdoor testing of solar collectors under covered and clear sky conditions in Switzerland is presented. Statistical averages are determined for three collector parameters, the thermal loss coefficient, and the optical efficiency for pure diffuse radiation and pure direct radiation. The gross heat output delivered monthly by the collector is calculated in a given climate under standard conditions, and tables are produced which give the average monthly efficiency. Forty hot water collectors are tested, and a spectral analysis of the different glass covers and absorbers used in the tests indicate that the transmission of the covers depends strongly on the origin of the glass. Test results from 1978 to 1979 show that points are spread over a large domain, so that a 10% variation in optical efficiency may induce a 20% variation in the yearly gross heat output of the collector. D.L.G.

A81-47260 Correlation studies of the intensities of direct and diffuse radiation (Korrelationsuntersuchungen der Intensitäten der direkten und der diffusen Strahlung). K. R. Schreitmüller (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Technische Physik, Stuttgart, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 755-764. 7 refs. In German.

A model of atmospheric scattering and absorption processes is used to study the ratio of diffuse to total radiation, an essential criterion for the design of solar energy systems. It is shown that, for the assumptions used, this ratio is independent of local concentration variations of the scattering particles in the vertical direction. The computed and measured correlation curves agree well if an increasing number of Mie-scattering particles with increasing turbidity is assumed. Statistical studies and indoor experiments confirm the calculated dependence of the shape of the correlation curves on the solar altitude. B.J.

A81-47422 Environmental enhancement of the oceans by increased solar radiation from space. J. Klassi (Expedition Earth, Inc., Los Angeles, CA). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-243.* 10 p.

This paper explains how increased solar radiation from Space Light systems can enhance Ocean Thermal Energy Conversion (OTEC), ocean kelp farming, sea-food production and rejuvenation of polluted oceans. Space Light Reflectors focused on OTEC sites can enhance ocean thermal energy conversion by increasing the temperature difference between sun-warmed surface waters and the cold ocean depths. Focused on kelp farms, Space Light Reflectors can enhance methane production by providing optimal sunlight for maximum kelp yield. In conjunction with nutrient-rich water from ocean Upwelling Pipes, Space Light can stimulate the growth of phytoplankton on which commercially valuable fish feed. Efficient integration of these space and ocean systems can produce energy and restore life to polluted oceans. (Author)

A81-47501 Solar jubilee - 25 years of the sun at work; Proceedings of the Annual Meeting, Phoenix, AZ, June 2-6, 1980. Volumes 3.1 & 3.2. Meeting sponsored by ISES, Arizona Solar Energy Association, SERI, et al. Edited by G. E. Franta and B. H. Glenn (Solar Energy Research Institute, Golden, CO). Newark, DE, International Solar Energy Society, 1981. Vol. 3.1, 700 p.; vol. 3.2, 850 p. Price of two volumes, $125.

Among the topics discussed are the agricultural and industrial applications of solar energy, greenhouses, the biological and chemical conversion of biomass, energy plantations, thermochemical conversion of biomass, domestic water heating systems, active solar cooling, combined active solar heating and cooling, thermal energy storage for solar heating systems, design methods for active solar heating, combined solar heat pump systems, solar ponds, low temperature collector design and testing, solar concentrator test facilities, line focus concentrator components, small solar power systems, point focus concentrator components and central receiver conceptual design studies, and low concentration collectors. Also considered are passive solar systems, architectural synthesis of passive solar elements, case studies in passive heating and cooling, the modeling and measurement of passive systems, passive solar heating techniques and components, photovoltaic device technology, applications of photovoltaics, flat plate and concentrator photovoltaic system design, environmental testing and performance evaluation of photovoltaic systems, selective surfaces and radiative properties, cost/performance relationships in the photovoltaic design process, the economics of residential solar applications, solar device marketing, policies for energy decentralization, solar energy organizations, solar radiation, wind resource assessment and siting, dispersed and large scale wind system applications, and general problems in wind energy utilization. O.C.

A81-47505 Agricultural energy; National Energy Symposium, Kansas City, MO, September 29-October 1, 1980, Selected Papers. Volume 1 - Solar energy livestock production. Volume 2 - Biomass energy crop production. Volume 3 - Food processing. Symposium sponsored by the American Society of Agricultural Engineers, U.S. Department of Energy, U.S. Department of Agriculture, et al. St. Joseph, MI, American Society of Agricultural Engineers, 1981. Vol. 1, 282 p.; vol. 2, 314 p.; vol. 3, 96 p. Price of three volumes, members, $39.50; nonmembers, $49.50.

Among the topics covered are solar grain drying, solar collector design, construction and evaluation, applications of greenhouse solar systems, solar space heating for livestock buildings, solar heat pumps, wind energy for agricultural heating systems, the application of solar energy to the raising of poultry, microcomputer control of environmental systems, and solar cooling. Also discussed are corncob gasification, ethyl alcohol fuel production, corn-residue harvesting systems, agricultural residue furnaces, agricultural produce-derived diesel fuel substitutes, machine energy requirements, the use of wind energy for refrigeration and irrigation pumping, greenhouse design and performance, and irrigation pumping efficiency. Attention is also given to the use of solar energy in such food-processing operations as drying, canning, pasteurization, milling and kilning. O.C.

A81-47593 # Development and design of the flexible solar cell sheet for the space project Space Telescope (Entwicklung und

Auslegung des flexiblen Solarzellen-Lakens für das Raumfahrtprojekt Space Telescope). J. Koch (Telefunken AG, Wedel, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-081.* 12 p. 6 refs. In German.

Space Telescope (ST) represents a joint project of NASA and ESA. A telescope will be placed by the Shuttle in orbit at an altitude of approximately 500 km. After completion of its observational program (maximum 5 years), the telescope will be brought back to earth. Important components of the Space Telescope will be developed and manufactured in Europe. The solar generator will be manufactured by a British aerospace company. A German company is responsible for development and delivery of the subsystem containing the solar cell sheet. Every ST solar generator consists of four flexible solar cell sheets. Every solar cell sheet contains 5 Solar Panel Assembly (SPA) units. Attention is given to SPA design, the conduction of the development work, the development models, the material specifications, and manufacturing plans. G.R.

A81-47598 # Light construction elements from CFK for satellite solar generators of different size (Leichtbaustrukturen aus CFK für Satellitensolargeneratoren verschiedener Grösse). H. Bansemir and W. Buchs (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-080.* 25 p. 7 refs. In German.

Based on typical satellite systems, the structural principles of three types of solar generators are presented: a fixed solar generator for research satellites, an expandable solar generator with sandwich panels for station to station broadcasting satellites, and an expandable solar generator with frames and prestressed membranes for direct transmitting radio and television broadcasting. The requirements of the various generators and their construction materials are used to develop the typical structure elements. The different elements used in power conducting and connection, such as the bearing joints, the loops, and the inserts are considered with respect to their construction and use. The stability behavior of the sandwich panel mountings as well as their thermal requirements are discussed in detail. Schematics and charts are included. J.F.

A81-47681 Optimized second stage concentrator. E. Kritchman (Chicago, University, Chicago, IL). *Applied Optics,* vol. 20, Sept. 1, 1981, p. 2929-2933. 5 refs. Contract No. DE-FG02-79ET-00089.

The incorporation of a second-stage trumpetlike reflective element at the focal plane of a paraboloidal dish reflector is analyzed to examine the improvement in solar concentration capability. The optimally adapted trumpet compensates for the optical aberrations of the dish and for large f/nos. The consequent concentration capability is comparable to the ideal. (Author)

A81-47682 Luminescent solar concentrators and the reabsorption problem. R. W. Olson, R. F. Loring, and M. D. Fayer (Stanford University, Stanford, CA). *Applied Optics,* vol. 20, Sept. 1, 1981, p. 2934-2940. 12 refs. Research supported by the Petroleum Research Fund; NSF Grant No. DMR-79-20380.

The problem of reabsorption in luminescent solar concentrators (LSC) is discussed. A mathematical development is presented which enables the LSC gain to be calculated based on the optical properties of the materials and a random walk formalism. Two- and three-dimensional analyses are used. A detailed set of calculations for a common dye (rhodamine 6G) is used to examine the practicality of employing a single dye. The effects of diameter, thickness, and quantum yield on the LSC output are presented. The spectrum of the LSC output as a function of concentration is calculated. It is suggested that LSCs can be made more efficient with a system which utilizes radiationless electronic excited state transport and trapping as intermediate steps between absorption and reemission. Trap emission substantially avoids the reabsorption problem. (Author)

A81-47683 Fresnel lens analysis for solar energy applications. E. Lorenzo and A. Luque (Madrid, Universidad Politécnica, Madrid, Spain). *Applied Optics,* vol. 20, Sept. 1, 1981, p. 2941-2945. 10 refs. Research sponsored by the Ministerio de Industria y Energía.

An arbitrarily shaped, lineal Fresnel lens is analyzed in two roles: (1) that of a sole concentration stage, and (2) that of the first stage in a two-stage concentration system in which the second stage considers the first as a Lambertian source. Gain and lens position are determined for all possible configurations, and it is demonstrated that a curved lens with a refractive index approaching infinity and with a given profile is an ideal concentrator. O.C.

A81-47837 Semiconductor device development in the 1970's and 1980's - A perspective. S. M. Sze (Bell Telephone Laboratories, Inc., Murray Hill, NJ). *IEEE, Proceedings,* vol. 69, Sept. 1981, p. 1121-1131. 20 refs.

In the 1970s more than 40,000 papers were published on semiconductor devices, with numerous breakthroughs in device concept and performance. The papers were grouped into four main categories: bipolar, unipolar, microwave, and photonic. Unipolar development expanded most rapidly in the 1970s, followed by photonic devices. Bipolar development expanded at a slower rate, and microwave development declined, indicative of its reaching a mature stage. New developments in bipolar and unipolar devices include oxide-isolated bipolar transistors, I2L power thyristors, submicrometer MOSFETs, laser-processed silicon-insulator devices, nonvolatile memories, and CCDs. It appears that the minimum feature length of these devices will continue to shrink, and new device configurations will minimize parasitics and power dissipation. New microwave devices include the high-efficiency IMPATT, permeable-base transistors, and MESFETs; it is expected that the gap between the present upper limit of microwave frequency (approximately 100 GHz) and the lower limit of infrared (approximately 1000 GHz) will be narrowed or eliminated. Isotype and anisotype heterojunctions will be used in photonic devices and superlattice structures. Devices discussed in this area include the quaternary laser, avalanche photodetectors, and concentrator and thin-film solar cells. J.F.

A81-47978 Advances in computer technology - 1980. Volume 1 - Proceedings of the International Computer Technology Conference, San Francisco, CA, August 12-15, 1980. Conference sponsored by the American Society of Mechanical Engineers. Edited by A. Seireg (Wisconsin, University, Madison, WI). New York, American Society of Mechanical Engineers, 1980. 476 p. $60.

Topics discussed include computers in energy systems, robots and manipulators, computing systems and mini - micro systems, and CAD systems. Papers are presented on the optimization for digital governors and digital automatic voltage regulators used in power systems, on a programmable flexible assembly system with an industrial robot, on models and metrics for software management and engineering, and on the proper role of interactive language in computer aided design. Attention is also given to flux distribution on a solar central receiver, to kinesthetic coupling between operator and remote manipulator, to the automatic generation of dynamics equations by computer, and to an implementable algorithm for computer-aided design problems with or without dynamic constraints. C.R.

A81-47980 # Computer simulation of solar collector temperatures under stagnation conditions. I. T. Hwang, P. Y. Wang, and P. S. Chopra (Argonne National Laboratory, Argonne, IL). In: Advances in computer technology - 1980. Volume 1 - Proceedings of the International Computer Technology Conference, San Francisco, CA, August 12-15, 1980. New York, American Society of Mechanical Engineers, 1980, p. 61-66. 6 refs. Research sponsored by the U.S. Department of Energy.

The absorber plate of an inactive solar collector can reach very high temperatures (greater than 230 C). Then, when the relatively cool heat transfer liquid is pumped through the collector, a steep temperature gradient develops that imposes severe thermal stress on the plate. To evaluate plate deformation and thermal stress, it is essential to have a thorough understanding of the relationship between changes in the plate temperature, changes in the fluid temperatures, and changes in the intensity of solar insolation. This paper presents the temperature responses that were calculated using the IBM Continuous System Modeling Program III (CSMP III). (Author)

A81-48024 # Measurement of flat-plate collector heat loss coefficients. N. M. Nahar (Central Arid Zone Research Institute,

Jodhpur, India). *Regional Journal of Energy, Heat and Mass Transfer,* vol. 3, Apr. 1981, p. 123-133. 12 refs.

An indoor method for direct measurement of the overall heat loss coefficient is developed so that solar energy can be more efficiently trapped by optimized flat-plate solar collectors. A schematic diagram of the indoor test set-up is given, with liquid temperature controlled by an electrical contact thermometer, and relay circulated by a pump to maintain a constant flow rate. The overall heat loss coefficient is measured in a bond duct type collector with single and double glazings, and is found to vary from 3.5 to 4.7 per sq Wm-K with zero wind speed. The coefficient is also reported for controlled wind speeds, and heat losses are found to increase by 13.5 and 7.5% for single and double glazed collectors respectively. The coefficient is presented as a function of plate temperature, and results are compared with calculated values, demonstrating good agreement. D.L.G.

A81-48108 678-mV open-circuit voltage silicon solar cells. A. W. Blakers and M. A. Green (New South Wales, University, Kensington, Australia). *Applied Physics Letters,* vol. 39, Sept. 15, 1981, p. 483-485. 18 refs. Research supported by the National Energy Research, Development and Demonstration Council of Australia.

A new high-performance cell structure has been developed, combining the better features of metal insulator semiconductor and p-n junction technologies. The metal-insulator-NP junction (MINP) cell technology described has an inherently superior performance to either of its constituent technologies, producing open-circuit voltages up to 678 mV (AMO, 25 C) for silicon cells. Analysis of the dark saturation current of MINP devices as a function of bulk resistivity indicates that both bulk and surface recombination contribute to this current, with the former dominating. Prospects for exceeding 700-mV open-circuit voltage with this approach are discussed. The structure is particularly well suited for fabrication using ion implantation. (Author)

A81-48144 Solar ponds. H. Tabor (Scientific Research Foundation, Jerusalem, Israel). *Solar Energy,* vol. 27, no. 3, 1981, p. 181-194. 45 refs.

The history and current status of salt-gradient non-convecting solar ponds are presented. These ponds are large-area collectors, capable of providing low-cost thermal, mechanical, or electrical energy using low-temperature turbo-generators. The basic theory of salt-gradient solar ponds is sketched; the effects of wind, leakage, and fouling and their constraints on location selection for solar ponds are discussed. The methods of building and filling the ponds, as well as extracting heat from them are explained in detail. Practical operating temperatures of 90 C can be obtained with collection efficiencies between 15% and 25%, demonstrating the practical use of the ponds for heating and cooling purposes, power production, and desalination. A condensed account of solar pond experience in several countries is given. This includes the 150 kW solar pond power station (SPPS) operating in Israel since December, 1979 and a 5000 kW unit currently under development. A study of the economics involved in using the ponds is presented: despite a low conversion efficiency, the SPPS is shown to have applications in many countries. J.F.

A81-48145 An analysis of the non-convecting solar pond. M. N. A. Hawlader and B. J. Brinkworth (University College, Cardiff, Wales). *Solar Energy,* vol. 27, no. 3, 1981, p. 195-204. 26 refs. Research supported by the Science Research Council of England.

The thermal behavior of the non-convecting solar pond is examined by numerically solving dynamic equations of radiation absorption and heat loss. The analysis incorporates hourly meteorological data from a site in southern England. Temperature histories for the first years of operation are given, showing the influence of the leading physical characteristics of the pond. Pond temperatures are shown to be strongly dependent on the effective extinction coefficient for solar radiation and the thermal losses from the pond bottom. The temperature history approaches a quasi-steady form within two to three years of operation, depending on the load demand. It is shown that modest loads (around 10% of the average insolation) can be used in this climate at temperatures appropriate for practical application. Performance estimates from this study are compared with earlier estimates, providing a pointer to potential solar pond performance in other high-latitude maritime climates. J.F.

A81-48147 Yearly average performance of the principal solar collector types. A. Rabl (Solar Energy Research Institute, Golden, CO). *Solar Energy,* vol. 27, no. 3, 1981, p. 215-233. 33 refs.

The results of hour-by-hour computer calculations for 26 U.S. meteorological stations are used to derive universal correlations for the yearly total energy that can be delivered by various solar collector types: flat plates, evacuated tubes, CPC, collectors that track about one axis, collectors that track about two axes, and central receivers. The correlations, polynomials of first and second order in yearly average insolation, latitude, and threshold, are used to find the yearly collectible energy by reading a single graph and multiplying the coordinates by the collector parameters. The method is shown to reproduce the results of the computer calculations with an accuracy of 2% for flat plates and 2-4% for concentrators. The method can be applied to photovoltaic systems, solar-augmented industrial process heat systems, or solar thermal power systems; it can also be used to rate collectors on the basis of yearly average performance or to evaluate the effects of collector degradation, the benefits of collector cleaning, and the gains from collector improvements. J.F.

A81-48175 * Solar energy. D. Rapp (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA; Texas, University, Richardson, TX). Englewood Cliffs, NJ, Prentice-Hall, Inc., 1981. 527 p. 103 refs. $32.

The book opens with a review of the patterns of energy use and resources in the United States, and an exploration of the potential of solar energy to supply some of this energy in the future. This is followed by background material on solar geometry, solar intensities, flat plate collectors, and economics. Detailed attention is then given to a variety of solar units and systems, including domestic hot water systems, space heating systems, solar-assisted heat pumps, intermediate temperature collectors, space heating/cooling systems, concentrating collectors for high temperatures, storage systems, and solar total energy systems. Finally, rights to solar access are discussed. B.J.

A81-48188 # Si MIS solar cells by anodization. J. Nanjo, H. Yamamoto, and H. Hasegawa. *Hokkaido University, Faculty of Engineering, Bulletin,* July 1981, p. 65-73. 9 refs. In Japanese, with abstract in English.

The formation of thin insulating layers by anodic oxidation has been investigated as an alternative way of fabricating low-cost silicon MIS solar cells. Anodizing has been carried out both under constant voltage and constant current conditions in an ethylene glycol solution of KNO3. It is found that in both cases the open-circuit voltage increases without a reduction in the short-circuit current, but the constant-voltage process is easier to control and is characterized by better reproducibility than the constant-current process. A maximum open-circuit voltage of 0.52 V, as compared with 0.37 V for the Schottky cell, has been achieved in the constant-voltage mode at 0.5 V. V.L.

A81-48365 Back-up electrical power needs for residential solar water heaters. B. L. Capehart and M. R. Peabody (Florida, University, Gainesville, FL). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 473-477.

A81-48471 A new method for the measurement of series resistance of solar cells. S. K. Agarwal, R. Muralidharan, S. C. Jain (Solid State Physics Laboratory, Delhi, India), A. Agarwala, and V. K. Tewary (Birla Institute of Technology and Science, Pilani, India). *Journal of Physics D - Applied Physics,* vol. 14, Sept. 14, 1981, p. 1643-1646. 5 refs.

A method is proposed for measuring the series resistance of solar cells based on the observed nonlinearity in the short-circuit current-light intensity relation. It is shown that the nonlinearity is a manifestation of the effects of series resistance, which can thus be determined from the slope of a plot of the natural logarithm of the difference between the light-generated current and the short-circuit current against the short-circuit current. The method is illustrated in a study of space-quality n(+)p Si solar cells under AMO simulation at various distances from the light source, where the light-generated current is determined from a linear extrapolation of the relation of short-circuit current to illumination intensity. Comparison with three previous methods for determination of the series resistance (the

illuminated curve method, the p-n junction-dark forward characteristic method and the method of Rajkanan and Shewchum (1979)) reveals the present method to be faster and more accurate, requiring the measurement of a single parameter as a function of light intensity. A.L.W.

A81-48472 Depth profile composition studies of thin film CdS:Cu2S solar cells using XPS and AES. V. G. Bhide, S. Salkalachen, A. C. Rastogi (National Physical Laboratory of India, New Delhi, India), C. N. R. Rao, and M. S. Hegde (Indian Institute of Science, Bangalore, India). *Journal of Physics D - Applied Physics*, vol. 14, Sept. 14, 1981, p. 1647-1656. 29 refs. Research sponsored by the Tata Energy Research Institute.

Studies of the surface composition and depth profiles of thin film CdS:Cu2S solar cells based on the techniques of X-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES) are reported. Specimens were fabricated by the thermal deposition of polycrystalline CdS films onto silver-backed electrodes predeposited on window glass substrates, followed by texturization in hot HCl and chemical plating in a hot CuCl(I) bath for a few seconds to achieve the topotaxial growth of CuS films. The XPS and AES studies indicate the junction to be fairly diffused in the as-prepared cell, with heat treatment in air at 210 C sharpening the junction, improving the stoichiometry of the Cu2S layer and thus improving cell performance. The top copper sulfide layer is found to contain impurities such as Cd, Cl, O and C, which may be removed by mild Ar(+) ion beam etching. The presence of copper deep in the junction is invariably detected, apparently in the grain boundary region in the form of CuS or Cu(2+) trapped in the lattice. It is also noted that the nominal valence state of copper changes abruptly from Cu(+) to Cu(2+) across the junction. A.L.W.

A81-48475 Ion implanted polycrystalline silicon solar cells. L. D. Nielsen (Danmarks Tekniske Hojskole, Lyngby, Denmark). *Physica Scripta*, vol. 24, Aug. 1981, p. 390, 391.

Polycrystalline silicon pn-junction solar cells have been prepared by ion implantation. Results are presented for cells based on wafers of a large-grained vapor-phase-grown material. Enhanced UV-sensitivity has been demonstrated, and AM1 efficiencies of 11% have been obtained without an optimized antireflective coating. (Author)

A81-48492 Improved mobility in OM-VPE-grown Ga/1-x/In/x/As. W. T. Dietze, M. J. Ludowise, and C. B. Cooper (Varian Associates Solid State Laboratory, Palo Alto, CA). *Electronics Letters*, vol. 17, Sept. 17, 1981, p. 698, 699. 11 refs. Contract No. XP9-8081-1.

A method is proposed for improving the quality of Ga(1-x)In(x)As grown by organometallic vapor phase epitaxy, a process especially attractive for the large volume production of solar cells. The proposed improvement involves the use of a trimethylindium-trimethylarsenic adduct, synthesized in the gas phase, as the In source, and AsH3 as the primary As source. The improved epitaxial layers have higher mobilities and lower background doping levels compared to layers grown with trimethylarsenic as the sole As source. V.L.

A81-48561 A potential show stopper. J. E. Drummond (Power Conversion Technology, Inc., San Diego, CA). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record.

New York, Institute of Electrical and Electronics Engineers, 1980, p. 415-420. 10 refs. Contract No. DE-AC03-79ER-10341.

The effects of thermal self-focusing instability on radio-wave power transmission in the SPS program are examined. It is found that, without lowering the power per beam, orbital radius, or operating wavelength of solar power satellites, the thermal self-focusing, fluctuation-amplifying instability will be excited in the F-region during at least some periods of the sunspot cycle. This instability could result in a significant phase disruption of both the guidance beam and power beam. Raising the operating frequency of the power beam from 2.45 GHz to 4 GHz would eliminate the instability as a significant effect on beam quality even at the highest power contemplated, 10 GW. Furthermore, lowering and reorienting the orbits to sun-synchronous, iso-insolation orbits would severely limit the growth of the self-focusing instability and reduce the required rectenna area by about a factor of 10 and eliminate the need for the large universal joint on the antenna. B.J.

A81-48933 A generalised approach to lifetime measurement in pn junction solar cells. S. R. Dhariwal and N. K. Vasu (Government College, Ajmer, India). *Solid-State Electronics*, vol. 24, Oct. 1981, p. 915-927. 21 refs.

In the recent years a number of new methods have been proposed and earlier methods reviewed for the measurement of minority carrier lifetime in solar cells. These include the open circuit voltage decay, reverse recovery, photoconductivity decay, spectral response, short circuit capacitance measurement, impedance measurement, light-induced photovoltaic decay and open circuit to short circuit switching methods. This paper presents a common mathematical formulation from which results for all these methods can be obtained. This enables one to compare the relative merits of these methods. (Author)

A81-48949 Heterogeneous photocatalytic oxidation of aromatic compounds on TiO2. M. Fujihira, Y. Satoh, and T. Osa (Tohoku University, Sendai, Japan). *Nature*, vol. 293, Sept. 17, 1981, p. 206-208. 31 refs.

The photocatalytic oxidation of aromatic compounds by means of H2O2 produced on TiO2 powders is investigated as a possible means for the efficient utilization of solar energy. The process investigated involves the generation of H2O2 in water from photo-induced electrons and holes in the conduction and valence bands of the TiO2 catalyst, which then decomposes into the hydroxyl radical and hydroxide anion by the Fenton reaction. When TiO2 photocatalyst in a mixture of water and an organic substrate was illuminated by a 500-W Xe lamp or 500-W high-pressure mercury arc lamp in air, analysis of the product revealed that every aromatic compound (benzene, toluene and acetophenone) was hydroxylated to produce the corresponding phenol, as well as biphenyl from benzene, benzaldehyde from toluene, and phenol from acetophenone. Yields of the organic products can be improved by regulating the pH of the system and by the addition of catalysts for hydroxyl radical formation, resulting in quantum yields as high as 1-5%. A.L.W.

A81-49242 Fluorescent planar collector-concentrators - A review. A. Goetzberger and V. Wittwer (Fraunhofer-Gesellschaft, Arbeitsgruppe für solare Energiesysteme, Freiburg im Breisgau, West Germany). *Solar Cells*, vol. 4, Aug. 1981, p. 3-23. 19 refs. Bundesministerium für Forschung und Technologie Contract No. ET-4190-A.

Fluorescent planar collector-concentrators are a new concept for the conversion of solar energy into electrical and thermal energy. The main advantages of this concept are the concentration of direct light and the collection of diffuse light with inexpensive large-area collectors and small-area solar cells. In combination with photovoltaic cells, this type of collector offers the advantage of separating the various wavelengths of light and converting them using solar cells with different band gaps. This paper reviews such systems, with emphasis on theoretical models, efficiency, collector properties, and experimental results. B.J.

A81-49243 Conversion of solar radiation by fluorescence - Application to the encapsulation of cells (Transformation du rayonnement solaire par fluoresce - Application à l'encapsulation des cellules). D. Sarti, F. Le Poull, and P. Gravisse (Laboratorie Bric, Croissy-sur-Seine, Yvelines, France). *Solar Cells*, vol. 4, Aug. 1981, p. 25-35. 11 refs. In French. Ministère de l'Industrie Contract No. 293,694.

A cost-effective approach to the encapsulation of solar cells is presented. The presence of fluorescent substances, associated with a cascade of light in the polymethylmethacrylate (PMMA) resin, encasing the silicon solar cells, resulted in a 25 percent increase in the conversion efficiency of photovoltaic modules. The support (Altuglas 1710) on which the solar cells are placed was also shown to play a significant role in the process. This improvement is a result of (1) a better spectral match between the incident radiation and the solar cell sensitivity and (2) a concentration of radiation due to the total internal reflections in the PMMA matrix. J.F.

A81-49244 High efficiency silicon cells for luminescent solar concentrators. C. M. Garner, F. W. Sexton, and R. D. Nasby (Sandia Laboratories, Albuquerque, NM). *Solar Cells*, vol. 4, Aug. 1981, p. 37-46. 12 refs. Research supported by the U.S. Department of Energy.

Energy conversion efficiencies of 18% and 19.4% at 0.1 W/sq cm and 1 W/sq cm, respectively, were measured for a luminescent solar concentrator cell under an air mass of one solar spectrum. This cell was designed for operation under illumination of 600 nm wavelength and 1 W/sq cm. From these results and spectral response data, an efficiency of 26% can be projected for illumination at 600 nm. This agrees well with computer code calculations of 28%. The substrate doping level, cell grid pattern, minority carrier lifetime and anti-reflection coating properties were studied to optimize the cell performance for 600 nm and longer wavelengths. (Author)

A81-49245 The silicon concentrator photovoltaic generator Sophocles - Performance and costs based on material characteristics. D. Esteve, G. Vialaret, and F. Therez (CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes, Toulouse, France). *Solar Cells*, vol. 4, Aug. 1981, p. 47-59. 11 refs.

The purpose of this paper is to show that, in the short term, a solution can be found to enable the immediate exploitation of concentrator photovoltaic systems. The technical requirements, tracking system, optical system and thermal dissipation necessary for concentrator generators are described. A description of the prototype generator 'Sophocles' is presented. The results of various experiments are given. Finally, the prospects of reductions in cost for a concentrator generator using a higher concentration ratio and more efficient solar cells, which can lead to a price of $4/W(p) if all expenses are taken into account, are reviewed. (Author)

A81-49246 Autonomous photovoltaic converter with linear focusing concentrator. J. P. David, F. Floret, J. Guerin, J. C. Paiva, and L. Aiache (Aix-Marseille I, Université, Marseille, France). *Solar Cells*, vol. 4, Aug. 1981, p. 61-70. 7 refs. Research supported by the Commissariat à l'Energie Solaire; Délégation Générale à la Recherche Scientifique et Technique Contract No. 78-7-0052.

An autonomous photovoltaic converter with a linear focusing concentrator allowing an effective concentration gain of 20 was designed, realized and tested. The photocells are special silicon cells; their cooling system is passive. The concentrator is a Fresnel-type segmented mirror. Part of the electrical power supplied by the device is used in its own sun-tracking system, the other part charges a 12 V, 30 A h, lead battery and the energy so stored during the day is used at night to light a room by a neon tube. The realization and performance of this prototype converter are described. Although cost estimation does not seem meaningful, further developments of such modules are discussed. (Author)

A81-49247 Study of and tests on a hybrid photovoltaic-thermal collector using concentrated sunlight. C. Gibart (Société Européenne de Propulsion, Vernon, Eure, France). *Solar Cells*, vol. 4, Aug. 1981, p. 71-89. 6 refs. Commission of European Communities Contract No. 459-78-1-ESF.

A hybrid prototype photovoltaic-thermal collector using concentrated sunlight was studied theoretically, realized and tested. Reasons are given for choosing this concept. The prototype design is then described and explanations are given for the different technological solutions that are adopted. The test set-up, instrumentation and measurements are described further. The experimental peak electrical and thermal efficiencies are then presented as functions of temperature and concentration ratio and are compared with the efficiencies of specific collectors. Technical feasibility is demonstrated, but economic viability cannot be established at present. Trends for future developments are then indicated. (Author)

A81-49248 Performance of a photovoltaic concentration module consisting of silicon solar cells with a facet cylindrical mirror COSS. R. Bomal and P. Ragot (Commissariat à l'Energie Atomique, Département des Etudes Mécaniques et Thermiques, Gif-sur-Yvette, Essonne, France). *Solar Cells*, vol. 4, Aug. 1981, p. 91-100.

A81-49300 On the surface recombination current of metal-insulator semiconductor inversion layer solar cells. O. M. Nielsen (Danmarks Tekniske Hojskole, Lyngby, Denmark). *Journal of Applied Physics*, vol. 52, Sept. 1981, p. 5870-5872. 14 refs.

The current-voltage characteristics of Al-SiO2-pSi MIS inversion layer solar cells are investigated under dark and illuminated conditions. The cells were fabricated on 111 line-type and 100 line-type pSi wafers with resistivities of 10-15 and 8-10 ohm cm, respectively, with a structure in which the area between the contact holes is treated as an ideal abrupt n(+)-p diode. A crossover point is observed between the dark and the illuminated curves for all 111 line-type cells, however not for the 100 line-type cells. The 111 line-type cells are also found to exhibit lower open-circuit voltages, with the open-circuit voltage differences greater than would be expected on the basis of the dark characteristics. Results are explained in terms of the dependence of the illuminated recombination current on the interface state density, which should therefore be made as small as possible to reduce the surface recombination current and increase open-circuit voltage. A.L.W.

A81-49456 Solar energy technology handbook. Part A - Engineering fundamentals. Edited by W. C. Dickinson (California, University, Livermore, CA) and P. N. Cheremisinoff. New York, Marcel Dekker, Inc. (Energy, Power, and Environment. Volume 6), 1980. 894 p. $85.

Aspects regarding the solar resource are considered, taking into account solar energy and the biosphere, extraterrestrial electromagnetic solar radiation, solar geometry and time, the terrestrial solar spectrum, terrestrial solar radiation availability, a new U.S. network for solar radiation measurements, the instrumentation for solar radiation measurements, and infrared radiation measurements. A description of solar thermal collectors is provided, giving attention to flat-plate and nonconcentrating collectors, concentrating collectors, nonconvective salt-gradient solar ponds, shallow solar ponds, fundamental materials considerations for solar collectors, outdoor testing of solar materials and solar collectors, and standard procedures for collector performance testing. Topics in the area of photovoltaics are related to the principles of photovoltaic conversion, solar cell fabrication, and photovoltaic materials. Attention is also given to bioconversion, wind energy, and solar energy storage systems. G.R.

A81-49457 Solar energy technology handbook. Part B - Applications, systems design, and economics. Edited by W. C. Dickinson (California, University, Livermore, CA) and P. N. Cheremisinoff. New York, Marcel Dekker, Inc. (Energy, Power, and Environment. Volume 6), 1980. 817 p. $85.

The application of solar technology are examined, taking into account domestic water heating, swimming pool heating, building space heating, solar cooling, passive solar design, total energy systems design, the distillation of sea water, irrigation pumping, food dehydration, industrial process heat, data acquisition systems, solar simulation computer programs, and calculation procedures for determining the thermal performance of active solar space heating and domestic hot water systems. Approaches considered for electric power generation are related to thermal conversion, photovoltaics, ocean thermal energy conversion, and wind, waves, and tides. Attention is also given to a simplified method for sizing active solar space heating, an economic methodology for solar hot water and space heating systems, an economic methodology for solar industrial process heat systems, and barriers and incentives in the commercialization of solar energy. Aspects concerning environmental, health, and safety issues are also explored. G.R.

A81-49466 National Passive Solar Conference, 4th, Kansas City, MO, October 3-5, 1979, Proceedings. Volume 4. Edited by G. Franta (Solar Energy Research Institute, Golden, CO). Conference sponsored by the U.S. Department of Energy and International Solar Energy Society. Newark, DE, International Solar Energy Society, 1981. 792 p. $65.

Papers concern recent experience in the research, development and application of passive solar technology. Specific topics include the legislative barriers and incentives to passive solar systems, coupled thermal and lighting simulations for evaluating daylighting design effectiveness, passive solar applications in inner city housing, radiative cooling in a desert climate, salinity gradient solar ponds, the retrofit of a masonry home for passive space heating, the performances of active and passive solar domestic hot water systems, builder experience with passive solar home construction, the use of solar energy installations on farm buildings, and a method of determining the thermal performance of passive storage walls. A.L.W.

A81-49519 * Contact resistivities of sputtered TiN and Ti-TiN metallizations on solar-cell-type-silicon. M. Maenpaa (Califor-

nia Institute of Technology, Pasadena, CA; Technical Research Centre of Finland, Esbo, Finland), M.-A. Nicolet, I. Suni (California Institute of Technology, Pasadena, CA), and E. G. Colgan (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Solar Energy*, vol. 27, no. 4, 1981, p. 283-287. 25 refs. Research supported by the U.S. Department of Energy.

The resistivities of TiN and Ti-TiN contacts on a shallow junction solar-cell-type silicon substrate have been determined by the *method of the transmission line model. The contacts investigated are* shown to be suitable for standard solar cells from an electrical point of view. Contact resistivity values of the order of 0.0001 ohm/sq cm as obtained for the n(+)Si-TiSi2-TiN contact system may be acceptable for concentrations up to 100 times, but lower values are necessary beyond this point. V.L.

A81-49521 **An analysis of convective losses from cavity solar central receivers.** A. M. Clausing (Illinois, University, Urbana, IL). *Solar Energy*, vol. 27, no. 4, 1981, p. 295-300. 8 refs.

A simple analytical model has been developed in order to provide a framework for designing experimental programs for convective loss determinations, for analyzing available experimental data from solar receiver test programs, and for estimating the convective loss at a relatively small cost. Analytical results and experimental evidence indicate that the convective loss from cavity receivers is appreciable, while the effects of wind on the convective loss under normal operating conditions are minimal. The proposed analytical model provides a means of determining the relative importance of the internal resistances and predicting the bulk air temperature within the convective zone inside the cavity. V.L.

A81-49716 # **Block diagram of the thermoregulator controlling a cylindrical solar collector and the analysis of the thermal process for the optimization of heat production (Schema functionala a regulatorului care comanda procesul termic al unui concentrator solar cilindric si studiul regimului termic in vederea optimizarii conditiilor de extragere a caldurii).** L. David (Timisoara, Institutul Politehnic, Timisoara, Rumania). *Studii si Cercetari de Fizica*, vol. 33, no. 9, 1981, p. 907-916. 5 refs. In Rumanian.

N81-28482# Applied Research Association, Inc., Albuquerque, N. Mex.
FULL-SCALE LOAD TESTS OF EXPERIMENTAL SOLAR-COLLECTOR FOUNDATIONS
Douglas H. Merkle Mar. 1981 36 p Presented at the ASCE Spring Conf., Las Cruces, N. Mex., 27 Mar. 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-7076; CONF-810341-1) Avail: NTIS HC A03/MF A01

Four drilled, reinforced concrete piers, typical of foundations utilized for single axis tracking solar collector systems, were tested to failure under both eccentric lateral and vertical loads. Previously developed equations for lateral and vertical load capacity yielded reasonable predictions, but the tests disclosed the need to improve the foundation anchor bolt assembly, and possibly also the method of mounting the collectors to the foundations. Nevertheless, the lateral and vertical failure loads and moments of all four piers well exceeded specified design values. DOE

N81-28515*# Days Inn of America, Inc., Atlanta, Ga.
SOLAR DOMESTIC HOT WATER SYSTEM MANUAL FOR DAY'S INN, GARLAND, TEXAS Final Report
May 1981 36 p refs Sponsored in part by NASA
(Grant EG-77-G-01-1632)
(NASA-CR-161802) Avail: NTIS HC A03/MF A01 CSCL 10A

The Solar Domestic Hot Water System installed at Day's Inn, I-30 and 6222 Beltline, Garland, Texas, is described. The system is a solar collector array used to provide from 39.9 percent in December, to 84.7 percent in August, of the domestic hot water usage of the Day's Inn in Garland, Texas. The system is an automatic draindown design employing an atmospheric vented storage tank for storing the hot water collected by the 998 sq. ft. collector array. S.F.

N81-28517*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN DESCRIPTION OF THE SCHUCHULI VILLAGE PHOTOVOLTAIC POWER SYSTEM Final Report
Anthony F. Ratajczak, Richard W. Vasicek, and Richard DeLombard May 1981 100 p
(Contract DE-AI01-79ET-20485)
(NASA-TM-82650; DOE/NASA/20485-10) Avail: NTIS HC A05/MF A01 CSCL 10B

A stand alone photovoltaic (PV) power system for the village of Schuchuli (Gunsight), Arizona, on the Papago Indian Reservation is a limited energy, all 120 V (d.c.) system to which loads cannot be arbitrarily added and consists of a 3.5 kW (peak) PV array, 2380 ampere-hours of battery storage, an electrical equipment building, a 120 V (d.c.) electrical distribution network, and equipment and automatic controls to provide control power for pumping water into an existing water system; operating 15 refrigerators, a clothes washing machine, a sewing machine, and lights for each of the homes and communal buildings. A solar hot water heater supplies hot water for the washing machine and communal laundry. Automatic control systems provide voltage control by limiting the number of PV strings supplying power during system operation and battery charging, and load management for operating high priority at the expense of low priority loads as the main battery becomes depleted. A.R.H.

N81-28521*# Belz Investment Co., Memphis, Tenn.
SOLAR HEATING SYSTEM INSTALLED AT BELZ INVESTMENT COMPANY, MEMPHIS, TENNESSEE Final Report
Jun. 1981 100 p refs Sponsored in part by NASA
(Contract EM-78-F-01-5210)
(NASA-CR-161803) Avail: NTIS HC A05/MF A01 CSCL 10A

A hot air solar system which utilizes flat plate air collectors is discussed. Collector areas for each of four buildings cover 780 sq ft, with storage capacity of 390 cu ft per building. The air system has a special air handling unit to move air through the collectors and into and out of the rock storage, with connection to the air duct distribution system. The heat of the motor is added to the heat delivered to the system. The solar system also includes four motorized special low leakage dampers and two gravity fabric dampers. The system is automatically controlled by a solid state controller with three thermistors: one located in the collectors, one in the rock box to plenum, one in the return air duct from the heated space. A three stage heating thermostat, located in the conditioned space, controls the operation. E.A.K.

N81-28524*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLAR THERMAL POWER SYSTEMS PARABOLIC DISH PROJECT Annual Technical Report
V. C. Truscello 15 May 1981 94 p refs Prepared in cooperation with JPL, California Inst. of Technology, Pasadena
(Contracts NAS7-100; DE-AT04-81AL-16228)
(NASA-TM-82371; JPL-PUB-81-39; DOE/JPL-1060-45) Avail: NTIS HC A05/MF A01 CSCL 10A

The status of the Solar Thermal Power Systems Project for FY 1980 is summarized. Included is: a discussion of the project's goals, program structure, and progress in parabolic dish technology. Analyses and test results of concentrators, receivers, and power converters are discussed. Progress toward the objectives of technology feasibility, technology readiness, system feasibility, and system readiness are covered. E.A.K.

N81-28525# Committee on Science and Technology (U. S. House).
OVERSIGHT: WESTERN SOLAR ENERGY ACTIVITIES
Washington GPO 1980 130 p refs Hearing before the Subcomm. on Energy Develop. and Applications of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 123, 3 Jan. 1980
(GPO-63-657) Avail: Subcommittee on Energy Development and Applications

Development and commercialization of solar energy technology is discussed with regard to the case of California, which leads the other States in its encouragement of solar incentives. The operation of the Western Sun Solar Center, one of four regional solar centers of DOE with responsibility for commercialization, is assessed. S.F.

N81-28527# Committee on Science and Technology (U. S. House).
OVERSIGHT: SOLAR PHOTOVOLTAIC PROGRAM
Washington GPO 1980 164 p Hearing before the Subcomm. on Energy Develop. and Applications of the Comm. on Sci. and

Technol., 96th Congr., 2nd Sess., no. 135, 29 Feb. 1980 (GPO-64-863) Avail: Subcommittee on Energy Development and Applications

Public Law 95-590, the Solar Photovoltaic Energy Systems Research Development and Demonstration Act of 1978, is reviewed, along with the Department of Energy's implementation of the 10 year photovoltaic program. Controversy settles on DOE's emphasis on research and development to the detriment of marketing development and demonstration. S.F.

N81-28531# Sandia Labs., Albuquerque, N. Mex.
OPERATING EXPERIENCE AT THE CENTRAL RECEIVER TEST FACILITY (CRTF)
John T. Holmes, W. Ken Bell, David L. King, Larryl K. Matthews, and Larry O. Seamons 1981 10 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2504C; CONF-810509-13) Avail: NTIS HC A02/MF A01

The CRTF, constructed to develop solar central receiver components, began operating in October, 1978. To date, three solar receivers that used either air, water/steam, or a molten nitrate salt as their working fluid were successfully characterized. Also, seven heliostat concepts were evaluated. These included two competing designs for the 10 MWe solar pilot plant now under construction near Barstow, California, a privately sponsored design, and four advanced designs. Almost three years of operation of the CRTF provided data and experience on the performance and maintenance requirements for typical components of a solar central receiver system. DOE

N81-28533# Department of Energy, Washington, D. C. Energy Information Administration.
ENERGY DATA REPORT: SOLAR COLLECTOR MANUFACTURING ACTIVITY, JULY - DECEMBER 1980
Mar. 1981 50 p
(DOE/EIA-0174/80-2) Avail: NTIS HC A03/MF A01

Statistics on solar collector manufacturing activity for both solar thermal collectors and photovoltaic modules through 1980 are presented. Summary data are given for the number of manufacturers and collector area produced each year from 1974 through 1980; data for collector type are included, i.e., low temperature or medium temperature and special collectors. Producer shipments are tabulated according to location of company headquarters, producer size, and collector types. Impport and export activity is tabulated; and tables are given showing the application according of end use, market sector, and market sectors and company headquarers location. The number of companies engaged in activities related to solar collector manufacturing for 1978 through 1980 are listed; and the number of manufacturers and market sector are tabulated for photovoltaic modules manufacturing activities. DOE

N81-28534# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
INDUSTRIAL AND AGRICULTURAL PROCESS HEAT INFORMATION USER STUDY
W. W. Belew, B. L. Wood, T. L. Marle, and C. L. Reinhardt Mar. 1981 246 p
(Contract EG-77-C-01-4042)
(SERI/TR-751-751) Avail: NTIS HC A11/MF A01

Information on solar industrial and agricultural process heat (IAPH) are described. The results of a study on many different solar technologies, identify types of information each group needed and the best ways to get information to each group. Results from 10 IAPH groups of respondents are analyzed in this report: IPH Researchers; APH Researchers; Representatives of Manufacturers of Concentrating and Nonconcentrating Collectors; Plant, Industrial, and Agricultural Engineers, Educators, Representatives of State Agricultural Offices, and County Extension Agents. DOE

N81-28536# Sandia Labs., Albuquerque, N. Mex. Exploratory Systems Div.
DESIGN, COST, AND PERFORMANCE COMPARISONS OF SEVERAL SOLAR THERMAL SYSTEMS FOR PROCESS HEAT. VOLUME 3: RECEIVERS
J. B. Woodard, Jr. Mar. 1981 114 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-8281-Vol-3) Copyright. Avail: NTIS HC A06/MF A01

The receiver subsystem converts reflected solar radiation into thermal power by heating a working fluid. The cost and performance were estimated for the receiver subsystem for parabolic troughs, parabolic dishes, and central receivers over a wide range of temperatures and power levels for thermal power applications. The fundamental design philosophy employed, the constraints identified, the tradeoffs performed and the cost and performance results obtained for each receiver in the study matrix are described. DOE

N81-28537# Sandia Labs., Albuquerque, N. Mex. Energy System Studies Div.
DESIGN, COST AND PERFORMANCE COMPARISONS OF SEVERAL SOLAR THERMAL SYSTEMS FOR PROCESS HEAT. VOLUME 4: ENERGY CENTRALIZATION
J. J. Iannucci and L. D. Hostetler Mar. 1981 94 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-8282-Vol-4) Avail: NTIS HC A05/MF A01

A large matrix of self-consistent piping systems for dishes, troughs, and central receivers are designed, costed, and analyzed for performance. The solar installations collect thermal energy at temperatures ranging from 2000 to 20000 F, at sizes of 3, 30, 300, and 1500 megawatts thermal. First order design differences and similaies are highlighted, with emphasis on the comparison of dish and trough piping. Dishes are found to inefficient piping networks due to the large length of piping required. DOE

N81-28538# Houston Univ., Tex. Energy Lab.
USER MANUAL FOR THE UNIVERSITY OF HOUSTON SOLAR CENTRAL RECEIVER, CELLWISE PERFORMANCE MODEL: NS, VOLUME 1
F. W. Lipps and L. L. Vant-Hull Dec. 1980 198 p refs 2-Vol.
(Contract DE-AC03-79SF-10763)
(DOE/SF-10763/T9-Vol-1; SAN-0763-4-Vol-1) Avail: NTIS HC A09/MF A01

The central receiver cellwise performance model which simulates the optical performance of a solar central receiver system is described. The system contains a collector field with a large number of identical, individually guided, heliostats which reflect sunlight to a tower top receiver. For simulation, the collector field is divided into cells, and a representative heliostat at each cell center is used to estimate the effect of the heliostats in the cell. Typical applications include: a receiver flux density run, an annual performance summary run, a start-up performance study, and a performance study during a cloud passage. DOE

N81-28539# Houston Univ., Tex. Energy Lab.
USER MANUAL FOR THE UNIVERSITY OF HOUSTON SOLAR CENTRAL RECEIVER, CELLWISE PERFORMANCE MODEL: NS, VOLUME 2
F. W. Lipps and L. L. Vant-Hull Dec. 1980 123 p 2 Vol.
(Contract DE-AC03-79SF-10763)
(DOE/SF-10763/T9-Vol-2; SAN-0763-4-Vol-2) Avail: NTIS HC A06/MF A01

A complete listing is given of the inputs and outputs of four test runs designed to illustrate the most important features of the NS cellwise performance code. DOE

N81-28542# Duke Univ., Durham, N. C.
ASSESSMENT OF ACTIVE SOLAR SYSTEMS IN THE RESIDENTIAL SECTOR OF NORTH CAROLINA, 1974 - 1995 Report, 1 Nov. 1978 - 31 Dec. 1979
Diane Brown and Karen St.John 1 Feb. 1981 55 p refs Sponsored by Dept. of Commerce
(NCEI-0030) Avail: NTIS HC A04/MF A01

An evaluation is presented of the contribution active solar systems can make in North Carolina's residential sector over the next 15 years. The report is divided into 5 parts: introduction; current solar industry status; projected use of active solar systems to 1995; maximum potential for active solar systems to 1995; recommendations for state solar incentives. Information in the appendices includes: conversion methodology; square feet of collector to Btu; economic analysis of solar systems based on life costs; methodology for percentage breakdowns on projected solar system sales; North Carolina solar manufacturers/distributors and national manufacturers; solar legislation; economic analysis of solar systems; and data sources. DOE

N81-28545# Alabama Univ. in Huntsville. Dept. of Mechanical Engineering.
NUMERICAL AND EXPERIMENTAL STUDIES OF LIQUID STORAGE TANK THERMAL STRATIFICATION FOR A SOLAR ENERGY SYSTEM

S. T. Wu Nov. 1980 81 p refs
(Contracts DE-AS02-77CS-34479; EG-77-S-02-4479)
(DOE/CS-34479/3) Avail: NTIS HC A05/MF A01

The results of theoretical and experimental studies of thermal stratification in liquid energy storage tanks for the performance of solar energy systems are presented. The investigation was divided into three areas: (1) justification of the importance of thermal stratification inside the energy storage tanks; (2) development of simple mathematical model which is compatible with existing solar energy system simulation code; and (3) validation of mathematical models by experimental data obtained from realistic solar energy system operations. DOE

N81-28546# Sandia Labs., Livermore, Calif. Energy Systems Studies Div.
IMPACT OF NATURAL CLEANING ON THE SELECTION OF A WASHING SYSTEM FOR SOLAR COLLECTORS
Alan Kerstein Apr. 1981 25 p refs
(Contract DE-AC04-76DP-00189)
(SAND-81-8636) Avail: NTIS HC A02/MF A01

The desired optical properties (reflectivity, transmissivity, etc.) of solar energy collector surfaces such as mirrors and photovoltaic surfaces are degraded over time by soiling. Cost benefit evaluation of alternative methods for washing the surface or retarding the optical degradation must take into account natural cleaning processes such as precipitation and frost, which impact the scheduling as well as the benefits of washing. A probabilistic method developed to address this question is used to compare truck-mounted versus mirror-mounted washing systems for central receiver plants. The comparison of these systems is shown to be sensitive to the seasonally-varying frequency and effectiveness of natural cleaning processes. The implications of this analysis for such diverse issues as cost/benefit evaluation of soil-retardant mirror coatings and formulation of plant site selection criteria are noted. DOE

N81-28547# Sandia Labs., Livermore, Calif.
DESIGN, COST, AND PERFORMANCE COMPARISONS OF SEVERAL SOLAR-THERMAL SYSTEMS FOR PROCESS HEAT. VOLUME 2: CONCENTRATORS
E. D. Eason Mar. 1981 68 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-8280-Vol-2) Avail: NTIS HC A04/MF A01

The major mechanical design and cost differences between concentrator subsystems are identified. Parabolic dishes and troughs are designed to the same specifications as heliostats, using the same glass mirror/steel structure design concept and their costs are estimated on a consistent, comparable basis, using the heliostat cost data base. Inherent cost differences arise from differences in geometry, the cost of providing curvature and wind loadings. The estimated cost increases, relative to heliostats, are 15 percent to 50 percent for dishes and 0 percent to 30 percent for troughs, considering the combined effect of several analysis uncertainties. DOE

N81-28551# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
DESIGN CONSIDERATIONS FOR SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS: NONTRACKING AND LINE FOCUS COLLECTOR TECHNOLOGIES
Charles F. Kutscher, ed. Mar. 1981 64 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-632-783) Avail: NTIS HC A04/MF A01

Items are listed that should be considered in each aspect of the design of a solar industrial process heat system. The collector technologies covered are flat plate, evacuated tube, and line focus. Qualitative design considerations are stressed rather than specific design recommendations. DOE

N81-28552# Brookhaven National Lab., Upton, N. Y.
STUDY OF GAP STATES IN A-Si:H ALLOYS BY MEASUREMENTS OF PHOTOCONDUCTIVITY AND SPECTRAL RESPONSE OF MIS SOLAR CELLS
P. E. Vanier, A. E. Delahoy, and R. W. Griffith 1981 7 p refs Presented at the Conf. on Tetrahedrally Bonded Amorphous Semi-Conductors, Carefree, Ariz., 12 Mar. 1981
(Contract DE-AC02-76CH-00016)
(BNL-29160; CONF-810331-1) Avail: NTIS HC A02/MF A01

Modifications in n(E) were studied by the effects of selected impurities on the conversion efficiency and spectral response of MIS and p-i-n solar cells. A picture of the density of gap states n(E) in glow discharge a-Si:H is constructed using four different kinds of transport measurement on a large number of samples. The minimum in n(E) lies 0.4 eV below E sub c, rather than in the middle of the gap. A distribution of fast recombination centers lies at mid gap, and two sets of hole traps lie between mid gap and the valence band.

N81-28553# Mueller Associates, Inc., Baltimore, Md.
ECONOMIC ANALYSIS OF COMMERCIAL SOLAR COMBINED SPACE-HEATING AND HOT-WATER SYSTEMS
23 Sep. 1980 66 p Prepared for Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(ANL-K-80-53; MAI-204) Avail: NTIS HC A04/MF A01

Typical commercial solar energy systems and typical cost and performance levels are outlined. The economic performance of solar energy systems are described through the use of cash flow diagrams. The diagrams indicate the cumulative cash situation of a solar investment over the life of the investment. The economic performance of solar energy systems is outlined through the calculation of equivalent return on investment (ROI). Appendices are included to enable calculating the ROI for any particular solar energy system investment. DOE

N81-28554# Mueller Associates, Inc., Baltimore, Md.
ECONOMIC ANALYSIS OF NON-TAXED COMMERCIAL SOLAR HOT WATER SYSTEMS AND COMBINED HEATING AND HOT WATER SYSTEMS
23 Sep. 1980 85 p
(Contract MAI-205)
(ANL-K-80-44) Avail: NTIS HC A05/MF A01

An economic analysis of nontaxed commercial solar systems is presented. A realistic evaluation of current cost effectiveness of nontaxed commercial solar energy systems is provided. Economic considerations involved in the decisions to invest in a solar system are described. Easy to use tools to make rational decisions regarding economic viability of nontaxed commercial solar energy systems in a particular application are outlined. E.A.K.

N81-28561# Midwest Research Inst., Golden, Colo. Solar Thermal Program Branch.
SOLAR THERMAL COST GOALS
R. B. Edelstein Jan. 1981 9 p refs Presented at the 3rd Ann. Systems Simulation, Economic Analysis/Solar Heating and Cooling Operational Results Conf., Reno, Nev., 29 Apr. - May 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-633-1063; CONF-810405-13) Avail: NTIS HC A02/MF A01

Setting of goals for a research, development and demonstration program is critical in measuring its progress and ensuring its success. The development of cost goals for the DOE Solar Thermal Program by the Solar Thermal Cost Goals Committee (STCGC), led by the Solar Energy Research Institute, is described. The objective of the STCGC is to determine a consistent set of time-related cost and performance goals for concentrating collector systems based on market value and intermediate goals based on attainable cost levels. Accomplishments thus far include: definition of cost goals and their function in program planning, delineation of competing energy system costs, development of a breakeven costing methodology for assessing market value, determination of attainable costs for solar thermal systems, setting financial and economic parameters, and calculation of market value as a function of each competing fuel type, application, and region. DOE

N81-28562# Midwest Research Inst., Golden, Colo.
PREFERENCES AND CONCERNS OF POTENTIAL USERS IN THE SELECTION OF SOLAR THERMAL SYSTEMS FOR INDUSTRIAL AND SMALL UTILITY APPLICATIONS
James B. Gresham (Science Applications, Inc., Golden Colo.) and Thomas A. Kriz Mar. 1981 12 p refs Presented at the 8th Energy Technol. Conf. and Exposition, Washington, D.C., 9-11 Mar. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-731-1128; CONF-810315-9) Avail: NTIS HC A02/MF A01

To achieve widespread application in the industrial and utility sectors, solar systems must be economically competitive. Economic viability is, in turn, determined by a number of supporting criteria, ranging from system reliability to dispatch characteristics to how the system supports the main product line. In addition, solar systems possess some inherent attributes that may render

some of the traditional supporting criteria inappropriate or require their redefinition. Those criteria and their relation to the solar investments are discussed in three steps. First, the main concerns and preferences of the potential users, as identified in recent SERI studies, are identified. Second, the equitability of the resulting decision criteria for solar investments are examined. Finally, the implications of these criteria for solar energy's penetration into these markets are discussed. DOE

N81-28564# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THREE-YEAR PERFORMANCE STUDY OF THE MEAD, NEBRASKA, 25-kWp PHOTOVOLTAIC POWER SYSTEM
Henry J. Bullwinkel and Raymond F. Hopkinson 1981 6 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philidelphia, 27-30 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/122) Avail: NTIS HC A02/MF A01

The performance of a 25 kWp photovoltaic (PV) solar energy system was studied. Electrical energy produced by the PV system provided 100% of the power needed throughout the growing season to meet the irrigation requirements for an 80 acre cornfield, as well as significant portions of power required for PV related crop drying and fertilizer manufacturing experiments. Field data indicate that the PV system performs up to expectations, if allowance is made for component degradation and seasonal soil/snow accumulation on the array. DOE

N81-28565# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RELIABILITY OF TERRESTRIAL PHOTOVOLTAIC MODULES AT VARIOUS DOE/MIT LINCOLN LABORATORY TEST SITES
S. E. Forman and M. P. Themelis 30 Mar. 1981 5 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/126; CONF-810526-1) Avail: NTIS HC A02/MF A01

During the past four years, acting under the auspices of the US Department of Energy, Massachusetts Insitute of Technology Lincoln Laboratory built and operated in the United States photovoltaic power-generating systems ranging in size from less than 1 kWp to 100 kWp. Slightly more than 11,000 modules from several maufacturers were utilized at these sites with a cumulative number of electricl failures of approximately 2%. Discussion is presented of module performance at two of these sites; a 25-kWp array field at Mead, Nebraska, and a 100-kWp array field at Natural Bridges National Monument, Utah. Data and photographs of module failures, failure modes, physical and electrical degradation, and array diagnostics are presented for each of the five different types of modules utilized at these sites. DOE

N81-28566# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLAR PHOTOVOLTAIC RESIDENCE IN CARLISLE, MASSACHUSETTS
S. J. Strong (Solar Design Associated, Lincoln, Mass.) and B. E. Nichols 1981 4 p Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 27-30 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/129; CONF-810509-9) Avail: NTIS HC A02/MF A01

The first solar photovoltaic house designed and constructed under the US Department of Energy's Solar Photovoltaic Residential Project is studied. The house, which is powered by a 7-k Wp photovoltaic (PV) system, will be used to assess the occupants' acceptance of and reactions to residential photovoltaic systems and to familiarize utilities, builders, developers, town building officials and others with issues concerning photovoltaic installations. The house includes energy conservation and passive solar features. It utilizes a roof mounted, flat plate PV array which operates in a two way energy exchange mode with the electric utility. The energy conservation and passive solar features of this house are described and a detailed description of the utility interactive photovoltaic system is presented, along with initial performance data. DOE

N81-28567# Midwest Research Inst., Golden, Colo.
APPLIED RESEARCH IN THE SOLAR THERMAL ENERGY SYSTEMS PROGRAM
C. T. Brown (Georgia Inst. of Technology, Atlanta) and J. M. Lefferdo Mar. 1981 7 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26-30 May 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-633-1148; CONF-810509-10) Avail: NTIS HC A02/MF A01

Within the Solar Thermal Research and Advanced Development (RAD) program a coordinated effort in materials research, fuels and chemical research and applied research is being carried out to meet the systems needs. Each of these three program elements is described with particular attention given to the applied research activity. DOE

N81-28568# Mueller Associates, Inc., Baltimore, Md.
ECONOMIC ANALYSIS OF RESIDENTIAL SOLAR WATER HEATERS
John Carlock and Ronald Overton 23 Sep. 1980 98 p refs
(Contract W-31-109-eng-38)
(ANL-K-80-68; MAI-201) Avail: NTIS HC A05/MF A01

A residential solar water heater, cost and performance information, and monthly costs and savings of the typical system are discussed. Economic evaluations of solar water heaters are presented in increasingly complex levels of detail. Utilizing a typical system, the effective interest rate that the purchaser of a system would receive on money invested is shown for all regions of the country. The importance of numerous variables that can make a significant difference on the economics of the system is described. Methods for calculating the payback period for any nontypical solar water heater are described. This calculated payback period is shown to be related to the effective interest rate that the purchaser of the system would receive for a typical set of economic conditions. A method is presented to calculate the effective interest rate that the solar system can provide. DOE

N81-28569# Arizona State Univ., Tempe. Coll. of Architecture.
HARDWARE PACKAGE AND WORKSHOP DEVELOPMENT FOR HOMEOWNER SOLAR WATER HEATER Final Report
Stanley A. Mumma Sep. 1980 288 p refs
(Contract DE-FG03-78SF-01973; Grant EM-78-G-03-1973)
(DOE/SF-01973/T1) Avail: NTIS HC A13/MF A01

It was the purpose of this project to: (1) develop a standard solar hot water heater package, (2) develop a workshop for the assembly of these components by the homeowner, (3) provide guidance on how the components may be retrofit to existing homes in accordance with local codes and good practices, (4) provide operating and maintenance instructions, and (5) provide this community service at a target cost of $300 to $400 for the complete solar water package including the enrollment and workshop. The solar hot water system's thermal performance and development of a solar company are discussed. Nationwide expansion of the program is proposed. DOE

N81-28570# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
USE OF AN OPEN-CYCLE ABSORPTION SYSTEM FOR HEATING AND COOLING
D. R. Schlepp and R. K. Collier Mar. 1981 7 p refs Presented at the Intern. Solar Energy Soc. Am. Sect. Ann. Conf., Philadelphia, 26-30 May 1981
(Contracts EG-77-C-01-4042; DE-AC02-77CH-00178)
(SERI/TP-631-1159; CONF-810509-11) Avail: NTIS HC A02/MF A01

Solar cooling for commercial applications using open cycle absorption refrigeration systems was investigated. If an open cycle absorption can be operated as a chemical heat pump for winter heating operation, the system offers year round operation that makes the system economically viable for many regions of the US. An analysis of heating operation for the open cycle system using a computer program that simulates heat and mass transfer processes for any environmental condition is also presented. The open cycle absorption refrigeration system can be operated as a chemical heat pump. Simulations for winter heating operation were run for five US cities, with solar SOP's in the range of 0.6 to .16. It is concluded that at these levels, the OCAR system can provide full heating and cooling operation for office buildings in many southern US cities. DOE

N81-28571# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
VALUE OF THERMAL STORAGE IN SOLAR IPH SYSTEMS
S. M. Hock and M. E. Karpuk Dec. 1980 7 p refs Presented at the 3rd Ann. Systems Simulation, Econ. Analysis/Solar Heating and Cooling Operational Results Conf., Reno, Nov., 27 Apr. 1981
(Contracts EG-77-C-01-4042; DE-AC02-77CH-00178)
(SERI/TR-731-905; CONF-810405-14) Avail: NTIS

HC A02/MF A01

The value of thermal storage for three solar industrial process heat systems for capacities of 3 to 4000 hours was determined. The dominant source of storage value is backup fuel savings with additional value derived from increased capital equipment utilization and elimination. A computer simulation was used to model the operation of the solar IPH system and predict the amount of fuel saved by heat delivered from storage. Sensitivity of storage value of process temperature, collector cost, load profile, insolation, and storage efficiency was calculated. Storage values ranged from heat zero t as high as $42/kWH of storage capacity. DOE

N81-28586# Sandia Labs., Albuquerque, N. Mex.
INCENTIVES FOR SOLAR ENERGY IN INDUSTRY
Kenneth D. Bergeron May 1981 33 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0048) Avail: NTIS HC A03/MF A01

Several issues are analyzed on the effects that government subsidies and other incentives have on the use of solar energy in industry, as well as on other capital-intensive alternative energy supplies. Discounted cash flow analysis is used to compare tax deductions for fuel expenses with tax credits for capital investments for energy. The result is a simple expression for tax equity. The effects that market penetration of solar energy has on conventional energy prices are analyzed with a free market model. It is shown that net costs of a subsidy program to the society can be significantly reduced by price. Several government loan guarantee concepts are evaluated as incentives that may not require direct outlays of government funds; their relative effectiveness in achieving loan leverage through project financing, and their cost and practicality, are discussed. DOE

N81-28587# Battelle Pacific Northwest Labs., Richland, Wash.
PHOTOVOLTAICS
J. E. Garnier Apr. 1981 31 p refs Prepared for Washington Univ., Bellingham
(Contract DE-AC06-76RL-01830)
(PNL-SA-9464) Avail: NTIS HC A03/MF A01

Drawings, graphs, and brief notes are presented. They are used to outline the theory of solar cells and the national photovoltaic program. DOE

N81-28588# Sandia Labs., Albuquerque, N. Mex.
IMPLEMENTATION PLAN (MAY 1979): BATTERIES FOR SPECIFIC SOLAR APPLICATIONS
Robert P. Clark Apr. 1981 18 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-0216) Avail: NTIS HC A02/MF A01

The scope and objectives of the batteries for specific solar applications Project (BSSAP) are discussed. The BSSAP consists of five major tasks: (1) Battery Requirements Analysis, (2) Laborator Evaluation; (3) Photovoltaic Advanced Systems Tests; (4) Photovoltaic Applications Experiments; and (5) Battery Research and Development. All five tasks are described, and the schedule and milestones for completing each task are listed. Requirements for annual reporting and reviews are specified, and the ESSAP is linked to the existing Sandia/DOE PV Project. DOE

N81-28591# California Energy Commission, Sacramento.
DIFFUSION OF SOLAR ENERGY TECHNOLOGIES IN THE NEW-CONSTRUCTION MARKET: A SURVEY OF NEW SOLAR-HOME AND CONVENTIONAL-HOME BUYERS
Diana Rains, Deborah Dunipace, and C. K. Woo Feb. 1981 64 p
(DOE/EIA-10189/T2) Avail: NTIS HC A04/MF A01

Consumer motivations for choosing a solar energy equipped home when the nonsolar or conventional model was available were investigated. The approach was to test the relative importance of demographic, dwelling unit, and heating system characteristics in household decisions to purchase a home equipped with solar energy devices. Two statistical models were developed: one to examine the relationship between the types of home buyers (as an identifiable market segment) and the decision to purchase a solar home; and the other to compare the energy use of solar vs. conventional homes selected in the sample. DOE

N81-28603# National Bureau of Standards, Washington, D.C. Center for Building Technology.
WIND, EARTHQUAKE, SNOW, AND HAIL LOADS ON SOLAR COLLECTORS
Louis Cattaneo, James Robert Harris, Timothy A. Reinhold, Emil Simiu, and Charles W. C. Yancey Jan. 1981 95 p refs Sponsored in part by DOE
(PB81-164550; NBSIR-81-2199) Avail: NTIS HC A05/MF A01 CSCL 10A

Wind-tunnel, full-scale, and field studies of wind and snow loads on flat plate solar collectors are described and results are used to develop information, guidelines, and criteria for the design of flat plate collectors subjected to the action to wind, snow, and earthquake loads. Also given are data on hail loads, based on information and studies available in the literature. GRA

N81-29189# Ames Lab., Iowa. Materials Sciences Program.
PREPARATION OF HIGH-PURITY SILICON USING THERMITE REACTIONS Final Report, 1 Oct. 1979 - 30 Nov. 1980
F. A. Schmidt and D. K. Rehbein 1980 106 p refs Sponsored in part by ARCO Solar, Inc.
(Contract W-7405-eng-82)
(IS-4762) Avail: NTIS HC A06/MF A01

A preparation of silicon by metallothermic reduction of sodium fluorosilicate (Na2SiF6) and silicon tetrafluoride (SiF4) using magnesium and sodium was evaluated. Reduction of Na2SiF6 with magnesium gave a product containing 35 to 42 wt % magnesium. The impurities from the Na2SiF6 were found to concentrate in the silicon alloy produced. Reduction with sodium yielded finely divided silicon in a salt matrix. The reduction of SiF4 produced by the thermal dissociation of Na2SiF6 was then investigated. With magnesium as reductant, no thermal booster was required but the product was again a silicon magnesium alloy. A small quantity of silicon comparable in purity to that produced from the silane process was also prepared by the sodium reduction of SiF4. A preliminary cost analysis of producing 225 kg of silicon per day by the metallothermic reduction of SiF4 with sodium was also prepared. DOE

N81-29255# SRI International Corp., Menlo Park, Calif.
SOLAR PHOTO-CATALYTIC HYDROGEN: SYSTEMS CONSIDERATIONS, ECONOMICS, AND POTENTIAL MARKETS Final Report
Robert V. Steele and Jeffrey G. Witwer May 1981 87 p refs
(Contract DE-AC03-80ER-10190; SRI Proj. CRU-2043)
(DOE/ER-10190/T1) Avail: NTIS HC A05/MF A01

A three part analysis was done consisting of an examination of the physcial principles of solar photocatalytic energy conversion and the status of research in this area, an economic analysis of the potential costs of producing hydrogen from such a system, and an analysis of the markets for hydrogen and the possible penetration of these markets by solar photocatalytic hydrogen. The cost range of flat plate thermal collectors, heliostats, and a photovoltaic system are compared. The cost range of flat plate thermal collectors was used to represent the cost of photocatalytic systems. On the basis o the photovoltaics cost outlook, it is found that photocatalytic systems would not cost less than $180 to $330 per sq m range. On the basis of the heliostat cost outlook; a cost lower than $180 to $330 per m could be projected only for very large production volumes and very large installations. DOE

N81-29270# California Univ., Livermore. Lawrence Livermore Lab.
SOLAR COAL GASIFICATION: PLANT DESIGN AND ECONOMICS
William R. Aiman, Charles B. Thorsness, and David W. Gregg 23 Feb. 1981 12 p refs Presented at the 73rd Ann. Meeting of the Am. Inst. of Chem. Engr., Chicago, Nov. 1980 Revised Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84610-Rev-1; CONF-801104-6) Avail: NTIS HC A02/MF A01

A plant design was layed out in which focused solar energy is used to gasify coal and the resulting synthesis gas is converted into pipeline gas. The overall performance of the plant and its economics were compared to a similar Lurgi plant. The advantage of the solar coal gasification (SCG) method is conservation of coal, 40% more product can be produced from a given amount of coal. The primary detriment of SCG is he 8 h/day operation; which leads to a higher plant investment for a given annual production. This factor is twice as important as the cost of the

heliostat field. Thus, operating costs are lower but capital costs are higher. DOE

N81-29305# Mueller Associates, Inc., Baltimore, Md.
AIR LEAKAGE IN RESIDENTIAL SOLAR HEATING SYSTEMS
Jefferson G. Shingleton, David E. Cassel, and Ronald L. Overton Feb. 1981 200 p refs Sponsored in part by DOE, Washington, D.C. and HUD, Washington, D.C.
(Contract NBS-78-SBCA-3534)
(PB81-176380; NBS-GCR-81-302) Avail: NTIS HC A09/MF A01 CSCL 13A

A series of computer simulations was performed to evaluate the effects of component air leakage on system thermal performance for a typical residential solar heating system, located in Madison, Wisconsin. Auxiliary energy required to supplement solar energy for space heating was determined using the TRNSYS computer program, for a range of air leakage rates at the solar collector and pebble bed storage unit. The effects of heat transfer and mass transfer between the solar equipment room and the heated building were investigated. The effect of reduced air infiltration into the building due to pressurized by the solar air heating system were determined. A simple method of estimating the effect of collector array air leakage on system thermal performance was evaluated, using the f CHART method. GRA

N81-29396# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
DIRECT CONTACT LIQUID-LIQUID HEAT EXCHANGER FOR SOLAR HEATED AND COOLED BUILDINGS Final Report, 1 Jan. 1979 - 30 May 1980
Susumu Karaki and P. Brothers Jun. 1980 161 p refs
(Contracts DE-AS02-76CS-32867; EY-76-S-02-2867)
(DOE/CS-32867/12; C00-2867-8) Avail: NTIS HC A08/MF A01

The technical and economic feasibility of using a direct contract liquid-liquid heat exchanger (DCLLHE) storage unit in a solar heating and cooling system is established. Experimental performance data were obtained from the CSU Solar House I using a DCLLHE for both heating and cooling functions. A simulation model for the system was developed. The model was validated using the experimental data and applied in five different climatic regions of the country for a complete year. The life-cycle cost of the system was estimated for each application. The results are compared to a conventional solar system, using a standard shell-and-tube heat exchanger. It is concluded that while there is a performance advantage with a DCLLHE system over a conventional solar system, the advantage is not sufficiently large to overcome slightly higher capital and operating costs for the DCLLHE system. DOE

N81-29399# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
DIRECT CONTACT LIQUID-LIQUID HEAT EXCHANGER FOR SOLAR-HEATED AND COOLED BUILDINGS Final Report, 1 Jan. 1979 - 30 May 1980
S. Karaki and P. Brothers Jun. 1980 165 p refs
(Contract DE-AS02-76CS-32867)
(DOE/CS-32867/T1) Avail: NTIS HC A08/MF A01

The procedure used was to obtain experimental performance data from a solar system using a DCLLHE for both heating and cooling functions, develop a simulation model for the system, validate the model using the data, apply the model in five different climatic regions of the country for a complete year, and estimate the life-cycle cost of the system for each application. The results are compared to a conventional solar system, using a standard shell-and-tube heat exchanger. DOE

N81-29402# Bechtel National, Inc., San Francisco, Calif.
PRELIMINARY HEAT PIPE TESTING PROGRAM Final Technical Report
Mar. 1981 282 p refs Sponsored in part by Dynatherm Corp. and Foster Wheeler Development Corp.
(Contract DE-AC03-79SF-10756)
(DOE/SF-10756/1) Avail: NTIS HC A13/MF A01

The combined cycle solar power system studies are described. The heat pipe receiver analysis and its results are presented. The test plans and designs of the test stands and test articles are described. The test results and evaluation of these results are presented. Author (DOE)

N81-29403# E-Tech, Inc., Atlanta, Ga.
SOLAR-ASSISTED HEAT PUMP FIELD PERFORMANCE EVALUATION Final Report
28 Nov. 1980 151 p refs
(DOE/SF-10549/T1) Avail: NTIS HC A08/MF A01

An analysis carried out to determine some guidelines to use in laying out six ground coil installations is summarized. The installation of the solar assisted ground coupled heat pumps is described. The instrumentation employed at each of the installations in order to obtain performance data is discussed. DOE

N81-29436# Oak Ridge National Lab., Tenn. Solid State Div.
APPLICATIONS OF LASER ANNEALING AND LASER-INDUCED DIFFUSION TO PHOTOVOLTAIC CONVERSION First Year Report, 1 Mar. 1980 - 28 Feb. 1981
Douglas H. Lowndes, Rosa T. Young, and Richard F. Wood 1981 20 p refs Presented at the High Efficiency Concentrator and 3-5 Compd. Contractors In-Depth Rev. Meeting, Raleigh, N.C., 31 Mar. - 2 Apr. 1981
(Contract W-7405-eng-26)
(CONF-810349-1) Avail: NTIS HC A02/MF A01

It is demonstrated that a variety of techniques involving pulsed laser irradiation of both single crystal and polycrystalline silicon by pulsed lasers can result in the reproducible achievement of high efficiency silicon solar cells. Pulsed laser annealing after an ion implantation step results in melting (for a time of order 100 nsec) and essentially defect free liquid phase epitaxial regrowth with approx. 0.5 microns of the surface. Complete electrical activation of a number of dopant ions, at concentrations exceeding ordinary solubility limits, is demonstrated and crystalline (polycrystalline) silicon solar cell efficiencies of 16.6 percent (12.5 percent) obtained. Unique and beneficial advantages of pulsed laser processing in polycrystalline silicon are discussed. DOE

N81-29459# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
EVALUATION OF CONVENTIONAL ELECTRIC POWER GENERATING INDUSTRY QUALITY ASSURANCE AND RELIABILITY PRACTICES
R. T. Anderson and H. A. Lauffenburger Mar. 1981 110 p refs
(Contract DE-AC02-77CH-00178)
(SERI/TR-742-784) Avail: NTIS HC A06/MF A01

The techniques and practices utilized in an allied industry (electric power generation) that might serve as a baseline for formulating Quality Assurance and Reliability (QA and R) procedures for photovoltaic solar energy systems were studied. The study results provide direct near term input for establishing validation methods as part of the SERI performance criteria and test standards development task. DOE

N81-29526*# SRI International Corp., Menlo Park, Calif.
AN ANALYSIS OF SOLAR PANEL ASSEMBLY AS A PRISON INDUSTRY
Ruth M. Lizak Nov. 1980 84 p refs
(Contract NAS2-10143; SRI Proj. 8134)
(NASA-CR-166158) Avail: NTIS HC A05/MF A01 CSCL 10A

An analysis of the effect of manufacturing solar collectors by California prison inmates is presented. It was concluded that the concept is feasible and would have little adverse effect on the private sector's solar industry. L.F.M.

N81-29533*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PERFORMANCE EVALUATION OF THE SOLAR BUILDING TEST FACILITY
Ronald N. Jensen Aug. 1981 27 p refs
(NASA-TM-83127; L-14595) Avail: NTIS HC A02/MF A01 CSCL 10A

The general performance of the NASA Solar Building Test Facility (SBTF) and its subsystems and components over a four year operational period is discussed, and data are provided for

a typical one year period. The facility consists of a 4645 sq office building modified to accept solar heated water for operation of an absorption air conditioner and a baseboard heating system. An adjoining 1176 sq solar flat plate collector field with a 114 cu tank provides the solar heated water. The solar system provided 57 percent of the energy required for heating and cooling on an annual basis. The average efficiency of the solar collectors was 26 percent over a one year period. M.G.

N81-29537# Solaron Corp., Englewood, Colo.
DEVELOPMENT OF A HIGH PERFORMANCE AIR HEATER THROUGH USE OF AN EVACUATED TUBE COVER DESIGN Final Report
D. E. Jones, L. E. Shaw, and G. O. G. Loef 1981 137 p refs
(Contracts DE-AC04-78CS-34193; EM-78-C-04-4193)
(DOE/CS-34193/T1) Avail: NTIS HC A07/MF A01

Work consisted of a literature survey, fabrication of the tubes, solar transmittance tests, thermal conductance tests, collector design, prototype construction; prototype testing, and finally performance and cost evaluation. Two types of evacuated tubes were manufactured, clear tubes and tubes with an infrared reflective coating. The tubes were arranged parallel in a close packed flat array to form a transparent cover for the collector. The array transmittance of clear tubes is similar to that of two flat sheets of low absorptance glass. The coated tube array had substantially reduced transmittance. Thermal conductance tests indicated that the tube arrays perform similar to two flat sheets of glass with an evacuated space. DOE

N81-29538# Kimpel (Timothy H.), Roseville, Ohio.
USING THE SUN AND WASTE WOOD TO HEAT A CENTRAL OHIO HOME Final Technical Report, 1 Sep. 1980 - 1 Mar. 1981
Timothy H. Kimpel 1981 39 p
(Contract DE-FG02-79R5-10146)
(DOE/R5-10146/2) Avail: NTIS HC A03/MF A01

A house in Ohio built on a south facing slope with two levels above ground on the north, east, and west sides and three levels exposed to the southern winter Sun is described. The following topics are discussed: a general history of the project; operation of the system; backup heat source (wood); collection of data; and the procedure for determining actual heat loss. The calculation of the solar contribution percentage and the amount of mass to be included in the greenhouse and problems with an indirect gain wall are also discussed. The location of the wood stove in the system is noted and east wall temperature data are given. Soil temperature, air infiltration, thermal comfort, and energy usage are enumerated. DOE

N81-29541# Wisconsin Univ. - Madison.
APPLICATION OF SOLAR HOT WATER AND GEOTHERMAL PRINCIPLES TO CLOSED-CYCLE AQUACULTURE Final Report
Richard A. Yanzito Apr. 1981 51 p
(Contract DE-FG02-80R5-10253)
(DOE/R5-10253/1) Avail: NTIS HC A04/MF A01

The design of an underground silo where warm water food fish could be raised to market size under controlled conditions. The building and solar concept analysis for the closed cycle aquaculture system are described. Energy conservation features of the design include Earth berming and insulation of the production silo and enclosure, a waste water reclaim system and a solar heating system. Much of the water surface area is covered with removable plants to minimize evaporative heat losses. An energy conservation analysis is also reported and the F-Chart computer program is described. The system chosen utilizes single glazed flat plate collectors in a closed loop antifreeze system. Makeup water is introduced during an 8 hour period each day. Solar energy is transferred from the antifreeze solution to the makeup water after it leaves the waste water heat exchanger. DOE

N81-29544# JBF Scientific Corp., Wilmington, Mass.
NORTHEAST REGIONAL ASSESSMENT STUDY FOR SOLAR ELECTRIC OPTIONS IN THE PERIOD 1980 - 2000
Apr. 1981 330 p refs
(Contract DE-AC06-77ET-20375)
(DOE/ET-20375/T1) Avail: NTIS HC A15/MF A01

Opportunities for demonstration and large scale deployment of solar electric facilities are identified and assessed. Technical, economic, and institutional factors that can contribute to an accelerated use of solar energy for electric power generation are defined. The following topics are covered: a description of the Northeast Region and its solar resources, central station applications, a dispersed user analysis; user viewpoints and institutional factors, and market potential for dispersed solar electric systems. DOE

N81-29549# Acurex Corp., Mountain View, Calif. Alternate Energy Div.
SOLAR PRODUCTION OF INDUSTRIAL PROCESS STEAM. PHASE 2: FABRICATION AND INSTALLATION Final Report, 1 Jul. 1978 - 31 Jan. 1980
S. B. Youngblood Feb. 1981 173 p refs
(Contract DE-AC03-77CS-31713)
(SAN-1713-3) Avail: NTIS HC A08/MF A01

A solar facility that provides 445 K (345 F) process steam is described. The facility consists of 1070 sq m (11,520 sq ft) of parabolic trough concentrating collectors, an 18,921 l (5000 gal) flash boiler, and a 20 hp circulating pump. The construction, startup/checkout, costs, and performance of this solar facility are summarized. DOE

N81-29552# Los Alamos Scientific Lab., N. Mex. Economics Group.
REGIONAL VARIATION IN SOLAR ENERGY ECONOMIC PERFORMANCE
Dean Brunton, Christina Kirschner, Shaul Ben-David, and Fred Roach 1981 5 p refs Presented at the Ann. of the Intern. Solar Energy Soc., Philadelphia, 26-29 May 1981 Prepared in cooperation with New Mexico Univ., Albuquerque
(Contract W-7405-eng-36)
(LA-UR-81-1203; CONF-810509-35) Avail: NTIS HC A02/MF A01

A solar economic performance code (EASE-III) was used to indicate the extent of production function variations as applied to a Trombe wall solar design incorporated in a new home. The economic performance of the solar heated residence was compared to the alternative non solar home heated by the characteristic conventional fuel of each region. These economic results are used to discuss the impact of subsidy programs. DOE

N81-29555# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
SOLAR-ENERGY STORAGE-SYSTEMS ANALYSIS
R. W. Leigh Apr. 1981 9 p refs Presented at the Contractor's Inform. Exchange Meeting, Chicago, Apr. 1981
(Contract DE-AC02-76CH-00016)
(BNL-29405; CONF-810459-3) Avail: NTIS HC A02/MF A01

Systems analysis activities related to energy storage in solar applications are described, and the purpose, methods and, where available, the results of each study are summarized. Areas of investigation include storage of electrical and thermal energy in solar total energy systems, a theoretical investigation of the value of storage, and the national fuel displacement potential of semi-passive solar storage walls. The cost effectiveness of a spectrum of passive solar storage devices and the value of several possible improvements in these devices are also subjects of interest. DOE

N81-29562# Sandia Labs., Albuquerque, N. Mex.
COMPARATIVE ANALYSIS OF COMBINED FLAT-PLATE PV/T COLLECTORS WITH SEPARATE PHOTOVOLTAIC AND THERMAL COLLECTORS
E. R. Hoover 1981 6 p refs Presented at the 15th IEEE PV Specialists Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2217C; CONF-810526-3) Avail: NTIS HC A02/MF A01

The conditions under which a combined photovoltaic/thermal (PV/T) collector is more cost effective than separate flat-plate photovoltaic and thermal collectors were determined. The annual performance of the separate PV/T system and four different combined PV/T systems were simulated. Based on the equivalent electrical and thermal outputs and the 1986 DOE cost goal for PV modules (70 cents/Wp), the maximum allowable incremental cost to upgrade the conventional thermal collector to a combined PV/T collector was determined. For all of the

cases considered, the separate PV/T collectors are more cost effective than the combined PV/T collectors. DOE

N81-29563# Sandia Labs., Albuquerque, N. Mex.
THERMAL IMPEDANCE EFFECTS IN GaAs HIGH CONCENTRATION PHOTOVOLTAIC CELLS
R. J. Chaffin 1981 5 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2333C; CONF-810526-4) Avail: NTIS HC A02/MF A01

Heteroface GaAs cells were proposed for use at high concentration levels (up to 600 suns). Economic studies of photovoltaic arrays at high concentration have shown that efficiency increases of a few percent cell cost increases of 100 to 200% while maintaining the array cost at a constant $/Wp. Typical thermal heat sink designs will reduce cell efficiencies at high concentrations by similar or larger amounts. Measurements on typical GaAs assemblies are presented. These data show that improved thermal designs are needed to fully take advantage of concentrator economics at high insolations. DOE

N81-29564# Sandia Labs., Albuquerque, N. Mex.
DEVELOPMENT AND EVALUATION OF A LOW-COST PHOTOVOLTAIC CONCENTRATOR MODULE
B. D. Shafer, C. B. Stillwell, and H. Togami 1981 6 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1210C; CONF-810526-7) Avail: NTIS HC A02/MF A01

The module is 0.85 by 0.85 meters by 0.2 meters deep. It can be configured for stand alone applications of several hundred watts or used as a basic building block for multi-kilowatt systems. Measurements indicate an efficiency of 13.7% at 28 C cell temperature. The module has excellent potential for competitiveness in today's $5 to 10/watt market as well as the projected lower costs for future markets. DOE

N81-29565# Sandia Labs., Albuquerque, N. Mex.
COST EFFECTIVENESS OF CONCENTRATING PHOTOVOLTAIC-THERMAL (PVT) SYSTEMS VS. SIDE-BY-SIDE SYSTEMS FOR TWO INTERMEDIATE APPLICATIONS
M. Rios, Jr., M. W. Edenburn, and P. A. Allen 1981 10 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1219C; CONF-810526-6) Avail: NTIS HC A02/MF A01

Hour-by-hour simulations of the performance of three solar energy systems - concentrating photovoltaic-thermal (PVT), flat panel photovoltaic with conventional thermal (FPPV/CT) system, and flat panel photovoltaic with solar thermal (FPPV/ST) system were conducted. Life-cycle-cost analyses were than conducted for array sizes ranging from 31 k W sub p to 936 kW sub p. The three systems were compared to each other by computing the ratio of the annual cost of each system to the annual cost of conventional energy. It is concluded that, of the three systems analyzed. PVT potentially has the highest break-even costs with conventional energy; the cost effectiveness of PVT vs FPPV/CT is very strongly dependent on the ratios of direct normal to total solar availability; and at $1/W sub p ($84 sq m) for flat panel PV modules and $120/sq m for solar thermal collectors, PVT collectors can cost up to about $195/sq m for breakeven with FPPV/ST. DOE

N81-29566# General Electric Co., Schenectady, N. Y.
POINT-FOCUS CONCENTRATOR SOLAR CELL MOUNTS USING DIRECT-BONDED COPPER
H. F. Webster, N. F. Shepard (General Electric Co., Philadelphia, Pa.), and E. P. Jochym (General Electric Co., Syracuse, N.Y.) 1981 24 p refs Presented at 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-7111C; CONF-810526-5) Avail: NTIS HC A02/MF A01

A solar cell mount assembly was developed for use in 70 suns which will provide the cell with adequate cooling and electrical isolation over a long operating life. The assembly consisted of a copper to alumina to copper sandwich which was made by the direct bonding process. This sandwich was attached to the cell and the copper mounting stud by the use of a low fatigue solder. This mount was designed to be part of a system built to meet the 1980 cost goal of $2.80 per watt of electrical output. DOE

N81-29567# Sandia Labs., Albuquerque, N. Mex. Solar Technical Liaison Div.
USE OF ALUMINUM IN SOLAR ENERGY
Robert P. Stromberg 1980 26 p Presented at the Aluminum Assoc. Alternate Energy Workshop, Washington, D.C., 8 Oct. 1980
(Contract DE-AC04-76DP-00789)
(SAND-81-0604C; CONF-8010178-1) Avail: NTIS HC A03/MF A01

Current solar hardware for electric power generation being tested or in place at some industrial plants was briefly reviewed. The use of aluminum in the solar industry and the economics of aluminum requirements in the industry as they currently exist are discussed broadly. Many photographs illustrate the presentation. DOE

N81-29568# Sandia Labs., Albuquerque, N. Mex. Photovoltaic Projects Div.
PHOTOVOLTAIC SYSTEM DEFINITION AND DEVELOPMENT PROJECT
Mar. 1981 230 p Abstracts of proceedings of 2nd Project Integration Meeting of the Sandia Photovoltaic Systems Definition and Development Proj., Albuquerque, N. Mex., 7-8 Apr. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-0823C; CONF-810453) Avail: NTIS HC A11/MF A01

The objectives of the project intgration meeting were to: overview the plans and strategy of the Department of Energy (DOE) Photovoltaic Program in the context of photovoltaic systems development; exchange information on ongoing work and related activities; and provide a means of coordinating project activities. This meeting emphasized balance of system technology development activities for grid-connected applications. Presentations covered application specific subsystem requirements, current cost and hardware data, and assessments of future development directions. Abstracts of the presentations are included. DOE

N81-29569# Sandia Labs., Albuquerque, N. Mex.
CHARACTERIZATION OF p+nn+ SILICON CONCENTRATOR SOLAR CELLS
R. D. Nasby, C. M. Garner, H. T. Weaver, F. W. Sexton, and J. L. Rodriguez 1981 6 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(SAND-80-2196C; CONF-810526-12) Avail: NTIS HC A02/MF A01

The conversion efficiency, temperature coefficients of performance parameters, and the linearity of the short circuit current with irradiance are reported for silicon p+nn+ concentrator solar cells of 0.3 ohm-cm base resistivity. Conversion efficiencies of 20 percent at 27 C were measured on the best cells over concentrations from 20 to 100 suns. A value of 0.26 percent/C was determined for the normalized temperature coefficient of efficiency for irradiance levels at which the efficiency was maximum. The deviation from linearity of the short circuit current irradance was measured and found to be slightly superlinear in the multihundred-sun concentration range. Performance of cells with 1.0 and 10 ohm-cm base resistivities were also measured, and experimental and theoretical comparisons are made between the three cell types. DOE

N81-29573# Oklahoma State Univ., Stillwater. School of Technology.
DESIGN AND FIELD TESTING OF SOLAR-ASSISTED EARTH COILS Final Report, 1 Aug. 1978 - 31 Jan. 1981
J. E. Bose 1981 106 p
(Contracts DE-AS03-79CS-30210; EM-78-S-01-4257)
(DOE/CS-30120/T1) Avail: NTIS HC A06/MF A01

A nominal 1000-foot, 4-inch, PVC coil buried in a serpentine pattern is the heat source/sink for two commercial heat pump systems. This system is vented which allows the easy placement of thermocouples down its length to measure changes in temperature as well as changes in overall U values as a function of length. Integral to the earth coil is a 1000-gallon uninsulated water storage tank in which solar energy from 210 sq ft of solar collectors (single-glazed, metal absorber) can be added directly to the heat pump, circulated through the 1000-foot earth coil system, or added to an insulated storage tank for direct

transfer. Temperature ranges for this type of system at the four-foot level are from a nominal range of 78OF to a low of 42OF in the absence of heat rejection of absorption. The second type of earth coil was a vertical coil approximately 240 feet in length. The vertical heat exchanger consists of a 5-inch PVC pipe which is capped at both ends and pressurized at approximately 15 PSIG. This sealed and pressurized heat exchanger allows a low power pump to circulate water through both the heat pump and vertical heat exchanger system. DOE

N81-29574# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
LOW-COST EVACUATED-TUBE SOLAR COLLECTOR. APPENDICES, VOLUME 2 Final Report, 15 Sep. 1978 - 31 May 1980
31 May 1980 392 p
(Contract EM-78-C-04-4228)
(DOE/CS-30133/T1-Vol-2) Avail: NTIS HC A17/MF A01

A low cost solar heat energy collector module and array was designed using the evacuated tube, selective absorber, air cooled concept. Glass tubing as used in fluorescent lamps with automatic sealing methods is a key feature of the evacuated tube design. A molded fiber glass concentrating reflector panel and sheet metal header assembly are proposed. Major design problems involved included the cost of materials and labor, thermal expansion and distortion problems, high stagnation and operating temperatures, isolation, thermal efficiency, sealing, joining, air pressure drop, and weight of the preassembled module. A cost of less than $5 per active square foot of collecting surface has been estimated for materials and labor of the module and its mounting frame. DOE

N81-29576# ECA, Inc., Woodridge, Ill.
ATMOSPHERIC CORROSION OF BATTEN AND ENCLOSURE MATERIALS FOR FLAT PLATE SOLAR COLLECTORS
Sep. 1980 38 p refs
(Contract W-31-109-eng-38)
(ANL/EES/TM-135) Avail: NTIS HC A03/MF A01

Sensors at nine test sites provided atmospheric data. Other data were obtained by analyzing corrosion samples that were exposed for varying periods of time. The results of the first test period are summarized. DOE

N81-29577# Automation Industries, Inc., Silver Spring, Md. Vibro Labs. Div.
SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION, OCTOBER 1979-APRIL 1980: BOND CONSTRUCTION, GLADSTONE, MISSOURI
E. N. Ashman 1980 84 p refs
(Contract DE-AC01-79CS-30027)
(SOLAR/1050-81/14) Avail: NTIS HC A05/MF A01

This active solar system uses 465 sq ft of liquid flat plate collectors and an 800-gallon steel tank for storage. The system was designed to provide 58% of the heating load and 85% of the hot water. Due to control and equipment problems, the system supplied 16% of the space heating and 48% of the domestic hot water requirements during times when the system operated. DOE

N81-29578# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION FOR HELIO-THERMICS, INC., LOT 6 SINGLE FAMILY RESIDENCE; GREENVILLE, SOUTH CAROLINA
D. Moore 19 Mar. 1981 58 p
(Contract DE-AB01-76CS-31020)
(SOLAR/1025-81/50) Avail: NTIS HC A04/MF A01

An instrumented single family residence in Greenville, South Carolina, has approximately 1086 square feet on conditioned space. Solar energy is used for space heating the home and preheating domestic and water (DHW). Solar energy enters the attic through a 416 square foot aperture which is double glazed with corrugated, translucent, fiberglass reinforced, acrylic panels. Warm air accumulates in the peak of the attic roof and circulates through the conditioned space or through storage by an air handler. Solar energy is stored in an 870 cubic foot storage bin containing 85,460 pounds of crushed rock located under the house. cold water is preheated in the attic by thermosiphoning water from the 80 gallon preheat tank through a manifold system of copper tubes. These tubes are attached to black sheet metal plates. Preheated city water is stored in the preheat tank and supplied, on demand, to a conventional 80 gallon DHW tank. When solar energy is insufficient to satisfy the space heating load, a water to air heat exchanger in the hot air supply duct provides auxiliary energy for space heating. A gas fired water heater provides auxiliary energy for the water to air heat exchanger and the DHW. DOE

N81-29579# G K Systems, Inc., Westlake Village, Calif.
TRACKING INSTRUMENT AND CONTROL FOR SOLAR CONCENTRATORS Final Technical Report, Oct. 1979 - Jan. 1981
John Gray and John Kuhlman 31 Jan. 1981 176 p
(Contract DE-AC01-79ET-21109)
(DOE/ET-21109/T1) Avail: NTIS HC A09/MF A01

The tracker users a single photo sensor, and a rotating aperature to obtain tracking accuracies better than 1.5 mrads (0.1 degs). Peak signal detection is used to eliminate tracking of false sources, i.e., clouds, etc. A prism is employed to obtain an extended field of view (150 degs axially - 360 degs radially). The tracker digitally measures the Sun's displacement angle relative to the concentrator axis, and repositions it incrementally. This arrangement permits the use of low cost nonservo motors. The local controller contains microprocessor based electronics, incorporating digital signal processing. DOE

N81-29581# Martin Marietta Corp., Denver, Colo.
SOLPAS: PASSIVE SOLAR ALGORITHMS. USER'S MANUAL
Mar. 1981 189 p
(Contract DE-AC01-78CS-35243)
(MCR-81-543) Avail: NTIS HC A09/MF A01

This users' guide documents library of passive solar heating subroutines that are compatible with the generalized MITAS thermal network analyzer. The objective of the SOLPAS activity has been to develop and document the essential routines needed to perform passive solar simulations with the existing MITAS program. Several example models are described that could be adapted easily to specific user applications. The following are included: SOLPAS basic structure, alphabetical listing of SOLPAS routines; selected MITAS subroutines, and SOLPAS examples. DOE

N81-29583# Sandia Labs., Albuquerque, N. Mex. Systems Analysis Div.
EXPERIMENTAL PARABOLIC TROUGH COLLECTOR PERFORMANCE CHARACTERIZATION
L. L. Lukens May 1981 20 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0313) Avail: NTIS HC A02/MF A01

Experimental data from the Collector Module Test Facility at Sandia National Laboratories, Albuquerque, are used to develop a collector performance model and characterize three parabolic trough solar collectors. The independent variables used in the model are selected and fitted to the experimental data using a multiple linear regression technique. The collector model developed accounts for optical performance, including incident angle effects and thermal losses, both linear and nonlinear. DOE

N81-29591# Texas Technological Univ., Lubbock.
CELL STRING MODEL WITH MIRROR GAP SHADING FOR A PARABOLIC-TROUGH PHOTOVOLTAIC COLLECTOR
J. R. Burns and M. W. Edenburn Apr. 1981 44 p Prepared in cooperation with Sandia National Labs.
(Contract DE-AC04-76DP-00789)
(SAND-81-0069) Avail: NTIS HC A03/MF A01

A model is described of a photovoltaic cell string which is illuminated by a parabolic trough reflector. The model shows what effect reflector gaps have on cell illumination and how this effect influence shunting of dioded strings for various angles of solar incidence. The model was formulated to study diode string length and determine how best to maximize power under variant incidence angles. Qualitative results suggest that a nonuniform dioding arrangement would minimize power losses due to shunting; that small strings should be used where shading is most probable; and, for north-south axis collectors, that the receiver should be moved northward to avoid end losses and end shading of the receiver. DOE

N81-29592# Sandia Labs., Albuquerque, N. Mex. Automated Test Systems Development Div.
ON-SITE DATA ACQUISITION SYSTEM FOR PHOTOVOL-

TAIC APPLICATIONS EXPERIMENTS
Thomas L. Evans Apr. 1981 53 p
(Contract DE-AC04-76DP-00789)
(SAND-81-0897) Avail: NTIS HC A04/MF A01

This system is fully automated, and the acquired data is transmitted periodically to a remote Data Reduction Center for analysis and reporting. The data acquisition system can also be used for on site data presentations to facilitate photovoltaic system start up and prove in. DOE

N81-29599# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SOLAR INDUSTRIAL PROCESS HEAT: A STUDY OF APPLICATIONS AND ATTITUDES Final Report
V. Wilson Apr. 1981 75 p refs Prepared in cooperation with Insights West Inc., Los Angeles, Calif.
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-98348-1) Avail: NTIS HC A04/MF A01

Data were gathered through site visits to 100 industrial plants. The site specific data suggests several possible near term market opportunities for solar thermal energy systems. Plants using electricity as their primary fuel for industrial process heat were identified, on the basis of their high fuel prices, as attractive early entry markets for solar energy. Additional opportunities were reflected in plants that had accomplished much of their conservation plans, or bad sizeable percentages of their operating budgets committed to energy expenses. A suitability analysis identified eleven industrial plants as highly suitable for solar thermal applications, they included producers of fluid milk, pottery, canned and bottled soft drinks, fabricated structural metal, refined petroleum, aluminum cans, chrome and nickel plating and stamped frame metal and metal finishings. DOE

N81-29600# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ANALYSIS AND TEST OF LINE-COMMUTATED INVERTERS FOR USE IN RESIDENTIAL PHOTOVOLTAIC POWER SYSTEMS
E. E. Landsman 1981 9 p refs Presented at 15th IEEE PV Specialists Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/127; CONF-810526-2) Avail: NTIS HC A02/MF A01

The line-commutated inverter is a phase-controlled rectifier operating in the regenerative mode. Existing analyses emphasize rectifier mode of operation and there has been minimal treatment of the regenerative mode. A detailed theoretical analysis coupled with observation of operating inverters is leading to a better understanding of inverter operation which may lead to improvement in power factor and a reduction of harmonic currents. The normalized results of the theoretical analysis, test data, and waveforms are presented. DOE

N81-29601# Mueller Associates, Inc., Baltimore, Md.
ECONOMIC ANALYSIS OF COMMERCIAL SOLAR WATER-HEATING SYSTEMS
23 Sep. 1980 71 p
(Contract W-31-109-eng-38)
(ANL-K-80-55; MAI-Rept-203) Avail: NTIS HC A04/MF A01

The economic performance of solar energy systems is described through the use of Cash Flow Diagrams. The economic performance of solar energy systems is described through the calculation of equivalent Return-On-Investment (ROI). Appendices are included that enable one to calculate the ROI for any particular solar hot water system investment. DOE

N81-29602# Eisenstadt (Melvin) and Associates, Inc., Albuquerque, N. Mex.
PERFORMANCE WARRANTIES FOR RESIDENTIAL AND LIGHT-COMMERCIAL PHOTOVOLTAIC SYSTEMS
Melvin Eisenstadt Apr. 1981 101 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-7008) Avail: NTIS HC A06/MF A01

The warranty law and its liability is examined. The Uniform Commercial Code and the Federal Magnuson Moss Warranty Act are analyzed in regard to photovoltaic (PV) systems. Warranties written, oral, and those implied by law are discussed. The potential liabilities of manufacturers and sellers of PV equipment are investigated and legal methods to limit such liabilities are discussed. The PV warranties cover primarily materials, workmanship, and electrical performance; all are highly defective legally, none conform with the Magnuson-Moss Warranty Act, and potential liability under the Uniform commercial code is great. It is concluded that the PV industry lacks understanding of warranty law and its liabilities. E.A.K.

N81-29603# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PERFORMANCE EVALUATION OF A REFRIGERANT-CHARGED THERMOSYPHON SOLAR DHW SYSTEM
Robert Farrington, Michael DeAngelis, Louise Morrison, and Douglas Dougherty Apr. 1981 7 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC02-77CH-00178)
(SERI/TP-721-1140; CONF-810509-21) Avail: NTIS HC A02/MF A01

Refrigerant-charged passive solar domestic hot water (SDHW) systems, which can be installed even in freezing climates, may achieve the high performance and reliability of direct thermosyphon systems. The prototype was installed in a single-family residence using a stabilized R-11 as the heat transfer fluid. A system analysis was performed based on measured data. The analysis method and preliminary results, which indicate that there is reason to be optimistic about this type of system are discussed. DOE

N81-29608# Department of Agriculture, Clay Center, Nev. Meat Animal Research Center.
ANAEROBIC FERMENTATION OF BEEF CATTLE MANURE Final Report
A. G. Hashimoto, Y. R. Chen, and V. H. Varel Jan. 1981 76 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-98372-1) Avail: NTIS HC A05/MF A01

The conversion of livestock manure and crop residues into methane and a high protein feed ingredient by thermophilic anaerobic fermentation is summarized. The major biological and operational factors involved in methanogenesis are discussed, and a kinetic model that describes the fermentation process is presented. Substrate biodegradability, fermentation temperature, and influent substrate concentration to have significant effects on CH4 production rate. Assessment of the energy requirements for anaerobic fermentation systems showed that the major energy requirement for a thermophilic system was for maintaining the fermenter temperature. The next major energy consumption was due to the mixing of the influent slurry and fermenter liquor. An approach to optimizing anaerobic fermenter s by selecting design criteria that maximize the net energy production per unit cost is presented. DOE

N81-29609# Rockwell International Corp., Canoga Park, Calif. Energy Systems Group.
SOLAR REPOWERING SYSTEM FOR TEXAS ELECTRIC SERVICE COMPANY PERMIAN BASIN STEAM ELECTRIC STATION UNIT NO. 5, EXECUTIVE SUMMARY Final Report, 27 Sep. 1979 - 15 Jul. 1980
15 Jul. 1980 35 p refs
(Contract DE-AC03-76SF-10607)
(DOE/SF-10607/T1; ESG-80-22) Avail: NTIS HC A03/MF A01

The conceptual design and economic assessment of a sodium-cooled, solar central receiver repowering system are described. As expected, the economic assessment of the specific concept for that site indicates that the cost of energy is greater than that resulting from the burning of natural gas alone in the existing plant (principally as a result of the current cost of heliostats and the scheduled retirement date of Unit No. 5). Favorable economics for similar types of plants can be projected for the future. The annual fuel savings are equivalent to 218,500 barrels of crude oil, with a total dollar value of $21.5 M and $93.6 M for a 7-year life and a 25-year life, respectively. However, it has also been found that favorable interpretations of the Fuel Use Act and an improved regulatory climate will be necessary for this economic viability to be reached. DOE

N81-29610# Los Alamos Scientific Lab., N. Mex.
PHYSICS OF PASSIVE SOLAR BUILDINGS
J. D. Balcomb 1981 7 p refs Presented at Am. Soc. for Engr. Educ. Ann. Conf., Los Angeles, 22 Jun. 1981
(Contract W-7405-eng-36)
(LA-UR-81-903; CONF-810627-1) Avail: NTIS HC A02/MF A01

Methods to characterize and analyze passive solar buildings are discussed. Simplifying assumptions which make this analysis tractable without compromising significant accuracy or loss of insight into the basic physics of the situation are described. The overall nature of the mathematical simulation approach and validation procedures based on data from test rooms and monitored buildings are outlined. Issues of thermal comfort, simplified methods of analysis based on correlation procedures are reported and the nature of the economic conservation solar optimization process is explored. DOE

N81-29613# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
LOW-COST PASSIVE SOLAR-RETROFIT OPTIONS FOR MOBILE HOMES
S. Brant, Michael Holtz, and Mark Tasker Mar. 1981 7 p refs Presented at the AS/ISES Ann. Meeting, Philadelphia, 26-30 May 1981
(Contract EG-77-C-01-4042)
(SERI/TP-721-1138; CONF-810509-22) Avail: NTIS HC A02/MF A01

Passive solar heating and cooling retrofit options can significantly reduce the energy consumption of new and existing mobile homes. The initial efforts of the Solar Energy Research Institute to explore the solar potential for the existing stock of mobile homes and those in the production stage are described. DOE

N81-29626# Sandia Labs., Albuquerque, N. Mex.
INTRODUCING THE NEW PHOTOVOLTAIC DATA REDUCTION CENTER
H. D. Pruett, J. T. Muldoon (Boeing Computer Services, Seattle, Wash.), and H. Z. Kriloff (Boeing Computer Services, Seattle, Wash.) 1981 12 p refs Presented at Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2576C; CONF-810509-3) Avail: NTIS HC A02/MF A01

The center archives the data, analyzes it, and generates monthly performance reports of potential interest to researchers, designers, and other data users. Due to the rapidly evolving nature of the photovoltaic field, particular emphasis was placed on making reports available in a timely manner, and on making the DRC structure flexible enough to adapt to changing requirements. The overall structure incorporated in the data and information system is described, details of the hardware and software utilized are presented, and the output product (monthly performance reports) is illustrated with examples taken from experimental sites that are now operational. DOE

N81-29627# Sandia Labs., Albuquerque, N. Mex.
THE CVD ZrB2 AS A SELECTIVE SOLAR ABSORBER
E. Randich and D. D. Allred (Energy Conversion Devices, Troy, Mich.) 1981 12 p refs Presented at Intern. Conf. on Metallurgical Coatings, San Francisco, 6-10 Apr. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-2176C; CONF-810425-2) Avail: NTIS HC A02/MF A01

Coatings of ZrB2 and TiB2 for photothermal solar absorber applications were prepared using chemical vapor deposition (CVD) techniques. Oxidation tests suggest a maximum temperature limit for air exposure of 600 K for TiB2 and 800 K for ZrB2. Both materials exhibit innate spectral selectivity with emittance at 375 K ranging from 0.06 to 0.09 and solar absorptance for ZrB2 ranging from 0.67 to 0.77 and solar absorptance for TiB2 ranging from 0.46 to 0.58. ZrB2 has better solar selectivity and more desirable oxidation behavior than TiB2. A 0.071 micrometer antireflection coating of Si3N4 deposited on the ZrB2 coating leads to an increase in absorptance from 0.77 to 0.93, while the emittance remains unchanged. DOE

N81-30109# Johns Hopkins Univ., Laurel, Md.
US COAST GUARD STUDY ON SOLAR POWERED AIDS TO NAVIGATION (SPAN)
W. E. Allen and J. E. Tarr Feb. 1981 107 p refs Sponsored in part by Coast Guard
(PB81-190233; JHU/APL-SR-81-3) Avail: NTIS HC A06/MF A01 CSCL 17G

This study evaluates a system using a secondary battery, recharged daily to the extent practicable by a photovoltaic solar panel mounted on the aid. Factors affecting performance of this system are discussed. Nickel cadmium and lead acid batteries are evaluated and compared as energy storage elements, considering such factors as cycle life, allowable depth of discharge, and cost. Candidate charge regulators are also evaluated. Included in this report is a discussion of areas requiring further research. GRA

N81-30225# California Univ., Livermore. Lawrence Livermore Lab.
PROPOSED SOLAR-FURNACE STUDY OF ZINC SULFATE DECOMPOSITION
Oscar H. Krikorian and Pamela K. Shell 16 Apr. 1981 7 p refs Presented at the Solar Thermal Test Facilities Users Association Ann. Business and Technical Meeting, Pasadena, Calif., 20-24 Apr. 1981
(Contract W-7405-eng-48)
(UCRL-85743; CONF-810469-1) Avail: NTIS HC A02/MF A01

A solar furnace study of zinc sulfate is proposed. The advantages of the high temperatures and rapid heating rates provided by solar collectors for the decomposition of zinc sulfate. The use of a rotary kiln designed to improve the efficiency in working with solids that have low absorbtivities, such as solid sulfates, is planned. The overall goal is to establish the applicability of solar central receivers to thermochemical cycles that can use solid state sulfate decomposition as the high temperature step. DOE

N81-30255# Giner, Inc., Waltham, Mass.
CORROSION CONTROL MANUAL FOR ALUMINUM SOLAR-COLLECTOR PANELS USING GLYCOL-WATER SOLUTIONS FOR HEAT TRANSFER/FREEZE PROTECTION
May 1981 13 p
(Contract DE-AC04-79CS-31072)
(DOE/CS-31072/1) Avail: NTIS HC A02/MF A01

Types of general and localized corrosion of aluminum are described, and factors that initiate or accelerate corrosion are discussed. Recommendations are made for controlling corrosion of aluminum. Aluminum corrosion inhibitors are listed for use with ethylene glycol and propylene glycol, and instructions are given for preparing inhibited glycols. DOE

N81-30352 Rice Univ., Houston, Tex.
THE PHOTOTRON Ph.D. Thesis
Sedgwick Lewis Simons, Jr. 1981 107 p
Avail: Univ. Microfilms Order No. 8116995

A potentially more efficient mode of operation in which the electron period of motion is approximately half of the radio frequency (RF) period is considered. Computer plots of the electron trajectories reveal that unlike the multi-pass mode; this mode exhibits a genuine electron bunching process. Since these modes operate at low bias voltages an investigation of space charge effects and electron emisson energy was made. Theoretical results from a computer program based on an analysis by Guernsey and Fu show that potentials within the phototron can be dramatically reshaped by space charge, altering electron motion in the phototron and filtering show electrons out of the beam. Experimental measurements of the electron energy spectra document this filtering effect. Efficiency calculations show that the greatest restriction on overall efficiency is due to the photocathode itself. The test model tubes show a cathode efficiency of only about 1%, but better materials may improve this value to about 10%. If the efficiency of the conversion of dc to RF in the phototron can also be improved, an overall device efficiency of 1% for the conversion of sunlight into RF may be realized in the near future. Dissert. Abstr.

N81-30515*# Solarex Corp., Rockville, Md.
A MODULE EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT (MEPSDU) Quarterly Report, 1 Mar. - 31 May 1981
31 May 1981 52 p refs Sponsored by NASA and DOE Prepared for JPL
(Contract JPL-955902)
(NASA-CR-164673; DOE/JPL-955902-81/2; JPL-9950572; QR-2) Avail: NTIS HC A04/MF A01 CSCL 10A

The purpose of this program is to demonstrate the technical readiness of a cost effective process sequence that has the

potential for the production of flat plate photovoltaic modules which met the price goal in 1986 of $.70 or less per watt peak. Program efforts included: preliminary design review, preliminary cell fabrication using the proposed process sequence, verification of sandblasting back cleanup, study of resist parameters, evaluation of pull strength of the proposed metallization, measurement of contact resistance of Electroless Ni contacts, optimization of process parameter, design of the MEPSDU module, identification and testing of insulator tapes, development of a lamination process sequence, identification, discussions, demonstrations and visits with candidate equipment vendors, evaluation of proposals for tabbing and stringing machine. Author

N81-30516*# MB Associates, San Ramon, Calif.
PROCESS DEVELOPMENT FOR AUTOMATED SOLAR CELL AND MODULE PRODUCTION. TASK 4: AUTOMATED ARRAY ASSEMBLY Quarterly Report
John J. Hagerty 15 Jul. 1981 42 p
(Contract JPL-955699)
(NASA-CR-164682; DOE/JPL-955699-81/04; JPL-9950574; QR-4) Avail: NTIS HC A03/MF A01 CSCL 10A

Progress in the development of automated solar cell and module production is reported. The unimate robot is programmed for the final 35 cell pattern to be used in the fabrication of the deliverable modules. The mechanical construction of the automated lamination station and final assembly station phases are completed and the first operational testing is underway. The final controlling program is written and optimized. The glass reinforced concrete (GRC) panels to be used for testing and deliverables are in production. Test routines are grouped together and defined to produce the final control program. E.A.K.

N81-30519*# Union Carbide Corp., Oak Ridge, Tenn.
LOW COST SOLAR ARAY PROJECT: EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT FOR PRODUCING SEMICONDUCTOR-GRADE SILICON USING THE SILANE-TO-SILICON PROCESS Quarterly Progress Report, Apr. - Jun. 1981
Jun. 1981 71 p Sponsored by NASA and DOE Prepared for JPL
(Contract JPL-954334)
(NASA-CR-164680; DOE/JPL-954334-19; JPL-9950577) Avail: NTIS HC A04/MF A01 CSCL 10A

This phase consists of the engineering design, fabrication, assembly, operation, economic analysis, and process support R&D for an Experimental Process System Development Unit (EPSDU). The mechanical bid package was issued and the bid responses are under evaluation. Similarly, the electrical bid package was issued, however, responses are not yet due. The majority of all equipment is on order or has been received at the EPSDU site. The pyrolysis/consolidation process design package was issued. Preparation of process and instrumentation diagram for the free-space reactor was started. In the area of melting/consolidation, Kayex successfully melted chunk silicon and have produced silicon shot. The free-space reactor powder was successfully transported pneumatically from a storage bin to the auger feeder twenty-five feet up and was melted. The fluid-bed PDU has successfully operated at silane feed concentrations up to 21%. The writing of the operating manual has started. Overall, the design phase is nearing completion. Author

N81-30523*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.
DESIGN DATA PACKAGE AND OPERATING PROCEDURES FOR MSFC SOLAR SIMULATOR TEST FACILITY
Jun. 1981 174 p refs Sponsored in part by DOE
(Contract DEN8-6)
(NASA-CR-161825; WYLE-TR-531-48) Avail: NTIS HC A08/MF A01 CSCL 10A

Design and operational data for the solar simulator test facility are reviewed. The primary goal of the facility is to evaluate the performance capacibility and worst case failure modes of collectors, which utilize either air or liquid transport media. The facility simulates environmental parameters such as solar radiation intensity, solar spectrum, collimation, uniformity, and solar attitude. The facility also simulates wind conditions of velocity and direction, solar system conditions imposed on the collector, collector fluid inlet temperature, and geometric factors of collector tilt and azimuth angles. Testing the simulator provides collector efficiency data, collector time constant, incident angle modifier data, and stagnation temperature values. E.A.K.

N81-30525*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PARABOLIC DISH SOLAR THERMAL POWER ANNUAL PROGRAM REVIEW PROCEEDINGS
Herb J. Holbeck 1 May 1981 277 p refs Proceedings of conf. held in Pasadena, Calif., 13-15 Jan. 1981
(Contracts NAS7-100; DE-ATC4-81AL-16228)
(NASA-CR-164696; JPL-Pub-81-44; DOE/JPL-1060-46; JPL-5105-83) Avail: NTIS HC A13/MF A01 CSCL 10A

The development and testing of concentrators, receivers, and power conversion units are reported. System design and development for engineering experiments are described. Economic analysis and market assessments for advanced development activities are discussed. Technology development issues and application/user needs are highlighted. For individual titles, see N81-30526 through N81-30557.

N81-30526*# Ford Aerospace and Communications Corp., Newport Beach, Calif.
THE SCSE ORGANIC RANKINE ENGINE
Frank P. Boda *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 5-9

Avail: NTIS HC A13/MF A01 CSCL 10B

The engine is the heart of a Power Conversion Subsystem (PCS) located at the focal point of a sun-tracking parabolic dish concentrator. The ORC engine employs a single-stage axial-flow turbine driving a high speed alternator to produce up to 25 kW electrical output at the focus of each dish. The organic working fluid is toluene, circulating in a closed-loop system at temperatures up to 400 C (750 F). Design parameters, system description, predicted performance and program status are described. T.M.

N81-30527*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
JAY CARTER ENTERPRISES, INCORPORATED STEAM ENGINE
In its Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 11-15 refs

Avail: NTIS HC A13/MF A01 CSCL 10B

The Small Community Solar Thermal Power Experiment (SCSE) selected an organic rankine cycle (ORC) engine driving a high speed permanent magnet alternator (PMA) as the baseline power conversion subsystem (PCS) design. The back-up conceptual PCS design is a steam engine driving an induction alternator delivering power directly to the grid. The development of the automotive reciprocating simple rankine cycle steam engine and how an engine of similar design might be incorporated into the SCSE is discussed. A description of the third generation automotive engine is included along with some preliminary test data. Tests were conducted with the third generation engine driving an induction alternator delivering power directly to the grid. The purpose of these tests is to further verify the effects of expander inlet temperature, input thermal power level, expansion ratio, and other parameters affecting engine performance to aid in the development of an SCSE PCS. T.M.

N81-30528*# Foster-Miller Associates, Inc., Waltham, Mass.
STEAM ENGINE RESEARCH FOR SOLAR PARABOLIC DISH
Roger L. Demler *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Proc. 1 May 1981 p 17-22 refs

Avail: NTIS HC A13/MF A01 CSCL 10B

The parabolic dish solar concentrator provides an opportunity to generate high grade energy in a modular system. Most of the capital is projected to be in the dish and its installation. Assurance of a high production demand of a standard dish could lead to dramatic cost reductions. High production volume in turn depends upon maximum application flexibility by providing energy output options, e.g., heat, electricity, chemicals and combinations thereof. Subsets of these options include energy storage and combustion assist. A steam engine design and experimental program is described which investigate the efficiency potential of a small 25 kW compound reheat cycle piston engine. An engine efficiency of 35 percent is estimated for a 700 C steam temperature from the solar receiver. T.M.

N81-30529*# Garrett Turbine Engine Co., Phoenix, Ariz.
SOLAR BRAYTON ENGINE/ALTERNATOR SET
L. Six and R. Elkins *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 23-35

Avail: NTIS HC A13/MF A01 CSCL 10B

Work on the Mod O solar Brayton engine/alternator set is redirected to utilize solarized components of the automotive advanced gas turbine (AGT). The new configuration is referred to as the Mod I. Commercialization of solar Brayton engines thus should be enhanced not only by relating the design to an engine expected to reach the high quantity, low cost production rates associated with the automotive market, but also by the potential the AGT components provide for growth of efficiency and power rating. This growth would be achieved through use of ceramics in later versions making operation possible at temperatures up to 2500 F. The longer program duration and higher cost of the Mod I is considered. T.M.

N81-30530*# United Sterling, Inc. Alexandria, Va. Concept Analysis Dept.
FIRST PHASE TESTING OF SOLAR THERMAL ENGINE AT UNITED STIRLING
Worth Percival and Hans-Goeran Nelving *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 37-44 refs

Avail: NTIS HC A13/MF A01 CSCL 10B

The objective of the program is to demonstrate that the Stirling engine is a practical efficient and reliable energy converter when integrated with a parabolic dish concentrator, and that it has the potential of being cost competitive with fossil fueled electric generating systems of today. The engine, with its receiver (solar heat exchanger), alternator and control system, is described. T.M.

N81-30531*# Fairchild Stratos Corp., Manhattan Beach, Calif.
NON-HEAT PIPE RECEIVER/P-40 STIRLING ENGINE
Richard A. Haglund *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 47-50

Avail: NTIS HC A13/MF A01 CSCL 10A

The technology for a full-up hybrid dish-Stirling Solar Thermal Power system is discussed. Overall solar-to-electric efficiency for the dish-Stirling system demonstration is approximately 30%. Hybrid operation is provided by fossil fuel combustion augmentation, which enables the Stirling engine to operate continuously at constant speed and power, regardless of insolation level, thus providing the capability to operate on cloudy days and at night. T.M.

N81-30532*# General Electric Co., Evendale, Ohio. Advanced Energy Programs Dept.
HEAT PIPE SOLAR RECEIVER WITH THERMAL ENERGY STORAGE
W. F. Zimmerman *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 51-56

Avail: NTIS HC A13/MF A01 CSCL 10A

An HPSR Stirling engine generator system featuring latent heat thermal energy storge, excellent thermal stability and self regulating, effective thermal transport at low system delta T is described. The system was supported by component technology testing of heat pipes and of thermal storage and energy transport models which define the expected performance of the system. Preliminary and detailed design efforts were completed and manufacturing of HPSR components has begun. T.M.

N81-30533*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE DEVELOPMENT OF AN 85-kW (THERMAL) AIR BRAYTON RECEIVER
M. Greevan (AiResearch Manufacturing Co., Torrance, Calif.) and William Owen *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 57-65

Avail: NTIS HC A13/MF A01 CSCL 10A

The results of the program from its inception through December 1980 are presented. The design requirements, concept, and significant analysis upon which the receiver is based are described. The fabrication processes that have been utilized in the construction of the prototype receivers at the test station are summarized. The test and evaluation phase at the Parabolic Dish Test Site are described. T.M.

N81-30534*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE DEVELOPMENT OF AN 85-kW (THERMAL) STEAM RANKINE SOLAR RECEIVER
Clifford C. Wright (AiResearch Manufacturing Co., Torrance, Calif.) and Herman Bank *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 67-74 refs

Avail: NTIS HC A14/MF A01 CSCL 10A

The receiver is a once-through monotube boiler designed for steam/electric and process steam applications at pressures up to 17.24 MPa (2500 psia) and temperatures up to 704 C (1300 F). The unit is 76.2 cm (30.0 in.) in diameter and 95.8 cm (37.7 in.) in length; it weighs 220 kg (485 lb). Its heat transfer surface, which is 45.7 cm (18 in.) in diameter by 57 cm (22.4 in.) long, is an Inconel 625, cylindrical, tube-coil assembly composed of primary and reheat sections. A test unit was successfully operated at up to 6.9 MPa (1000 psia) and 704 C (1300 F) with solar input from a 11-m-dia parabolic dish concentrator. T.M.

N81-30535*# Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div.
ORGANIC RANKINE CYCLE RECEIVER DEVELOPMENT
Harold J. Haskins *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 75-79 ref

Avail: NTIS HC A13/MF A01 CSCL 10A

The selected receiver concept is a direct-heated, once-through, monotube boiler operated at supercritical pressure. The cavity is formed by a cylindrical copper shell and backwall, with stainless steel tubing brazed to the outside surface. This core is surrounded by lightweight refractory insulation, load-bearing struts, and an outer case. The aperture plate is made of copper to provide long life by conduction and reradiation of heat away from the aperture lip. The receiver thermal efficiency is estimated to be 97 percent at rated conditions (energy transferred to toluene divided by energy incident on aperture opening). Development of the core manufacturing and corrosion protection methods is complete. T.M.

N81-30536*# General Electric Co., Philadelphia, Pa.
SOLAR THERMAL PARABOLIC DISH ENERGY APPLICATIONS
Walter Pijawka *In* JPL Parabolic Dish Solar Thermal Ann. Program Rev. Proc. 1 May 1981 p 87-106

Avail: NTIS HC A13/MF A01 CSCL 10A

Vu-graphs are presented that show that applications are a viable distributed renewable power generation option. Quality energy can be produced in the form of electricity and high temperature heat. Modular systems are described that can be distributed to new or existing plants and that are mass producible with the associated economies of production. T.M.

N81-30537*# Ford Aerospace and Communications Corp., Newport Beach, Calif.
STATUS OF THE CURRENT PARABOLIC DISH TECHNOLOGY
Calhoun Sumrall *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 107-115

Avail: NTIS HC A13/MF A01 CSCL 10B

Vu-graphs are presented that show that point focus distributed receiver distributed generation systems are cost competitive with current utilities. System cost caveats and typical power module costs are described. Major problems inhibiting commercialization of the parabolic dish technology were reviewed. T.M.

N81-30538*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CHARACTERIZATION OF POINT FOCUSING TEST BED CONCENTRATORS AT JPL
Donald J. Starkey *In its* Parabolic Dish Solar Thermal Power

Ann. Program Rev. Proc. 1 May 1981 p 135-142 Sponsored in part by DOE
Avail: NTIS HC A13/MF A01 CSCL 10A

The characterization data were measured using both a flux mapper and a cold water calorimeter. The flux mapper uses a Kendall Radiometer as the sensing device. It is mounted on an x, y, z motor-driven positioning mechanism that allows the sensor to take an x-y flux raster at several Z planes in the vicinity of the concentrators nominal focal plane. Various concepts were tried to protect the concentrator structure from being damaged by the Sun's energy during sun acquisition and deacquisition. A description of both the passive and active protective systems is presented. T.M.

N81-30539*# General Electric Co., Philadelphia, Pa.
GENERAL ELECTRIC POINT FOCUS SOLAR CONCENTRATOR STATUS
J. Zimmerman *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 143-147 ref

Avail: NTIS HC A13/MF A01 CSCL 10A

The concentrator design approach evolved by a systemmatic process of examining the operating requirements particular to *the solar application, minimizing material content through detail* structural design and structurally efficient subsystem features, and utilizing materials and processes compatible with high volume production techniques. The design approach, the present concentrator configuration and the status of the hardware development are described. T.M.

N81-30542*# Los Alamos Scientific Lab., N. Mex.
DEVELOPMENT AND TESTING OF THE SHENANDOAH COLLECTOR
George S. Kinoshita *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 161-170 Sponsored by DOE
(SAND-81-0028A) Avail: NTIS HC A13/MF A01 CSCL 10A

The test and development of the 7-meter Shenandoah parabolic dish collector incorporating an FEK-244 film reflective surface and cavity receiver are described. Four prototypes tested in the midtemperature Solar System Test Facility indicate, with changes incorporated from these development tests, that the improvements should lead to predicted performance levels in the production collectors. Author

N81-30543*# Power Kinetics, Inc., Troy, N.Y.
FRESNEL CONCENTRATING COLLECTOR
William Rogers, David Borton, Mark Rice, and Robert Rogers *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 171-178

Avail: NTIS HC A13/MF A01 CSCL 10A

An advanced point focusing solar technology demonstrated potential for near term commercialization as a renewable energy technology. The design features combine to produce a highly efficient, low cost, safe, adaptable, durable system which is simple to manufacture, install and maintain. S.F.

N81-30544*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE SMALL COMMUNITY SOLAR THERMAL POWER EXPERIMENT
Taras Kiceniuk *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 187-189

Avail: NTIS HC A13/MF A01 CSCL 10A

Contractors were asked to develop a preferred system concept, to perform sensitivity analyses, and to outline recommended approaches for the follow-on design program of a one-megawatt solar thermal demonstration plant. The systems recommended by the contractors in each of the categories were: (1) McDonnell-Douglas Astronautics Company: Central tower with field of south-facing heliostats; (2) General Electric Company: Field of parabolic dishes with steam piped to a central turbine-generator unit; and (3) Ford Aerospace and Communications Corporation: Field of parabolic dishes with a Stirling cycle engine/generator unit at the focus of each dish. A description of each of the proposed experimental plants is given. S.F.

N81-30545*# Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div.
DEVELOPMENT OF THE SMALL COMMUNITY SOLAR POWER SYSTEM
Robert H. Babbe *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 191-196

(Contract JPL-955637)
Avail: NTIS HC A13/MF A01 CSCL 10A

The status of the Small Community Solar Thermal Power Experiment is presented. Activities on the Phase 2 single/module development effort are presented, together with plans for the Phase 3 1 MWe demonstration plant. A description of the various subsystems and components is given with emphasis on the unmanned microprocessor based plant control subsystem. Latest performance figures are given for the 1 MWe plant, based on 56 power modules, each consisting of a 12m low cost concentrator, a cavity receiver, a Rankine power conversion subsystem and a ground mounted solid-state rectifier. Overall plant efficiency at rated conditions is 15.8 percent. Advanced glass concentrator designs yield 20 percent overall efficiencies. S.F.

N81-30546*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SITE PARTICIPATION IN THE SMALL COMMUNITY EXPERIMENT
Herb J. Holbeck and Merrilee Fellows *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 197-204
Avail: NTIS HC A13/MF A01 CSCL 10A

The Small Community Solar Thermal Experiment, planned to test a small, developmental solar thermal power plant in a small community application, is assessed. The baseline plan is to install a field of parabolic dishes with distributed generation to provide 1 MWe of experimental power. Participation by the site proposer is an integral element of the experiment; the proposer will provide a ten-acre site, a connection to the electrical distributional system servin the small community, and various services. In addition to the primary participant, site study efforts may be pursued at as many as five alternative sites. S.F.

N81-30547*# Los Alamos Scientific Lab., N. Mex.
DEFINITIVE DESIGN OF THE SOLAR TOTAL ENERGY LARGE-SCALE EXPERIMENT AT SHENANDOAH, GEORGIA
R. W. Hunke and J. A. Leonard *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 205-208 Sponsored by DOE
(SAND-81-0029A) Avail: NTIS HC A13/MF A01 CSCL 10A

Construction of a Solar Total Energy Large Scale Experiment at Shenandoah, Georgia, is described. The Solar Total Energy System (STES) is designed with capacity to supply electricity and thermal energy to a knitwear plant at the Shenandoah site. The system will provide 400 kilowatts electrical and 3.5 megawatts thermal energy. The STES is a cascaded total energy system configuration. It uses parabolic disch collectors and a steam turbine-generator. The electrical system will be grid connected to the Georgia Power Company system. S.F.

N81-30548*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE JPL ISOLATED APPLICATION EXPERIMENT SERIES
Richard R. Levin *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 209-213

Avail: NTIS HC A13/MF A01 CSCL 10A

The technical, operational, and economic readiness of parabolic dish power systems for a variety of applications in the power range below 10 MWe are discussed. Power systems are developed and tested to the point where commercialization efforts lead to successful market penetration. A key element in this strategy is the use of experiments to test hardware and assess operational readiness. The Isolated Application Experiments are described and their objectives discussed. S.F.

N81-30549*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INDUSTRIAL APPLICATION EXPERIMENT SERIES
Steven A. Bluhm *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 215-216

Avail: NTIS HC A13/MF A01 CSCL 10B

Two procurements within the Industrial Application Experiment Series of the Thermal Power Systems Project are discussed. The first procurement, initiated in April 1980, resulted in an award to the Applied Concepts Corporation for the Capital Concrete Experiment: two Fresnel concentrating collectors will be evaluated in single-unit installations at the Jet Propulsion Laboratory Parabolic Dish Test Site and at Capitol Concrete Products, Topeka, Kansas. The second procurement, initiated in March 1981, is titled, 'Thermal System Engineering Experiment B.' The objective of the procurement is the rapid deployment of developed parabolic dish collectors. S.F.

N81-30550*# Applied Concepts Corp., Reston, Va.
A FRESNEL COLLECTOR PROCESS HEAT EXPERIMENT AT CAPITOL CONCRETE PRODUCTS
J. Scott Hauger *In* JPL Parabolic Dish Solar Thermal Poweer Ann. Program Rev. Proc. 1 May 1981 p 217-221

Avail: NTIS HC A13/MF A01 CSCL 10B
An experiment is planned, conducted and evaluated to determine the feasibility of using a Power Kinetics' Fresnel concentrator to provide process heat in an industrial environment. The plant provides process steam at 50 to 60 psig to two autoclaves for curing masonry blocks. When steam is not required, the plant preheats hot water for later use. A second system is installed at the Jet Propulsion Laboratory parabolic dish test site for hardware validation and experiment control. Experiment design allows for the extrapolation of results to varying demands for steam and hot water, and includes a consideration of some socio-technical factors such as the impact on production scheduling of diurnal variations in energy availability. S.F.

N81-30552*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
COST GOALS
John Hoag *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 247-250

Avail: NTIS HC A13/MF A01 CSCL 05C
Cost goal activities for the point focusing parabolic dish program are reported. Cost goals involve three tasks: (1) determination of the value of the dish systems to potential users; (2) the cost targets of the dish system are set out; (3) the value side and cost side are integrated to provide information concerning the potential size of the market for parabolic dishes. The latter two activities are emphasized. S.F.

N81-30553*# Science Applications, Inc., Golden, Colo.
AN ASSESSMENT OF THE INDUSTRIAL COGENERATION MARKET FOR PARABOLIC DISH SYSTEMS
J. W. Doane *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 251-253

Avail: NTIS HC A13/MF A01 CSCL 10B
The value analysis technique used is straightforward. Maximum allowable life-cycle system cost for the cogeneration system is determined as the sum of the present value of fuels displaced plus the present value of revenues from exported power. Each conventional fuel displaced is described by a unit cost in the first year, a uniform annual consumption rate, and a uniform annual escalation rate for unit cost. Exported energy flows are treated the same as displaced energy. S.F.

N81-30555*# IIT Research Inst., Chicago, Ill.
FUELS AND CHEMICALS FROM BIOMASS USING SOLAR THERMAL ENERGY
G. Giori, R. Leitheiser (Quaker Oats Co.), and M. Wayman (Toronto Univ.) *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 263-267 ref

Avail: NTIS HC A13/MF A01 CSCL 10A
The significant nearer term opportunities for the application of solar thermal energy to the manufacture of fuels and chemicals from biomass are summarized, with some comments on resource availability, market potential and economics. Consideration is given to the production of furfural from agricultural residues, and the role of furfural and its derivatives as a replacement for petrochemicals in the plastics industry. S.F.

N81-30556*# Midwest Research Inst., Golden, Colo.
SOLAR THERMAL MATERIALS RESEARCH AND DEVELOPMENT
B. P. Gupta *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 269-273

Avail: NTIS HC A13/MF A01 CSCL 10A
Objectives of the Materials Research and Development effort are examined. The behavior and interaction of different materials used in solar thermal technologies are studied so as to create a sound technical base for future system and component designs. Materials are developed to extend the application potential of systems by either making materials more reliable in difficult operating environments or by offering lower cost alternatives to presently used materials. Solar thermal systems designed for electric power, industrial process heat from low to high temperature, and fuels and chemicals applications are discussed. S.F.

N81-30557*# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SOLAR ENERGY WATER DESALINATION IN THE UNITED STATES AND SAUDI ARABIA
Werner Luft and Jim William *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 275-282

Avail: NTIS HC A13/MF A01 CSCL 10B
Five solar energy water desalination systems were designed to deliver 6000 cubic m/day of desalted water from either seawater or brackish water. Two systems will be selected for pilot plant construction. The pilot plants will have capacities in the range of 100 to 400 m/day. Goals of the Project Agreement for Cooperation in the Field of Solar Energy, under the auspices of the United States-Saudi Arabian Joint Commission on Economic Cooperation, are to: (1) cooperate in the field of solar energy technology for the mutual benefit of the two countries, including the development and stimulation of solar industries within the two countries; (2) advance the development of solar energy technology in the two countries; and (3) facilitate the transfer between the two countries of technology developed under this agreement. S.F.

N81-30564# Army Construction Engineering Research Lab., Champaign, Ill.
DEVELOPMENT OF AN ACCEPTANCE TEST FOR SOLAR ENERGY SYSTEMS Final Report
D. M. Joncich and D. L. Johnson Jun. 1981 83 p refs (AD-A101654; CERL-TR-E-173) Avail: NTIS HC A05/MF A01 CSCL 10/1
This report describes the development and field evaluation of a short-duration procedure and an instrumentation package for testing whether a newly installed solar energy system is performing to design specifications. The U.S. Army Construction Engineering Research Laboratory: (1) defined a general solar system schematic and identified its major components; (2) developed test procedures for determining the thermal performance of these components; (3) bought and programmed equipment to perform the prescribed component test and to produce the test data; (4) subjected the acceptance test concept and instrumentation package to a field evaluation at a newly installed Army solar energy system; and (5) incorporated the results of the field evaluation as modifications to the solar acceptance test. This report concludes that a simple, quantitative test of short duration can determine whether a newly installed solar system is operating as specified. The results of the research have revealed the potential for performing such a test with low-cost metering installed at the time of building construction.
Author (GRA)

N81-30565# Hughes Aircraft Co., Los Angeles, Calif. Space and Communications Group.
HIGH EFFICIENCY SOLAR PANEL. PHASE 2: GALLIUM ARSENIDE Final Report, 15 Sep. 1977 - 30 Sep. 1980
George Wolff, Sanjiv S. Kamath, and George J. Vendura Wright-Patterson AFB, Ohio AFWAL Mar. 1981 127 p refs (Contract F33615-77-C-3150; AF Proj. 682J) (AD-A101317; HAC-SCG-00453R; AFWAL-TR-80-2128) Avail: NTIS HC A07/MF A01 CSCL 10/2
The goals of the GaAs High Efficiency Solar Panel Program were to demonstrate experimentally that space cells with efficiencies of 16% or better can be consistently produced. In developing the cells, fabrication processes were to be streamlined and perfected so cells are readily producible in large quantities. All the goals of the program were met in that the process for growing cells with fficiencies greater than 16% was fully

developed. Cells with efficiencies greater than 18% were produced. A comprehensive qualification test program was successfully conducted, and the GaAs cells are now fully space qualified.
Author (GRA)

N81-30566# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
TECHNICAL AND ECONOMIC EVALUATION OF A BRAYTON-RANKINE COMBINED CYCLE SOLAR-THERMAL POWER PLANT
J. D. Wright and Richard J. Copeland May 1981 6 p refs Presented at Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26-30 May 1981 Submitted for publication
(Contract DE-AC02-77CH-00178)
(SERI/TP-631-1154; CONF-810509-36) Avail: NTIS HC A02/MF A01

An assessment of gas-liquid direct-contact heat exchange and of a new storage-coupled system was conducted. Both technical and economic issues are evaluated. Specifically, the storage-coupled combined cycle is compared with a molten salt system. The open Brayton cycle system is used as a topping cycle, and the reject heat powers the molten salt/Rankine system. In this study the molten salt system is left unmodified, the Brayton cycle is integrated on top of a Marietta description of an existing molten salt plant. This compares a nonoptimized combined cycle with an optimized molten salt system. DOE

N81-30567# Midwest Research Inst., Golden, Colo.
OPTIMIZING THE PERFORMANCE OF DESICCANT BEDS FOR SOLAR-REGENERATED COOLING
R. Barlow and K. Collier Mar. 1981 5 p refs Presented at Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC02-77CH-00178)
(SERI/TP-631-1157; CONF-810509-28) Avail: NTIS HC A02/MF A01

The use of computer simulations as well as a simplified psychrometric analysis to determine the increase in cooling system performance that can be realized through the use of nonhomogeneous or staged desiccant beds was investigated. A staged bed of four hypothetical desiccants gives, a 10% higher cooling capacity than a silica gel bed of the same thickness. Alternatively, the same cooling capacity is produced by a staged bed 37% thinner than the silica gel bed. It is suggested that these effects can be employed to reduce the parasitic power requirements of deciccant cooling systems. DOE

N81-30568# Midwest Research Inst., Golden, Colo.
MIS AND PN JUNCTION SOLAR CELLS ON THIN FILM POLYCRYSTALLINE SILICON
A. Ariotedjo, K. Emery, G. Cheek, P. Pierce, and T. Surek May 1981 5 p refs Presented at 15th IEEE PV Specialists Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC02-77CH-00178)
(SERI/TP-614-1214; CONF-810526-9) Avail: NTIS HC A02/MF A01

The potential of MIS type solar cells for low cost terrestrial photovoltaic systems were assessed. Performance, stability, and cost effectiveness were among the factors studied. Several types of MIS and SIS solar cells are included in the matrix study. The MIS and p/n junction solar cells are compared on essentially identical thin film polycrystalline silicon materials. Preliminary data on the different cell structures on thin film epitaxial silicon on metallurgical grade substrates are presented. DOE

N81-30571# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
MIS SILICON SOLAR CELLS: POTENTIAL ADVANTAGES
G. Cheek, R. Mertens (ESAT, Heverlee, Belgium), and K. U. Leuven (ESAT, Heverlee, Belgium) May 1981 6 p refs Presented at 15th IEEE PV Specialists Conf., Orlando, Fla.
(Contracts EG-77-C-01-4042; DE-AC02-77CH-00178)
(SERI/TP-612-1190; CONF-810526-10) Avail: NTIS HC A02/MF A01

Recent progress with silicon solar cells based on the MIS or SIS structure was reviewed. To be competitive with pn junction technology in the near term, these cells must be much cheaper *or have a higher efficiency in a production environment. Apparently,* the minority carrier MIS cells have the greatest potential for large scale applications. The data currently indicate that all types of MIS/SIS cells have some inherent instability problems. DOE

N81-30573# HITEK, Inc., Sweet Home, Oreg.
KEITH KEESECKER OFFICE BUILDING Final Technical Report
Charles L. Bliege 26 Jan. 1981 52 p
(Contracts DE-FC03-78CS-32144; EM-78-F-03-2144)
(DOE/CS-32144/T1) Avail: NTIS HC A04/MF A01

The solar collection system of an office building in oregon is described. This two story office building has 4000 sq ft of space and a sq ft basement. The solar heating system has 936 sq ft of flat plate collectors and a phase change storage system. A *description of the system operation, the acceptance* test plan, as built wiring and piping schematics, and predicted performance data are included. DOE

N81-30574# Sandia Labs., Albuquerque, N. Mex. Systems and Applications Development Div.
CLEANING STRATEGIES FOR PARABOLIC-TROUGH SOLAR-COLLECTOR FIELDS; GUIDELINES FOR DECISIONS
Kenneth D. Bergeron and James M. Freese Jun. 1981 54 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0385) Avail: NTIS HC A04/MF A01

The guidelines are based on information obtained in past research studies, as well as interviews with vendors and users of cleaning and water treatment equipment. The basic procedure recommended utilizes high pressure portable washing equipment. However, since the cleaning problem is so site-specific, no single, detailed approach can be specified. A systematic procedure for evaluating the particular requirements of a site is therefore given. This will allow the solar energy system operator to develop a cleaning strategy which is cost effective because it is suited to local conditions. DOE

N81-30575# Sandia Labs., Albuquerque, N. Mex. Systems and Applications Development Div.
INITIAL EXPERIENCE AND PRELIMINARY RESULTS: SOLAR COLLECTOR MATERIALS EXPOSURE TO THE IPH SITE ENVIRONMENT
Duane E. Randall and Virgina L. Morris Mar. 1981 192 p refs Prepared in cooperation with McDonnell-Douglas Astronautics, Co., Huntington Beach, Calif.
(Contract DE-AC04-76DP-00789)
(SAND-81-0290) Avail: NTIS HC A09/MF A01

The influence of the industrial plant site environment upon the performance characteristics of solar collector reflector and receiver materials was evaluated at industrial process heat solar project sites. The program demonstrates that the industrial environment offers a variety of sources that affect the optical characteristics of reflectors and receivers through the mechanisms of soiling and corrosion. DOE

N81-30576# Sandia Labs., Albuquerque, N. Mex. Solar Energy Projects.
REAL-TIME PERFORMANCE TESTING OF PHOTOVOLTAIC-CONCENTRATOR MODULES
D. A. Pritchard 1981 5 p refs Presented at the 15th IEEE PV Specialists Conf., 11 May 1981, Orlando, Fla.
(Contract DE-AC04-76DP-00789)
(SAND-81-1145C; CONF-810526-11) Avail: NTIS HC A02/MF A01

A description of the resources at the Photovoltaic Advanced Systems Test Facility is presented. These resources include a multi-level data acquisition system for collector module performance testing, associated user-interactive software for accomplishing these tests, and extensive support hardware. A group of standard tests was developed for module characterization. Descriptions of these tests ans sample results for a variety of module designs are presented. DOE

N81-30578# Sandia Labs., Albuquerque, N. Mex.
PHOTOVOLTAIC CONCENTRATOR TECHNOLOGY
E. C. Boes and B. D. Shafer 1981 6 p refs Presented at the 15th IEEE PV Spec. Conf., 11 May 1981, Orlando, Fla.
(Contract DE-AC04-76DP-00789)
(SAND-81-1211C; CONF-810526-21) Avail: NTIS HC A02/MF A01

The most significant of the recent advances in the development of concentrating photovoltaic collectors are described. Highlights are: in moderate volume production (100,000 sq m per year), current designs could be sold for $3.70 to $5.20 per annualized

peak watt, completely installed; several array designs have annual efficiencies of 10 to 13 percent, developmental have achieved 16 percent; and concentrator Si cells were tested above 20 percent at 27 C and 50X. DOE

N81-30579# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RESIDENTIAL PHOTOVOLTAIC POWER SYSTEMS FOR THE NORTHEAST
Miles C. Russell 1981 5 p Presented at the 15th IEEE Photovoltaic Specialists' Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/132; CONF-810526-24) Avail: NTIS HC A02/MF A01

The construction and testing of five Prototype Systems are reported. Each of these systems utilizes a roof-mounted photovoltaic array and allows excess solar-generated electric energy to be fed back to the local utility grid, eliminating the need for on-site storage. Specific features of the five Prototype Systems now under test are presented, and performance results to date are discussed. DOE

N81-30580# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RESIDENTIAL PHOTOVOLTAIC SYSTEM DESIGNS
M. C. Russell 1981 5 p refs Presented at the 15th IEEE PV Specialists' Conf., Orlando, Fla., 11 May 1981 and 16th Intersoc. Energy Conversion Eng. Conf., Atlanta, 9-14 Aug 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/123; CONF-810526-17) Avail: NTIS HC A02/MF A01

The construction and testing of five Prototype Systems are described. All systems utilize a roof-mounted photovoltaic array and allow excess solar-generated electric energy to be fed back to the local utility grid, eliminating the need for on-site storage. Residential photovoltaic system design issues are discussed an specific features of the five Prototype Systems are presented. DOE

N81-30581# Sandia Labs., Albuquerque, N. Mex.
INTERDIGITATED BACK CONTACT SOLAR CELL WITH HIGH-CURRENT COLLECTION
C. M. Garner, R. D. Nasby, F. W. Sexton, J. L. Rodriguez, and D. P. Norwood 1981 8 p refs Presented at the 15th IEEE PV Specialists' Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2206C; CONF-810526-13) Avail: NTIS HC A02/MF A01

Internal current collection efficiencies greater than 90% and energy conversion efficiencies of 18 % at 30 suns were measured on a laboratory version of the interdigitated back contact (IBC) solar cell. A phosphorous gettering diffusion was performed on the front surface and then etched off to achieve these high current collection efficiencies. Thermal oxides were grown on the front and back of the cell to passivate the silicon surfaces. Although the internal collection efficiencies of the cell were high, series resistance caused the fill factor (FF) to decrease at concentrations above 30 suns. Dark current measurements on cells with a new grid spacing indicate that the series resistance is much lower than in the previous cell design. It is suggested that this should result in higher efficiencies at high concentration. DOE

N81-30588# Sandia Labs., Livermore, Calif. Surface Metallurgy Div.
DEVELOPMENT OF SOLAR ENERGY IN PERU
Hugh O. Pierson and Alipio Nahui (ITINTEC, Lima, Peru) Jun. 1981 24 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0764) Avail: NTIS HC A02/MF A01

Development of solar energy technology utilization in Peru is discussed. Peru receives a high degree of solar radiation (except for part of its coastal area) and has almost an ideal climate for the development of solar energy. The development of low temperature applications, including the design of passive solar heated buildings for the high Andes, the design and evaluation of various types of solar water heaters and crop dryers for both household and industrial uses (based on flat plate collectors), and the construction of a desalinization prototype plant are reported. Photovoltaic systems are investigated for suitable applications and have an excellent potential, especially in telecommunications. DOE

N81-30591# Little (Arthur D.), Inc., Cambridge, Mass.
SOLAR HEATING AND COOLING (SHAC) SIMULATION PROGRAMS: ASSESSMENT AND EVALUATION. VOLUME 1: SUMMARY REPORT Final Report
Richard L. Merriam May 1981 26 p refs
(EPRI Proj. 1269-1)
(EPRI-EM-1866) Avail: NTIS HC A03/MF A01

Solar heating and cooling system simulation programs available to use by electric utilities was evaluated. A comprehensive reference manual describing the characteristics of computer programs and manual methods was developed. An analysis of the intended capabilities of 11 programs is carried out. The programs are described and ranked by application. Four programs (AXCESS, DEROB, EMPSS, TRNSYS) for three building types (residential, light commercial, and heavy commercial) and three heating and cooling system classes (conventional, active solar, passive solar are tested. The results are compared and related to the program analytical bases. The user experience encountered during the program testing is highlighted and the user related factors for the four programs are compared The applicability of the 11 programs to utilities is explored DOE

N81-30593# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
FACILITIES DEVELOPMENT, SAN DIEGO, CALIFORNIA SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION, JANUARY 1980 - DECEMBER 1980
K. D. Evans 1980 82 p refs
(Contract DE-AC01-79CS-30027)
(SOLAR/1017-80/14) Avail: NTIS HC A05/MF A01

A 31-unit apartment site which uses 520 square of flat-plate collectors for domestic water heating is discussed. A 1,000 gallon glass-lined storage tank is located underground. The overall solar fraction is 35 percent. Problems are discussed. DOE

N81-30594# Institute for Telecommunication Sciences, Boulder, Colo.
ALTERNATE FREQUENCY ANALYSIS FOR THE SOLAR POWER SYSTEM
E. L. Morrison and W. B. Grant 1981 147 p refs
(Contract DE-AI01-80ER-10160)
(DOE/ER-10160/T5) Avail: NTIS HC A03/MF A01

Frequencies below the proposed 2.45 GHz are not recommended because of increased compatibility problems with a large population of existing systems and target spacebeams and rectenna areas. Higher frequencies increase troposphere interactions which significantly reduce system efficiency during storm conditions. The increased media modulation effects at higher frequencies complicate the spacetenna control functions, including the stability of the main beam aim point and side lobe amplitude control loops. DOE

N81-30606# General Electric Co., Philadelphia, Pa. Advanced Energy Programs Dept.
LOW-COST ACTIVELY-COOLED LINEAR PHOTOVOLTAIC RECEIVER
N. F. Shepard, Jr. 1981 20 p refs Presented at the 15th IEEE Photovoltaic Specialists Conf., Orlando, Fla., 11-15 May 1981 Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(SAND-81-7113C; CONF-810526-14) Avail: NTIS HC A02/MF A01

The design concept, which employs a pair of nested glass tubes, offers the potential for low-cost production through reduced material content and design simplicity. A specially configured borosilicate glass tube functions as the mounting surface for the solar cell circuit in this dual focus receiver geometry. This inner tube, which is capped at each end to provide an interior dead air space, is inserted within a 2 inch ID glass pipe which is part of the Corning Pyrex beaded pressure process piping system. The selected receiver coolant, which is designated as Synfluid (2 centistokes kinematic viscosity), is circulated through the outer glass pipe in direct contact with the solar cell circuit active area. The concentrated irradiance from the parabolic trough impinges on the outer glass pipe and is optically transmitted through the clear synthetic mineral oil to the solar cell circuit. DOE

N81-30608# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LIQUID PHOTOVOLTAIC/THERMAL COLLECTORS FOR RESIDENTIAL APPLICATIONS

Susan D. Hendrie, Pattabiraman Raghuraman, and Charles Cox 1981 4 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/137; CONF-810526-22) Avail: NTIS HC A02/MF A01

The fabrication of a second generation, liquid photovoltaic/thermal collector is described. Results of computer simulations indicate that the collector unit, which incorporates novel cell and framing concepts, yields significnatly improved performance results over earlier units tested. Predicted performance values of 55% thermal efficiency and 11% electrical efficiency make the performance and this collector competitive with its single function solar thermal and photovoltaic counterparts. DOE

N81-30609# Lincoln Lab., Mass. Inst. of Tech., Lexington.
OPERATING EXPERIENCE WITH THE NATURAL BRIDGES NATIONAL MONUMENT PHOTOVOLTAIC POWER SYSTEM
F. John Solman and Barbara L. Grossman 1981 6 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/135; CONF-810526-15) Avail: NTIS HC A02/MF A01

A 100-kW photovoltaic power system was constructed and made operational. A comparison of system simulation with actual operation was performed and good agreement was found. Conservation measures and their benefits are described. Operating experience with the system is presented, including measured component performance of the arrays, batteries, inverters, and system overhead loads. DOE

N81-30616# Sandia Labs., Albuquerque, N. Mex.
ARRAY SUBSYSTEM DEVELOPMENT FOR PHOTOVOLTAIC-ARRAY FIELDS
H. N. Post and D. G. Schueler 1981 7 p refs Presented at the 15th IEEE Photovoltaic Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1193C; CONF-810526-20) Avail: NTIS HC A02/MF A01

The array subsystems portion of a photovoltaic power system represents the major cost item in a system and typically includes the photovoltaic modules, array foundations and structures, field wiring, array installation, and system electrical protection. Array cost-efficiency tradeoffs were examined and evaluated in terms of allowable subsystem costs. In addition, cost data and installation experience for a typical intermediate-size flat panel (ground mounted) application experiment are examined with a focus on cost reduction activities. Subsystem requirements and design considerations are discussed and specific results and guidelines for low-cost array field design are presented. DOE

N81-30617# Sandia Labs., Albuquerque, N. Mex.
OVERVIEW: RECENT DEVELOPMENTS AND POTENTIAL OF PHOTOVOLTAIC CONCENTRATING COLLECTORS
D. G. Schueler 1981 5 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1222C; CONF-810526-19) Avail: NTIS HC A02/MF A01

Definition and development of technology for low cost photovoltaic concentrating collectors are discussed. The most promising candidate approaches are point focus an linear-focus Fresnel lens designs using silicon solar cell technology and two axis tracking. Incremental improvements in these base line designs are expected to lead to cost effective photovoltaic collector subsystems. Recent developments in photovoltaic concentrator technology with respect to its long range economic potential are reviewed. DOE

N81-30629# Oak Ridge National Lab., Tenn. Solar and Special Studies Section.
EXPERIENCE FROM DOE PHOTOVOLTAIC GRANT PROJECTS
S. I. Kaplan 1981 8 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26-30 May 1981
(Contract W-7405-eng-26)
(CONF-810509-38) Avail: NTIS HC A02/MF A01

Two large solar photovoltaic (PV) energy systems are scheduled for operation. Although both are located at 2 year colleges in the south central U.S. and are of roughly comparable output capability, their configuration and operating objectives differ considerably. The systems are described and significant items of experience during their design, construction, testing and operation are chronicled. DOE

N81-30632# Massachusetts Inst. of Tech., Cambridge.
RETROFITTING RESIDENCES WITH PHOTOVOLTAIC/THERMAL COLLECTOR SYSTEMS
Duncan B. Sheldon and Susan M. Frank 1981 5 p refs Presented at the 16th Intersoc. Energy Conversion Eng. Conf., Atlanta, 9-14 Aug. 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/131; CONF-810812-5) Avail: NTIS HC A02/MF A01

Photovoltaic/thermal collector areas as low as 10 sq m are favorably matched to the operation of a conventional warm air heating system. The performances of three combined collector heating systems which are designed to operate primarily in the boosting mode were simulated. Comparison of the annual performances of these systems determines which components should be included in a retrofit system. Additional components such as a thermal storage tank and a heat pump are considered. DOE

N81-30634# *Sandia Labs., Albuquerque, N. Mex.*
PHOTOVOLTAIC-SYSTEM DEVELOPMENT STATUS
Gary J. Jones 1981 5 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC04-76DP-00789)
(CONF-810509-37) Avail: NTIS HC A02/MF A01

Existent price and performance goals for photovoltaic applications are discussed. Specific attention is given to efforts to reduce present costs, especially for the nonphotovoltaic system elements such as power processing, field installation, and systems engineering. The impact of the efficiency of dc to ac conversion is also discussed. E.A.K.

N81-30641# Sandia Labs., Albuquerque, N. Mex.
DESIGN OF PHOTOVOLTAIC SYSTEMS FOR RESIDENTIAL APPLICATIONS
Gary J. Jones 1981 6 p refs Presented at the 15th IEEE PV Specialists Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1241C; CONF-810526-29) Avail: NTIS HC A02/MF A01

Advantages and limitations of the potential residential photovoltaic system market and the impact of recent studies on future designs are reviewed. Typical system configurations are projected based on the existence of ideal rate structures and utility interactive operation. Sizing tradeoffs are analyzed in detail showing that systems from 3 kW/sub p/ to 10 kW/sub p/ are probable. Based on load considerations, development of 4 kW/sub p/ and 8 kW/sub p/ systems is suggested. The impact of this choice on array sizing as a function of site is discussed. DOE

N81-30649# State Univ. of New York at Albany. Atmospheric Sciences Research Center.
SOLAR DEMONSTRATION PROJECT IN A FAST-FOOD RESTAURANT
Donald McClenahan Nov. 1980 130 p refs Sponsored by New York State Energy Research and Development Authority
(PB81-196545; NYERDA-80-20) Avail: NTIS HC A07/MF A01 CSCL 13A

The results of a two-phase program in which the first phase included the successful use of heat reclamation equipment and energy conservation techniques at a typical fast-food restaurant are described. The project's second phase involved the engineering, designing, installation and interfacing of a solar collector system at the facility. The report will help to serve as a guide for other restaurants around the state, and possibly the nation, which wish to install energy saving systems, or adopt energy-saving techniques, geared to their special needs and equipment. GRA

N81-30653# Virginia Polytechnic Inst. and State Univ., Blacksburg.
EFFECTS OF TEST FLUID COMPOSITION AND FLOW RATES ON THE THERMAL EFFICIENCY OF SOLAR COLLECTORS Final Report

William C. Thomas Aug. 1980 93 p refs Sponsored in part by NBS and DOE
(PB81-180267; NBS-GCR-80-254; VPI-SU-80-03) Avail: NTIS HC A05/MF A01 CSCL 13A

Experimental and analytical investigations were carried out to determine the significance of the heat transfer fluid and mass flow rate on the thermal performance of two liquid heating flat plate solar collectors. The collector thermal performance was lowered significantly for high concentrations of glycol and mineral base oil. GRA

N81-30655# Design Alternatives, Inc., Washington, D. C.
PLANNING LOCAL SOLAR PROJECTS
1981 66 p
(Contract CSA-D9AF-009)
(PB81-197014) Avail: NTIS HC A04/MF A01 CSCL 13A

A handbook which is used as an aid in local solar project development is presented. The purpose of this guidebook is to serve as a guide in the development, implementation, and evaluation of a local solar project. GRA

N81-31625*# Portsmouth Public Schools, Va.
SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT JAMES HURST ELEMENTARY SCHOOL, PORTSMOUTH, VIRGINIA Final Report
Jul. 1981 166 p Sponsored in part by NASA. Marshall Space Flight Center
(Contract EM-78-F01-5205)
(NASA-CR-161830) Avail: NTIS HC A08/MF A01 CSCL 10B

Solar heating and a hot water system installed in an elementary school in Portsmouth, Virginia are examined. The building is zoned into four heating/cooling areas. Each area is equipped with an air handling unit that is monitored and controlled by central control and monitoring system. The solar system for the building uses a collector area of 3,630 sq. ft. of flat plate liquid collectors, and a 6,000 gallon storage tank. System descriptions, maintenance reports, detailed component specifications, and design drawings to evaluate this solar system are reported. E.A.K.

N81-31653# Ehrenkrantz Group, New York, N. Y.
IDENTIFICATION OF PRODUCT AND MATERIAL DIFFERENCES IN ACTIVE SOLAR SYSTEMS
Stephen D. Weinstein 30 Sep. 1980 81 p Prepared in cooperation with Mueller Associates, Inc.
(Contract W-31-109-eng-38)
(ANL-K-81-74) Avail: NTIS HC A05/MF A01

Deficiencies in products and materials used in active solar systems are identified. Architects and engineers were interviewed concerning design of solar installations, computer modeling, reliability and durability, project review, and construction administration. The responses of manufacturers of solar equipment to the evaluations of the design community are presented. DOE

N81-31655# Stanford Univ., Calif.
SOLAR SPACE- AND WATER-HEATING SYSTEM AT STANFORD UNIVERSITY. CENTRAL FOOD SERVICES BUILDING Final Report
May 1980 143 p refs
(Contract DE-AB03-77CS-31522)
(DOE/CS-31522/T2) Avail: NTIS HC A07/MF A01

The closed-loop drain-back system is described as offering dependability of gravity drain-back freeze protection, low maintenance, minimal costs, and simplicity. The system features an 840 square-foot collector and storage capacity of 1550 gallons. The acceptance testing and the predicted system performance data are briefly described. Solar performance calculations were performed using a computer design program (FCHART). Bidding, costs, and economics of the system are reviewed. Problems are discussed and solutions and recommendations given. An operation and maintenance manual is given. DOE

N81-31657# Sandia Labs., Livermore, Calif.
SELECTION AND CONCEPTUAL DESIGN OF AN ADVANCED THERMAL-ENERGY-STORAGE SUBSYSTEM FOR COMMERCIAL-SCALE (100 MWe) SOLAR CENTRAL-RECEIVER POWER PLANT
Feb. 1981 201 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-8190; BAW-1662) Avail: NTIS HC A10/MF A01

Advanced thermal energy storage concepts were developed and evaluated which are applicable to a 100 MWe solar central receiver plant using water/steam as the working fluid. Three concepts were selected that offered potential for cost and performance improvements over the oil/rock concepts. From the three concepts selected, the moving bed thermal energy storage system using a free flowing refractory material as the heat transport and storage media was chosen. A conceptual design was developed, including estimates for cost and performance. DOE

N81-31658# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.
STORAGE IN RESIDENTIAL SOLAR TOTAL-ENERGY SYSTEMS
R. W. Leigh Dec. 1980 85 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51230) Avail: NTIS HC A05/MF A01

The potential role of energy storage devices in solar total energy systems operating in a stand alone mode is examined. High temperature thermal storage is examined in the context of systems employing parabolic trough collectors and Rankine cycle conversion while batteries are evaluated in systems based on parabolic dish concentrators with Stirling cycle conversion or on nonconcentrating photovoltaic systems. In all three systems, storage was found to be advantageous in cases involving high future fuel prices and collectors meeting current cost goals, while storage was not found to be viable at fuel prices remaining near current levels and collector costs exceeding current expectations by substantial margins. Factors making storage more or less desirable are discussed. Throughout, analyses based on minimum cost (optimal) systems are employed. DOE

N81-31659# Ueland and Junker, Architects and Planners, Philadelphia, Pa.
SOLAR ATRIUM: A HYBRID SOLAR HEATING AND COOLING SYSTEM
Donald L. Larson May 1981 26 p Prepared in cooperation with Drexel Univ.
(Contracts DE-FG02-77CS-34135; EG-77-G-04-4135)
(DOE/CS-34135/T4) Avail: NTIS HC A03/MF A01

Solar atrium is a hybrid system of solar heating and cooling consisting of a central atrium space having a south wall aperture with movable insulating/shading louvers and a rock thermal storage unit in the basement. In addition, the atrium contains an open pool which serves as thermal mass and a source of humidity. Back up space heating and cooling is furnished by an air to air heat pump. Hot air is collected from the atrium ceiling and circulated by a fan through the rock bed and into the house duct system. A demonstration house in Philadelphia, Pennsylvania was designed, constructed, and monitored to test the concept. DOE

N81-31663# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SECOND-GENERATION HELIOSTAT DETAIL DESIGN REPORT
R. K. Knowles Aug. 1980 204 p
(Contract DE-AC04-76DP-00789)
(SAND-78-8192; MDC-G8631) Avail: NTIS HC A10/MF A01

The second generation heliostat design and a summary of the compliance of the design to the key heliostat requirements are reviewed. The heliostat hardware is described. The hardware and software design used to fulfill the requirements and the analysis and test used to evaluate related performance are presented. The technical feasibility and potential cost savings of a variety of automated mirror inspection techniques are assessed. DOE

N81-31665# Sandia Labs., Albuquerque, N. Mex.
COMMERCIALIZATION OF A PHOTOVOLTAIC CONCENTRATOR: ACUREX REPORT Final Report
J. Kull, G. Litzinger, B. Masters, and K. Yasuda Jul. 1981 167 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-7082; FR-80-11/AE) Avail: NTIS HC A08/MF A01

A development program is described that has produced a new photovoltaic (PV) concentrator and concentrator manufactur-

ing facility. The new PV concentrator features active cooling and thermal energy recovery. Background information, a program description, key results, and recommendations for future work are provided. The concentrator design, operating experience, and production capability are described. The optical, electrical and mechanical considerations were addressed by evaluating various possible alternatives in engineering trade studies. Two receiver configurations selected based on study results are described. The performance of the new concentrator array was examined in a preliminary series of tests. DOE

N81-31666# Boeing Co., Seattle, Wash. Solar Heating and Cooling Demonstration Program Office.
WAVERLY HOMES, INC. (LOT 13) SINGLE FAMILY RESIDENCE, WESTMINSTER, COLORADO. SOLAR PROJECT DESCRIPTION
26 Mar. 1981 50 p
(Contract DE-AB01-76OS-31020)
(SOLAR/1022-81/50) Avail: NTIS HC A03/MF A01

The use of solar energy for space heating a single family home and preheating incoming city water is discussed. The system has an array of flat plate collectors with a gross area of 351 square feet. Air is used to deliver solar energy from the collector array to storage and to the space heating and hot water loads. Solar energy is stored in the basement in a 175 cubic foot concrete tin containing 17,500 pounds of rock. Solar energy preheated city water is stored in an 80 gallon preheat storage tank and supplied, to a conventional 40 gallon domestic hot water (DHW) tank. When solar energy is insufficient to satisfy the space heating load, a gas furnace provides auxiliary energy for space heating. Similarly, a gas heater in the DHW tank provides auxiliary energy for water heating. DOE

N81-31668# Science Applications, Inc., La Jolla, Calif.
COMPARISON OF CONVENTIONAL AND AND SOLAR-WATER-HEATING PRODUCTS AND INDUSTRIES REPORT
Darryl Noreen, Robert Lechevalier, Michael Choi, and Jeff Morehouse 11 Jul. 1980 299 p refs
(Contract DE-AC03-80CS-30217)
(DOE/CS-30217/T1) Avail: NTIS HC A13/MF A01

Issues are examined in the framework of the conventional-hot-water industry. Based on the results of this solar hot water assessment study, documented proof is presented to show that the solar industry possesses over 20 good solar hot water systems. A total of eight generic types are currently being produced, but a majority of the systems being sold are included in only five generic types. The good systems are well-packaged for quality, performance and installation ease. These leading systems are sized and designed to fit the requirements of the consumer in every respect. DOE

N81-31670# Sandia Labs., Livermore, Calif. Large Power Systems Div.
SOLAR POWER TOWER DESIGN GUIDE: SOLAR THERMAL CENTRAL RECEIVER POWER SYSTEMS. A SOURCE OF ELECTRICITY AND/OR PROCESS HEAT
Kirk W. Battleson Apr. 1981 162 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-8005) Avail: NTIS HC A08/MF A01

Preliminary evaluations of whether a solar thermal central receiver plant is technically and economically feasible and desirable, for the potential user's application are reported. The cost elements, performance, and operation of solar central receiver systems are described. DOE

N81-31673# Ingenieurbuero, Bruehl (West Germany).
SOLAR ENERGY MODEL GOENNEBEK. DEVELOPMENT AND PLANNING OF A SELF-SUPPORTING HEATING PLANT FOR GREENHOUSES Final Report.
Bernard Gerhards Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 133 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-119; ISSN-0340-7608) Avail: NTIS HC A07/MF A01

The recovery, storage, and saving of energy in greenhouses by application of solar energy is investigated. Self-sufficiency is sought by making use of long-term storage of summer heat. A pilot installation is described consisting of a greenhouse with air collector, a medium-term accumulator, a long-term water heat storage tank and a 1500 m square plane collector field. Detailed construction plans and data on energy requirements and costs are given. Full independence from fossil fuels of the greenhouse and adjacent auction hall and office space is demonstrated. Control and programming is performed by a process computer. The highly efficient heat insulation system is credited for most of the success. The present installation requires only 40% of the energy needs of a regular double glass greenhouse. Author (ESA)

N81-32279# Los Alamos Scientific Lab., N. Mex.
STATUS REPORT ON SOLAR-ABSORBER-PAINT COATINGS Progress Report
S. W. Moore Jul. 1981 22 p refs
(Contract W-7405-eng-36)
(LA-8897-SR) Avail: NTIS HC A02/MF A01

The stability and durability of solar absorber paint coatings were investigated. Changes in optical properties and physical failure of the coatings are described. The effects of elevated temperatures, moisture, humidity, ultraviolet radiation, outdoor stagnation, and outgassing were examined. The basic optical properties investigated were absorptance and emissivity. DOE

N81-32311# American Agriculture Foundation, Inc., Denver, Colo.
SOLAR ETHANOL DEMONSTRATION PLANT: REPORT OF PHASE 1, TECHNOLOGY ASSESSMENT AND PHASE 2, CONCEPT SELECTION
1 Jan. 1981 82 p refs
(Contract DE-AC07-80ID-12098)
(DE81-027181; DOE/ID-12098/T2) Avail: NTIS HC A05/MF A01

A versatile facility for demonstrating the feasibility of on-farm, small scale ethanol production using solar energy as the primary heat source is described. This facility is capable of processing the full range of feed stocks not only the sugar and starch crops but also the cellulose feedstocks. Engineering and cost analysis was performed to formulate a preliminary design for a unique solar ethanol demonstration plant for on-farm use. Energy requirements were calculated for a variety of starches, simple sugars, and cellulose. A complete listing of all feedstocks examined is presented. The design requirements and the detailed process plant design information with flow, layout and performance information are given along with the results of the ethanol feedstock energy requirements study. Supporting details of the solar collector selection process are included. The ethanol fermentation process, the range of cellulose-ethanol production processes, and a detailed description of the Solar Collector performance model are addressed. DOE

N81-32456# Brookhaven National Lab., Upton, N. Y. Solar Technology Group.
SOLAR ENERGY AND HEAT PUMPS: CAN THIS MARRIAGE BE SAVED
John W. Andrews 1981 10 p refs Presented at the IECEC *Conf., Atlanta, 9-14 Aug.* 1981
(Contract DE-AC02-76CH-00016)
(DE81-024371; BNL-29627; CONF-810812-26) Avail: NTIS HC A02/MF A01

Work on systems for building space and water heating and space cooling which combine vapor compression heat pumps with the use of solar energy led to promising system configurations which portend reasonable cost and beneficial impact on utility load profiles in addition to conserving energy. A historical perspective on this work are presented. The ranges of system possibilities are elucidated and two promising systems are described. DOE

N81-32457# Brookhaven National Lab., Upton, N. Y. Solar Technology Group.
TEST RESULTS OF PROTOTYPE SOLAR ASSISTED HEAT PUMPS
Mark A. Catan and Edward A. Kush 1981 8 p refs Presented at the IECEC Conf., Atlanta, 9-14 Aug. 1981
(Contract DE-AC02-76CH-00016)
(DE81-024372; BNL-29626; CONF-810812-23) Avail: NTIS HC A02/MF A01

Results of steady state tests of a prototype solar-assisted heat pump using a simulator are reported. The nominal goal for the project; construction of a prototype capable of achieving a heating coefficient of performance of 6 at an entering water temperature of 32 C (90 F), was achieved. Factors related to

reliability and potential for performance improvement of the design are treated. Plans for future testing and application of performance data to system studies are discussed. DOE

N81-32458# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
SOLAR-HEAT-PUMP SIMULATOR
Mark A. Catan 1981 7 p refs Presented at the DOE Heat Pump Contractors' Program Integration Meeting, McLean, Va., 2-4 Jun. 1981
(Contract DE-AC02-76CH-00016)
(DE81-024370; BNL-29679; CONF-810672-24) Avail: NTIS HC A02/MF A01

A solar assisted heat pump (SAHP) hardware simulator was constructed to demonstrate the potential of the vapor compression heat pump to obtain high COP's at high source temperatures, to explore the means to obtain such high efficiencies, and to test prototype hardware resulting from the SAHF development program. The original water coolant system which simulated heating loads was upgraded to accommodate liquid to air heat pumps. A further refinement to the simulator was the addition of a on-line data acquisition and reduction facility. Testing of an experimental mockup heat pump designed to operate efficiently under SAHP system conditions demonstrated that very high COP's can be achieved with conventional components. One prototype marketable SAHP constructed by Northrop has been tested under steady state conditions using the simulator. DOE

N81-32459# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
TECHNICAL SUPPORT: SOLAR ASSISTED HEAT PUMP SYSTEMS
J. W. Andrews 1981 10 p refs Presented at the DOE Heat Pump Contractors' Program Integration Meeting, McLean, Va., 2-4 Jun. 1981
(Contract DE-AC02-76CH-00016)
(DE81-102509; BNL-29681; CONF-810672-23) Avail: NTIS HC A02/MF A01

Technical and program planning provided in connection with the development of energy conserving and cost effective solar assisted heat pump systems is reviewed. The background of the program is outlined. DOE

N81-32507# Oak Ridge National Lab., Tenn. Solid State Div.
APPLICATION OF LASER ANNEALING AND LASER-INDUCED DIFFUSION TO PHOTOVOLTAIC CONVERSION
R. T. Young, D. H. Lowndes, G. A. vanderLeeden, and R. F. Wood 1981 22 p refs Presented at the Polycrystalline Silicon Subcontractors' Rev. Meeting, Alexandria, Va. 17-19 Jun. 1981
(Contract W-7405-eng-26)
(DE81-024125; CONF-810690-1) Avail: NTIS HC A02/MF A01

The electrical properties of individual grain boundaries were investigated and correlated with the mismatch of grain orientations. The effects of heat treatment on the grain boundaries were examined. The effects of lithium diffusion on polycrystalline Si solar cells were determined and (4) the calibration and operation of A Si-CVD system was calibrated and operated in the temperature range from 400 to 1100 C with SiH4 and SiH2Cl2 as the source gasses. DOE

N81-32604*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SATELLITE POWER SYSTEM CONCEPT DEVELOPMENT AND EVALUATION PROGRAM. VOLUME 2: SYSTEM DEFINITION
Jul. 1981 116 p refs
(NASA-TM-58236; JSC-17300) Avail: NTIS HC A06/MF A01 CSCL 10A

The system level results of the system definition studies performed by NASA as a part of the Department of Energy/NASA satellite power system concept development and evaluation program are summarized. System requirements and guidelines are discussed as well as the major elements that comprise the reference system and its design options. Alternative system approaches including different system sizes, solid state amplifier (microwave) concepts, and laser power transmission system cost summaries are reviewed. An overview of the system analysis and planning efforts is included. The overall study led to the conclusion that the reference satellite power system concept is a feasible baseload source of electrical power and, within the assumed guidelines, the minimum cost per kilowatt is achieved at the maximum output of 5 gigawatts to the utility grid. Major unresolved technical issues include maximum allowable microwave power density in the ionosphere and performance/mass characteristics of laser power transmission systems. A.R.H.

N81-32605*# Monegon Ltd., Gaithersburg, Md.
PHOTOVOLTAIC STAND-ALONE SYSTEMS: PRELIMINARY ENGINEERING DESIGN HANDBOOK Final Contractor Report
H. L. Macomber, John B. Ruzek, and Frederick A. Costello Aug. 1981 248 p refs Prepared in cooperation with Costello (Frederick A.), Inc. and Bird Engineering Research Associates, Inc.
(Contract DEN3-195; DE-AI01-79ET-20485)
(NASA-CR-165352; DOE/NASA/0195-1; M206) Avail: NTIS CSCL 10A

Component design and engineering information, including estimation and reduction strategies, FV array characteristics, and material on batteries, power handling equipment, and back up systems are presented. The data needed to begin the design process and preliminary system design considerations are discussed. These considerations include analysis of insolation and siting, system sizing, feasibility assessment and reliability engineering approaches. Information on system design procedures and applicable codes and standards is presented. Information on system installation, operation, maintenance issues, personnel and facility safety requirements and various means of calculating insolation, including computer software and statistical computations are emphasized. T.M.

N81-32606*# Wyle Labs., Inc., Huntsville, Ala.
INDOOR TEST FOR THE THERMAL PERFORMANCE EVALUATION OF THE DEC 8A LARGE MANIFOLD SUNMASTER EVACUATED TUBE (LIQUID) SOLAR COLLECTOR
Sep. 1981 33 p refs
(Contract DEN0-00006)
(NASA-CR-161845; WYLE-TR-531-49) Avail: NTIS HC A03/MF A01 CSCL 10A

The Sunmaster DEC 8A Large Manifold solar collector using simulated conditions was evaluated. The collector provided 17.17 square feet of gross collector area. Test conditions, test requirements, an analysis of results, and tables of test data are reported. E.A.K.

N81-32609*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOLAR DRIVEN LIQUID METAL MHD POWER GENERATOR Patent Application
Ja H. Lee (Vanderbuilt Univ.) and Frank Hohl, inventors (to NASA) Filed 15 May 1981 15 p
(NASA-Case-LAR-12495-1; US-Patent-Appl-SN-263830) Avail: NTIS HC A02/MF A01 CSCL 10A

A method for solar electric power generation in space is described. A solar energy collector focuses solar energy onto a solar oven which is attached to a mixer which in turn is attached to the channel of a MHD generator. Gas enters the oven and a liquid metal enters the mixer. The gas/liquid metal mixture is heated by the collected solar energy and moves through the MHD generator thereby generating electrical power. The mixture is then separated and recycled. NASA

N81-32610 Committee on the Judiciary (U. S. Senate).
DOE'S ROLE IN THE SOLAR ENERGY INDUSTRY, AND POSSIBLE ANTICOMPETITIVE TRENDS
Washington GPO 1981 107 p refs Hearing before the Subcomm. on Antitrust, Monopoly and Business Rights of the Comm. on the Judiciary, 96th Congr., 2nd Sess., 14 Nov. 1980 (GPO-73-785) Avail: Subcommittee on Antitrust, Monopoly, and Business Rights

The concerns of small business in the solar energy field are discussed. The acquisitions of small companies by larger energy-intense companies was reviewed. Possible Federal regulations for the solar energy industry are considered and the overall solar energy policy for the nation is addressed. T.M.

N81-32615# Naval Postgraduate School, Monterey, Calif. Dept. of Administrative Sciences.
A STUDY OF PASSIVE SOLAR SPACE HEATING TECHNIQUES APPLIED TO FAMILY HOUSING UNITS WITHIN THE CONTINENTAL UNITED STATES M.S. Thesis
William Frederic Carr, Jr. Mar. 1981 135 p refs
(AD-A102714; NPS-54-81-003) Avail: NTIS HC A07/MF A01 CSCL 13/1

Passive solar energy is presented as an alternative to conventional space heating for existing and future government family housing units. The extent of the current energy problem is presented together with the implications of the findings of the Workshop on Alternative Energy Strategies. These findings significantly influence the impending energy problems facing the Department of Defense. A technical analysis is made of five passive solar space-heating design alternatives in five climate zones within the continental United States to determine the potential savings in conventional heating fuel and dollars to the Department of Defense. In addition, major advantages and disadvantages of solar energy are presented. Recommendations for the utilization of passive solar energy in family housing units conclude the thesis. Author (GRA)

N81-32619# Illinois Central Coll., East Peoria.
ALTERNATE HOME ENERGY APPLICATION AND DEMONSTRATION: PROJECT AHEAD Final Report
1 May 1981 80 p
(Contract DE-FG02-79R5-10112; Proj. AHEAD)
(DOE/R5-10112/T1) Avail: NTIS HC A05/MF A01

Project AHEAD, (Alternate Home Energy Application and Demonstration), an energy efficient, moderate cost, solar assisted home was demonstrated. The structure has three types of passive solar concepts: a trombe wall; a greenhouse; and a direct gain area. Project activities and the facility are described. DOE

N81-32620# Plasma Physics Corp., Locust Valley, N. Y.
PLASMA-ASSISTED CVD OF FLUORINATED, HYDROGENATED AMORPHOUS SILICON Final Report
John H. Coleman, John P. Hammes, and Harold J. Wiesmann 1981 42 p refs
(Contract DE-AC02-77CH-00178)
(SERI/TR-8041-2-T2) Avail: NTIS HC A03/MF A01

Three novel large area alpha-Si:H solar cells were developed. The following configurations are presented: inverted NIP/SS cells with an improved red response; inverted alpha-Si:H/alpha-BiH heterojunction cells with high V/sub oc/; and NIP/metal cells with a CVD P layer grown pyrolytically from silane and diborane. Experiments used disilane as the deposition gas for the intrinsic layer in both NIP/SS and PIN/SS structures. Coatings of In2O3, were applied to NIP/SS cells to evaluate its potential as a conductive coating in practical amorphous silicon solar cells. DOE

N81-32624# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
PERFORMANCE OF EVACUATED TUBULAR SOLAR COLLECTORS IN A RESIDENTIAL HEATING AND COOLING SYSTEM Final Report, 1 Oct. 1978 - 30 Sep. 1979
W. S. Duff and G. O. G. Loef Mar. 1981 196 p refs
(Contracts DE-AS02-76CS-32577; EY-76-S-02-2577)
(COO-2577-20) Avail: NTIS HC A09/MF A01

Operation of CSU Solar House I during the heating season of 1978-1979 and during the 1979 cooling season is discussed. The systems comprised an experimental evacuated tubular solar collector, a nonfreezing aqueous collection medium, heat exchange to an insulated conventional vertical cylindrical storage tank and to a built up rectangular insulated storage tank, heating of circulating air by solar heated water and by electric auxiliary in an off peak heat storage unit, space cooling by lithium bromide absorption chiller, and service water heating by solar exchange and electric auxiliary. The system is compared with CSU Solar Houses I, II and III. The experimental collector provides solar heating and cooling with minimum operational problems. Improved performance, particularly for cooling, resulted from the use of a very well insulated heat storage tank. Day time electric auxiliary heating is avoided by use of off peak electric heat storage. DOE

N81-32627# Midwest Research Inst., Golden, Colo. Systems Development Branch.
APPLICATION OF SOLAR PONDS TO DISTRICT HEATING AND COOLING
Cecile M. Leboeuf Apr. 1981 41 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-731-1036) Avail: NTIS HC A03/MF A01

A preliminary investigation is reported of the feasibility of incorporating solar ponds into subdivisions to provide district heating, domestic hot water (DHW), and district cooling. Two locations were chosen for analysis: Fort Worth, Texas and Washington, D.C. Solar ponds were sized to meet space heating, cooling, and DHW loads in each location for differing community sizes. Parameters such as storage layer temperature, pond geometry, and storage depth vs surface area were varied to determine the most effective approach to solar pond utilization. A distribution system for the district heating system was designed, including sizing of heat exchangers, piping, and pumps. Cost estimates for the pond and distribution system were formulated by using data generated in pond sizing, as well as associated system costs (e.g., salt costs and distribution system costs). Finally, solar ponds were found to be competitive with residential flat plate collector systems, with delivered energy costs as low as $16.00/GJ. DOE

N81-32634# Midwest Research Inst., Golden, Colo.
INVESTIGATION OF SOLAR CELLS BASED ON Cu2O Quarterly Report, 1 Dec. 1980 - 28 Feb. 1981
Larry C. Olsen (Joint Center for Graduate Study, Richland, Wash.) Apr. 1981 26 p
(Contract DE-AC02-77CH-00178)
(SERI/PR-9190-1-T2; QR-3) Avail: NTIS HC A03/MF A01

Efforts during this quarter concentrated on: studies of the effect of copper purity on Cu2O resistivity and cell performance; thermodynamic investigations of T1/Cu2O Schottky barriers. Samples from two different rods of five-nines purity copper were submitted for spark source mass spectrographic analyses. Cu2O substrates grown from copper wafers cut from the two rods exhibited significantly different resistivities, one much high than the other. It was determined that the material which yields high resistivity material is characterized by relatively large levels of impurities. DOE

N81-32635# Johnson Controls, Inc., Milwaukee, Wis.
COMMERCIALIZATION OF A THICK-FILM SOLAR CELL Final Technical Report, 15 Sep. 1980 - 30 Apr. 1981
Guy D. McDonald 1981 81 p refs Prepared for Midwest Research Inst.
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-8104-2-T4) Avail: NTIS HC A05/MF A01

No technical problems were encountered in the preparation of screen printed cadmium sulfide layers. High conductivity (less than 5 ohm cm resistivities) adherent layers could be produced on 7059 glass, Nesatron and tin oxide coated glass. No macro pinholes were observed in thick films. Solar cells produced from screen printed CdS had a maximum open circuit voltage of 0.44 volt and a maximum observed short circuit current of 8 ma/cm(2) under AM 1 illumination. A maximum cell efficiency of 2.2% was obtained. This performance is not felt to be a limitation produced by the screen printing approach but to be a limitation produced by the screen printing approach but to be reflective of an unoptimized procedure for producing Cu2S on the CdS film and the lack of a suitable post thermal treatment technique. DOE

N81-32637# EIC, Inc., Newton, Mass.
THERMAL STORAGE STUDIES FOR SOLAR HEATING AND COOLING: APPLICATIONS USING CHEMICAL HEAT PUMPS Final Report, 15 Sep. 1979 - 15 Apr. 1980
P. O. D. Offenhartz Apr. 1981 134 p refs
(Contract DE-AC02-79CS-30248)
(DOE/CS-30248/T1) Avail: NTIS HC A07/MF A01

The simulation of chemical heat pumps and simulations (including heating, cooling, and domestic hot water) were performed for Washington, D.C. and Ft. Worth, Texas. Direct weekly comparisons of the H2SO4/H2O and CaCl2/CH3OH cycles were carried out. Projected performance of the NH4NO3/NH3 cycle was also investigated, and was identical to H2SO4/H2O. In all simulated cases, the solar collector is a fixed evacuated tube system. With standard residential loads, the chemical heat pumps performed well. Gas fired backup via the heat pump was quite effective in reducing fossil fuel consumption. Chemical heat pumps are designed to reject heat at relatively high

temperatures, however, they are also effective in providing domestic hot water. DOE

N81-32639# United Technologies Corp., South Windsor, Conn. Power Systems Div.
INVESTIGATION OF A FAMILY OF POWER CONDITIONERS INTEGRATED INTO THE UTILITY GRID
Steven A. Eckhouse Jun. 1981 84 p
(Contract DE-AC04-76DP-00789)
(SAND-81-7016; FCR-2820) Avail: NTIS HC A05/MF A01

The design of a power conditioner for residential size solar photovoltaic applications is described. The ac and dc interface requirements are discussed. The design includes a simplified schematic, mechanical layout, and functional description. Performance and efficiency projections, and cost and reliability estimates are given. DOE

N81-32640# Martin Marietta Corp., Denver, Colo.
SECOND-GENERATION HELIOSTAT DEVELOPMENT, VOLUME 2
Apr. 1981 200 p
(Contract DE-AC04-76DP-00789)
(SAND-81-8176-Vol-2; MCR-81-1713) Avail: NTIS HC A09/MF A01

The design, manufacture, testing and cost analysis of the second generation heliostat are described. The following topics are discussed: the drawing tree for the heliostat; structural data of the rack assembly; drive mechanism and mirror assemblies, tests and results; a trade study on the pedestal foundation design; cost analysis worksheets; study of an edge support mirror module; and a study of a single motor, differential brake heliostat drive mechanism. DOE

N81-32642# Sandia Labs., Livermore, Calif. Applied Mechanics Div.
NONLINEAR THERMAL AND STRUCTURAL ANALYSIS OF A BRAZED SOLAR-CENTRAL-RECEIVER PANEL
L. M. Napolitano, Jr. and M. P. Kanouff Jul. 1981 45 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-8017) Avail: NTIS HC A03/MF A01

The panel incorporates a new way of joining tubes - brazing to intermediate filler strips which can affect the panel's lifetime. To calculate the stresses and strains for the worst-case section of the experimental panel. A nonlinear elastic-plastic analysis was performed with the MARC finite element computer code, which takes the temperature dependence of the material properties into account. From the results, tube design lifetimes are predicted. The analysis shows that concerns for cracking and reduction in lifetime are warranted, but a more detailed fracture analysis is necessary to determine whether there is a stable-crack-growth problem. DOE

N81-32643# Sandia Labs., Livermore, Calif. Large Power Systems Div.
INTERNATIONAL ENERGY AGENCY SMALL SOLAR POWER SYSTEMS (SSPS) PROJECT REVIEW
A. F. Baker May 1981 65 p
(Contract DE-AC04-76DP-00789)
(SAND-81-8216) Avail: NTIS HC A04/MF A01

The building of the small solar system project by the International Energy Agency in America province in Spain is reviewed. Background on the project and a definition and technical description of the main subsystems for the central receiver system and distributed collector system which are included in the project are provided. The current status of the planning for the tests and operation phase of the project are discussed. DOE

N81-32645# Sandia Labs., Albuquerque, N. Mex.
CONCEPTUAL DESIGN AND SYSTEM ANALYSIS STUDY FOR A HYBRID SOLAR PHOTOVOLTAIC/SOLAR THERMAL ELECTRIC POWER SYSTEM. VOLUME 3: APPENDICES Final Report
Jul. 1981 169 p Prepared in cooperation with Spectrolab, Inc., Sylmar, Calif.
(Contract DE-AC04-76DP-000789)
(SAND-80-7014-3) Avail: NTIS HC A08/MF A01

Hybrid photovoltaic/solar thermal electric conversion systems were analyzed. Several types of hybrid systems, photovoltaic only systems, and solar thermal electric systems in terms of performance and cost were compared. The computer code used in the analyses and background information on heat engines, thermal efficiencies of photovoltaic thermal collectors, and optical considerations for central receiver plants is also described. DOE

N81-32646# Sandia Labs., Albuquerque, N. Mex.
STUDY OF POTENTIAL PHOTOVOLTAIC/THERMAL APPLICATIONS IN THE COMMERCIAL SECTOR Final Report
C. D. Parker Jul. 1981 153 p refs
(Contract DE-AC04-78DP-00789)
(SAND-80-7175) Avail: NTIS HC A08/MF A01

Applications for photovoltaic thermal (PV/T) systems, a procedure for ranking applications in the service, commercial, and institutional (SCI) sectors by using the energy consumption data base (which tabulates energy use by sector, region, fuel type, and end use) was identified. Temperature requirements of end use; effects of temperature on efficiencies, cost of fuels replaced, and thermal and electrical loads are considered. The electrical load and the temperature requirement of the thermal load determine size of the array, which meets the requirements of the entire electrical load. The rankings indicate the PV/T arrays are more cost effective than PV only arrays for most commercial applications. Absorption cooling can usually be substituted for vapor compression cooling. The high school load profiles are used for a PV/T array application. It is shown that the PV/T array can be used advantageously. DOE

N81-32648# Argonne National Lab., Ill.
TECHNOLOGY ASSESSMENT OF SOLAR ENERGY SYSTEMS: LOCAL EMPLOYMENT IMPACTS OF THE TASE ENERGY SCENARIOS
K. K. Smeltzer Nov. 1980 37 p refs
(Contract W-31-109-eng-38)
(ANL/EES-TM-134) Avail: NTIS HC A03/MF A01

The local requirements and impacts of on-site employment by the energy facilities embodied in the high and low solar scenarios of the Technology Assessment of Solar Energy project are analyzed. After presenting an overview of the project and the scenarios are postulated, the general energy-related employment consequences of these scenarios are discussed and are identified. These sources include a wide variety of solar and conventional energy systems whose construction/installation and operation and maintenance employment requirements are summarized from a variety of sources. These employment data, along with the scenarios' projections of energy contributions by each technology type, are used to determine the technology-specific, on-site employment requirements of the scenarios. Finally the likely local social and economic impacts of these requirements are identified and discussed. DOE

N81-32651# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION FOR LANDURA CORPORATION SINGLE-FAMILY RESIDENCE, STAYTON, OREGON
24 Jul. 1981 57 p
(Contracts DE-AB01-76CS-31020; HUD-H-2372)
(SOLAR/1069-81/50) Avail: NTIS HC A04/MF A01

The solar project in a single family residence in Stayton, Oregon is discussed. The side has approximately 1500 square feet of conditioned space. The solar energy system has an array of flat plate collectors with a grass area of 357 square feet. The roof beneath the collector array is designed as a reflector surface and increases the effective collector area to 1072 square feet. Water is used as the transfer medium. Solar energy is stored above ground in two 1250 gallon tanks. Supply water is preheated in a heat exchanger coil in storage tank 1 and supplied, on demand, to a conventional 65 gallon DHW tank. DOE

N81-32655# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PRELIMINARY OPERATIONAL RESULTS OF THE LOW TEMPERATURE-SOLAR INDUSTRIAL-PROCESS-HEAT FIELD TESTS
Charles F. Kutscher and Roger L. Davenport Jun. 1981 43 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-029129; SERI/TR-632-385R) Avail: NTIS HC A03/MF A01

Three hot water systems and four hot air systems are evaluated. All are low-temperature projects (process heat at

temperatures below 2120 F). Performance results, project costs, and problems encountered are summarized. Flat-plate, evacuated-tube, and line-focus collectors are all represented in the program, with collector array areas ranging from 2500 to 21,000 sq ft. Collector array efficiencies ranged from 12% to 36% with net system efficiences from 8% to 33%. Low efficiencies are attributable in some cases to high thermal losses and, for the two projects using air collectors, are due in part to high parasitic power consumption. Problems have 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

N81-32657# *Altus Corp., San Jose, Calif.*
FINAL DRAFT: IEA TASK 1. REPORT ON SUBTASK D, OPTIMIZATION CF SOLAR HEATING AND COOLING SYSTEMS
T. L. Freeman, ed. Mar. 1981 55 p refs
(Contract DE-AC03-80CS-30579)
(DOE/CS-30579/T1) Avail: NTIS HC A04/MF A01

A review of general techniques and specific methods useful in the optimization of solar heating and cooling systems is undertaken. A discussion of the state of the art and the principal problems in both the simplified thermal performance analysis and economic analysis portions of the optimization problem are presented. Sample economic analyses are performed using several widely used economic criteria. The predicted thermal results of one typical, widely used simplified method is compared to detailed simulation results. A methodology for and the results of a sensitivity study of key economic parameters in the life cycle cost method are presented. Finally, a simple graphical optimization technique based on the life cycle cost method is proposed. DOE

N81-32662# Zeopower Co., Natick, Mass.
DEVELOPMENT OF LOW-COST INTEGRATED ZEOLITE COLLECTOR Final Report, 25 Sep. 1978 - 24 Sep. 1980
Dimiter I. Tchernev Jul. 1981 96 p refs
(Contract DE-AC03-78CS-32117)
(DE81-027660; DOE/CS-32117/T1; DOE/SAN-2117/1) Avail: NTIS HC A05/MF A01

The optimum zeolite loading and the best zeolite for this purpose were determined by careful mathematical analysis, followed by experimental test, to confirm the theoretical results. The integrated collector design was then completed and the collector was constructed. After sealing and vacuum testing the zeolite panels and heat exchanges, the collector was coated with flat black paint and provided with double glazing, aluminum frame and insulation. Preliminary testing indicates close agreement with theoretical predictions of its performance. DOE

N81-32663# Department of Energy, Washington, D. C. Assistant Secretary for Conservation and Renewable Energy.
PHOTOVOLTAIC ENERGY SYSTEMS: PROGRAM SUMMARY
Jan. 1981 473 p
(DE81-026471; DOE/CE-0012) Avail: NTIS HC A20/MF A01

The ongoing research, development, and demonstration efforts of the Photovoltaics Program are highlighted and each of the US Department of Energy's current photovoltaics projects initiated or renewed during fiscal year 1980 is described. The program is briefly summarized, including the history and organization and highlights of advanced research and development, testing, and utilization in federal facilities. An exhaustive bibliography is included. DOE

N81-32666# Los Alamos Scientific Lab., N. Mex. Solar Energy Group.
DESIGN AND ANALYSIS OF DIRECT GAIN SOLAR HEATED BUILDINGS
William O. Wray Jun. 1981 119 p refs
(Contract W-7405-eng-36)
(DE81-026428; LA-8885-MS) Avail: NTIS HC A06/MF A01

Direct solar gains through south facing windows can supply a significant portion of the space heating needs of properly designed residential and light commercial buildings. The performance of a direct gain building depends on the climate, the solar collection area, the heat loss characteristics of the building envelope, the amount of thermal storage mass within the living space, and many other design parameters or options. This relationship is complex and can be fathomed only by a systematic rsearch program involving both experimentation and analysis. Such a program was completed, and the results are presented in a form that is appropriate for quantitative thermal design. DOE

N81-32668# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SOLAR THERMAL ENERGY SYSTEMS RESEARCH AND ADVANCED DEVELOPMENT PROGRAM REVIEW
W. A. Hunt, comp. Apr. 1981 163 p refs Conf. held in Oakland, Calif., 8-9 Apr. 1981
(Contract DE-AC02-77CH-00178)
(SERI/CP-633-1145) Avail: NTIS HC A08/MF A01

Advancement in research and development in solar energy systems was investigated. The following topies are discussed: systems applications, fuel and chemicals research, solar materials research, and applied research. E.A.K.

N81-32669# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PREPARATION AND PROPERTIES OF EVAPORATED CdTe FILMS COMPARED WITH SINGLE CRYSTAL CdTe Progress Report, 1 Feb. - 30 Apr. 1981
Richard H. Bube 1981 29 p ref Prepared in cooperation with Stanford Univ.
(Contract DE-AC02-77CH-00178)
(SERI/PR-9330-1-T2) Avail: NTIS HC A03/MF A01

The design, constructing and testing of the hot wall vacuum evaporation system is discussed. A calculation of the optimum possible efficiency for an n-p CdTe homojunction indicates a value of 14%. A background is provided on the growth of over 50 CdTe single crystals. Use of crystal regrowth and vibration during growth both increase crystal quality. Initial investigation of the properties of grain boundaries in p-type CdTe:P crystals indicates a grain boundary height of 0.44 eV unaffected by illumination. It is suggested that grain boundaries are more strongly pinned in p-type than in n-type CdTe. DOE

N81-32672# Midwest Research Inst., Golden, Colo. Buildings Systems Development Branch.
ACTIVE CHARGE/PASSIVE DISCHARGE SOLAR HEATING SYSTEMS: THERMAL ANALYSIS AND PERFORMANCE COMPARISONS
Joel Swisher Jun. 1981 43 p refs
(Contracts DE-AC02-77CH-00178; EG-77-G-01-4042)
(DE81-027282; SERI/TR-721-1104) Avail: NTIS HC A03/MF A01

This type of system combines liquid-cooled solar collector panels with a massive integral storage component that passively heats the building interior by radiation and free convection. The TRNSYS simulation program is used to evaluate system performance and to provide input for the development of a simplified analysis method. This method, which provides monthly calculations of delivered solar energy, is based on Klein's Phi-bar procedure and data from hourly TRNSYS simulations. The method can be applied to systems using a floor slab, a structural wall, or a water tank as the storage component. Important design parameters include collector area and orientation, building heat loss, collector and heat exchanger efficiencies, storage capacity, and storage to room coupling. Performance simulation results are used for comparisons with active and passive solar designs. DOE

N81-32675# BDM Corp., Albuquerque, N. Mex.
CONCEPTUAL DESIGN AND ANALYSIS OF A 100-MWe DISTRIBUTED LINE FOCUS SOLAR POWER PLANT, VOLUME 1 Final Report
1981 269 p
(Contract DE-AC03-78ET-20524)
(DE81-025991; DOE/ET-20524/1-Vol-1) Avail: NTIS HC A12/MF A01

The concept of a Solar Power Plant is discussed. the following are included: executive summary, program overview, subsystem parametric analysis, system analysis and selection, conceptual design, and performance and cost summary. L.F.M.

N81-32677# Oak Ridge National Lab., Tenn. Energy Div.
APPLICATIONS OF HIGH-TEMPERATURE SOLAR HEAT TO THE PRODUCTION OF SELECTED FUELS AND CHEMICALS
S. E. Beall, Jr., C. E. Bamberger, and H. A. Goeller Jul. 1981 134 p refs
(Contract W-7405-eng-26)
(DE81-027070; ORNL/TM-7441) Avail: NTIS HC A07/MF A01

Processes requiring heat in the 1500 to 2500 range were investigated. Hydrogen production by several thermochemical mens, carbon monoxide production by thermochemical and direct thermal dissociation, and nitrogen fixation by direct thermal reaction of nitrogen and oxygen in air are considered. The engineering feasibility of the processes is discussed. The problem of matching the conventional and innovative processes to a high temperature solar supply was studied. Some solar thermal power plants of current designs were examined and several advanced concepts of highly concentrating systems are considered for very high temperature applications. DOE

N81-32679# Sandia Labs., Albuquerque, N. Mex. Photovoltaic Data and Information Systems Div.
INTERMEDIATE PHOTOVOLTAIC-SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 1: FOR MT. LAGUNA RADAR STATION SITE, MT. LAGUNA, CALIF.
Jul. 1981 18 p Prepared in cooperation with Boeing Computer Services Co., Seattle
(Contract DE-AC04-76DP-00789)
(SAND-81-7090/1; DE81-028189) Avail: NTIS HC A02/MF A01

A program for constructing a remote military photovoltaic power network and for demonstrating that a dc-ac photovoltaic energy conversion system, without on site energy storage, can effectively augment a diesel-powered electric grid, is outlined. Included are a list of paticipants, insolation and operating data, definitions of operational and data collection modes, system specifications and subsystem descriptions. DOE

N81-32680# General Electric Co., Sunnyvale, Calif. Advanced Reactor Systems Dept.
THERMAL PERFORMANCE AND DYNAMIC STABILITY OF SOLAR PILOT PLANT RECEIVER PANEL TEST OF CRTF
E. A. Hernandez Jan. 1981 43 p refs
(Contract DE-AC04-76DP-00789)
(ARSD-00088; SAND-81-8181) Avail: NTIS HC A03/MF A01

Thermal performance of a solar heated boiler panel is reported. The test panel geometry incorporates design features and pilot plant operating conditions are simulated. Overall thermal performance and axial distribution of temperatures and absorbed heat flux are predicted with a steady state code included. Differential pressure and temperature oscillations are identified as characteristic of density wave dynamic channel instability. Selective experimentally determined unstable conditions are also predicted to be unstable with a state of the art dynamic stability code, STEAMFREQ-I. DOE

N81-32681# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
THE 10 MWe SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT SOLAR FACILITIES DESIGN INTEGRATION, RADL ITEM 1-10 Technical Status Report
Jul. 1980 20 p
(Contract DE-AC03-79SF-10499)
(DOE/SF-10499/T37) Avail: NTIS HC A02/MF A01

Accomplishments are reported in the areas of: program management, system integration, the beam characterization system, receiver unit, thermal storage subsystems, master control system, plant support subsystem and engineering services. A solar facilities design integration program action items update is included. Work plan changes and cost underruns are discussed briefly. (LEW) DOE

N81-32682# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
THE 10 MWe SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT SOLAR FACILITIES DESIGN INTEGRATION, RADL ITEM 1-10 Technical Status Report
Aug. 1980 16 p
(Contract DE-AC03-79SF-10499)
(DOE/SF-10499/T36) Avail: NTIS HC A02/MF A01

Work on the plant support subsystems and engineering services is reported. The master control system, thermal storage subsystem, receiver unit, and the beam characterization system were reviewed. Progress in program management and system integration is highlighted. T.M.

N81-32683# BDM Corp., Albuquerque, N. Mex.
CONCEPTUAL DESIGN AND ANALYSIS OF 100 MWe DISTRIBUTED LINE FOCUS SOLAR POWER PLANT Final Report
[1981] 336 p refs
(Contract DE-AC03-78ET-20524)
(DE81-025572; DOE/ET-20524/1-Vol-2) Avail: NTIS HC A15/MF A01

The several efficiency of the ski model t-700 lpt solar collector with varied RTS configurations, and the analytical efficiency models of the CS/RTS were validated. Efficiency is determined as a function of solar insolation and average collector thermal transfer fluid temperature. There different receiver tube/annulus and two thermal transfer fluids are used for each configuration. E.A.K.

N81-32684# Energy Technology Engineering Center, Canoga Park, Calif.
TC-100 SOLAR-COLLECTOR REVIEW PROGRAM Final Summary Report
A. J. Darnell, W. P. Marlatt, and J. K. Roberts Jun. 1981 54 p refs
(Contract DE-AC03-76SF-00700)
(DE81-028762; ETEC-TDR-81-3) Avail: NTIS HC A04/MF A01

Field and laboratory tests, materials investigation and tests, and thermal modeling work were conducted to determine the extent and effect of serpentine oxidation on thermal performance of the TC-100 solar collector. This work included measurements at six field installations to determine the extent of atmospheric fin oxidation on typical solar collectors at each site. Thermal efficiency performance tests were conducted at the Gilroy Foods solar installation. Field performance tests were conducted separately on the two essentially identifically constructed halves of this solar collector installation which had experienced significantly different periods of stagnation, i.e., subjected to solar insolation without coolant flow. DOE

N81-32690# Sandia Labs., Albuquerque, N. Mex.
LINE-FOCUS CONCENTRATING SOLAR COLLECTORS
James A. Leonard and Virgil L. Dugan 1980 9 p Presented at the Conf. on New and Renewable Energy Sources, Nairobi, Kenya, Aug. 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2394C; CONF-810802-1) Avail: NTIS HC A02/MF A01

An overview of the line focus concentrating solar collector technology and applications is presented. The collectors, some of the key features of the engineering approach, instantaneous and all day performance and operating data, temperature capabilities and limitations for selected collectors, projected future capabilities for peak and annual performance are described. Projected system capital costs and annualized life cycle cost for thermal energy produced are discussed. Several existing application projects which employ line concentrating collectors are reviewed. DOE

N81-32692# Applied Research Association, Inc., Albuquerque, N. Mex.
FULL SCALE LOAD TESTS OF EXPERIMENTAL SOLAR COLLECTOR FOUNDATIONS
D. H. Merkle Jun. 1981 114 p refs Presented at the ASCE Spring Conf., Las Cruces, N. Mex., 27 Mar. 1981 Prepared for Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE81-026044; SAND-80-7076; CONF-810341-1) Avail: NTIS HC A06/MF A01

Four drilled, reinforced concrete piers typical of foundations utilized for single axis tracking solar collector systems were tested

to failure under both eccentric lateral and vertical loads. The tests showed the need to improve the foundation anchor bolt assembly, and also the method of mounting for collectors to the foundations. The lateral and vertical failure loads and moments of all four piers well exceeded specified design values. DOE

N81-32699# MacMillan Co. of India, Madras.
PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON BIOLOGICAL APPLICATIONS OF SOLAR ENERGY
A. Gnanam, ed., S. Krishmaswamy, ed. (Maduraj Kamaraj Univ., India), and Joseph S. Kahn, ed. (North Carolina State Univ. at Raleigh) 1980 231 p refs Conf. held at Maduraj, India, 1-5 Dec. 1978
(PB81-195307) Copyright. Avail: NTIS HC A11/MF A01 CSCL 10B

Solar energy harvesting through photosynthetic means for biomass and biofuel production is discussed. Global and regional aspects of solar energy photosynthesis and productivity, nitrogen fixation, biomass, extreme environment, model systems, and biofuels and chemicals are addressed. GRA

N81-32701# National Bureau of Standards, Washington, D.C. Center for Building Technology.
UNCERTAINTY IN DETERMINING THERMAL PERFORMANCE OF LIQUID-HEATING FLATPLATE SOLAR COLLECTORS *Final Report*
Elmer Streed and David Waksman Apr. 1981 102 p refs Sponsored in part by DOE
(PB81-205452; NBS-TN-1140) Avail: NTIS HC A06/MF A01 CSCL 10A

Thermal performance measurements of eight liquid-heating flat-plate solar collectors are presented. Statistical anaysis of data, sets for each collector type within test sites and between test sites was done using ASTM recommended methods to evaluate test method measurement uncertainty. The influence of thermal performance data uncertainty on collector material degradation, collector rating, and calculated system performance is described. GRA

N81-32703# Illinois Inst. of Natural Resources, Springfield. Solar Energy Sect.
F-CHART HANDBOOK. ACTIVE SOLAR SYSTEM SIZING AND ECONOMIC ANALYSIS PROGRAM
Gary W. Mielke Apr. 1981 15 p
(PB81-210551; ILLDOE-81/01) Avail: NTIS HC A02/MF A01 CSCL 13A

The program is applicable to active solar space and service water heating systems that incorporate typical flat-plate solar collectors. The program is based on the F-Chart method of estimating annual system thermal performance. This program uses a standard life-cycle cost analysis methodology to calculate optimum solar system size and present economic performance data. The F-Chart program is designed to be used by anyone interested in, or involved with, solar heating systems. This handbook describes both information input requirements and the resultant thermal and economic analyses. GRA

N81-33222*# *Jet Propulsion Lab., California Inst. of Tech.*, Pasadena.
SYSTEMS TEST FACILITIES EXISTING CAPABILITIES COMPILATION
Robert Weaver 1 Aug. 1981 45 p refs
(Contracts NAS7-100; DE-A101-76ET-20356; JPL Proj. 5240-3) (NASA-CR-164851; DOE/ET-20356/1; JPL-Pub-81-14) Avail: NTIS HC A03/MF A01 CSCL 14B

Systems test facilities (STFS) to test total photovoltaic systems and their interfaces are described. The systems development (SD) plan is compilation of existing and planned STFs, as well as subsystem and key component testing facilities. It is recommended that the existing capabilities compilation is annually updated to provide and assessment of the STF activity and to disseminate STF capabilities, status and availability to the photovoltaics program. E.A.K.

N81-33313# New Hampshire Univ., Durham. Dept. of Chemical *Engineering.*
SOLAR-ENHANCED COAL GASIFICATION USING HIGH-TEMPERATURE SOLAR ENERGY
S. M. Lakshmanan, F. K. Manasse, and V. K. Mathur 1980 21 p refs Presented at the Natl. Solar Energy Conv., Annamalainagar, India, Dec. 1980
(Contract DE-AC02-79ET-21067)
(DE81-025020; CONF-801264-1) Avail: NTIS HC A02/MF A01

A fluidized bed coal gasification system using solar energy for the production of synthesis gas is described. The problems relating to its commercialization are also discussed. DOE

N81-33356# Los Alamos Scientific Lab., N. Mex.
ATTACHED-SUNSPACE PASSIVE SOLAR-HEATED RESIDENCES: A STUDY OF NATIONWIDE PATTERNS OF ECONOMIC FEASIBILITY FOR THE EXISTING HOUSING STOCK
F. Roach and C. Kirschner Jun. 1981 135 p
(Contract W-7405-eng-36)
(DE81-026309; LA-8889-MS) Avail: NTIS HC A07/MF A01

Performance estimates for attached-sunspace passive solar-heated residences were incorporated into the Los Alamos/UNM EASE 3 Model. These estimates are used to analyze the economic performance of a passive sunspace design when retrofitting onto an existing single-family home. Several key parameters are evaluated, including loan or mortgage terms, ownership period, resale potential, and competing conventional fuel prices. General economic and design parameters are combined in one version of life-cycle costing to evaluate the feasibility of both owner-built and contractor-built attached sunspaces for 220 regions in the contiguous US. The conventional fuel alternatives are natural gas, heating oil, electric resistance, and electric heat pump. The optimal sunspace design in determined for the fuel alternatives by minimizing the combined solar and conventional delivered cost of heat. An analysis of fuel used for space heating in existing homes is used to discuss the retrofit potential for the 220 regions. Results show that the prospect for conventional fuel displacement through retrofit of attached sunspace is very good, and that the design's economic performance is enhanced in regions with expensive conventional fuel alternatives. DOE

N81-33414# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
INVESTIGATION OF A FAMILY OF POWER CONDITIONERS INTEGRATED INTO A UTILITY GRID: CATEGORY 1 Final Report
P. Wood and R. P. Putkovich Jul. 1981 107 p Prepared for Sandia National Lab.
(Contracts DE-AC04-76DP-00789; DE-AC02-79ET-29359)
(DE81-029394; SAND-81-7030) Avail: NTIS HC A06/MF A01

Technical issues regarding ac and dc interface requirements were studied. A baseline design was selected to be a good example of existing technology which would not need significant development effort for its implementation in residential solar photovoltaic systems. Alternative technologies are evaluated to determine which meet the baseline specification, and their costs and losses are evaluated. Areas in which cost improvements can be obtained are studied, and the three best candidate technologies--the current sourced converter, the HF front end converter, and the programmed wave converter--are compared. It is concluded that the designs investigated will meet, or with slight improvement could meet, short term efficiency goals. Long term efficiency goals could be met if an isolation transformer were not required in the power conditioning equipment. None of the technologies studied can meet cost goals unless further improvements are possible. DOE

N81-33496*# Boeing Engineering and Construction, Seattle, Wash.
WIND LOADS ON FLAT PLATE PHOTOVOLTAIC ARRAY FIELDS (NONSTEADY WINDS) *Final Report*
Ronald D. Miller and Donald K. Zimmerman Aug. 1981 96 p refs Sponsored by NASA and DOE Prepared for JPL, California Inst. of Tech., Pasadena
(Contract JPL-954833)
(NASA-CR-164745; DOE/JPL-954833-81/4; JPL-9950-594) Avail: NTIS HC A05/MF A01 CSCL 20K

Techniques to predict the dynamic response and the structural dynamic loads of flat plate photovoltaic arrays due to wind turbulence were analyzed. Guidelines for use in predicting the turbulent portion of the wind loading on future similar arrays

are presented. The dynamic response and the loads dynamic magnification factor of the two array configurations are similar. The magnification factors at a mid chord and outer chord location on the array illustrated and at four points on the chord are shown. The wind tunnel test experimental rms pressure coefficient on which magnification factors are based is shown. It is found that the largest response and dynamic magnification factor occur at a mid chord location on an array and near the trailing edge. A technique employing these magnification factors and the wind tunnel test rms fluctuating pressure coefficients to calculate design pressure loads due to wind turbulence is presented. E.A.K.

N81-33603*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A COMPARATIVE ASSESSMENT OF SOLAR THERMAL ELECTRIC POWER PLANTS IN THE 1-10 MWe RANGE
L. S. Rosenberg and W. R. Revere Jun. 1981 80 p refs
(Contracts NAS7-100; DE-AT04-81AL-16228; JPL Proj. 5105-88)
(NASA-CR-164854; JPL-Pub-81-53; DOE/JPL-1060/21) Avail: NTIS HC A05/MF A01 CSCL 10A

The candidate power system technologies were ranked in terms of the cost of electric energy each system produces. In all cases, it was assumed that development programs would result in mature power plant systems that could be commercially manufactured. The results of the study, a brief description of the systems examined, and the methodologies used are presented. T.M.

N81-33604*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EVALUATION OF THE EFFECTS OF A FREEZE/THAW ENVIRONMENT ON CELLULAR GLASS
P. Frickland, E. Cleland, and T. Hasegawa 15 Aug. 1981 73 p refs
(Contract NAS7-100; DE-AT04-81AL-16228; JPL Proj. 5105-81)
(NASA-CR-164856; JPL-Pub-81-29; DOE/JPL-1060/44) Avail: NTIS HC A04/MF A01 CSCL 01A

Using the evaluation criteria of water vapor permeability and conformability, a protective butylrubber/silicone conformal coating system was selected for use on Foamglas substrates in a freeze/thaw environment. The selection of a specific freeze/thaw cycle which closely models field conditions is discussed. A sampling plan is described which allows independent evaluation of the effects of conformal coatings, cycle number and location within the environmental chamber. The results of visual examination, measurement of density, modulus of rupture and Young's modulus are reported. Based upon statistical evaluation of the experimental results, it is concluded that no degradation in mechanical properties of either coated or uncoated Foamglas occurred within the duration of the test (53 freeze/thaw cycles). T.M.

N81-33605*# Spire Corp., Bedford, Mass.
INTEGRAL GLASS ENCAPSULATION FOR SOLAR ARRAYS Final Report
G. A. Landis Jul. 1981 79 p refs Sponsored in part by DOE Prepared for JPL
(DOE/JPL-954521-81/15; JPL-9950-589; FR-81-10046) Avail: NTIS HC A05/MF A01

Electrostatic bonding technology, an encapsulation technique for terrestrial solar array was developed. The process produces full integral, hermetic bonds with no adhesives or pottants. Panels of six solar cells on a simple glass superstrate were produced. Electrostatic bonding for making the cell front contact was also developed. A metal mesh is trapped into contact with the cell front during the bonding process. Six cell panels using the bonded mesh as the only cell front contact were produced. The possibility of using lower cost glass, with a higher thermal expansion mismatch to silicon, by making lower temperature bonds is developed. However, this requires a planar surface cell. E.A.K.

N81-33606*# California Inst. of Tech., Pasadena.
EVALUATION AND VERIFICATION OF EPITAXIAL PROCESS SEQUENCE FOR SILICON SOLAR CELL PRODUCTION Quarterly Report, 1 Apr. - 30 Jun. 1981
D. Redfield Jul. 1981 21 p refs Sponsored in part by DOE Prepared for JPL
(Contract NAS7-100)
(NASA-CR-164875; DOE/JPL-955825-81/2; JPL-9950-590; QR-2) Avail: NTIS HC A02/MF A01 CSCL 10A

The applicability of solar cell and module processing sequences, to be used on lower cost epitaxial silicon wafers was evaluated. The extent to which the process sequences perform effectively when applied to film, solar cells formed by epitaxial deposition of Si on potentially inexpensive substrates of upgraded metallurgical grade Si is examined. It is concluded that these substrates are satisfactory in their cell performance. E.A.K.

N81-33607*# Pennsylvania Univ., Philadelphia.
ANALYSIS AND EVALUATION IN THE PRODUCTION PROCESS AND EQUIPMENT AREA OF THE LOW-COST SOLAR ARRAY PROJECT Final Report
M. Wolf Apr. 1981 319 p refs Sponsored by NASA and DOE Prepared for JPL, California Inst. of Tech., Pasadena
(Contract JPL-954976)
(NASA-CR-164867; DOE/JPL-954976-81/13) Avail: NTIS HC A14/MF A01 CSCL 10A

The effect of solar cell metallization pattern design on solar cell performance and the costs and performance effects of different metallization processes are discussed. Definitive design rules for the front metallization pattern for large area solar cells are presented. Chemical and physical deposition processes for metallization are described and compared. An economic evaluation of the 6 principal metallization options is presented. Instructions for preparing Format A cost data for solar cell manufacturing processes from UPPC forms for input into the SAMIC computer program are presented. J.D.H.

N81-33609*# Westinghouse Electric Corp., East Pittsburgh, Pa. Advanced Energy Systems Div.
A MODULE EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT (MEPSDU) Quarterly Report, 1 Jun. - 31 Aug. 1981
31 Aug. 1981 61 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955909)
(NASA-CR-164877; DOE/JPL-955909-81/3; JPL-9950-595; QR-3) Avail: NTIS HC A04/MF A01 CSCL 10A

Subsequent to the design review, a series of tests was conducted on simulated modules to demonstrate that all environmental specifications (wind loading, hailstone impact, thermal cycling, and humidity cycling) are satisfied by the design. All tests, except hailstone impact, were successfully completed. The assembly sequence was simplified by virtue of eliminating the frame components and assembly steps. Performance was improved by reducing the module edge border required to accommodate the frame of the preliminary design module. An ultrasonic rolling spot bonding technique was selected for use in the machine to perform the aluminum interconnect to cell metallization electrical joints required in the MEPSDU module configuration. This selection was based on extensive experimental tests and economic analyses. T.M.

N81-33610*# General Electric Co., Philadelphia, Pa. Energy Systems and Technology Div.
INTEGRATED RESIDENTIAL PHOTOVOLTAIC ARRAY DEVELOPMENT
N. F. Shepard, Jr. 14 Aug. 1981 74 p Sponsored by NASA and DOE Prepared for JPL, Pasadena, Calif.
(Contract JPL-955894)
(NASA-CR-164865; DOE/JPL-955894-3) Avail: NTIS HC A04/MF A01 CSCL 10A

The design details of an optimized integrated residential photovoltaic module/array are presented. This selected design features a waterproofing and mounting scheme which was devised to simplify the installation procedures by the avoidance of complex gasketed or caulked joints, while still maintaining a high confidence that the watertight integrity of the integral roofing surface will be achieved for the design lifetime of the system. The production and installation costs for the selected module/array design are reported for a range of annual production rates as a function of the cost of solar cells. M.G.

N81-33611*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR COOLING SYSTEM PERFORMANCE, FRENCHMAN'S REEF HOTEL, VIRGIN ISLANDS Final Report
Harry Harber 25 Sep. 1981 25 p refs
(Contracts DEN8-00005; DEN8-00007; DEN8-0000021)

(NASA-TM-82442) Avail: NTIS HC A02/MF A01 CSCL 10A

The operational and thermal performance of a variety of solar systems are described. The Solar Cooling System was installed in a hotel at St. Thomas, U. S. Virgin Islands. The system consists of the evacuated glass tube collectors, two 2500 gallon tanks, pumps, computerized controller, a large solar optimized industrial sized lithium bromide absorption chiller, and associated plumbing. Solar heated water is pumped through the system to the designed public areas such as lobby, lounges, restaurant and hallways. Auxiliary heat is provided by steam and a heat exchanger to supplement the solar heat. E.A.K.

N81-33612*# LinCom Corp., Pasadena, Calif.
SOLAR POWER SATELLITE ANTENNA PHASE CONTROL SYSTEM HARDWARE SIMULATION, PHASE 4: VOLUME 1: EXECUTIVE SUMMARY Final Report
W. C. Lindsey, A. V. Kantak, and C. M. Chie Mar. 1981 22 p refs 3 Vol.
(Contract NAS9-16097)
(NASA-CR-167393; TR-0381-1280-Vol-1) Avail: NTIS HC A02/MF A01 CSCL 10A

The phase control system is described. Potential sources of phase error are identified and the performance leading to selection of the allowable phase error for each source is summarized. The pilot transmitter, the effects of ionospheric, the master slave returnable timing system (MSRTS), the SPS receiver, and the high power amplifier for dc to microwave conversion are considered separately. Design parameters of the pilot transmitter and spacetenna transponder are presented. J.D.H.

N81-33613*# LinCom Corp., Pasadena, Calif.
SOLAR POWER SATELLITE ANTENNA PHASE CONTROL SYSTEM HARDWARE SIMULATION, PHASE 4. VOLUME 2: ANALYTICAL SIMULATION OF SPS SYSTEM PERFORMANCE Final Report
W. C. Lindsey, A. V. Kantak, and C. M. Chie Mar. 1981 93 p refs 3 Vol.
(Contract NAS9-16097)
(NASA-CR-167394; TR-0381-1280-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 10A

The pilot signal parameter optimization and power transponder analyses are presented. The SPS antenna phase control system is modeled and the hardware simulation study described. Ionospheric and system phase error effects and the effects of high power amplifier phase and amplitude jitters are considered. Parameter optimization of the spread spectrum receiver, consisting of the carrier tracking loop and the code tracking loop, is described. J.D.H.

N81-33614*# LinCom Corp., Pasadena, Calif.
SOLAR POWER SATELLITE ANTENNA PHASE CONTROL SYSTEM HARDWARE SIMULATION, PHASE 4. VOLUME 3: SOLARSIM USERS MANUAL Final Report
W. C. Lindsey, A. V. Kantak, and C. M. Chie Mar. 1981 41 p refs 3 Vol.
(Contract NAS9-16097)
(NASA-CR-167395; TR-0381-1280-Vol-3) Avail: NTIS HC A03/MF A01 CSCL 10A

Documentation of the interactive software package designed to predict the effect of certain electrical and mechanical imperfections on the performance of the SPS system is presented. The capabilities of the SOLARSIM program to quantify the spacetenna performance parameter values are described: The SOLARSIM package can compute the RMS pointing error, title effects, MPTX code tracking loop performance, MPTX carrier tracking loop performance, averaged power pattern, and the power transfer efficiency. J.D.H.

N81-33616# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
NUMERICAL SOLUTION OF NATURAL CONVECTION IN AN INCLINED RECTANGULAR CAVITY WITH PARTITIONS M.S. Thesis
Thomas K. Toltzien Dec. 1980 96 p refs
(AD-A103389; AFIT/GAE/AA/80D-23) Avail: NTIS HC A05/MF A01 CSCL 10/1

A numerical investigation was conducted on two-dimensional natural convection within inclined rectangular enclosures partitioned into 45 degree triangular cells. The time dependent governing equations, vorticity, energy, and stream function, were solved by an ADI method and a Gauss-Seidel SOR technique. The numerical procedure was validated for rectangular enclosures, then modified for triangular cells. Heat transfer coefficients were determined for an inclined square enclosure with a diagonal partition for Grashof numbers less than 200,000 and inclination angles between 10 degrees and 90 degrees. These results show a diagonal partition reduces the heat transferred by natural convection across an inclined square enclosure by more than 50%. Author (GRA)

N81-33623# Florida Solar Energy Center, Cape Canaveral.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 1: THE STATE OF SOLAR ENERGY TECHNOLOGY
D. L. Block Apr. 1981 27 p refs
(Contract DE-FC02-79CS-30278)
(DE81-029002; DOE/CS-30278/T15) Avail: NTIS HC A03/MF A01

The state of solar energy technology, economic considerations, problems/needs, and suggested government is assessed. Solar industry and state and local government actions are discussed. The federal government programs and the role of the federal government are emphasized. It is anticipated that the photovoltaics, passive, biomass, hot water, space heating and wind programs are all within short term of the private marketplace. DOE

N81-33626# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SIMULATED PERFORMANCE OF THE STAND-ALONE PHOTOVOLTAIC SYSTEM AT NATURAL BRIDGES NATIONAL MONUMENT
B. L. Grossman Mar. 1981 39 p
(Contract DE-AC02-76ET-20279)
(DE81-027274; DOE/ET-20279/125) Avail: NTIS HC A03/MF A01

A stand alone photovoltaic (PV) system was evaluated. A computer model was used to describe and analyze the individual system components and the performance of the system as a whole. Various methods of looking at system performance are identified and explored: (1) available array energy; (2) yearly energy flow; and (3) load categorization. These methods provide a basis for design and operational refinements as well as a reference for future analyses using actual data. DOE

N81-33627# Sandia Labs., Albuquerque, N. Mex.
HANDBOOK FOR THE CONCEPTUAL DESIGN OF PARABOLIC TROUGH SOLAR ENERGY SYSTEMS PROCESS HEAT APPLICATIONS
R. W. Harrigan Jul. 1981 320 p refs
(DE81-029290; SAND-81-0763) Avail: NTIS HC A14/MF A01

This report presents the techniques needed to execute conceptual designs of process heat systems employing parabolic trough solar collectors. The design tools are presented in graphical format, and each of 26 SOLMET sites is explicitly represented. The conceptual design resultant from the application of the design charts contained within this handbook approximates the collector area needed to displace a constant thermal demand, the land area needed for collector deployment, the appropriate quantity of sensible heat storage, the fraction of fossil fuel displaced by solar, and the capital cost of the collector-storage subsystem. DOE

N81-33628# Sandia Labs., Albuquerque, N. Mex. Dept. of Solar Energy Projects.
MODULAR INDUSTRIAL SOLAR RETROFIT SYSTEM CONSTRAINTS, SPECIFICATIONS, AND GUIDELINES
Karl Wally, ed. Aug. 1981 60 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029289; SAND-81-1300) Avail: NTIS HC A04/MF A01

A programmatic, physical and regulatory reference environment for which the systems shall be designed is defined. This encompasses a large segment of process steam applications, so that system designs developed for it will be widely applicable with little or no modification. Minimum design requirements at all levels are detailed, and design methodologies, features, and practices are recommended for consideration in any MISR design. DOE

N81-33629# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
ORGANIC RANKINE CYCLE COUPLED TO A SOLAR POND BY DIRECT-CONTACT HEAT EXCHANGE: SELECTION OF A WORKING FLUID
John D. Wright Jun. 1981 35 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-028400; SERI/TR-631-1122) Avail: NTIS HC A03/MF A01

The saturated and halogenated hydrocarbons for use as working fluids were evaluated. It is posited that heat from a solar pond may be used to drive an organic Rankine cycle and produce electricity. Use of a direct contact boiler, in which the organic fluid is bubbled through a stream of pond brine, may reduce the plant cost by about 25%. Low vapor pressure fluids maximize cycle efficiency by minimizing pumping requirements, but require a larger turbine. It is found that pentane is the working fluid best suited to this application because of its high efficiency, low solubility in the pond, and reasonable turbine cost. DOE

N81-33630# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC-SYSTEM APPLICATION: EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 1 FOR NEWMAN POWER STATION SITE, EL PASO, TEXAS
Jul. 1981 16 p Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE81-029283; SAND-81-7086/1) Avail: NTIS HC A02/MF A01

A project is described for application of a photovoltaic power supply to computers that control the operation of a combined cycle power plant. The photovoltaic power supply will be used with an existing DC facility. The project is briefly outlined, and the participants are listed. Relevant weather data and reference operating conditions are given and four operational and collection modes are described. System specifications are given and the solar array, protection, and data acquisition and instrumentation subsystems are described. DOE

N81-33631# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION: FIRST MANUFACTURED HOMES (LOT 219) SINGLE FAMILY RESIDENCE, LUBBOCK, TEXAS
D. Moore 21 Aug. 1981 50 p
(Contracts DE-AB01-76CS-31020; HUD-H-2372)
(DE81-028120; SOLAR/1047-81/50) Avail: NTIS HC A03/MF A01

A system designed to provide solar space heating and to preheat domestic hot water is described. The collector, storage, energy to load, and auxiliary subsystems are described. Operation of the solar and auxiliary systems may involve one or more of five modes of operations: collector to storage, direct solar to space heating, storage to space heating, preheating domestic hot water, and auxiliary space heating. Original cost estimates for provisioning and installation of the solar system are given. DOE

N81-33635# Sandia Labs., Albuquerque, N. Mex. Energy Systems and Technology Div.
DESIGN OF A PHOTOVOLTAIC SYSTEM WITH ON-SITE STORAGE FOR A SOUTHWEST ALL-ELECTRIC RESIDENCE
E. M. Mehalick, R. Felice, G. J. Tully, J. Johnson, J. Parker, and G. OBrien Jun. 1981 220 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029282; SAND-80-7170) Avail: NTIS HC A10/MF A01

The design of a photovoltaic residence employing on-site storage has been developed for a south-western site. Performance data is provided for Phoenix and Albuquerque locations. The roof mounted array is typical of projected retrofit installations. Detailed installation and electrical drawings are provided. DOE

N81-33638# Northrup, Inc., Hutchins, Tex.
SECOND-GENERATION HELIOSTAT DEVELOPMENT. VOLUME 2. Final Report, 16 Jul. 1979 - 31 Mar. 1981
Mar. 1981 172 p refs Prepared in cooperation with Bechtel National, Inc. and Booz-Allen and Hamilton, Inc. Prepared for Sandia National Labs.
(Contract DE-AC04-76DP-00789)
(DE81-028869; SAND-81-8178-Vol-2) Avail: NTIS HC A08/MF A01

The designs, methods, and procedures involving the field assembly and installation of heliostats are described. About 50% of the maintenance cost is related to mirror washing. Mechanical maintenance, constituting about 35% of the total, involves clean up and painting of steel parts. Electrical and electronic components maintenance is also discussed. The cost per installed heliostat and the annual cost of owning, operating and maintaining a collector subsystem for a 50 MWe (peak) solar central receiver electrical power plant are determined. DOE

N81-33641# Yale Univ., New Haven, Conn.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 2: PASSIVE SOLAR TECHNOLOGY
Donald Watson Apr. 1981 61 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029003; DOE/CS-30278/T16-Vol-2) Avail: NTIS HC A04/MF A01

The status of passive solar heating and cooling for residential, commercial, and agricultural applications, and of daylighting is summarized. Passive solar energy is used in the broad sense describing a comprehensive approach to design that considers all climatic impacts on a building, and includes planning on the multi-building scale. The key roles of the designer and of innovation in the building industry are discussed. Numerous terms are defined and the origins of several are discussed. Passive design principles are summarized. Performance and costs of passive solar technologies are examined. Passive energy design tools and methods are considered in the context of the overall process by which building decisions are made to achieve the integration of new techniques into conventional design. DOE

N81-33642# Colorado State Univ., Fort Collins.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 3: ACTIVE SPACE HEATING AND HOT WATER SUPPLY WITH SOLAR ENERGY
S. Karaki and G. O. G. Loef Apr. 1981 35 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029004; DOE/CS-30278/T12-Vol-3) Avail: NTIS HC A03/MF A01

Several types of solar water heaters are described and assessed. These include thermosiphon water heaters and pump circulation water heaters. Auxiliary water heating is briefly discussed, and new and retrofit systems are compared. Liquid-based space heating systems and solar air heaters are described and assessed, auxiliary space heating are discussed, and new and retrofit solar space heating systems are compared. The status of flat plate collectors, evacuated tube collectors, and thermal storage systems is examined. Systems improvements, reliability, durability and maintenance are discussed. The economic assessment of space and water heating systems includes a comparison of new systems costs with conventional fuels, and sales history and projections. The variety of participants in the solar industry and users of solar heat is discussed, and various incentives and barriers to solar heating are examined. Several policy implications are discussed, and specific government actions are recommended. DOE

N81-33643# Arizona State Univ., Tempe. College of Architecture.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 4: SOLAR AIR CONDITIONING: ACTIVE, HYBRID AND PASSIVE
John I. Yellott Apr. 1981 58 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029005; DOE/CS-20278/T5-Vol-4) Avail: NTIS HC A04/MF A01

The status of absorption cycle solar air conditioning and the Rankine cycle solar cooling system is reviewed. Vapor jet ejector chillers, solar pond based cooling, and photovoltaic compression air conditioning are also briefly discussed Hybrid solar cooling by direct and indirect evaporative cooling, and dehumidification by desiccation are described and discussed. Passive solar cooling by convective and radiative processes, evaporative cooling by passive processes, and cooling with roof ponds and movable

insulation are reviewed. Federal and state involvement in solar cooling is discussed. DOE

N81-33644# Tennessee Univ., Knoxville. Energy, Environment and Resources Center.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 5: SOLAR INDUSTRIAL PROCESS HEAT
Edward Lumsdaine Apr. 1981 82 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029006; DOE/CS-30278/T7-Vol-5) Avail: NTIS HC A05/MF A01

The Solar Industrial Process Heat (SIPH) assessment is done to candidly examine the contribution SIPH is realistically able to make in the near and long-term energy futures of the United States. The performance history of government and privately funded SIPH demonstration projects and the present status of SIPH technology are discussed. Before making final recommendations, the influence of economic and socio-political factors (which have a very large effect on the acceptability and application of any new, alternate energy technology) are considered. Focus is on evacuated tube, parabolic trough, and multiple reflector solar collectors. Auxiliary equipment which is part of a SIPH system such as pumps, blowers, controls, and heat exchangers and storage (where applicable) are also discussed. DOE

N81-33645# Arizona Univ., Phoenix.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 6: PHOTOVOLTAIC TECHNOLOGY ASSESSMENT
Charles E. Backus Apr. 1981 41 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029007; DOE/CS-30278/T9-Vol-6) Avail: NTIS HC A03/MF A01

Industrial production of photovoltaic systems and volume of sales are reviewed. Low cost silicon production techniques are reviewed, including the Czochralski process, heat exchange method, edge defined film fed growth, dentritic web growth, and silicon on ceramic process. Semicrystalline silicon, amorphous silicon, and low cost poly-silicon are discussed as well as advanced materials and concentrator systems. Balance of system components beyond those needed to manufacture the solar panels are included. Nontechnical factors are assessed. The 1986 system cost goals are briefly reviewed. DOE

N81-33647# Houston Univ., Tex. Energy Lab.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 9: HELIOSTAT SYSTEMS: TECHNICAL AND ECONOMIC ASSESSMENT
A. F. Hildebrandt and C. L. Laurence Apr. 1981 92 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029010; DOE/CS-30278/T13-Vol-9) Avail: NTIS HC A05/MF A01

An extensive review of the literature is provided on heliostat central receiver systems including subsystem design and research experiments, full scale system designs, assessments, evaluations, rankings, application and marketing studies, and heliostat manufacturing studies. The current status of heliostat system development is reviewed and assessed. Recent design reports are examined, and expected economic and performance improvements are reported. Recommendations are made for the role that government can play in heliostat systems development, and for state and federal policies for development of solar commercialization and the formation of heating utilities. DOE

N81-33649# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering and Applied Mechanics.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 11: THE SOLAR INDUSTRY IN THE UNITED STATES: ITS STATUS AND PROSPECTS, 1981
John A. Clark Apr. 1981 47 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029030; DOE/CS-30278/T8-Vol-11) Avail: NTIS HC A03/MF A01

The energy production goals for the solar industry, and the industry's present status are described. Manufacturing and sales of low and medium temperature solar collectors from 1974 to 2000 are analyzed, and the HUD/DOE solar demonstration programs' relative merits are discussed. Certain characteristics of the conventional water heating industry are briefly described DOE

N81-33650# Western Sun, Portland, Oreg.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 12: STATE AND COMMUNITY COMMERCIALIZATION ISSUES
Ronald D. Doctor and Janice Hamrin (Alliance for Renewable Energy, Sacramento, Calif.) Apr. 1981 57 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029087; DOE/CS-30278/T14-Vol-12) Avail: NTIS HC A04/MF A01

The need to overcome economic and institutional barriers and make the transition to using renewable energy sources is briefly explained, and advantages to implementation of solar technology on the state and local government levels are discussed. The role of government involvement is defined, and the gathering and dissemination of information are discussed. Consumer protection; reliability assurance; and redress for problems. Each of these parts is discussed. Mandates, economic incentives, and subsidies are described and analyzed. DOE

N81-33651# Spectrolab, Inc., Sylmar, Calif.
CONCEPTUAL DESIGN AND SYSTEM ANALYSIS STUDY FOR A HYBRID SOLAR PHOTOVOLTAIC/SOLAR THERMAL ELECTRIC POWER SYSTEM. VOLUME 2: STUDY RESULTS Final Report
Jul. 1981 242 p Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE81-026737; SAND-80-7014/2-Vol-2) Avail: NTIS HC A11/MF A01

A hybrid photovoltaic/solar thermal electric conversion system is described. Several types of hybrid systems, photovoltaic only systems, and solar thermal electric systems were compared in performance and cost. It is found that hybrid systems potentially competitive with photovoltaic only or solar thermal electric conversion systems. However, hybrid systems do not appear to have a significant advantage on a levelized cost per kilowatt hour basis. DOE

N81-33652# Spectrolab, Inc., Sylmar, Calif.
CONCEPTUAL DESIGN AND SYSTEM-ANALYSIS STUDY FOR A HYBRID SOLAR PHOTOVOLTAIC/SOLAR THERMAL ELECTRIC POWER SYSTEM. VOLUME 1: EXECUTIVE SUMMARY
Jul. 1981 59 p Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE81-026162; SAND-80-7014/1-Vol-1) Avail: NTIS HC A04/MF A01

Studies on hybrid photovoltaic/solar thermal electric conversion systems are summarized. Several types of hybrid systems, photovoltaic only systems, and solar thermal electric systems were compared on performance and cost. Hybrid systems are shown to be competitive with photovoltaic only or solar thermal electric conversion systems, however, hybrid systems do not appear to have a significant advantage on a levelized cost per kilowatt hour basis. DOE

N81-33654# New Hampshire Univ., Durham. Dept. of Chemical Engineering.
CONTINUOUS TWO-STAGE SOLAR-GASIFICATION SYSTEM
V. K. Mathur, S. M. Lakshmanan, F. K. Manasse, V. Venkataramanan, and R. W. Breault 1980 20 p refs Presented at the AICHE 73rd Ann. Meeting, Chicago, 16-20 Nov. 1980 Submitted for publication
(Contract DE-AC02-79ET-21067)
(DE81-025019; CONF-801104-16) Avail: NTIS HC A02/MF A01

The use of solar themal energy has the potential to play an important role in the production of fuels and chemicals. A continuous two stage fluidized bed hybrid solar coal gasification system designed at the University of New Hampshire to produce synthesis gas from various feed stocks - coal, lignite and peak

is discussed. Heat and material balance are presented. The experimental data obtained from this bench scale unit will be useful for the commercialization of this technology. Economics of commercial solar gasification plants weight reference to their size are discussed. A suitable capacity for a solar hybrid plant is estimated to be 1.45 x 10 to the 6th power cu cm (50 MM SCF) per day of SNG. DOE

N81-33658# Pacific Sun, Inc., Palo Alto, Calif.
OAKMEAD SOLAR BUILDINGS
Mar. 1981 161 p refs
(Contract DE-FC03-77CS-31521)
(DOE/CS-31521/T1) Avail: NTIS HC A08/MF A01

Twin 50,000 square feet industrial buildings, incorporating both active and passive solar design features, in the Oakmead Industrial Park, Santa Clara, California, employ slab floor construction and tilt-up concrete walls. A structural facia on the north extreme of each building provides a 45 deg support for approximately 2900 square feet of high-performance flat plate collectors. These liquid-based collectors form the basis for an active solar subsystem which includes a unique control logic to manage energy in a Second Law sense. The south-facing, vertical tilt-up concrete wall has been modified to accommodate some 1200 square feet of air-based collector fashioned after a Trombe design. The tilt-up wall fabrication technique is commonly used in commercial and industrial building construction, and shows promise for ready adaptation to passive solar heating applications. The combined active and passive subsystems were designed to provide approximately 90% of the annual energy requirements for heating and hot water. DOE

N81-33660# Schumacher (J. C.) Co., Oceanside, Calif.
LOW-COST-SILICON-PROCESS DEVELOPMENT. PHASE 4: PROCESS IMPROVEMENT Quarterly Technical Progress Report
R. V. Giraudi and C. G. Newman Apr. 1981 62 p refs
(Contract DE-AC02-77CH-00178)
(DE81-769623; SERI/PR-8279-1-T2; QTPR-2) Avail: NTIS HC A04/MF A01

During this period process improvement studies continued in the mini-plant, focusing on the correlation of current mini-plant yield results with prior laboratory scale work. Silicon bromination in the synthesis unit and tribromosilane purification in the distillation unit proceeded efficiently and without complication. Tribomosilane yields in the synthesis unit were low due to unobtainable higher reaction temperatures. Initial polycrystalline silicon production studies indicate consistent yields of 85%. The laboratory scale static bulk reactor system was calibrated by observing the decomposition of t-butyl chloride. A free space reactor apparatus was assembled and tribromosilane decompositions, as a function of dilution in argon, was studied. DOE

N81-33662# Kraftanlagen A.G., Heidelberg (West Germany).
DOMESTIC WATER HEATING BY SOLAR ENERGY Final Report
Friedrich Reinmuth Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 37 p in GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-062; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 8

A solar hot water plant was equipped with extensive measuring instrumentation. The main results of tests carried out during 1 year, are: the average collector efficiency during 1 year operation is 15.9%; the total collector area of 30 sqm (23 sqm oriented to the south-west and 7 sqm to the south-east) produces 3.9 MWhr useful heat in 12 months; the climatic data of the test year (Sun radiation and outside temperatures) approximately agree with multiyear average data from the German weather bureau); and the 30 sqm collector plant only supplies 16% of the total yearly heat demand of the new dwelling of 150 sqm useful area (for space and hot water heating). Author (ESA)

N81-33665# Metallgesellschaft, A.G., Frankfurt am Main (West Germany). Metall-Lab.
DEVELOPMENT OF COMPONENTS FOR THE SOLAR HEATING CIRCUIT Final Report
Manfred Moeller Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 84 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-154; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 17,65

An aluminum/manganese/zirconium alloy suitable for the roll-bond method was developed and a process for the manufacture of solar absorbers on the basis of this material is described. Correctly adjusted inhibited glycol-water mixtures and synthetic heat transfer fluids proved their value for solar installations with aluminum components. The pH-value and the efficiency of the inhibitors of glycol-water mixtures must be regularly controlled. If synthetic heat transfer fluids are used, care should be taken that they, and also the installation, are free from water in order to avoid corrosion damage. With the present status of technology, water to which inhibitors or inhibitor mixtures are added, is not suited for this purpose. Author (ESA)

N81-33666# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany). Neue Technologie.
QUALIFICATION OF THE M. A. N. SOLAR FARM MODULE TYPE 3/32 AS PART OF A DEMONSTRATION PROGRAM Final Report.
Karl Wildenrotter Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 46 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-162; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 9

The structure, the collectors, the driving and piping systems were optimized. A special electronic tracking system was developed. Critical components were tested and qualified. Mechanical and thermal tests of the complete module were conducted. The applicability of alternative mirror elements was studied. Improvements in the construction allow for higher efficiency and a reduction in production costs of 17%. The installed driving power was reduced from 430 to 203 W and the module weight from 2500 to 1900 kg. Author (ESA)

N81-33672# Thermo Electron Corp., Waltham, Mass.
THE DEVELOPMENT OF SOLAR-ASSISTED GAS-FIRED APPLIANCES Final Report, Phase 1
Kenneth G. Hagen 12 Sep. 1980 161 p refs
(Contract GRI-5014-343-0189)
(PB81-217606; TE-4274-69-81; GRI-79/0098) Avail: NTIS HC A08/MF A01 CSCL 10A

The application of solar assistance to gas-fired appliances other than space and water heating systems was accomplished for the residential and commercial sectors. This included an assessment of the energy use characteristics of residential and commercial appliances and the relationship to solar availability. Selected applications indicate a higher likelihood of early commercial viability than can be expected with active solar space heating and cooling systems. High solar utilization and system simplicity can be combined with certain appliance applications. GRA

N81-33673# Illinois Inst. of Natural Resources, Springfield. Resources Development Div.
PROJECT SUMMARIES OF THE ILLINOIS LOW-COST SOLAR ENERGY DEMONSTRATION GRANT PROGRAM 1980
Allen Elrod Jul. 1980 26 p
(PB81-210577; ILLDOE-80/21) Avail: NTIS HC A03/MF A01 CSCL 13A

Funding for each project is part of the grant program conducted by the Illinois Institute of Natural Resources. Local governments and community organizations trained local labor in low-cost solar technology and built either a solar greenhouse, vertical wall collectors, or window box collectors as demonstration projects to low-income neighborhoods. The report highlights each project and provides contact persons for further details. GRA

03
HYDROGEN

Includes hydrogen production, storage, and distribution.

A81-42589 **Proposal for a possible use of fusion power for hydrogen production within this century.** W. Seifritz (Zürich, Eidgenössische Technische Hochschule, Würenlingen, Switzerland). *International Journal of Hydrogen Energy*, vol. 6, no. 4, 1981, p. 331-338. 16 refs.

Consideration is given to the possibility of building a commercial fusion power reactor before the turn of the century. The main element incorporated by the proposed system is the PACER project powerplant, which employs the explosive deuterium-deuterium (D-D) fusion process. Because all required technology already exists, PACER is believed to represent the quickest way to harness fusion on a large scale. It is argued that such reactors, scattered throughout the world on a series of 'energy parks', will meet a 30 TW global energy demand after the depletion of fossil fuel resources. Consideration is also given to both the breeding of fissile materials and the electrolytic production of hydrogen; a by-product of which would be deuterium fuel. O.C.

A81-42590 **Solar synthetic fuel production.** E. Bilgen (Ecole Polytechnique; Exergy Research Corp., Montreal, Canada) and C. Bilgen (Exergy Research Corp., Montreal, Canada). *International Journal of Hydrogen Energy*, vol. 6, no. 4, 1981, p. 349-362. 12 refs. Department of Supply and Services Contracts No. 11SQ-31025-7-1509-5; No. 08SX-31155-8-6602.

In this paper, a thermodynamic study is presented on solar hydrogen production using concentrated solar energy. In the first part, the direct decomposition process has been studied. The temperature requirements at various partial pressures of H2O, H2 and H yields, thermal efficiency and separation of products are discussed. In the second part, using consistent costing bases, the cost of hydrogen is estimated for solar-direct decomposition process and solar-electrolysis process. It has been found that the solar-direct decomposition process concept provides hydrogen costs in the range of $22/GJ which are lower by $15-$26 than those provided by a solar electrolysis process. (Author)

A81-42592 **Hydrogen combustion test in a small gas turbine.** M. Nomura, H. Tamaki, T. Morishita, H. Ikeda, and K. Hatori (Ministry of Transport, Ship Research Institute, Mitaka, Tokyo, Japan). *International Journal of Hydrogen Energy*, vol. 6, no. 4, 1981, p. 397-412.

Details of the gaseous hydrogen combustion test in a can-type conventional gas-turbine combustor and the operating performance of a 275 PS (202 kW) small gas turbine are provided. Initially, experiments were conducted to determine the configuration of the hydrogen fuel nozzles on a combustor test facility. The kerosene fueled gas turbine combustor was used without modification of the original configuration and dimensions. Secondly, the operation performance of the gas turbine was investigated when the gaseous hydrogen was used as a substitute fuel for kerosene fuel. The kerosene fuel supply system was removed or rendered inoperative and a hydrogen flow metering system was newly installed. The high pressure storage cylinders were used to supply hydrogen to the fuel metering system. Data was obtained on pressure losses of the fuel nozzles, ignition performance, temperature distributions at the combustor outlet, combustion efficiency, liner wall temperature distributions, NOx emission levels, noise levels, operating performance, etc. (Author)

A81-42853 **Improvements leading to high efficiency alkaline electrolysis cells.** J. N. Murray and M. R. Yaffe (Teledyne, Inc., Teledyne Energy Systems, Timonium, MD). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.
Oxford and New York, Pergamon Press, 1981, p. 15-27. 9 refs. Research sponsored by the U.S. Department of Energy.

Recent progress in the improvement of the operating efficiency of alkaline water electrolysis cells for hydrogen production is discussed. Development efforts have been concentrated on the replacement of the conventional asbestos electrode separator by a porous electrode separator fabricated from polybenzimidazole, advanced electrode screening modules, extended duration tests of the improved electrocatalyst/electrode systems, and an engineering design and economics evaluation computer program designed to calculate the cost of hydrogen and the design of the cost-optimal electrolysis plant. The improvements undertaken thus far have resulted in an increase in cell voltage efficiency from less than 71% to 86% by the use of a new high-efficiency cathode structure and operation at higher temperatures and reasonably high current densities. A.L.W.

A81-42854 **Hydrogen production by high temperature, high pressure water electrolysis. I - Plant development.** I. Abe (Electric Power Development Co., Ltd., Tokyo, Japan), T. Fujimaki (Showa Denko, General Technical Research Laboratory, Japan), Y. Kajiwara (Hitachi Shipbuilding and Engineering Co., Ltd., Nuclear Engineering Dept., Tokyo, Japan), and Y. Yokoo (Mitsubishi Kakoki Kaisha, Research Dept., Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.
Oxford and New York, Pergamon Press, 1981, p. 29-41.

The development of a test plant with a hydrogen-production capacity of 4 cu Nm/hour based on a high-temperature, high-pressure water electrolyzer is discussed, and results of corrosion tests on metallic materials for plant construction are presented. The test plant electrolyzer was designed and constructed on the basis of the construction and testing of a series of bench-scale electrolyzers operating at atmospheric pressure with single and bipolar cell capacities from 20 to 300 l/hr. The test plant, in turn, is intended to be used to provide data for the design of a 20-cu Nm/hour pilot plant in the areas of cell structures, electrode and diaphragm evaluation, energy efficiency and the gas-liquid separator and control system. In order to select materials for the pilot plant, corrosion and stress corrosion cracking tests were performed on various stainless steels and higher nickel alloys in 30 wt % KOH at 130 and 150 C in O2 and Ar atmospheres. Results of the tests have shown type 310 ELC austenitic stainless steel to be sufficiently resistant for use at operating temperatures up to 150 C, at which no corrosion is observed. A.L.W.

A81-42855 **Hydrogen production by high temperature, high pressure water electrolysis. III - Design and construction of test plant.** Y. Kajiwara, S. Maezawa (Hitachi Shipbuilding and Engineering Co., Ltd., Nuclear Engineering Dept., Tokyo, Japan), and K. Matsunaga (Hitachi Shipbuilding and Engineering Co., Ltd., Plant Design Dept., Osaka, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 43-47.

The design and construction of a test plant of hydrogen capacity 4 cu Nm/hour based on high-temperature, high-pressure water electrolysis which was built to obtain technical data for the construction of a 20-cu Nm/hour pilot plant are outlined. The test plant is a forced circulation system comprised of an electrolyzer, electrolyte circulation line, gas-liquid separator, hydrogen/oxygen production gas line, measurement and control equipment, power conditioning equipment, and auxiliary equipment. The plant is designed to operate using a KOH electrolyte at 20 kg/sq cm pressure and 120 C temperature, and incorporates various safety features for operation monitoring, emergency shutdown and personnel protection. Principle construction materials were selected with a view towards corrosion resistance. Based on preliminary design studies, controlling methods and plant construction were selected to optimize the pressure load oscillation at the separator, and the separator was configured to optimize the void mixing rate. A.L.W.

A81-42856 **Specifications and measurements of alternative diaphragms for the industrial advanced alkaline electrolysis.** J. C. Bardin (Gaz de France, Paris, France). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.
Oxford and New York, Pergamon Press, 1981, p. 49-57.

Increasing the operating temperature of an alkaline electrolysis

cell to improve cell efficiency leads to a requirement for replacing the asbestos diaphragm used in conventional cells with new separator materials. The present paper discusses means for the evaluation of alternative material performance and formulates a set of specifications for diaphragm characteristics. The measurements to be made are in the areas of sample porosity, mechanical behavior, and wettability, with final selection to be on the basis of tests of the operating characteristics of a water electrolysis monocell at a temperature of 120 to 200 C, pressure of 60 bar, current density of 1 A/sq cm and active surface of 0.2 x 0.5 m. A.L.W.

A81-42857 Advanced alkaline water electrolysis. N. Wakabayashi, E. Torikai, Y. Kawami, and H. Takenaka (Osaka, Government Industrial Research Institute, Ikeda, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 59-72. 5 refs.

Results are presented of experimental studies of possible separators and electrodes for use in advanced, high-temperature, high-pressure alkaline water electrolyzers. Material evaluations in alkaline water electrolyzers at temperatures from 100 to 120 C have shown a new type polytetrafluoroethylene membrane impregnated with potassium titanate to be the most promising when the separator is prepared by the hydrothermal treatment of a porous PFTE membrane impregnated with hydrated titanium oxide. Measurements of cell voltages in 30% KOH at current densities from 5 to 100 A/sq dm at temperatures up to 120 C with nickel electrodes of various structures have shown the foamed nickel electrode, with an average pore size of 1-1.5 mm, to have the best performance. When the foamed nickel is coated by fine powdered nickel, carbonyl nickel or Raney nickel to increase electrode surface areas, even lower cell voltages were found, indicating better performance. A.L.W.

A81-42858 Development and operation of a hybrid acid-alkaline advanced water electrolysis cell. O. Teschke and M. Zwanziger (Campinas, Universidade Estadual, Campinas, Brazil). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 73-79. Financiadora de Estudos e Projetos Contracts No. IF/791; No. B/254.

A hybrid acid-alkaline water electrolysis cell has been developed for hydrogen production. The cell is based on the use of an acidic solution at the cathode and a basic solution at the anode to reduce the minimum theoretical voltage for water decomposition from the thermoneutral potential of 1.47 V to close to 1.4 V at 25 C and 1 atm. The pH differential is maintained by the removal of OH ions from the cathode section and water removal from the anode section, which can be driven by heat energy. A practical cell has been built using a solid polymer electrolyte in which, however, the cathodic compartment is not acidic but neutral. Tests with a platinum black cathode catalyst and a platinum-iridium anode catalyst have resulted in steady-state water hydrolysis at an applied voltage of 0.9 V, and a V-I diagram with a considerably lower slope than that of a conventional cell has been obtained at 90 C. A.L.W.

A81-42859 Advanced water alkaline electrolysis - A two years running of a test plant: 120 C - 160 C, 20 bars /about 300 p.s.i./. C. Bailleux (Electricité de France, Saint-Denis, Seine-Saint-Denis, France). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 81-98.

Results acquired in the two-year operation of an advanced pressurized forced-flow alkaline water electrolysis test plant are reported. The test loop consists of eight monopolar cells, circulator, filter units and heat exchangers designed to operate with a 40 wt percent KOH electrolyte at a temperature between 120 and 160 C, a pressure of 20 bars, a current density of 10 kA/sq M and input electric power of 1.75 W. Each cell is made up of two shells of 290 mm external diameter and thickness 40 mm on either side of an FEP-coated diaphragm with a working area of 120 x 120 mm. During the two years of operation, the duty factor for temperature operation has increased from 44 percent to more than 80 percent and that for electrolysis operation has increased from 27 percent to 60 percent, with continuous steady state operation for as long as 35 days. Tests have confirmed the stability of a chrysotile asbestos diaphragm when the electrolyte is doped with silica ions, and revealed deteriorations in materials stability due to gasket creep and metal corrosion. The behavior of the nickel electrodes was observed to be influenced by operating temperatures, cathodic deposits, electrode structure and thermal treatment. In spite of the careful design of the gravity separating tanks, purity of the produced O2 was found unsatifactory, although no trouble arose on the hydrogen side. Results of the operation of the test loop have been scaled up in order to predict the performance of a large-scale pilot plant. A.L.W.

A81-42860 Obtention and evaluation of polyethylene-based solid polymer electrolyte membranes fro hydrogen production. J. P. Masson, R. Molina, E. Roth (Commissariat à l'Energie Atomique, Fontenay-aux-Roses, Hauts-de-Seine, France), G. Gaussens, and F. Lemaire (Commissariat à l'Energie Atomique, Office des Rayonnements Ionisants, Saclay, Essonne, France). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 99-105. 13 refs. Research supported by the Commissariat à l'Energie Atomique; Délégation Générale à la Recherche Scientifique et Technique Contracts No. 77-7-1214; No. 79-7-0219.

The fabrication and testing of a polyethylene-based solid polymer electrolyte for use in hydrogen production by water electrolysis are discussed. The fabrication process involves the radiation grafting of styrene groups onto a polyethylene matrix, followed by the chemical sulphonation of the resulting polymer. The membrane produced has exhibited resistivities as low as 60 ohm cm for a 1-mm thickness, and other properties of the same order of magnitude as those of the commercially available but more expensive Nafion 014 membrane. Life tests carried out at a current density of 2 kA/sq m in single-cell modules with 10-sq cm active surface have revealed no noticeable degradation in membrane mechanical or electrical properties after 3000 hours for membranes reinforced by an organic polymer fabric. The development of an electrolyzer specifically designed for operation with a solid polymer electrolyte is currently under way. A.L.W.

A81-42861 Solid polymer electrolyte water electrolysis. H. Takenaka, E. Torikai, Y. Kawami, and N. Wakabayashi (Osaka, Government Industrial Research Institute, Ikeda, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 107-117. 8 refs.

Electrocatalyst performances and bonding to solid polymer electrolytes used for water electrolysis are investigated. Noble metal and metal alloy catalysts were plated to Nafion perfluorosulfonic acid polymer membranes without a binder by the use of a reducing agent solution held on the opposite side of the membrane from a metal salt solution. It was found that pretreatment of the membrane by hydrothermal treatment or gas plasma surface roughening improves metal adhesivity and thus reduces contact resistance between the membrane and the catalyst. Measurements of the constituents of cell voltage for platinum, rhodium and iridium anodes with platinum cathodes reveals that anodic overvoltage is a major component of voltage loss and depends on the type of electrocatalyst, being greatest for Pd and least for Ir. Ir and Ir-alloy electrodes, which were found to be the best catalysts for oxygen evolution, are found to have Tafel slopes of 0.04-0.06 V/decade. In a cell with a Pt cathode and Ir anode, cell voltage is observed to decrease with increasing temperature, reaching 1.56-1.59 V at a current density of 50 A/sq dm and 90 C, which corresponds to a thermal efficiency of 93-95%. A.L.W.

A81-42863 On the electrochemical behaviour of traditional materials for the production of hydrogen by electrolysis. L. A. Avaca, A. Carubelli, and E. R. González (São Paulo, Universidade, São Carlos, Brazil). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 127-134. 5 refs. Research supported by the Financiadora de Estudos e Projetos.

The relevance of relatively fast electrochemical measurements to the behavior of electrode materials subjected to prolonged operation

is evaluated as it relates to electrode materials for tank-type water electrolyzers. Polarization curves for the hydrogen and oxygen evolution reactions were recorded for cathodes of electrodeposited iron, nickel, tungsten and nickel-cobalt alloy and anodes electrodeposited nickel and nickel-cobalt alloy on mild steel plates in 28 percent KOH solution; variations of electrode potentials and cell voltage with time at a constant current density were also measured. Tafel plots obtained from the polarization curves are shown to differ from the steady potentials obtained after continuous operation for over 30 hours. Results are attributed to the pretreatments of the electrodes and solution necessary to obtain reproducible results in the kinetic experiments. A.L.W.

A81-42864 Electrolytic hydrogen production at packed bed electrode. Z. D. Stankovic (Beograd, Univerzitet, Bor, Yugoslavia). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 135-150. 18 refs.

Results are presented of the experimental production of electrolytic hydrogen at a packed bed electrode. Electrolysis was carried out in a two-compartment cell with a packed bed of spherical copper, nickel, pyrite, silver-coated glass or carbon-coated glass particles as the cathode and a platinum spiral anode in solutions of 5, 10, 20 and 30 wt % KOH and 20 wt % NaOH, KCl, H2SO4 and HCl. Measurements of the open-circuit potential and overpotential reveal only the bed of copper spheres to have an overpotential less than that of the platinum cathodic feeder. A lower overpotential was obtained in the KOH solutions, with a minimum at a concentration of 20 wt %. Particle volume as well as surface area are also observed to influence the overpotentials recorded, while electrolyte flow is found to increase the electrode potential for hydrogen reduction and increases in temperature decrease the potential. Results obtained thus demonstrate the feasibility of applying packed bed electrodes for electrolytic hydrogen production. A.L.W.

A81-42865 Low overvoltage electrocatalysts for hydrogen evolving electrodes. D. E. Brown, M. N. Mahmood, A. K. Turner, S. M. Hall, and P. O. Fogarty (British Petroleum Co., Ltd., Research Centre, Sunbury-on-Thames, Middx., England). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 151-163. 33 refs.

The performance of a transition-metal-based electrocatalyst for hydrogen-evolving cathodes is reported. Initial performance tests conducted at a temperature of 70 C in a 30% KOH electrolyte show overpotentials in the range of 70 to 90 mV at a current density of 1 A/sq cm, with only a small rise in overpotential with increasing current density. Results of long-term testing indicate the absence of any appreciable time variation in electrode overpotential for over 1000 hours, and the stability of the electrocatalyst coating to current interruption and reversal. A.L.W.

A81-42866 Electrocatalysis in the oxygen evolution. G. Fiori and C. M. Mari (Milano, Università, Milan, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 165-174. 18 refs. Research supported by the Commission of the European Communities.

The electrocatalytic properties of mixed nickel lanthanum oxides in the oxygen evolution reaction are examined. Catalytic films were deposited on bulk nickel substrates by the thermal decomposition of various mixtures of unstable salts of nickel, lanthanum, lithium, magnesium, iron and cobalt, and quasi-steady polarization curves and potential time curves at high and constant current densities were determined. The greatest electrocatalytic activity is observed for a nonstoichiometric oxide of formula Ni(0.2)Co(0.8)LaO3. It is also found that deposition by spraying the solution on the hot metallic surface is quicker and provides results as good as painting followed by thermal decomposition. A review of the pertinent literature studies concerning oxygen evolution reaction catalysts is presented which confirms the effectiveness of Ni and Co as anode catalysts. The probable role of La and the lack of stoichiometry in stabilizing the oxide is also indicated. A.L.W.

A81-42870 Hydrogen production by the GA sulfur-iodine process - A progress report. G. E. Besenbruch, K. H. McCorkel, J. H. Norman, D. R. O'Keefe, J. R. Schuster (General Atomic Co., San Diego, CA), and M. Yoshimoto (Idemitsu Kosan Co., Ltd., Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 243-256.

Progress made over a two-year period on a sulfur-iodine thermochemical water-splitting cycle is summarized. The major accomplishments are listed, among which are significant improvements in the chemistry of the process and the development of a conceptual, preliminary flow sheet for a sulfur-iodine cycle driven by solar energy. The results of the work carried out thus far are considered to demonstrate that thermochemical water splitting by the sulfur-iodine cycle is a feasible process and that thermal efficiencies in the range of 50% are attainable. The four areas into which the total process development has been divided - basic chemical investigations, material investigations, process engineering studies, and bench-scale testing - are discussed. It is concluded that the process will be shown to be a viable, economic alternative for hydrogen production. C.R.

A81-42872 The liquid hydrogen iodide decomposition process step for water-splitting applications. D. R. O'Keefe and J. H. Norman (General Atomic Co., San Diego, CA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.

Oxford and New York, Pergamon Press, 1981, p. 277-295. Research supported by the Gas Research Institute and General Atomic Co.

The reported studies are concerned with the optimization of the sulfur-iodine cycle used to obtain hydrogen from water. According to this cycle, sulfur dioxide reacts with iodine and water to form sulfuric acid and hydrogen iodide. Hydrogen and iodine are obtained as a result of the decomposition of HI. The homogeneous decomposition of HI could be used directly in a thermochemical process to split water. However, the temperature required would be relatively high. Catalyst utilization allows substantial temperature reduction for the same conversion rate. The decomposition of liquid HI is studied as another approach for enhancing HI conversion. A process step for liquid HI decomposition employing HI-I2 distillation is considered along with a process step for liquid HI decomposition employing I2 precipitation. The theoretical investigations were supplemented by precursory experimental studies to establish more fully the engineering viability of liquid HI decomposition. G.R.

A81-42875 Interfacing primary heat sources and cycles for thermochemical hydrogen production. M. G. Bowman (California, University, Los Alamos, NM). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.
Oxford and New York, Pergamon Press, 1981, p. 335-344. 13 refs.

It is pointed out that an efficient utilization of heat from high-temperature heat sources in processes, which employ thermochemical cycles to obtain hydrogen from water, can be achieved only if the reaction temperatures and heat requirements of the cycle match the maximum temperature and heat delivery characteristics of the heat source. An investigation is, therefore, conducted regarding the criteria for ideal cycles in terms of their potential for practical adaptation to available heat sources. Attention is given to a method for selecting cycles for specific maximum temperatures in terms of thermodynamic criteria for 'ideal' cycles, the heat source characteristics, the direct decomposition of H2O and CO2, oxide decomposition cycles, sulfuric acid - metal sulfate cycles, alternate sulfate cycles, and low temperature cycles. G.R.

A81-42876 The LASL bismuth sulfate thermochemical hydrogen cycle. K. E. Cox, W. M. Jones, and C. L. Peterson (California, University, Los Alamos, NM). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.

Oxford and New York, Pergamon Press, 1981, p. 345-364. 16 refs.

The development of cycles based on solid sulfate decomposition is considered, taking into account three cycles which have been

selected for extensive development. These cycles include the hybrid sulfur cycle, the sulfur-iodine cycle, and a sulfur-bromine cycle (Mark 13 cycle). Criteria used in the selection of these cycles include the use of an all-liquid or gas system, a maximum cycle temperature in the 1100 K range, and in two cases, the hybrid cycle and the Mark 13 cycle, the use of an electrochemical step for the low temperature hydrogen-producing reaction. All these cycles include evaporation of aqueous sulfuric acid solution, decomposition of sulfuric acid to water and sulfur trioxide followed by decomposition of sulfur trioxide to sulfur dioxide and oxygen as common steps. Attention is given to the choice of the metal sulfate system, the bismuth sulfate cycle, the solids decomposition facility, bismuth sulfate morphology, and aspects of process design. The bismuth sulfate cycle is found to be the most promising choice from the considered sulfate cycles.
G.R.

A81-42878 Thermochemical hydrogen production by SO2-CH3OH-I2 cycle. M. Dokiya, M. Fujishige, T. Kameyama, K. Fukuda, and H. Yokokawa (National Chemical Laboratory for Industry, Yatabe, Ibaraki, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.
Oxford and New York, Pergamon Press, 1981, p. 373-387. 13 refs.

Using the reaction 2CH3OH + I2 + SO2 + aq = 2CH3I + H2SO4 (aq), a family of CH3I cycles is designed and experimentally proved to be feasible. Assuming a process flow sheet and using industrial data, the probable thermal efficiency and cost of hydrogen are estimated. It is thought that the thermal efficiency and cost expected in the CH3I cycle will be nearly the same as in the water electrolysis process. The rather low thermal efficiency is seen as a result of the fact that 2 moles of methanol are circulating to produce 1 mole of hydrogen. A more efficient cycle will therefore be established when the amount of methanol can be reduced to 1 mole/H2. It is pointed out that some experimental results suggest that such a cycle is possible.
C.R.

A81-42880 Recovery of hydrogen from hydrogen sulfide with metals or metal sulfides. H. Kiuchi, I. Nakamura, K. Funaki, and T. Tanaka (Hokkaido University, Sapporo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.
Oxford and New York, Pergamon Press, 1981, p. 401-411. 10 refs.

Two types of reactions for the recovery of hydrogen from hydrogen sulfide using metals or metal sulfides are investigated. The first type of reaction, which involved the sulfurization of metals or metal sulfides with H2S and the thermal decomposition of the products into hydrogen, elemental sulfur and the original metals or metal sulfide, was studied by the measurement of H2 evolution in a packed bed of powders of Ag, FeS, Co9S8, Ni3S2 and various sulfide mixtures. The second type of reaction involves the sulfurization of a metal by H2S and the recovery of the metal by the oxidation of the metal sulfides formed, and was studied for the case of molten lead, molten lead with the addition of Ni or Co, Ag, Cu and Ni powders, and molten Ag-Bi alloy. Extents of reaction and temperature dependence were determined for each step of the reactions, and the repeatability of the cycles was examined.
A.L.W.

A81-42882 Development status of electrolysis technology for the sulfur cycle hydrogen production process. P. W. T. Lu and R. L. Ammon (Westinghouse Electric Corp., Pittsburgh, PA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.
Oxford and New York, Pergamon Press, 1981, p. 439-461. 25 refs.

The Sulfur Cycle Hydrogen Production Process comprises an electrochemical and a thermochemical reaction. In an electrolysis cell, sulfur dioxide dissolved in aqueous solutions is electrochemically oxidized to sulfuric acid at the anode, while hydrogen gas is evolved at the cathode. By use of thermal energy from a high-temperature heat source, sulfuric acid produced in the electrolyzer is vaporized and catalytically decomposed to form sulfur dioxide, water and oxygen. Four approaches for improving electrolysis technology are considered, including an electrochemical study of catalysts, the development of electrode fabrication processes, the optimization of cell configuration, and the selection and investigation of separator materials. Palladium and palladium oxide were found to be superior to platinum as electrocatalysts for SO2 oxidation.
G.R.

A81-42883 Processes for combined production of hydrogen and other chemical products without using fossil fuels. G. H. Schütz (Commission of the European Communities, Joint Research Centre, Ispra, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 463-475. 11 refs.

The advantages and disadvantages of the combined production of hydrogen and other chemical products are discussed. Potential feedstocks in addition to water are examined. Aside from fossil fuels, the most attractive hydrogen-producing system is found to be that using sulfur compounds and water. This system permits substantial quantities of hydrogen to be produced together with various amounts of sulfuric acid, ammonium sulfate, or calcium sulfate. The way in which the output of the by-product can be reduced with the aid of new processes is described. It is noted that hydrogen produced by such processes could be much cheaper than hydrogen from water electrolysis.
C.R.

A81-42885 Development of the Li-H cycle. F. Behr, F. Flocke, R. Schulten, H. Süssmann, and W. Weirich (Aachen, Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 489-501. 20 refs. Bundesministerium für Forschung und Technologie Contract No. ET-4133-A.

The first experiments with new hybrid family cycles that work with a metallic membrane permeable only to hydrogen in an atomic or protonic shape are discussed. The voltage of the electrochemical step is lowered by alkali and/or alkaline-earth metals on the back side of the cathode, which simultaneously acts as a membrane. The Li-H cycle shows that, as a result of the high electrolysis temperature, only very low losses of reversible work occur, that high current densities are attainable, and that no noble metals need be used for the electrodes.
C.R.

A81-42887 Process for the concurrent production of hydrogen, carbon monoxide and low-volatile, low-sulfur char by flash carbonization of coal. R. L. Savage, W. J. Chen, N. G. Patke, J. Y. Tong (Ohio University, Athens, OH), A. Sato (Chubu Institute, Kasugai, Nagoya, Japan), M. Hereth (Centec Consultants, Inc., Reston, VA), and W. E. Kneller (Toledo, University, Toledo, OH). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 519-536. 15 refs. Research supported by the Ohio Department of Energy, Ohio Air Quality Development Authority, and U.S. Department of the Interior.

Flash carbonization to produce hydrogen and carbon monoxide with the concurrent production of low-sulfur, low-volatile char from bituminous coal is investigated. High temperatures (more than 1255 K) and short reaction times (less than 5 sec) are used at pressures ranging from 1 to 35 atm. No tar is formed in the process, and the gas is separated immediately from the hot char, which is quenched to retain a volatile content of approximately 10-20%. Results of thermodynamic equilibrium calculations using the free energy minimization method and the equilibrium constant method are found to be in good agreement and are compared with experimental results. It is noted that predesign capital and operating cost estimates indicate that the cost of producing synthesis gas (hydrogen and carbon monoxide) by this process would be competitive with the cost of producing synthesis gas by the partial oxidation of methane when the by-product char is credited at the fuel equivalent value.
(Author)

A81-42889 Production of hydrogen from hydrogen sulfide by means of selective diffusion membranes. T. Kameyama, K. Fukuda, M. Fujishige, H. Yokokawa, and M. Dokiya (National Chemical Laboratory for Industry, Yatabe, Ibaraki, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen

Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 569-579. 10 refs.

The possibility of the use of microporous ceramic membranes for the effective production of hydrogen on the catalytic decomposition of hydrogen sulfide was examined. Both a microporous Vycor type glass membrane having a mean pore diameter of 45 A and a new microporous alumina membrane having a mean pore diameter of 1000 A were able to use as separation membranes for the H2 - H2S separation system; the former was stable up to 800 C and the latter up to higher temperatures. A new microporous alumina membrane has higher permeability than a microporous Vycor type glass membrane by about 50 times. The use of these membranes at the decomposition temperature of hydrogen sulfide has increased the yield of hydrogen continuously by about two times of equilibrium one. (Author)

A81-42891 Studies on ferric oxide electrodes for the photo-assisted electrolysis of water. M. V. C. Sastri and G. Nagsubramanian (Indian Institute of Technology, Madras, India). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 597-607. 9 refs. Ministry of Industrial Development Grant No. SPD/46(24)/74.

A81-42892 Photoassisted electrolysis of water by Si photoelectrodes. M. Noda (Aichi University of Education, Kariya, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 609-620. 15 refs.

The photoelectrolysis of water in NaOH and NaCl electrolytes, using Si semiconductor photoelectrodes, is presented. External bias voltage (V sub b) is applied between the p-type Si cathode and the Pt anode. If V sub b is absent, the potential of the Si electrode (V sub e) and the short circuit current between Si and Pt electrodes are increased by the illumination, which dissolves the Si surface. When V sub e exceeds the value of approximately 11.5 V, the photocurrent is greatly increased. Results of the study show a decomposition voltage of 1.4 V for 0.1 M NaOH, and less than approximately 1.9 V for 0.1 M NaCl, indicating a greater power conversion efficiency for the first case. Using illumination of 161 mW/sq cm and 82 mW/sq cm, maximum efficiencies of approximately 13.4 and 16.6%, respectively, are reported. An SnO2 coated silicon electrode can be used as a stable anode; its threshold potential is smaller than that of the uncoated sample, but the photocurrent saturates at a higher current value. K.S.

A81-42893 Photoassisted decomposition of water over doped rutile electrodes. N. Giordano, V. Antonucci, S. Cavallaro, R. Lembo (Messina, Università, Messina, Italy), and J. C. J. Bart (Montedison S.p.A., Novara, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2.
Oxford and New York, Pergamon Press, 1981, p. 621-630. 37 refs. Research supported by the Consiglio Nazionale delle Ricerche.

The photoelectrolysis of water on a series of doped TiO2 semiconductors is presented. The TiO2 electrodes are prepared from 1 mm thick laminae of titanium, oxidized in an oven at 700 C for 4 h, and repeatedly impregnated in aqueous or acid (HCL) solutions containing equimolar (1M) quantities of TiCl3 and nitrates (or chlorides) of the dopant metal. The electrode current-voltage characteristics are measured in a one-compartment cell, using a 1 m Na 2SO4 solution. A 400 W medium pressure mercury lamp, emitting in the 310 to 1000 nm range, is used as a light source. Cell potentials are measured with an electrometer. An expression is derived for the energy conversion efficiency, which is strongly influenced by the preparation procedure. Pt-doping has the most marked positive influence and results in an energy conversion of 2.8 percent at 1 sun concentration, vs. 0.5 percent for an undoped sample. It is suggested that the best dopants, such as Pt, act through a reduction of the surface, thereby decreasing its acidity and increasing n-typeness. K.S.

A81-42894 Hydrogen production by hybrid electrolysis combined with assistance of solar energy. Z. Takehara and S. Yoshizawa (Kyoto University, Kyoto, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 631-640.

As a means of reducing the electrical energy needed to produce hydrogen from water, a process is presented, whereby an aqueous sulfuric acid solution containing Fe(2+) ions is electrolyzed, hydrogen being an energy storage material which levels load variation of electrical utilities. In an electrolytic cell, Fe(2+) ions are oxidized on a packed bed carbon anode to form Fe(3+) ions. H(+) ions diffuse through a cation exchange membrane, and are then reduced to hydrogen gas on the cathode. The Fe(3+) ions, produced in the cell, are decomposed in a photodecomposition cell. Oxygen evolves on the TiO2 anode, illuminated by solar light; the produced H(+) ions are diffused through a cation exchange membrane and electrons move through the metal inserted in the membrane to the cathode. The solution containing Fe(+) ions, introduced in the cathode chamber, is reduced cathodically on the platinized platinum. Cell voltage is determined for the process and it is found to be only about 1.0 V for electrolysis of 50mA/sq cm at room temperature. For the case of direct electrolysis of 2N NaOH aqueous solution, the cell voltage is 2.2V electrolysis of 30mA/sq cm. Results indicate a large reduction of electrical energy needed for the production of hydrogen in the process presented. K.S.

A81-42895 Energy conversion efficiency of high dense photochemical system of Fe-I. T. Ohta, N. Kamiya, Y. Fujita, N. Kikuchi, and H. Nambu (Yokohama National University, Yokohama, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 641-651.

An Fe-I hydrogen producing system, utilizing a photochemical hybrid reaction, is presented. An expression is given for the first reaction of the cycle, and using the steady state method, an expression for the stored free energy is derived. The apparatus for the photochemical analysis is described. A concave mirror and a Fresnel lens, collecting the light on the photochemical chamber, are used for the high intensity experiments. Xenon lamps are used as a light source, and the varied intensity of light is 1-12 times greater than that of solar radiation. A photochemical energy conversion efficiency of approximately 15-20% is obtained. Temperature dependence of the forward and the backward rate of reaction is studied, as is the relationship between the rate of the photochemical reaction and the iodine concentration. It is shown that the photochemical energy conversion efficiency increases with an increase of the light intensity. K.S.

A81-42896 A photoelectrochemical-thermal hydrogen producing cycle involving a semiconductor liquid junction cell. W. Gissler (Commission of the European Communities, Joint Research Centre, Ispra, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 653-661. 22 refs.

A photoelectrochemical-thermal hydrogen producing cycle is proposed involving a semiconductor liquid junction solar cell. In contrast with direct photoelectrolysis, the proposal is based upon a photoelectrochemical oxidation or reduction of the n- or p-type semiconductor electrode respectively in an aqueous electrolyte. In subsequent thermal reaction steps the water splitting process is completed, and the semiconductor electrode is regenerated. The advantage of the method is that semiconductors of band gap energies which are well matched to the solar spectrum can be used and correspondingly high solar energy conversion efficiencies can be obtained. The drawback is that the electrode regeneration process is in general quite complicated. The method is demonstrated by using a trigonal selenium electrode which allows a relatively simple regeneration. First experimental results on the photoelectrochemical reaction step are reported. (Author)

A81-42897 A novel photo-galvanic cell using anthraquinone-2-sulfonate. A. Roy and S. Aditya (University College of Science and Technology, Calcutta, India). In: Hydrogen energy

progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 663-670. 14 refs. Research supported by the Council of Scientific and Industrial Research of India.

A photochemical cell (PEC), based on the photochemistry of anthraquinone-2-sulfonate (D), is presented. In the presence of a formate, D(-) or D(2-) are produced from D, upon being illuminated, at a ph of 11.0. In the absence of oxygen, at the platinum electrode, the anodic reaction is D(-) resulting in D + e, or D(2-) resulting in D + 2e; and at the dark electrode, the cathodic reaction is O2 + 2H2O + 4e resulting in 4OH. Experimental results include the following: The cell's open circuit potential is 500 mV, and the open circuit potential is 180 microamps. Efficiency increases with platinized platinum electrode in the dark chamber, and it is improved even more with a CdS electrode in the illuminated chamber. A steady current of 120 microamps can be drawn upon illuminating it for 8 hours. The maximum power output is 4.2 x 10 to the -6th Watt. The advantage of the PEC cell is that the photochemical reaction does not show any back reaction, thereby imparting storage capability to the cell. K.S.

A81-42899 Experimental studies on direct thermal splitting of water. S. Ihara (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 685-692. 10 refs.

Experiments and preliminary results are presented on hydrogen separation from dissociated water vapor. A brief description of the experimental apparatus is presented. The beam sources are two xenon arc lamps, with an electrical input of 6.5 kW each, simulating solar energy utilization. Water vapor is heated on a protected tantalum disk, heated to about 2000 K. The resulting gas mixture is pumped up through a condenser and stored in a gas holder. Results of a gas-chromatographic analysis of the gas mixture are presented. K.S.

A81-42900 Potentiality of carbon dioxide radiolysis for hydrogen production. Y. Ikezoe, S. Sato, S. Shimizu, and H. Nakajima (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 693-703. 16 refs.

Carbon dioxide radiolysis was investigated theoretically and experimentally, and its potentiality for hydrogen production was examined. Elementary processes in the physical, physicochemical, and chemical stages of carbon dioxide radiolysis were examined from a viewpoint of energy conversion efficiency from radiation to chemical energy. The energy conversion efficiency in the physical stage was about 70%, and in the physicochemical stage about 40%. The back reaction in carbon dioxide radiolysis should be suppressed, which reduces product yields and lowers the energy conversion efficiency. Effects of additives such as propane and nitrogen dioxide, high absorbed doses, and fission fragment irradiation were studied experimentally. (Author)

A81-42901 Cell characteristics of various electrochemical photo-cells. K. Honda, A. Fujishima, and T. Inoue (Tokyo, University, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 753-763. 5 refs.

A description is presented of three types of electrochemical photocells with semiconductor photoelectrode/electrolyte junctions, classified according to the redox potentials in the solution species, and including a photoelectrolytic cell, a regenerative- and a heterogeneous-photovoltaic cell. Attention is given to sufficient solar absorption, separation of the photogenerated carriers, and rapid charge transfer at the electrode. Solar energy conversion efficiencies are presented. Design considerations include the following: (1) large output photovoltage based on good reversability of redox couples in the solution and large band bending of the semiconductor electrode; (2) sufficiently small resistance of the overall semiconductor-solution system; and (3) no filtering effect of the solution. K.S.

A81-42902 Fe2O3-coated Si electrodes for the photoelectrolysis of water. H. Morisaki, H. Ono, H. Dohkoshi, and K. Yazawa (University of Electro-Communications, Chofu, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 765-771. 9 refs.

A81-42903 Hydrogen evolution by photocatalytic reactions of some organic dyes and semiconductors. T. Sakata, T. Kawai (Institute for Molecular Science, Okazaki, Japan), T. Koiso, and M. Okuyama (Nagoya Institute of Technology, Nagoya, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 773-780. 16 refs.

Various organic dyes and powdered semiconductors are illuminated by visible light to bring about methylviologen - MV(2+) - reduction and hydrogen evolution from water, in an effort to study an 'artificial photosynthesis' process. MV(2+) is used as an electron acceptor, EDTA as an electron donor, and photochemical reactions are carried out both in nonaqueous solutions, such as dimethylsulfoxide, methanol, and in their mixtures with water. A 500W Xe lamp and a monochromator are used for monochromatic illumination at the peak wavelength of the visible absorption band of each molecule. The reduced MV(+) is monitored by a spectrophotometer, and a thermopile is used to determine the quantum efficiency of the reaction. Zn-chlorophyl-a and Zn-tetraphenylporphine show quite a high quantum efficiency. The preparation of the TiO2-RuO2 photocatalyst is described. The band gap illumination of TiO2 mixed with RuO2 leads to a continuous, catalytic production of hydrogen and oxygen from gaseous water at room temperature. The rate of hydrogen evolution per 100 mg of TiO2-RuO2, for 20 hours, is 11 micromoles at the stationary state. K.S.

A81-42904 A feasibility study of an airship as a LH2 tanker. T. Ishigohka (Seikei University, Musashino, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 817-822. 12 refs.

The use of an airship for transporting liquid hydrogen (LH2) is investigated, and a basic design along with two sets of specifications is proposed. Conventional means of transportation, i.e., marine and overland, are reviewed and dismissed, due to the large volume of the LH2. To use the electric power generated by the solar cells attached to the huge hull of the airship, the use of an electric propulsion system is proposed, and it is suggested that a superconducting generator and motor be used because of the fact that they are extremely lightweight. The economy of the use of such a system is stressed. K.S.

A81-42905 Surface properties of TiFe and TiFe-Nb 6.8 at% electrodes in aqueous solution. S. Fukushima and H. Tanabe (Muroran Institute of Technology, Muroran, Hokkaido, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 897-907. 9 refs.

Experiments are presented on TiFe and TiFe-Nb 6.8% (hydrogen chargeable intermetallic compounds) electrodes' ability to uptake hydrogen when cathodically polarized in an aqueous solution. The experimental procedure is described, and includes the preparation of the intermetallic compounds, the application of the potential sweep method to obtain the polarization characteristics of a sample electrode, and the behavior of the hydrogen absorbed by the electrode surface. It is shown that TiFe and TiFe-Nb 6.8% aid hydrogen evolution by an electrochemically catalytic effect which causes the formation of a mutual reaction layer between the electrode surface and the atomic hydrogen. The ability of the electrode surface to uptake hydrogen is improved (as are the electrode characteristics) by the addition of niobium. K.S.

A81-42910 * Hydrogen engines based on liquid fuels, a review. J. Houseman and G. E. Voecks (California Institute of

Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 949-968. 20 refs. Contract No. NAS7-100.

The concept of storing hydrogen as part of a liquid fuel, such as gasoline or methanol, and subsequent onboard generation of the hydrogen from such liquids, is reviewed. Hydrogen generation processes, such as steam reforming, partial oxidation, and thermal decomposition are evaluated in terms of theoretical potential and practical limitations, and a summary is presented on the major experimental work on conversion of gasoline and methanol. Results of experiments indicate that onboard hydrogen generation from methanol is technically feasible and will yield substantial improvements in fuel economy and emissions, especially if methanol decomposition is brought about by the use of engine exhaust heat; e.g., a methanol decomposition reactor of 3.8 provides hydrogen-rich gas for a 4 cylinder engine (1.952), and 80% of the methanol is converted, engine exhaust gas being the only heat supply. A preliminary outline of the development of a methanol-based hydrogen engine and a straight hydrogen engine is presented. K.S.

A81-42913 The effect of mixture strength and spark advance on detonation intensity in a small squish-chambered hydrogen fueled spark-ignition engine. M. A. Gammie and J. P. Bindon (Natal, University, Durban, Republic of South Africa). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1001-1013. 21 refs.

A81-42916 Hydrogen application to gasoline automotive engines. A. N. Podgornyi and A. I. Mishchenko (Akademiia Nauk Ukrainskoi SSR, Institut Problem Mashinostroeniia, Kharkov, Ukrainian SSR). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1041-1053. 5 refs.

The use of hydrogen-enriched lean gasoline-air mixtures in automotive engines has been investigated experimentally with reference to ignition limits and the exhaust gas toxicity. It is shown that by changing the gasoline-hydrogen ratio in a fuel-air mixture, it is possible to achieve normal combustion with very lean mixtures (excess air ratio 6-7). During idle operation, only hydrogen with an excess air ratio of no more than 4 should be used. The use of a gasoline-hydrogen mixture is found to improve fuel economy by 20-25%, while the exhaust toxicity can be maintained well below the acceptable limits. V.L.

A81-42919 A liquid organic carrier of hydrogen as a fuel for automobiles. M. Taube (Zürich, Eidgenössische Technische Hochschule, Würenlingen, Switzerland) and P. Taube. In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1077-1085. 15 refs.

A system for hydrogen-fueled automobile fuel supply based on the use of a liquid organic hydrogen carrier is presented. The system relies on the catalytic conversion of methylcyclohexane to toluene at a heat of 315 C to supply hydrogen fuel to the engine, and the regeneration of methylcyclohexane from toluene at filling stations using electrolytic hydrogen. Advantages of the system include the use of exhaust gases to supply heat for dehydrogenation, small size, a automobile driving radius of up to 320 km, low thermal pollution, the use of waste heat for district heating, carrier toxicity the same as gasoline, low electricity requirements, and economic competitiveness, while disadvantages relate to the technology of catalytic reactors, hydrogenation by-product toxicity, and the complex design of the proposed filling station, which would include an electrolytic plant, hydrogenation plant, filling equipment and district heating system. It is concluded, however, that the system appears feasible. A.L.W.

A81-42920 LH2-car with a two-stroke direct injection engine and LH2-pump. Y. Kobayashi, S. Furuhama, M. Iida, and Y. Enomoto (Musashi Institute of Technology, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1087-1101. 13 refs.

A two-stroke low-temperature direct injection engine and associated fuel supply system have been developed for a small-sized hydrogen-fueled passenger car. The engine includes an injector installed at the center of the cylinder heads which injects the fuel at a pressure of 1 MPa immediately after the closure of the exhaust port. Tests of the effects of air throttling on engine thermal efficiency and NO(x) emission have shown that during engine operation, air should be so throttled that mixtures of air excess ratio of 2 or more should not become leaner. The injection of fuel in a conical shape between the valve and the seat has been found to be preferable for fuel mixing, while the injection of cold (-30 C) fuel has been shown to suppress abnormal combustion (preignition) and reduce NO(x) emission. The fuel supply system consists of a liquid hydrogen tank, a synthetic piston pump for LH2 pumping at 1 MPa and a heat exchanger and reservoir to control injection fuel temperature. The engine and fuel supply system have been mounted in a Suzuki-Cervo minicar, which has achieved a maximum range of 350-400 km and top speed of 118 km/h. Future objectives include the improvement of the fuel tank and the development of a high-pressure LH2 pump. A.L.W.

A81-42921 Mixture formation and combustion in interaction with the hydrogen storage technology. K. Binder and G. Withalm (Daimler-Benz AG, Stuttgart, West Germany). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1103-1117. 15 refs. Research supported by the Bundesministerium für Forschung und Technologie.

Mixture formation systems which offer hydrogen in various pressure and temperature ranges are discussed, and a concept for a safe hydrogen engine with favorable fuel consumption is developed. Problems considered include irregular combustion due to preignition in the intake and compression phases, knocking combustion, and low output due to volumetric efficiency loss. Storage technology is also discussed. Disadvantages are found to be reduced by the selection of the mixture formation, with the selection partly dependent on the storage technology employed. The combination of external mixture formation and hydride storage unit, although requiring water injection, is found to be the most favorable system. Finally, cryogenic technology combined with an external mixture formation is considered as a future possibility. D.L.G.

A81-42923 Catalytic combustion of hydrogen - Development of oxide catalysts and experimental tests for combustor design. M. Haruta, Y. Souma, and H. Sano (Osaka, Government Industrial Research Institute, Ikeda, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2.
Oxford and New York, Pergamon Press, 1981, p. 1135-1147. 11 refs.

The development of novel composite oxide catalysts for low temperature catalytic combustion of hydrogen is described, along with experimental tests concerned with combustor design. The screening of potential catalysts showed that simple transition metal oxides could catalyze the combustion of hydrogen at temperatures somewhat above 100 C, and the investigation of composite oxide activities allowed the formulation of a highly active catalyst comprising Co and Mn oxides promoted by a small amount of Ag oxide. This catalyst has activities comparable to those of a supported Pd catalyst with low metal loading, and displayed good durability at high temperatures. O.C.

A81-42926 The diffusive combustion of hydrogen. A. Melvin (British Gas Corp., London, England). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2.

44) Oxford and New York, Pergamon Press, 1981, p. 1177-1186. 6 refs.

Theoretical modeling of catalytic combustion processes are discussed with emphasis on chemical and fluid dynamic factors controlling the stability of hydrogen diffusion flames. A study is also made to investigate the technique of diffusive catalytic combustion of hydrogen, and the conditions under which combustion occurs. A hydrogen diffusion flame is found less easily quenched than one of methane, and a streamlined refraction process is observed to drive oxygen by forced convection to the fuel side of the flame sheet. In addition, a maximum temperature of combustion in excess of 650 K prevented nitrogen oxides from forming, but allowed several percent of the hydrogen to escape from the catalyst bed, creating an explosion hazard. It is concluded that the technique's novel application is attractive; however, difficulties do exist with unburnt fuel emissions, and further research is required. D.L.G.

A81-42930 **An ammonia energy vector for the hydrogen economy.** L. Green, Jr. In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1265-1272. 25 refs.

This paper proposes the use of ammonia as a multipurpose energy vector. Synthesized from hydrogen produced in a large, centralized facility using nuclear process heat from a high-temperature, gas-cooled reactor (HTGR), the ammonia serves as a low-cost vehicle for energy storage and transmission, via pipeline, to remote demand centers where some of it serves as a clean-burning fuel for local cogeneration and process heat applications, and some of it is used for direct agricultural application or as feedstock for production of nitrogen-based fertilizers or other chemical processes. (Author)

A81-42931 **Hydrogen as a fuel - Production.** C. Schmidt (Comisión Chilena de Energía Nuclear, Santiago, Chile). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1317-1326. 5 refs.

Methods for the production of hydrogen as a fuel using different technologies are evaluated from a technical and economical point of view. The main characteristics of hydrogen are considered, and its properties are compared to those of methane and gasoline. Electrolysis is viewed as the most likely process for practical large-scale H2 production and offers the greatest potential for meeting necessary capital requirements. Thermochemical production of H2 offers the best efficiency (all by-products can be reinjected into the process), but lacks practical experience. Chemical production of H2 using coal as a primary raw material would be practical for countries with large resources of cheap coal. The low boiling point (-433 F), low gaseous density (0.005 lb/cu ft), and low energy requirements of H2 make its storage and transport the most difficult of all synthetic fuels. Moreover, the price of H2 is not competitive with the present price of petroleum. The production of synthetic natural gas and hydrogen is expected to have economical advantages in the near future. J.F.

A81-42932 **Presentation of a long-term energy system based on electricity and hydrogen vectors.** C. Derive, J. Y. Portas (Electricité de France, Direction des Etudes et Recherches, Paris, France), M. Pottier, and J. P. Roncato (Gaz de France, Direction des Etudes et Techniques Nouvelles, Paris, France). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1327-1343. 5 refs.

The problems associated with the design of an energy system based on a nuclear primary source are discussed with two main vectors: electricity and hydrogen. The advantage of hydrogen electrolysis in a long-term policy through the possibilities of seasonal transfer for nuclear energy is examined, and the R&D targets of involved techniques are outlined. An energy demand model, based on an analysis of the socioeconomic system outlining formation and evolution of energy needs, is presented. It is a simulation model, estimating energy consumptions and seasonal changes for various economic sectors. An optimization of the overall system, including production, transformation and consumer end-use devices, is achieved through a linear programming model, involing energy supply and demand, eefficiency and investment cost of all equipment. The technical and economical conditions of hydrogen development and its profits are discussed according to the results obtained for three scenarios for France in 2020. J.F.

A81-42933 **Assessment of the potential future market in Sweden for hydrogen as an energy carrier.** G. Carleson (Studsvik Energiteknik AB, Nykoping, Sweden). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3.
Oxford and New York, Pergamon Press, 1981, p. 1345-1359.

Future hydrogen markets for the period 1980-2025 are projected, the probable range of hydrogen production costs for various manufacturing methods is estimated, and expected market shares in competition with alternative energy carriers are evaluated. A general scenario for economic and industrial development in Sweden for the given period was evaluated, showing the average increase in gross national product to become 1.6% per year. Three different energy scenarios were then developed: alternatives were based on nuclear energy, renewable indigenous energy sources, and the present energy situation with free access to imported natural or synthetic fuels. An analysis was made, within each scenario of the competitiveness of hydrogen on both the demand and the supply of the following sectors: chemical industry, steel industry, peak power production, residential and commercial heating, and transportation. Costs were calculated for the production, storage and transmission of hydrogen according to technically feasible methods and were compared to those of alternative energy carriers. Health, environmental and societal implications were also considered. The market penetration of hydrogen in each sector was estimated, and the required investment capitalIII was shown to be less than 4% of the national gross investment sum. J.F.

A81-42934 **Hydrogen and fresh water production from sea water.** A.-M. A. El-Bassuoni, J. W. Sheffield, and T. N. Veziroglu (Miami, University, Coral Gables, FL). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3.
Oxford and New York, Pergamon Press, 1981, p. 1361-1372. 8 refs.

A review was made of hydrogen production as a source of energy. Hydrogen from sea water has mainly been produced by electrolysis. The chlorine and oxygen evolved at the anode makes this process very difficult. A proposal for hydrogen production from sea water by an electrochemical method is under investigation. In this investigation, fresh water and hydrogen can be produced simultaneously. The electric cell consists of a set of electrodes. Each electrode is suspended between two plastic membranes (cations and anions). Hydrogen will be evolved from the cation compartment and chlorine gas from the anion compartment. Cost estimation and evaluation of the process was made. (Author)

A81-42935 **Status of EPRI's hydrogen program.** B. R. Mehta (Electric Power Research Institute, Palo Alto, CA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1407-1414. 17 refs.

EPRI has, through a series of techno-economic studies, market evaluations and a survey of utility consumption of hydrogen, determined that: (1) hydrogen produced by water electrolysis could be of near term benefit to the utilities, (2) other thermochemical water splitting cycles do not offer significantly lower costs or improved efficiencies and (3) developing reliable, cost-effective water electrolyzers for utility applications would establish a 'hands-on' technological basis. The R&D strategy and program plans to develop small (20-50 kW) electrolyzers for generator cooling and its evolutionary growth towards use of hydrogen as an energy carrier are presented. (Author)

A81-42936 **Solar-hydrogen energy system-model applied to isolated island.** A. Ohsato, T. Hiki, S. Itoh, T. Sekiguchi, and T. Ohta (Yokohama National University, Yokohama, Kanagawa, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26,

1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1415-1430.

An energy system model is evaluated based on the case where an industry is introduced to an isolated island. A hybrid system is assumed, composed of the petroleum energy, solar energy, hydrogen energy, and electric power systems. The optimum economy and policy for the system is investigated using computer-aided linear programming (LP) and quadratic programming (QP) methods. The LP and QP modeling strategies proved useful when only economy was considered, but a modified LP model had to be used when environmental protection and acquisition stability were evaluated. The LP and QP models showed that the petroleum system is superior to the solar-hydrogen energy system in the present energy situation (considering an interrelationship between acquisition prices, conversion ratios, and transport prices), but a greater dependence on solar-hydrogen energy is expected for the future. The optimum policy of the system based on the modified LP model, however, showed the solar-hydrogen energy system to be superior to the petroleum system. J.F.

A81-42937 The use of solar energy - photovoltaic - in hydrogen production and arid zones like Saudi Arabia. A. A. M. Sayigh (Riyadh, University, Riyadh, Saudi Arabia). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1431-1439. 5 refs.

This paper deals with the use of photovoltaic technology for the production of hydrogen from water by electrolysis. First of all the amount of electricity needed for this process was assessed, then various types of solar cell systems to generate the electricity needed were discussed and the best system was established. Some of the investigations involved testing of solar cells with concentrators and with fixed tilt or tracking devices. Several small panels of solar cells were used in testing the effect of local dust and sand as well as the fixed tilt in the area of Riyadh. The cost of producing hydrogen by electrolysis using electricity from a conventional grid was calculated. This cost was compared with the cost of production of hydrogen if a solar cell array was used. The paper outlines the continuous price increase of oil to produce electricity and the rapid decrease in price of solar cells. Both these advances will lead to a cheaper way of producing hydrogen by solar energy. In addition it is shown that technology is almost trouble free and requires very little know-how as far as operation is concerned. (Author)

A81-42938 OTEC to hydrogen fuel cells - A solar energy breakthrough. J. R. Roney (Princeton Energy and Environmental Research Co., Princeton, NJ). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1441-1451. 11 refs.

Recent advances in fuel cell technology and development are discussed, which will enhance the Ocean Thermal Energy Conversion (OTEC)-hydrogen-fuel cell mode of energy utilization. Hydrogen obtained from the ocean solar thermal resources can either be liquified or converted to ammonia, thus providing a convenient mode of transport, similar to that of liquid petroleum. The hydrogen fuel cell can convert hydrogen to electric power at a wide range of scale, feeding either centralized or distributed systems. Although this system of hydrogen energy production and delivery has been examined with respect to the U.S.A., the international market, and especially developing countries, may represent the greatest opportunity for these future generating units. J.F.

A81-42939 Sea water for hydrogen and for municipal use. M. A. K. Lodhi (Texas Tech University, Lubbock, TX). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1453-1457.

The production of hydrogen from sea water using solar energy is discussed, and a set of parameters for the project is worked out. The energy produced by electrolysis is directly proportional to the rate of evaporation. If the water is collected in a sink reservoir from the sea and solar energy is used directly to produce hydrogen, the evaporation rate will increase and more hydraulic energy will be available. The end-product of hydrogen electrolysis is fresh water, which can be used for domestic, industrial, or agricultural purposes. Letting this water evaporate into the atmosphere might increase the humidity and lead to some environmental hazards. The cost of hydrogen production is currently greater than that of other conventional energies, despite its low transportation and distribution costs. J.F.

A81-42941 Hydrogen transfer and storage electrode systems. F. A. Lewis (Queen's University, Belfast, Northern Ireland). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1481-1483. 23 refs.

Electrode materials which can absorb and store large volumes of hydrogen are studied. These hydrogen storage electrodes, used in fuel cell systems, have additional application in hydrogen/hydrogen concentration or transfer cells. The catalytic activity and local cell hydrogen transfer processes at electrode services are discussed. Hydrogen mobility within both the storage material and the electrolyte, and the extent of concurrent evolution of hydrogen gas are considered. Variations of the chemical potential of the stored hydrogen are viewed as a function of the nature and storage capacity of the electrode material. The possibility of deformation of electrodes in cycles of use, resulting from expansions and contractions of the electrode material, as well as inhomogeneous stress distributions, necessitates consideration of such factors as hydride phase transitions and Gorsky effect phenomena. J.F.

A81-42943 Energy analysis of electrochemical systems for utilization and production of hydrogen. S. Yamauchi and K. Fueki (Tokyo, University, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1509-1518.

General aspects of energy analysis on electrochemical systems, electrolysis and fuel cell, are discussed. The first law of thermodynamics yields an enthalpy flow analysis. The second law yields an exergy flow analysis. Causes for exergy losses are discussed. They are (1) heat flow from the system, (2) generation of heat by dissipation process in the system such as overpotential and ohmic loss, and (3) a heat transfer process to heat the reactant to the reaction temperature. Explicit expressions are given for the exergy losses by these causes. (Author)

A81-42944 Operating characteristics of a LH2 fueled car and of a semiautomatic LH2 refueling station. W. Peschka (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Stuttgart, West Germany). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1561-1576. 8 refs.

Basing on earlier papers new test results and experiences are reported about refueling of LH2 automobile tanks by means of a semiautomatic refueling station described in an earlier paper. This refueling unit, designed and constructed only for the purpose of demonstration of liquid hydrogen handling by untrained people has been tested now for refueling of a LH2-car. On this car a special designed LH2-tank is mounted described in an earlier paper. The engine became converted for hydrogen fuel, but a switchback to gasoline fuel is possible by means of very simple manipulation. The vehicle and the refueling station were tested succesfully and are now in continuous operation for the demonstration of handability of LH2 fuel. The experiences made are encouraging and enable suggestions and recommendations for design and construction of safe LH2 fueled cars. (Author)

A81-42947 Analysis of a gas turbine and steam turbine combined cycle with liquefied hydrogen as fuel. Y. Tsujikawa and T. Sawada (Osaka Prefecture, University, Sakai, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1623-1635. 5 refs.

The performances of a combined cycle driven by the liquid

hydrogen are discussed. The cycle consists of a gas turbine with a precooler system, and a steam turbine heated by the exhaust energy of gas turbine. The liquid hydrogen has not only chemical but also low temperature exergy. The latter is about 10 per cent of the total exergy and is converted to the useful work through the precooling system and an auxiliary hydrogen turbine. The specific output and thermal efficiency of the combined cycle are much higher than those of a simple cycle gas turbine, but in order to succeed the combined cycle, it is necessary to check the pinch point which may take place in the boiling process which is heated by the exhaust energy of gas turbine. (Author)

A81-42949 The use of non-fossil derived hydrogen in coal conversion processes. J. S. Harrison, D. Merrick, M. Smith, and G. Rasmussen (Coal Research Establishment, Stoke Orchard, Glos., England). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1661-1678.

The National Coal Board, UK, carried out a technical and economic study of the use of non-fossil derived (NFD) hydrogen on three coal conversion processes: methanol synthesis, solid phase hydrogenation (hydrogasification) for substitute natural gas production, and liquid phase hydrogenation (liquifaction) for the manufacture of liquid fuels. Use of NFD hydrogen generally resulted in an increase in the conversion efficiency and carbon utilization, and a reduction in the number of component stages of the process. It was also shown that market conditions could exist in which the use of NFD hydrogen in coal conversion would be preferable to both conventional coal conversion and the direct use of hydrogen, irrespective of the coal price. Substitute natural gas production from synthesis gas (methanation) and the production of liquid fuels from synthesis gas by a Fischer-Tropsch synthesis route were also evaluated and showed similar technical and economic results. Preliminary results of the overall costs of using NFD hydrogen from a nuclear power/electrolysis plant showed that at present fuel prices, coal conversion processes using NFD hydrogen are not competitive with conventional processes, but would be if the price of coal were to double. J.F.

A81-42950 A balanced energy budget plan for hydrogen production and distribution. R. G. Williscroft (NOAA, Atlantic Marine Center, Norfolk, VA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1679-1696. 29 refs.

An integrated plan for hydrogen production and distribution within a balanced energy budget is outlined. Primary energy source is the sun, concentrated in earth orbit by satellite and beamed to selected planetside marine locations for hydrogen production from sea water. Primary distribution via already existent natural gas pipeline networks upgraded for hydrogen transmission is augmented by local network extensions and by surface marine transport using modified LNG carriers. The economic, social and environmental impact of this integrated approach is examined in its relationship to continued reliance upon fossil fuel and expanded use of nuclear fission, to increasing reliance upon so-called alternative energy sources, and to the forthcoming nuclear fusion option. (Author)

A81-42951 An efficient path of hydrogen production and consumption. N. Goto, A. Suzuki, and R. Kiyose (Tokyo, University, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1697-1706. 10 refs.

A mathematical model of the long-term transitional dynamics of an energy system from conventional to nuclear energies was constructed to assess hydrogen fuel. For illustration, a couple of types of hydrogen production processes, large-scale electrolysis and HTGR thermochemical decomposition of water, were considered. Much emphasis was placed upon estimating the expected benefit obtained from the HTGR hydrogen production technology R&D program by making comparison between the cases where the program will succeed in the year 2000 and in the year 2030. There are a lot of uncertain parameters associated with the assessment. The result, however, suggests that not static but marginal production costs are an indicator for hydrogen economy, reflecting all the relevant situations being considered in the model. (Author)

A81-42952 Recent review of thermochemical hydrogen production. G. E. Beghi (Commission of the European Communities, Joint Research Centre, Ispra, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1731-1748. 36 refs.

A survey is presented on the development to date of thermochemical water decomposition methods for the production of hydrogen. It is shown that: (1) both the technological feasibility of thermochemical processes and their competitiveness with water electrolysis have been demonstrated; (2) the scaling up of thermochemical methods to industrial production levels may proceed with existing technology; (3) the slowing down of programs concerned with the development of high temperature nuclear reactors could delay the scaling up of thermochemical hydrogen production to industrial levels; (4) this delay could, however, increase interest in such water decomposition processes as those employing photoreactions; and (5) the efficiency of thermochemical hydrogen production is highest in the case of systems with dedicated heat sources rated above 1000 MWth. O.C.

A81-42953 Recent advancements in water electrolysis systems in the United States. R. R. Reeves (U.S. Department of Energy, Office of Advanced Conservation Technologies, Washington, DC) and C. S. Grant (Aerospace Corp., El Segundo, CA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1785-1795. 7 refs.

The recent advancements and status of water electrolysis technology in the United States is discussed. Near-term demonstration and commercialization opportunities for advanced-state electrolyzers exist. The gap between the state-of-the-art technology and the technology necessary to make use of these opportunities is closing. Development of each unique and new application will act synergically to bring this technology into its full fruition. (Author)

A81-42954 Recent developments on IME-alkaline water electrolysis. H. Vandenborre, L. H. Baetslé, W. Hebel, R. Leysen, H. Nackaerts, and G. Spaepen (Centre d'Etude de l'Energie Nucléaire, Mol, Belgium). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1809-1815. Research sponsored by the Commission of the European Communities.

Demonstration on a laboratory scale is reported for the substitution of the conventional asbestos diaphragm in alkaline water electrolysis processes by thin sheets of polyantimonic acid and polysulfone. The membranes investigated withstand concentrated KOH solutions at up to 120 C, and have the necessary ion-conducting and gas-separating properties. It was also found that, by increasing the amount of polyantimonic acid in the membrane, electrolyte concentration can be lowered from 30 percent to 5 percent (by weight) without major effect on the cell voltage. O.C.

A81-42955 Advanced unipolar electrolysis. R. L. LeRoy and A. K. Stuart (Electrolyser, Inc., Etobicoke, Ontario, Canada). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1817-1830. 26 refs.

Substantially reduced capital costs and an efficiency exceeding 85% are foreseen for advanced unipolar electrolyzers. The new equipment preserves the recognized advantages of the unipolar design. Two generations of electrolyzer development are discussed. The first generation is based on conservative modifications to proven commercial designs and on the use of electrode activation. The resulting concepts have been fully demonstrated, and representative data are presented. The second-generation designs incorporate modifications which allow operation at current densities above kA/sq m. Results are reported which demonstrate feasibility in pilot cells. Both generations of advanced-unipolar electrolyzers will produce hydrogen at atmospheric pressure. Compression costs are reviewed. It is concluded that hydrogen compression external to the gas-

generating equipment is preferred over electrolysis at high pressures, for reasons of safety and economy. (Author)

A81-42958 Progress in water electrolysis at the conclusion of the first hydrogen programme of the European Communities. G. Imarisio (Commission of the European Communities, Brussels, Belgium). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1865-1872. 11 refs.

A review is presented of the progress in water electrolysis achieved by the first hydrogen production research and development program of the European Community. Among the program achievements cited are: (1) the development of promising anodic and cathodic electrocatalysts for both low temperature (80-120 C) and medium temperature (160-200 C) alkaline water electrolysis processes; (2) the development of several diaphragm and/or membrane materials which display good performance in the low temperature range, as well as promising diaphragms for medium temperatures; and (3) the confirmation of laboratory results through long term testing in small prototype installations. O.C.

A81-42959 Porous nickel electrodes in water electrolysis. I - Electrode preparation and polarisation studies in strong alkali. II - Use of porous nickel electrodes in multicell module. P. Ragunathan, S. K. Mitra, and M. G. Nayar (Bhabha Atomic Research Centre, Bombay, India). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1873-1900. 5 refs.

Replacement of 'plate' electrodes in water electrolysis cells by porous nickel electrodes leads to many advantages resulting in reduced specific energy consumption for hydrogen production. This paper describes the techniques developed to prepare the porous electrodes, their physical characteristics and their performance in strong alkali as hydrogen and oxygen gas electrodes. Steady state cell polarization studies over a range of 100 to 10,000 ASM at different temperatures were carried out in 6N K OH solution for different electrode samples prepared by alloy electrodeposition and powder metallurgy methods. Electrodes from these two methods were compared with respect to their electrochemical performance. The current carrying capacity at a given overvoltage was evaluated for different electrode thicknesses. Use of porous electrodes in electrolysis modules permits high current density operation at reduced cell voltages because the specific surface area in porous electrodes increases manifold due to fine pores and large pore densities. But the use of porous electrodes also imposes certain restrictions in design and operation of the module. The increased current densities cause high heat and gas generation fluxes within a small cell space, with the gases being released in the form of very fine bubbles. The above aspects are discussed in detail and the experimental studies carried out on the porous nickel electrodes to determine the bubble size, gas release and separation at different current densities are reported. Description of an electrolyzer of 1.5 cu nm/hr capacity and operation of the module with porous electrodes are given. (Author)

A81-42961 An early application of the Sulfur Cycle Hydrogen Production Process. G. H. Parker, G. H. Farbman, and W. A. Summers (Westinghouse Electric Corp., Pittsburgh, PA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1921-1927. 5 refs.

The electrochemical step of the Sulfur Cycle Hydrogen Production Process can be commercialized irrespective of the success or failure of activities in development of the high temperature thermochemical or heat source technologies. This version of the Sulfur Cycle, called the 'open-cycle', uses sulfur dioxide and water to produce two marketable products, i.e., hydrogen and sulfuric acid. An attractive application of the open-cycle has been identified in improving the gas cleanup systems for coal fired power plants. Analyses indicate that the revenues that could be realized by the power plant operator from the sale of hydrogen and sulfuric acid exceed the costs of owning and operating the Sulfur Cycle 'add-on' to the power plant. (Author)

A81-42969 Formation and properties of titanium-manganese alloy hydrides. T. Gamo, Y. Moriwaki, N. Yanagihara, T. Yamashita, and T. Iwaki (Matsushita Electric Industrial Co., Ltd., Central Research Laboratories, Moriguchi, Osaka, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2127-2143. 26 refs.

The measurement of pressure-composition isotherms in the temperature range 0-80 C was used in a study of the hydride formation and hydriding properties of Ti-Mn alloy systems. These systems have a hexagonal structure of MgZn2(Cl4) type known as the Laves phase. It was found that the Ti-Mn binary alloys whose atomic Ti content was less than 36% absorbed almost no hydrogen, while those containing more readily reacted with hydrogen at room temperature without any activation treatment. Ternary, quaternary and quinary alloys of the Ti-Mn system incorporating such transition metals as Zr, V, Cr, Fe, Co, Ni, Cu, Nb, Mo, Ta, La, and Ce were also studied, and the dissociation plateau pressure at 20 C was obtained in a range from 0.01 MPa to 1 MPa. O.C.

A81-42970 Thermal conductivity of metal hydride beds. S. Suda, N. Kobayashi (Kogakuin University, Hachioji, Tokyo, Japan), and K. Yoshida (Sekisui Chemical Industry, Central Research Laboratory, Osaka, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2157-2168. 8 refs.

Experimental results on the thermal conductivity and hydrogen absorption and desorption behavior of the TiMn1.5 hydride are correlated by means of a kinetic theory of gas and equilibrium behaviors. The effective thermal conductivity of the hydride is defined as the sum of two independent terms related to pressure and composition, and an empirical equation based on the experimental data is derived for the TiMn1.5 hydride. O.C.

A81-42972 Turbocharging the hydrogen-fueled internal combustion engine. F. Lynch (Denver, University, Denver, CO). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2257-2271.

Naturally aspirated, turbocharged and turbocharged-aftercooled configurations of spark-ignited, hydrogen-fueled Caterpillar 3304 are compared with the standard naturally aspirated diesel. Power, fuel consumption, and emissions are compared. Turbocharging the hydrogen engine provides power and fuel consumption data comparable to the naturally aspirated diesel while maintaining extremely low emissions. (Author)

A81-42973 Environmental impact of one year experience with a hydrogen bus. R. M. Zweig (Clean Fuel Institute, Riverside, CA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2273-2285. 16 refs.

An overview is presented of a municipal transportation system's hydrogen bus demonstration program. In addition to the operational and safety aspects of the system, the study undertook a detailed analysis of combustion emission pollutants during a year of operation. Among the air pollutants monitored were carbon monoxide, sulfur and nitrogen oxides, lead, photochemical oxidants such as ozone, and various hydrocarbons and particulates. It is concluded that while widespread adoption of hydrogen as a transportation fuel will greatly improve air quality, maintenance requirements will have to be significantly reduced in vehicles if they are to become economically feasible and metal hydride storage systems will have to become the norm in municipal bus design. O.C.

A81-42974 A three compartment electrolytic cell for anodic oxidation of sulfur dioxide and cathodic production of hydrogen. B. D. Struck, R. Junginger, D. Boltersdorf, and H. Neumeister (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980.

Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2315-2322. Commission of the European Communities Contract No. 511-78.

A81-42975 Prospects on hydrogen production for a generalized domestic, industrial and automotive, usage. D. Dini (Pisa, Universita, Pisa, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2363-2375.

Assuming the availability of advanced nuclear and solar systems as prime energy sources for electrolytic production of hydrogen, an assessment is made of high pressure electrolytic gasification, liquefaction and storage work requirements. Also, a pipeline network and associated equipment for the delivery and storage of hydrogen are considered in the context of a future replacement of all fossil fuels by hydrogen. Attention is given to space-based systems and terrestrial photovoltaics. O.C.

A81-43165 # Hydrogen fueled catalytic combustion for low thrust expendable turbojet engine. W. C. Elrod (USAF, Institute of Technology, Wright-Patterson AFB, OH), J. D. Durniak (USAF, Carswell AFB, NM), and L. E. Taylor. *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1715.* 5 p. 8 refs.

The performance of low cost expendable turbojet engines established from commercially available automotive type turbosuperchargers was investigated. The engine development centered primarily around obtaining a combustor design that would provide acceptable performance. Several types of combustors, both conventional and non-conventional, were examined. A hybrid design evolved incorporating fuel injection into a low velocity recirculation region in the dome followed by a catalytic element and requiring no ignition system when operated with hydrogen fuel. In addition, the catalytic element served to reduce the pattern factor at the combustor exit and should insure complete reaction of the fuel/air mixture. (Author)

A81-43999 Hydrogen energy - An inexhaustible abundant clean energy system. M. G. Nayar (Bhabha Atomic Research Centre, Bombay, India). *Indian Academy of Sciences, Proceedings (Engineering Sciences),* vol. 4, Apr. 1981, p. 57-73. 17 refs.

A review is presented of various hydrogen production processes from possible primary energy resources. The processes covered are nuclear coal gasification, thermochemical hydrogen production, and hydrogen production by electrolysis, which includes solid polymer electrolyte-based electrolyzers, high-temperature electrolyzers, and photoelectrochemical decomposition of water. Attention is given to hydrogen transport and storage (in metal hydride systems) and to its application as an automotive fuel. Hydrogen as a secondary energy source is also discussed, and its uses as an off-peak power storage medium and as an energy transmission medium are described. Costs, flow diagrams and chemical formulas are analyzed in detail. K.S.

A81-45099 The activation of FeTi for hydrogen storage - A different view. T. Schober and D. G. Westlake (Argonne National Laboratory, Argonne, IL). *Scripta Metallurgica,* vol. 15, Aug. 1981, p. 913-918. 26 refs. Research supported by the U.S. Department of Energy.

FeTi has to be activated before it will absorb hydrogen. Typically this activation is achieved by heating for 1 h at 400 C in H2 at a pressure of 2 MPa. In the current study, transmission electron microscopy is used to investigate the initial phases of the activation process for FeTi. A new model for the activation of FeTi is suggested on the basis of the results of the investigation. Annealing of FeTi in vacuum or hydrogen at low p(O2) levels results in catalytically active, bare FeTiOx surfaces via dissolution of the original oxide skin in the matrix. Additional catalytic activity is provided by islands of n-TiO2 (rutile) which are in epitaxial contact with the FeTi matrix. Simultaneously, clusters of Fe2Ti are formed via the reaction 2FeTi+O2 yields Fe2Ti+TiO2. New catalytic FeTi surface area is repeatedly created by cracking during the desorption cycles of the activation. G.R.

A81-47242 The possibilities of hydrogen in the large-scale utilization of solar energy (Einsatzmöglichkeiten von Wasserstoff bei grosstechnischer Solarenergienutzung). J. Nitsch and T. Schott (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Technische Physik, Stuttgart, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 307-319. In German.

It is noted that hydrogen is a promising energy carrier for use in the existing energy distribution system in Europe. The possible role of solar-generated hydrogen in the Federal Republic of Germany is considered in the framework of an energy scenario for the year 2050. The problems of availability and reliability are examined, assuming a large contribution from solar energy. The generation, storage, and transport of hydrogen is examined for realistic cases; and the costs of solar-generated hydrogen are estimated. B.J.

A81-47244 Hydrogen storage through adsorption (Speicherung von Wasserstoff durch Adsorption). H. Ewe, P. Brennecke, E. W. Justi, and H.-J. L. Selbach (Hamburg, Fachhochschule, Hamburg, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 331-336. In German.

Hydrogen can be stored by its reversible adsorption on the surface of a highly disperse adsorbent. The use of activated carbon with low specific weight and large surface is examined. The adsorption and desorption of hydrogen on several types of carbon were studied by means of a gravimetric sorption balance in the 77-300 K temperature range. At 77 K and 1 bar hydrogen pressure, up to 258 N cu cm hydrogen were adsorbed by 1 cu cm of the porous carbon. The apparent density of the carbon was determined to be 0.36 g/cu cm; accordingly, the weight of the adsorbed and stored hydrogen was 5.97% of the carbon weight, and the C:H ratio was about 3:1. B.J.

A81-48031 Hydrogen absorption and desorption characteristics of ferro-titanium alloys. M. Kitada (Hitachi, Ltd., Central Research Laboratory, Tokyo, Japan). *Journal of Materials Science,* vol. 16, Sept. 1981, p. 2527-2530.

Hydrogen absorption and desorption characteristics of commercially supplied ferro-titaniums with 41 to 51 at.% Ti have been studied. The characteristics are similar to those of high purity FeTi although the ferro-titaniums include some impurities. The activation temperatures of the ferro-titaniums are slightly higher than that of the high purity FeTi. Plateaus in the hydrogen absorption and desorption curves are not obvious compared with those of high purity FeTi. It is concluded that the ferro-titaniums are good, low-cost hydrogen storage materials. (Author)

A81-49249 Hydrogen production by marine photosynthetic bacteria - Effect of environmental factors and substrate specificity on the growth of a hydrogen-producing marine photosynthetic bacterium, Chromatium sp. Miami PBS 1071. Y. Ohta, J. Frank, and A. Mitsui (Miami, University, Miami, FL). *International Journal of Hydrogen Energy,* vol. 6, no. 5, 1981, p. 451-460. 24 refs. Research supported by the Solar Energy Research Institute.

A81-49725 Thermochemical and hybrid cycles for hydrogen production - A differential economic comparison with electrolysis. R. Shinnar, D. Shapira, and S. Zakal (City College, New York, NY). *I & EC - Industrial and Engineering Chemistry, Process Design and Development,* vol. 20, Oct. 1981, p. 581-593. 30 refs. Research supported by the Electric Power Research Institute.

A method for economic evaluation of new processes is presented. The method is especially suitable for evaluating new technology at a stage where much of the detailed process information is still missing. It is based on differential comparison of the new process with available technology for focusing on evaluating its advantages in dealing with stochiometric, thermodynamic, and process constraints and the interactions between them. The method is demonstrated by performing thorough evaluation of a class of processes that has been proposed for generation of hydrogen from nuclear reaction. The paper shows that one can conclude that the processes that have been

proposed in the literature are inferior to electrolysis of water and that this conclusion can be obtained without any detailed process information using only available thermodynamic properties of the components involved. (Author)

A81-49949 # **Hydrogen engines (Dvigateli na vodorode).** V. P. Barmin (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR), I. L. Varshavskii, and V. V. Goncharov (Akademiia Nauk SSSR, Institut Mashinovedeniia, Moscow, USSR). *Priroda*, Sept. 1981, p. 22-29. In Russian.

The development of internal combustion engines fueled by hydrogen or hydrogen mixtures is reviewed. The first systematic investigations in the 1920s of a one-cylinder engine with variable compression ratio, which demonstrated the possibility of qualitatively regulated hydrogen combustion at any range of loading, resulting in a greater engine efficiency, is discussed, and problems of premature ignition encountered due to the use of pure hydrogen fuel are noted along with a possible solution in the use of a special injector for the direct delivery of the hydrogen to the cylinder which, however, leads to strong knocking. Attention is then given to work begun in 1974 on an experimental one-cylinder hydrogen-air engine with various degrees of compression and hydrogen supplied from ferrosilicon and water, the improvement of gasoline engine operating efficiency by 5-10% additions of hydrogen, hydrogen addition to diesel fuels, and hydrogen addition to improve the carbon monoxide, hydrocarbon and NO(x) emissions levels of aircraft gas turbine engines. A.L.W.

N81-28287# Brookhaven National Lab., Upton, N. Y.
HYDROGEN PRODUCTION FROM SMALL HYDROPOWER SITES Final Report
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(Contract DE-AC02-76CH-00016)
(BNL-51309) Avail: NTIS HC A05/MF A01

A synergistic relationship was not found to exist between low head hydropower and electrolytic hydrogen production. The storageability of hydrogen was expected to mitigate problems of hydrogen generation variability associated with the use of low head hydropower as the power source. The expense of gaseous hydrogen storage equipment effectively eliminates storage as a means to decouple hydrogen demand and power/hydrogen production. From the opposite perspective, the availability of a low and stable cost of power from low head hydro was expected to improve the competitiveness of electrolysisj In actuality, the results indicated that hydroelectric power from small dams would be comparatively expensive by current grid power standards (mid 1979). Electrolysis, in the capacity range considered here, is less sensitive to the cost of the power than originally presumed. Other costs including depreciation and capital related charges are more significant. DOE

N81-29252*# Escher-Foster Technology Associates, Inc., St. Johns, Mich. Alternative Fuels Utilization Program.
HYDROGEN-VIA-ELECTRICITY CONCEPT. CRITIQUE REPORT
W. J. D. Escher Jan. 1981 78 p refs Sponsored in part by NASA and DOE
(NASA-CR-164546; DOE/CE-0005) Avail: NTIS HC A05/MF A01 CSCL 07D

The hydrogen-via-electricity (HvE) concept is the prospective use of hydrogen fuel produced electrolytically from the electric utility grid as a means of responding to conventional fuels shortages. The two sets of comments and critiques of this concept solicited from the Government/Government contractor group and from the electric utility companies are presented. DOE

N81-29264# Los Alamos Scientific Lab., N. Mex.
HYDROGEN PRODUCTION BY FLUID-BED RETORTING OF OIL SHALE
J. W. Barnes May 1981 24 p refs
(Contract W-7405-eng-36)
(LA-8832-MS) Avail: NTIS HC A02/MF A01

The oil produced from retorting of oil shales for refining into marketable products are discussed. Hydrogen requirements can be met by partial oxidation of a fraction of the shale oil produced or by direct processing of oil shale in a fluid bed. The economics and engineering feasibility of using fluid bed systems to produce hydrogen are examined. Fluid bed processing of oil shale to produce hydrogen might be technically and economically competitive with a more conventional shale retorting/partial oxidation method. A major development program would be required to demonstrate the feasibility of the fluid bed approach. DOE

N81-29268# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PHOTOCONVERSION OF ORGANIC SUBSTRATES INTO HYDROGEN USING PHOTOSYNTHETIC BACTERIA
Paul F. Weaver Mar. 1981 12 p refs Presented at the 5th Ann. IGT Energy from Biomass and Wastes Symp., Lake Buena Vista, Fla., 26-30 Jan. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-623-1073; CONF-810116-3) Avail: NTIS HC A02/MF A01

Under nitrogen limited conditions, photosynthetic bacteria photoconvert a wide variety of organic substrates nearly totally into H2 and CO2. More than 98 percent of the chemical energy of defined organic compounds even from dilute solutions can be recovered as combustible energy of the H2 produced. Not calculating the chemical energy input, radiant (solar) energy recoveries are approximately 5 percent over a wide range of incident light intensities. Batch cultures can photoproduce H2 at rates of 175 ml per gram dry weight of cells per hour when incubated in saturating light. With periodic refeeding, rates remain constant for several weeks. In closed containers H2 pressures of 735 psig can be generated. In principle, this pressure can be used to decrease storage volume of the gas, to move it through pipelines or to provide required process pressures. Alcohol stillage and food processing wastes are excellent photoconvertible substances. DOE

N81-30247# General Electric Co., Wilmington, Mass. Direct Energy Conversion Programs.
SOLID POLYMER ELECTROLYTE WATER ELECTROLYSIS TECHNOLOGY DEVELOPMENT FOR LARGE SCALE HYDROGEN PRODUCTION (DESIGN PHASE) Annual Report
J. H. Russell Nov. 1980 28 p refs Sponsored by the Gas Research Inst.
(PB81-201964; GRI-79/0102) Avail: NTIS HC A03/MF A01 CSCL 07A

The design for a water electrolysis module containing (14) cells each with 10 sq ft active area was completed. This included final drawings for Membrane/electrode assembly, Molded carbon current collector, Fluid plates, and Pneumatic end plates and boiling arrangements. GRA

N81-30279*# Billings Energy Corp., Independence, Mo.
HYDROGEN FROM COAL COST ESTIMATION GUIDEBOOK
Roger E. Billings [1981] 274 p refs Prepared for JPL
(Contracts NAS7-100; JPL-955261)
(NASA-CR-164692; JPL-955-578) Avail: NTIS HC A12/MF A01 CSCL 21D

In an effort to establish baseline information whereby specific projects can be evaluated, a current set of parameters which are typical of coal gasification applications was developed. Using these parameters a computer model allows researchers to interrelate cost components in a sensitivity analysis. The results make possible an approximate estimation of hydrogen energy economics from coal, under a variety of circumstances. T.M.

N81-32316# Brookhaven National Lab., Upton, N. Y. Dept. of Nuclear Energy.
THERMAL AND STRUCTURAL DESIGN ASPECTS OF HIGH-TEMPERATURE BLANKETS FOR FUSION SYNFUEL PRODUCTION
J. R. Powell, J. A. Fillo, and M. Reich 1981 10 p refs Presented at the 6th Intern. Conf. on Structural Mech. in Reactor Technol., Paris, 17-21 Aug. 1981
(Contract DE-AC02-76CH-00016)
(BNL-29312; CONF-810801-43) Avail: NTIS HC A02/MF A01

The most promising process, high temperature electrolysis (HTE) of steam at temperatures of > 1000 C is examined. In HTE, a large fraction (up to 50%) of the energy input to split water to hydrogen and oxygen comes from thermal energy. For

the projected operating conditions achieved by high temperature fusion blankets, overall efficiencies for hydrogen production should be on the order of 60%. The design, thermal-hydraulics, and materials for such blankets are discussed. DOE

N81-32318# Brookhaven National Lab., Upton, N. Y. Dept. of Nuclear Energy.
HYFIRE 2: A FUSION/SYNFUEL PRODUCER
J. A. Fillo 1981 4 p refs Presented at the 16th IECEC Conf., Atlanta, 9-14 Aug. 1981
(Contract DE-AC02-76CH-00016)
(DE81-023702; CONF-810812-21; BNL-29581) Avail: NTIS HC A02/MF A01

HYFIRE II is a point design study of a commercial fusion Tokamak reactor coupled to a high-temperature electrolysis (HTE) system for the production of hydrogen and oxygen. The purpose of the study is to assess the technical and economic feasibility of the application of fusion energy for the production of these basic fuels. The HYFIRE II fusion reactor design is based on the STARFIRE commercial power reactor, the primary differences are in the type of blankets between the two reactors, th power cycle design and in the increased thermal power rating (to 6000 MW(th)). Based on HYFIRE conceptual design studies to date, the following observations are made: (1) blanket designs have been identified to simultaneously meet global tritum breeding requirements and required energy splits between process steam and helium; (2) attractive tritium breeders such as LiAlO2 and liquid lead with dissolved lithium were identified; and (3) high H2 production efficiencies in the 50 to 55% range appear achievable. DOE

N81-32319# Los Alamos Scientific Lab., N. Mex.
SOLAR-THERMAL HYDROGEN PRODUCTION
Melvin G. Bowman 1981 9 p refs Presented at the Solar Thermal Test Facility (STTF) Workshop on STTF Testing for Long-Term System Performance, Albuquerque, N. Mex., 7-9 Jan. 1981
(Contract W-7405-eng-36)
(LA-UR-81-1730; DE81-025406; CONF-810137-2) Avail: NTIS HC A02/MF A01

Since hydrogen is not only an eventual and attractive fuel but is also a prime intermediate in the production of many fuels and chemicals, one extremely valuable utilization of a solar thermal facility would be its operation as a system for hydrogen production. Such a use would also fulfill the important requirement for energy storage. Solar thermal systems appear to offer the only practical method for significant hydrogen production from solar energy. The production could utilize advanced methods of water electrolysis if highly efficient generation of solar electricity were developed. Thermochemical cycles for water decomposition appear to be more promising if cycles that match the characteristics of solar heat sources can be developed. Advanced cycles based on solid sulfate or solid oxide decomposition reactions should interface advantageously with solar thermal systems. Sulfuric acid cycles can serve as standards of comparison for these new cycles as they are discovered and developed. DOE

N81-32696# Siemens A.G., Erlangen (West Germany). Forschungslab.
TWENTY kW FUEL CELL UNITS OF COMPACT DESIGN. PART 5: HYDROGEN PRODUCTION BY STEAM REFORMING OF METHANOL Final Report
Burghard Grave Bonn Bundesministerium fuer Forschung und Technologie Sep. 1980 231 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 5 Vol.
(BMFT-FB-T-80-058-Vol-5; ISSN-0340-7608) Avail: NTIS HC A11/MF A01

To assess its potential use in alkaline fuel cells, The production of hydrogen by steam reforming of methanol was studied analytically and experimentally. The reformer, the converter, and the purification system of a prototype installation were designed and the optimal operation parameters derived and experimentally confirmed. For comparison, hydrogen production by ammonia cracking was also studied. An estimate of the manufacturing costs for a fuel cell aggregate of 20 kW indicates economical operation only to be possible at very high duty cycles. As a result the project was terminated. Author (ESA)

N81-33266# National Bureau of Standards, Boulder, Colo. Center for Chemical Engineering.
SELECTED PROPERTIES OF HYDROGEN (ENGINEERING DESIGN DATA) Final Report
R. D. McCarty, J. Hord, ed., and H. M. Roder Feb. 1981 525 p refs
(PB81-211492; NBS-MN-168; LC-80-600195) Avail: NTIS HC A22/MF A01 CSCL 07D

Data on hydrogen properties research are presented. Thermophysical properties of liquid, liquid vapor, vaporous, and gaseous hydrogen are presented and the solid-liquid, solid vapor, and solid phase properties are compiled. Ortho para modifications of the hydrogen molecule and attendant property variations are considered. Combustion and safety data, pertinent to hazard analysis of hydrogen systems, and miscellaneous properties are collected. Data figures, data tables, and symbols, units, and conversion factors are summarized. GRA

04

FUELS AND OTHER SOURCES OF ENERGY

Includes fossil fuels, nuclear fuels, geothermal and ocean thermal energy, tidal energy, and wind energy.

A81-40847 * # Comparisons of advanced hydrocarbon rocket engines for earth-to-orbit vehicles. J. A. Martin (NASA, Langley Research Center, Space Systems Div., Hampton, VA). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1371.* 13 p. 14 refs.

The Space Shuttle has initiated a new era in earth-to-orbit transportation, and studies are now underway to assess the technology requirements for more advanced vehicles. Potential derivatives of the Space Shuttle and completely new vehicles might both benefit from advanced hydrocarbon engines, several versions of which were recently studied. In the present paper, selected single-stage vehicles have been compared using these engines. The results indicate that propane staged-combustion engines are attractive for this application. The potential effects of advanced engine materials are also shown. (Author)

A81-40867 # Degradation and characterization of antimisting kerosene /AMK/. R. J. Mannheimer (Southwest Research Institute, San Antonio, TX). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1423.* 9 p. 8 refs. U.S. Department of Transportation Contract No. FA79WA-4310.

The effect of elongational flow on polymer degradation has been studied by forcing AMK through metal screens and packed tubes at high velocities. At a specific power of 15 kWs/l, AMK exhibits filtration and ignition properties similar to Jet A in small-scale tests. A glycol/amine carrier fluid developed to promote rapid dissolution of FM-9 polymer in Jet A has been found to increase antimisting effectiveness, reduce gel formation and filtration resistance, and require less degrader power. Other fuel-soluble hydrogen bonding agents produce similar effects with FM-9 in Jet A. At low Reynolds numbers, the flow of AMK through metal screens and paper filters is characterized by a critical velocity that depends on polymer degradation, filter material, pore size, and the presence of hydrogen bonding agents. Below this critical velocity, the flow resistance of AMK is determined by the low shear viscosity. At a slightly higher velocity, the flow resistance increases dramatically. While this phenomenon is commonly observed with many polymer solutions, in the case of FM-9 it is also associated with gel formation that may result in filter plugging. However, at very high velocities, gel formation and filter plugging are no longer evident with either metal screens or packed tubes. (Author)

A81-40868 # Acceptability of shale derived fuel for Navy aircraft propulsion systems. P. A. Karpovich and C. J. Nowack (U.S. Naval Air Propulsion Test Center, Trenton, NJ). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1424.* 6 p. 15 refs.

As part of a joint DOD/DOE synthetic fuels program, 100,000 barrels of shale oil crude was produced by the Paraho process and refined into a spectrum of DOD fuels. The JP-5 fraction which is the subject of this paper, was evaluated in the laboratory in component and full-scale engine tests. Findings are compared to results obtained on a shale derived JP-5 produced earlier in a full scale refining program and with petroleum JP-5. Despite some minor deficiencies in fuel chemistry caused by the severe hydrotreatment of the crude the JP-5 fuel was found to be acceptable for Navy aircraft use. (Author)

A81-41342 Gas economy - Gas technology (Gaswirtschaft - Gastechnik). E. Scholand (Bochum, Ruhr-Universität, Bochum, West Germany). *Brennstoff-Wärme-Kraft,* vol. 33, Apr. 1981, p. 134-138. 127 refs. In German.

Economic developments in West Germany concerning fuel gas are examined. It is pointed out that an assured supply of natural gas for West Germany can only be obtained on the basis of prices of a market economy. Internal sources in West Germany provided about 34% of the fuel gas requirements. A contract concerning the import of 2.3 billion cu m liquid natural gas per year was concluded with Nigeria. Attention is given to questions of natural gas production, natural gas reserves, potential sources for importing natural gas, transportation, storage, distribution, consumption of natural gas by industry, installations for measurement and control, environmental protection, and the possibilities for a replacement of natural gas by products of coal gasification processes. G.R.

A81-41343 Regenerative energy sources (Regenerative Energiequellen). M. Meliss (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Brennstoff-Wärme-Kraft,* vol. 33, Apr. 1981, p. 138-145. 66 refs. In German.

The significance of the regenerative energy sources for West Germany is examined, taking into account heat pump installations, solar collectors, water power, wind energy converters, and biomass. It is estimated that between 250,000 and 400,000 heat pumps will be sold per year. Passive systems, low-temperature collector installations, and heat pumps are discussed. Attention is also given to high-temperature collector installations and solar cells, design data for a solar farming installation, the installation of a power station for utilizing wind energy, geothermal energy, wave energy conversion, the utilization of the temperature difference at different depths in sea water, questions of biomass conversion, and firewood. G.R.

A81-41727 Spark-assisted diesel for multifuel capability. K. Komiyama and I. Hashimoto (Komatsu, Ltd., Tokyo, Japan). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810072.* 12 p.

In order to evaluate the feasibility of spark-assisted diesel engine concept for multifuel capability in which forced spark can assist ignition in case of no self-ignition, a spark plug was adapted in the pre-combustion chamber of a conventional diesel engine. And performance tests and emission tests on the engine were carried out with methanol, ethanol, gasoline and diesel fuel. And also injection and combustion characteristics with the fuels were measured for the investigation of difference with each fuel. The test results show that this spark-assisted diesel has multifuel capability and it is concluded that this type of engine has enough potential for the future and alternate low cetane number fuel use and the performance is comparable to a conventional diesel engine with various fuels. (Author)

A81-41800 Biogas: Production and utilization. E. C. Price and P. N. Cheremisinoff (New Jersey Institute of Technology, Newark, NJ). Ann Arbor, MI, Ann Arbor Science Publishers, Inc., 1981. 152 p. 150 refs. $29.95.

Among the aspects of biogas production and utilization covered are: (1) the microbiology and biochemistry of the acid and methane production stages in the anaerobic process; (2) factors affecting the process, such as temperature, acidity and alkalinity, nutrients, and cations; (3) denitrification processes and systems; and (4) the process kinetics of suspended growth systems, packed columns, and fluidized beds. Also considered are such issues in the application of this technology as the digestion of municipal treatment plant sludges, animal wastes, food processing wastes and energy crops. Attention is in addition given to anaerobic digester design, offgas measurement of anaerobic digesters, and sludge treatment through soil conditioning and composting. O.C.

A81-42276 # The use of imagery of the earth to study the structure of degassing zones within oil and gas basins (Ispol'zovanie kosmicheskikh snimkov zemli pri izuchenii stroeniia zon degazatsii neftegazonosnykh basseinov). G. I. Amurskii and M. S. Bondareva (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Prirodnykh Gazov, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 5-10. 6 refs. In Russian.

Space imagery is used to identify and trace the local faults and fracture zones of several anticlinal structures in Central Asia. These zones, favorable to the vertical migration of stratified fluids, exhibit an increased permeability, and are therefore subject to degassing and the accumulation of gaseous sulfur. J.F.

A81-42496 # Experiments on a hurricane windmill model. V. W. Bolie (New Mexico, University, Albuquerque, NM). *Journal of*

Energy, vol. 5, July-Aug. 1981, p. 250, 251. 5 refs.

Airflow tests of a vertical-axis wind turbine model were performed to establish accurate endpoints for the curve of trans-rotor pressure vs trans-rotor flow rate. Calibrated free-field flow tests at wind speeds up to 25 m/s, and corroborating experiments using tufted-yarn flow tracers were performed, with the latter showing smoother flows at higher wind speeds. The rotor was also replaced by a close-fitting weighted solid disk to measure maximum available trans-orifice pressure drop. Results indicate that the vertical-axis turbines are superior in terms of simplicity, TV interference, and safety enclosed rotor blades, while producing the same amount of power as conventional windmills. Economically, however, the design would not be competitive in terms of dollars/kW/yr. D.L.G.

A81-42676 A comparative study of wind characteristics from different time periods. T. N. Goh and G. K. Nathan (National University of Singapore, Singapore). *Wind Engineering*, vol. 5, no. 2, 1981, p. 60-65. 7 refs.

Time-series modeling of wind data is used to examine the consistency of wind speed characteristics at two stations in Singapore for two periods: 1973, when highrise buildings started to emerge in the area surrounding one of the stations, and 1979, when highrise construction was almost completed. Possible changes in wind speed dynamics are inferred from the model changes and the results of the study are used in deciding whether past data from a given station are suitable for use in the future. It is concluded that past data should not be used in future studies, as changes in wind characteristics have occurred. The use of stochastic modelling as a regular means of monitoring wind characteristics is suggested. K.S.

A81-42677 Estimation of time series models for horizontal wind on the Norwegian west coast. K. J. Eidsvik (Norsk Institutt for Luftforskning, Lillestrom, Norway). *Wind Engineering*, vol. 5, no. 2, 1981, p. 66-72. 10 refs. Research supported by the Norwegian Institute for Energy Technology, Norwegian Statoil Co., and Norsk Hydro.

A time-series model of horizontal wind, sampled at 5 min intervals by automatic weather stations on the Norwegian west coast, is analyzed in order to estimate some characteristics of the stochastic wind variations, relevant to wind energy systems. Power spectra are estimated by fitting autoregressive models to the data, and Akaide's (1974) identification procedure is used. It is shown that low frequency energy dominates the power spectrum, especially during the winter. The minimum 5-min wind prediction error appears to vary more with the spectral intensity at lower frequencies than with the season. K.S.

A81-42678 Wind tunnel tests of sailwings for Darrieus rotors. P. S. Revell and K. W. Everitt (Warwick, University, Coventry, England). *Wind Engineering*, vol. 5, no. 2, 1981, p. 73-90. 5 refs.

Wind tunnel tests have been made to investigate the aerodynamics of sailwings intended for use in vertical axis wind turbines. The tests were made over the full range of angles of incidence and used a number of different membranes and pre-tensions. The majority of tests used a rigid trailing edge but a limited number of tests was made using a wire or nylon cord in a circular-arc shaped trailing-edge. The tangential and radial force coefficients were measured as also was the chordwise component of membrane tension. It is concluded that such turbines should produce a high starting torque and that their performance will be influenced by the trailing edge elasticity and pre-tension at quite low tip speed ratios. (Author)

A81-42679 Comparison of height extrapolation models and sensitivity analysis. A. S. Mikhail (Solar Energy Research Institute, Golden, CO) and C. G. Justus (Georgia Institute of Technology, Atlanta, GA). *Wind Engineering*, vol. 5, no. 2, 1981, p. 91-107. 19 refs.

With wind energy applications in mind, different techniques for wind speed height extrapolation are briefly reviewed, including similarity, power law, modified power law, 1/7 power law, logarithmic, and linear models. Meteorological tower data from Kennedy, Argonne, and nine nuclear power plant sites are used to compare the similarity model with the modified power law model. The analysis shows that the largest deviation between the two models occurs at low wind speeds and in very stable conditions. The sensitivity of the similarity model and the modified power law model to different input parameters is examined, and it is shown that for higher values of wind speeds (which would be of interest in wind energy application), both models are less sensitive to variation in wind speed and stability. Data from sites selected as candidates for installation of large DoE wind turbines are used to test and compare the modified power law model with the other widely used empirical models. K.S.

A81-42680 Wind power prospecting using aerial reconnaissance. J. E. Wade, R. W. Baker, P. A. Maule (Oregon State University, Corvallis, OR), and N. Butler (Bonneville Power Administration, Portland, OR). *Wind Engineering*, vol. 5, no. 2, 1981, p. 108-114. Research supported by the Bonneville Power Administration.

Results are reported for jet ranger helicopter aerial surveys, used for rapidly identifying locations with good wind power potential. An area of approximately 8500 sq km was covered in two one-day surveys; six good locations were noted in the Columbia River Gorge, and three in northeast Washington, based on wind-deformed trees. The procedures used are described, and surface and upper air data of the regions surveyed are indicated. Conclusions are presented including the following: the degree and direction of tree deformation can be easily discerned from a low-flying helicopter, and areas of wind-deformed trees can be used as a screening tool for identifying locations with strong persistent winds. Oblique-angle air photos seem to provide the best documentation of tree deformation. Data obtained can be used by utilities seeking information on where to focus efforts in wind power site evaluation, and by government agencies seeking a potential wind source evaluation to be incorporated into comprehensive energy and land use plans. K.S.

A81-42681 A simple model for the probability distribution of wind power with applications to large scale electricity generation. J. Haslett (Trinity College, Dublin, Ireland) and J. Carlin (Commonwealth Scientific and Industrial Research Organization, Div. of Mathematics and Statistics, Canberra, Australia). *Wind Engineering*, vol. 5, no. 2, 1981, p. 115-132. 12 refs. Research supported by the National Energy Research, Development and Demonstration Council of Australia.

A very simple model is presented for the distribution of wind power, the parameters of which could be determined from simple wind speed and power-velocity models, even in case of multiple site applications. It is shown how the model can be used together with data on the distribution of the load or demand for electricity to compute the distribution of the residual load placed on a conventional plant, when wind power is introduced into the grid. Applications of the model are presented. K.S.

A81-42906 Separation of hydrogen isotopes with uranium hydride. S. Imoto, T. Tanabe, and K. Utsunomiya (Osaka University, Suita, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 909-916. 10 refs.

The isotope effect on the decomposition behavior of uranium hydride is examined, since the separation of hydrogen isotopes is one of the most important processes in fission and fusion power generating systems. The decomposition equilibrium pressure is measured for UH3, UD3, and UH(1.5)D(1.5) in the temperature range of 500-700 K; the decomposition pressure of UD3 is higher than that of UH3, and UH(1.5)D(1.5) shows an intermediate decomposition pressure. The enthalpy and entropy formations are obtained and they are in good agreement with those determined by a calorimetric study. When the reaction reaches the point of equilibrium, deuterium is enriched in the gas phase, and the separation factor is approximately 1.3. Experiments on deuterium enrichment, made with a small cascade, also show a separation factor of about 1.3. A thermodynamic model for the case where the mixed hydride is the regular solution, is used, and it is shown that the separation factor is larger for gas mixtures with a high D/H ratio at higher temperatures and for those with a low D/H ratio at lower temperatures. K.S.

A81-43048 Producer gas engines in villages of less-developed countries. R. Datta (Exxon Research and Engineering Co., Linden, NJ) and G. S. Dutt (Princeton University, Princeton, NJ). *Science*, vol. 213, Aug. 14, 1981, p. 731-736. 36 refs.

It is argued that producer gas engines may be able to play an

important role in the near term in the decentralized production of mechanical energy in the rural areas of less-developed countries (LDCs). The producer gas engine system incorporates a solid biomass gasifier, gas cooler, gas cleaner, and ordinary internal combustion engine. The technology, which was first introduced in the 1930s, is capable of 20-30% efficiency (by contrast to less than 10% for steam engines powered by comparable fuels) and can operate on wood, bagasse, straw, and charcoal. Attention is given such issues as gasifier design, fuel processing, energy efficiency and gasification chemistry. A detailed comparison with other renewable resource-based mechanical energy alternatives pertinent to the LDCs is presented. O.C.

A81-43248 **Satellite observations of a geothermal submarine spring off Florida west coast.** F. A. Kohout (U.S. Geological Survey, Woods Hole, MA), R. C. Munson (NOAA, Norfolk, VA), R. M. Turner (U.S. Geological Survey, Reston, VA), and W. R. Royal. In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 570-578. 20 refs.

A81-43521 # **Using liquid fuels at low temperatures /3rd revised and enlarged edition/ (Primenenie zhidkikh topliv pri nizkikh temperaturakh /3rd revised and enlarged edition/).** B. A. Englin. Moscow, Izdatel'stvo Khimiia, 1980. 208 p. 228 refs. In Russian.

The properties of liquid fuels revealed during use at low temperatures in aircraft, motor vehicles, diesels, furnaces, gas turbines, motors, and boilers are presented. The changes to which the fuels are subjected under these conditions are described, as are the measures to be taken in avoiding the complications that arise from use at low temperatures. C.R.

A81-44336 * **Applications of polymer extrusion technology to coal processing.** D. W. Lewis (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 125-131. 5 refs. Research sponsored by the U.S. Department of Energy and NASA.

Upon heating, many of the middle-aged bituminous coals exhibit a plasticity very similar to polyethylene for a few minutes. Plastic coal can be extruded, pelletized or molded using common plastics technology and equipment. Investigations concerning the plastic state of coals are conducted with the objective to develop techniques which will make useful commercial applications of this property possible. Experiments which show the characteristics of plastic-state coal are discussed, and problems related to a continuous extrusion of coal are considered. Probably the most significant difference between the continuous extrusion of coal and the extrusion of a thermoplastic polymer is that volatiles are continuously being released from the coal. Attention is given to aspects of dragflow, solids feeding, and melt pumping. Application potentials for plastic coal extrusion might be related to coal gasification, direct liquefaction, and coal combustion. G.R.

A81-44433 **Hot dry rock geothermal energy.** G. Heiken, H. Murphy, G. Nunz, and R. Potter (California, University, Los Alamos, NM). *American Scientist,* vol. 69, July-Aug. 1981, p. 400-407. 31 refs.

Man-made geothermal systems are discussed which make it possible to extract heat from hot rocks in areas where natural fluids are insufficient for the development of hydrothermal energy. The location and magnitude of high- and low-temperature geothermal resources in the USA for such hot dry rock (HDR) systems are examined. An HDR concept is described in which water is injected into one of two nearly parallel wells connected at depth by man-made fractures; the injected water circulates through the fracture system, where it is heated by conduction from the hot rock, and hot fluid, which can be used for heating or for electric power generation, rises through the second well. Some heat-extraction experiments using the described concept are reviewed which are being conducted in a complex volcanic field in New Mexico. The economics of HDR energy is evaluated. F.G.M.

A81-44494 # **Energy extraction from fractured geothermal reservoirs in low-permeability crystalline rock.** H. D. Murphy, J. W. Tester, C. O. Grigsby, and R. M. Potter (California, University, Los Alamos, NM). *Journal of Geophysical Research,* vol. 86, Aug. 10, 1981, p. 7145-7158. 33 refs. Research supported by the U.S. Department of Energy.

The thermal performance and flow characteristics of two hot dry rock geothermal energy reservoirs created by the hydraulic fracturing of granitic rock are discussed. The reservoirs were produced by fracturing an injection well at a depth of 2.75 km and again 180 m deeper (rock temperature 185 C) on the west bank of the Valles Caldera, a dormant volcanic complex in northern New Mexico. Heat was extracted in a closed-loop operation by the injection of water into one well and the extraction of heated water from a separate well. Results of temperature measurements and thermal modeling for the first reservoir over an initial 75-day test period indicate a thermal exchange area of 8000 sq m, and coupled with flow rate surveys suggest an effective fracture radius of about 60 m with an average thermal power extracted of 4 MW. Evaluation of the second reservoir during a 32-day flow test indicates an effective heat transfer area of at least 45,000 sq m, and a mean reservoir volume nine times greater than that of the first reservoir. Further measurements have shown low flow impedances and downhole water losses for both reservoirs, with produced water of good quality and little insignificant induced seismic activity. A.L.W.

A81-44593 # **The influence of pressure on the evaporation dynamics of a drop of fuel (O vliianii davleniia na dinamiku ispareniia kapli topliva).** O. N. Lebedev and V. N. Marchenko (Novosibirskii Institut Inzhenerov Vodnogo Transporta, Novosibirsk, USSR). *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk,* June 1981, p. 12-15. 13 refs. In Russian.

Features of the phase transitions in the 'supercritical' region are considered for liquid fuel. The intensification that has been detected in the evaporation of a drop with an increase in the pressure of the surrounding gas is explained in physical terms. Analytic relationships characterizing the dynamics of drop evaporation are verified using extensive experimental data. In addition, the applicability of the quasi-equilibrium diffusion theory to the supercritical evaporation of fuel is corroborated. C.R.

A81-45234 * **Molecular carbon isotopic evidence for the origin of geothermal hydrocarbons.** D. J. Des Marais (NASA, Ames Research Center, Moffett Field, CA), J. H. Donchin, N. L. Nehring, and A. H. Truesdell (U.S. Geological Survey, Menlo Park, CA). *Nature,* vol. 292, Aug. 27, 1981, p. 826-828. 16 refs.

Isotopic measurements of individual geothermal hydrocarbons that are, as a group, of higher molecular weight than methane are reported. It is believed in light of this data that the principal source of hydrocarbons in four geothermal areas in western North America is the thermal decomposition of sedimentary or groundwater organic matter. O.C.

A81-45486 **Lateral coherence of longitudinal wind components in strong winds.** L. Kristensen (Forsogsanlaeg, Roskilde, Denmark), H. A. Panofsky (Pennsylvania State University, University Park, PA), and S. D. Smith (Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada). *Boundary-Layer Meteorology,* vol. 21, Sept. 1981, p. 199-205. 6 refs.

It is pointed out that the lateral coherence of wind speed has important applications to engineering problems, involving such systems as bridges, power lines, and windmills. The considered study has the objective to bring data concerning lateral coherence together and to devise a scheme from which lateral coherence of wind speed (for the longitudinal component of wind velocity) in strong winds (neutral stability) can be estimated. Theoretical aspects regarding the considered concepts are examined, taking into account the definition of coherence, the analysis of measurements of coherence in terms of 'Davenport similarity', and measurements in anisotropic turbulence occurring for example in the atmospheric surface layer. Attention is given to the test of a hypothesis reported by Kristensen and Jensen (1979); observations by Smith (1972), a recommended line for estimating the decay constant, and the 'elongation factor'. G.R.

A81-46250 **Turbulent gaseous combustion. I - Local species concentration measurements.** M. H. Lewis and L. D. Smoot

(Brigham Young University, Provo, UT). *Combustion and Flame,* vol. 42, Aug. 1981, p. 183-196. 16 refs. Research supported by the Electric Power Research Institute and Brigham Young University.

Experimental measurements were made of fuel mixture fraction profiles and species concentration profiles (O2, N2, CH4, CO, CO2, H2O, and tracer Ar) in turbulent natural gas diffusion flames. Twenty-eight tests were performed in an axisymmetric combustor with coaxial feed of fuel and air. The test variables included type and arrangement of sample probe, combustor wall temperature, and air feed temperature. Gas samples were obtained with both water-quench and water-cooled probes. Direct water-quench probes were more effective in quenching reactions inside the sampling probe than water-cooled probes; however, some of the CO2 in the gas samples was dissolved in the quench water. A 350 K change in the wall temperature had a negligible effect on gas mixing rates, but did alter the local gas species distributions somewhat. More complete combustion was achieved with elevated air feed temperatures, but more complete mixing was obtained at lower air temperatures. The results provide a data base for evaluating predictive computer models.

(Author)

A81-46461 **First Shuttle payload loading to begin.** C. Covault. *Aviation Week and Space Technology,* vol. 114, June 29, 1981, p. 54, 55, 57, 59.

The first Office of Space and Terrestrial Applications (OSTA 1) Space Shuttle payload, a multi-instrument array aimed at the development of oil and mineral exploration from space, will be carried into orbit by the second Columbia Orbiter mission. The Spacelab pallet mounting of the package incorporates: (1) the Shuttle imaging radar (SIR-A), which will study geological formations; (2) the Shuttle multispectral infrared radiometer; (3) a feature identification and location experiment; (4) an ocean color experiment; and (5) an air pollution measurement-from-satellite experiment. In one of the two OSTA 1 experiments to be conducted from the Shuttle cabin, photographic studies will be made of lightning propagation across thunderstorms. O.C.

A81-46473 **Biomass production and bioconversion to both fuel and food employing solar energy technology - An alternative to conventional farming and the conversion of food to fuel.** D. L. Wise (Dynatech R/D Co., Cambridge, MA). *Solar Energy,* vol. 27, no. 2, 1981, p. 159-178. 137 refs.

A process for the bioconversion of high-yield biomass to both fuel and food, judged more efficient than the conventional production of soybean meal and methanol, is described. Attention is given the diversion of farm land for the production of a conventional food/energy crop, such as corn, that will be subsequently converted to a liquid fuel. The technique presented involves growing biomass at optimum crop yield, then converting it to synthesis gas and finally, through bioconversion, to single-cell protein and methanol. Background for the various aspects of the system and its preliminary engineering economics are provided. O.C.

A81-47250 **Wind prevailing in German coastal regions (Das regionale Windangebot an den Deutschen Küsten).** G. Duensing (Deutscher Wetterdienst, Seewetteramt, Hamburg, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 441-449. In German.

Data from the Deutscher Wetterdienst were used to evaluate the wind energy potential of the German coast. A marked reduction of the strong winds prevailing over the sea as they move inland was noted from the medium wind velocity chart. It follows that only the immediate coastal areas of the North Sea and the Isle of Fehmarn will allow an optimal utilization of wind forces. A direct correlation between wind values and area suggests that an efficient compound system of wind energy converters should be installed, widely spaced, in that particular area. Structures should be able to withstand gust loads of at least 50 m/s in the coastal areas. B.J.

A81-47353 **Ore-controlling space geological objects and their assessment techniques applied to mineral prediction.** A. L. Stavtsev (Ministerstvo Geologii SSSR, Ob'edinenie Aerogeologiia, Moscow, USSR). *International Astronautical Federation; International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-107.* 4 p.

The importance of rupture dislocations is assessed, and it is noted that faults and fault zones are commonly well exhibited on space images. The combined analysis of fault identification charts and maps of the distribution of known mineral deposits makes it possible to assess the role of rupture dislocations in the spatial distribution of minerals and to delineate, through analogy, promising areas for mineral extraction. Attention is also given to the analysis of the ore-controlling importance of ring structures and to the combined application of identified space images and geological and geophysical data to a computerized mineral prediction. It is concluded that the application of space images to mineral exploration provides geologists with ample opportunity for studying the spatial distribution of metallic and nonmetallic ores and predicting their potential occurrences. C.R.

A81-47502 **Resource recovery today and tomorrow; Proceedings of the Ninth Biennial National Waste Processing Conference, Washington, DC, May 11-14, 1980.** Conference sponsored by the American Society of Mechanical Engineers. New York, American Society of Mechanical Engineers, 1980. 632 p. Members, $80.; nonmembers, $100.

Among the topics discussed are the opportunities and problems of energy recovery from solid wastes, an approach to burning refuse as a powerplant fuel, a technical evaluation of modular incinerators with heat recovery, the incineration of hazardous organic wastes, resource recovery through composting, the performance and testing of a ferrous metals recovery system, and the production of paper pulps from municipal solid waste. Also considered are a comprehensive municipal refuse characterization program, life cycle costing for resource recovery facilities, the prediction and testing of incinerator and boiler efficiency, the performance of zig zag classifiers at low particle concentrations, the biogasification of municipal solid wastes, and operations reports from municipal resource recovery programs. Attention is in addition given such pollution control issues as dry system and waterborne emission control technologies. O.C.

A81-47507 **Reaction engineering in direct coal liquefaction.** Edited by Y. T. Shah (Pittsburgh, University, Pittsburgh, PA). Reading, MA, Addison-Wesley Publishing Co. (Energy Science and Technology, No. 3), 1981. 411 p. $47.50.

Processes for direct coal liquefaction by solvent extraction are considered along with the structure and properties of coal and the mechanism of coal liquefaction, heteroatom removal during liquefaction, kinetic models for donor-solvent coal liquefaction, the design of coal liquefaction reactors, and the refining of coal liquids. Attention is given to the catalytic hydrogenation of coal in the presence of a solvent, the origin and character of coal, laboratory reactors for rate measurements, reaction networks based on lumped fractions, free-radical reaction models, reactor types, the compatibility of coal-derived liquids and petroleum fuels, the stability of coal liquids, thermal cracking, catalytic hydrotreating, catalytic cracking, and catalytic reforming. G.R.

A81-47511 **Chemical power sources.** V. S. Bagotskii and A. M. Skundin (Akademiia Nauk SSSR, Institut Elektrokhimii, Moscow, USSR). London and New York, Academic Press, 1980. 404 p. 112 refs. Translation. $64.50.

The working principles of chemical power sources are considered along with cell types, aspects of cell performance, the electrochemical aspects of cell operation, the porous systems used for real electrodes, questions of design and technology, operational problems, and applications of cells. Various cell systems are discussed, taking into account manganese-zinc cells with salt solution electrolyte, lead acid storage cells, nickel-cadmium and nickel-iron cells, alkaline cells with zinc anodes, compound cells, cells with nonaqueous solutions, cells with solid and molten electrolytes, and fuel cells. Attention is given to the use of magnesium and aluminum in chemical power sources, manganese-magnesium cells, water-activated reserve cells with magnesium anodes, chemical power sources with organic reactants, cells with PbO2 electrodes, standard cells, air (oxygen) electrodes, air-metal cells, nickel-hydrogen storage cells, chlorine-zinc storage cells, and lithium cells with aqueous electrolyte. G.R.

A81-47738 **Chemical kinetics in LNG detonations.** C. K. Westbrook and L. C. Haselman (California, University, Livermore,

CA). In: Gasdynamics of detonations and explosions; International Colloquium on Gasdynamics of Explosions and Reactive Systems, 7th, Göttingen, West Germany, August 20-24, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 193-206. 11 refs. Contract No. W-7405-eng-48.

The problem of detonability of vaporized mixtures of liquified natural gas and air is addressed, using a characteristic time analysis. Separate numerical models are used to treat the evolution of the blast wave produced by a charge of high explosive and the chemical ignition delay of the fuel-air mixture. These models are combined with experimental data to predict the amount of high explosive required to initiate a detonation of a stoichiometric mixture of methane and air, giving an estimate of 50-100 kg of high explosive in spherical geometry. The effects of minor constituents such as ethane and propane on methane-air detonability are examined, and the mechanism by which these minor constituents kinetically sensitize the fuel is discussed. (Author)

A81-47896 * **Continental rifting - Progress and outlook.** B. H. Baker (Oregon, University, Eugene, OR) and P. Morgan (Lunar and Planetary Institute, Houston, TX). *EOS*, vol. 62, July 21, 1981, p. 585-587. 8 refs.

It is noted that in spite of the flood of new data on continental rifts in the last 15 years, there is little consensus about the basic mechanisms and causes of rifting. The remarkable similarities in rift cross sections (shown in a figure), are considered to suggest that the anomalous lithospheric structure of rifts is more dependent on lithosphere properties than the mode of rifting. It is thought that there is a spectrum of rifting processes for which two fundamental mechanisms can be postulated: an active mechanism, whereby thermal energy is transmitted into the lithosphere from the underlying asthenosphere, and a passive mechanism by which mechanical energy is transmitted laterally through the lithosphere as a consequence of plate interactions at a distance. In order to permit the concept of the two fundamentally different mechanisms to be tested, a tentative classification is proposed that divides rifts into two basic categories: active rifting and passive rifting. Here, the magnitude of active rifting will depend on the rate at which lithosphere moves over the thermal source, with rifts being restricted to stationary or slow-moving plates. C.R.

A81-48022 # **An assessment of wind energy as an alternative energy resource in Malaysia.** F. F. Ling, J. Seah, and C. P. Tai (Malaya, University, Kuala Lumpur, Malaysia). *Regional Journal of Energy, Heat and Mass Transfer*, vol. 3, Apr. 1981, p. 81-96.

The paper investigates the prospect of wind power in the East Coast of Peninsular Malaysia based on wind statistics from meteorological stations at Mersing, Kuantan, Kota Bharu and Kuala Trengganu. From these data, the frequency, wind direction and velocity over a prolonged period are determined. The velocity and power duration curves are drawn and the power outputs are estimated for a 3.66m (12 ft) diameter wind propeller. (Author)

A81-48118 **The chemistry and technology of synthetic fuels.** A. Schriesheim and I. Kirshenbaum (Exxon Research and Engineering Co., Florham Park, NJ). *American Scientist*, vol. 69, Sept.-Oct. 1981, p. 536-542. 37 refs.

The variety of methods by which crude oil residua, coal and oil shale may be converted to synthetic fuels are considered, with attention to the chemical conversion processes that must be implemented on a large industrial scale. Among the technologies highlighted are (1) Flexicoking, in which residuum, preheated to 300 C, is sprayed into a reactor containing a fluidized solids bed of hot coke; the resulting thermal cracking of the residuum at 525 C forming gaseous and liquid products for conventional processing; (2) coal pyrolysis, a carbon rejection process that produces liquids, tars and coke; (3) hydroliquefaction, in which coal is liquefied directly by treatment with hydrogen at 450 C and pressures in the 70-200 atmospheres range; and (4) oil shale retorting, which is seen as requiring considerable further development before commercial feasibility is reached. O.C.

A81-48174 **Energy, the biomass options.** H. R. Bungay (Rensselaer Polytechnic Institute, Troy, NY). New York, Wiley-Interscience, 1981. 357 p. 383 refs. $29.95.

A critical survey of the production of fuels and chemicals from plant materials is presented. Critical evaluations of processes in use and options available for biomass are given along with recommendations concerning these options. Prospects for energy and chemicals from biomass are analyzed in terms of feedstocks, conversion processes, and the consequences of new technology. Particular consideration is given to such processes as thermochemical methods, anaerobic digestion, fractionation and pretreatment, fermentation, and photobiological processes. Cost and environmental factors are discussed. B.J.

A81-48316 # **Possibilities of using wind power in Hungary.** M. Blaho (Budapesti Muszaki Egyetem, Budapest, Hungary). *Periodica Polytechnica, Mechanical Engineering*, vol. 25, no. 1, 1981, p. 57-65.

A81-48318 # **Complex energetic utilization of high-CO2 natural gases.** G. Veres (Budapesti Muszaki Egyetem, Budapest, Hungary). *Periodica Polytechnica, Mechanical Engineering*, vol. 25, no. 1, 1981, p. 87-92.

A81-48319 # **Geothermal energy in Hungary.** F. Pikler (State Office of Technical Development, Budapest, Hungary). *Periodica Polytechnica, Mechanical Engineering*, vol. 25, no. 1, 1981, p. 93-98.

A81-48366 **Modeling the exploitation of thin geothermal reservoirs.** H. Rubin and S. Bachu (Technion - Israel Institute of Technology, Haifa, Israel). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 503-506.

Modeling the exploitation of thin geothermal reservoirs is achieved through three phases: (a) The bulk model approach which considers that the reservoir consists of a solid and liquid fractions having identical temperatures through the whole reservoir, (b) The one dimensional model approach which assumes that the reservoir consists of a thin saturated porous layer, bounded by thin impermeable layers. This approach neglects the effect of temperature variations in the vertical direction but takes into account heat transfer between the impermeable and porous layers, which leads to temperature variations in the horizontal direction, (c) The two dimensional model approach which takes into account temperature variations in the horizontal as well as vertical directions. Advantages and possible applications of each one of these approaches are considered in this article. (Author)

A81-48428 **Correlation of crude oils with their oil source formation, using high resolution GLC C6-C7 component analyses.** G. T. Philippi. *Geochimica et Cosmochimica Acta*, vol. 45, Sept. 1981, p. 1495-1513. 19 refs.

A novel method based on high resolution gas liquid chromatography (GLC) component analyses of shale and crude oil C6-C7 hydrocarbons is reported, by means of which the composition parameters in an oil are compared with the corresponding parameters in a shale. A similarity coefficient has been devised to measure the degree of correlation between crude oil and source rock hydrocarbons and between the hydrocarbons from different groups of crude oils, having 1.00 as its theoretical maximum value and a fraction close to zero as its minimum. With values above 0.80, correlation between the given hydrocarbons is considered good, and poor below 0.73. It has been found that erroneous crude oil-source rock combinations from areas with more than one source formation have low similarity coefficients, indicating that the correlation method proposed is functioning properly. O.C.

A81-48432 * **Thermal alteration of Cretaceous black shale by diabase intrusions in the eastern Atlantic. II - Effects on bitumen and kerogen.** B. R. T. Simoneit, S. Brenner, K. E. Peters, and I. R. Kaplan (California, University, Los Angeles, CA). *Geochimica et Cosmochimica Acta*, vol. 45, Sept. 1981, p. 1581-1602. 67 refs. Contract No. EY-76-3-03-0034; Grant No. NGR-05-007-221.

A81-48584 **Instability of parallel thermal cracks and its consequences for hot-dry rock geothermal energy.** Z. P. Bazant (Northwestern University, Evanston, IL). In: Thermal stresses in

severe environments; Proceedings of the International Conference on Thermal Stresses in Materials and Structures in Severe Thermal Environments, Blacksburg, VA, March 19-21, 1980.

New York and London, Plenum Press, 1980, p. 169-181. 14 refs. Research supported by the U.S. Department of Energy; NSF Grants No. AER-75-00187; No. ENG-75-14848-A01.

A review is conducted of recent work on instabilities of crack systems and applications to the hot-dry rock geothermal energy scheme. An outline is presented concerning the basic variational formulation of the crack stability problem, and the critical states of a system of parallel equidistant cooling cracks propagating into a halfspace are analyzed. The obtained solution is important for cases involving the withdrawal of heat from hot rock by circulation of water in cooling cracks. Some typical numerical results obtained by the finite element method are presented, and the effect of the temperature drop profile on the critical crack length is discussed. Other applications considered are related to parallel cooling cracks or drying shrinkage cracks in reinforced solids, such as concrete. G.R.

A81-48585 Thermal stresses in coal conversion pressure vessels built of layered construction. T. R. Tauchert (Kentucky, University, Lexington, KY). *In: Thermal stresses in severe* environments; Proceedings of the International Conference on Thermal Stresses in Materials and Structures in Severe Thermal Environments, Blacksburg, VA, March 19-21, 1980.

New York and London, Plenum Press, 1980, p. 183-205. 12 refs. Contract No. DE-AS05-77ET-05378.

An investigation is conducted of radially varying temperature and thermal stress distributions in layered pressure vessels designed for use in coal conversion processes. A least-squares residual method which incorporates Lagrange multipliers for satisfaction of initial, boundary, and interface conditions is employed in the case of transient heat conduction. Assuming orthotropic elastic behavior, a general solution is formulated for the stresses induced by combined temperature, pressures, and initial interferences between layers. The effects of heat-transfer resistance at layer contact surfaces are illustrated through several numerical examples. Attention is also given to the representation of a layered vessel as a homogeneous cylinder having an effective thermal conductivity. G.R.

A81-48684 # The use of satellite imagery for studying the structural features of the Caspian oil and gas region (Primenenie kosmicheskikh materialov dlia izucheniia strukturnykh osobennostei pri-Kaspiiskoi neftegazonosnoi provintsii). L. F. Volchegurskii and V. G. Pronin (Vsesoiuznoe Aerogeologicheskoe Nauchno-Proizvodstvennoe Ob'edinenie Aerogeologiia, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 32-38. 8 refs. In Russian.

Based on a study of satellite imagery, the boundaries of the Caspian oil and gas region are defined, and the linear structures, interpreted as faults or zones of faults, are distinguished. Ring structures, corresponding to the structures of the different horizons of the sedimentary cover and bedplate, are discussed. Based on the data obtained by satellite imagery, a detailed scheme of the oil and gas geological regionalization is presented. Such a study is then used to define the individual oil and gas zones within the range of the Caspian region, to trace the extended faults which play a significant role in forming these oil and gas zones, to select regions of seismic research, and to reinterpret the structural maps. J.F.

A81-48685 # The interrelation of linear and isometric objects on satellite imagery and the oil and gas structures of the Buzuluk Basin (O vzaimosviazi lineinykh i izometrichnykh ob'ektov na kosmicheskikh snimkakh i neftegazonosnykh struktur Buzulukskoi vpadiny). D. M. Trofimov and B. I. Dmitrieva (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 39-44. 5 refs. In Russian.

A81-48936 Remote sensing in development. C. K. Paul (U.S. Agency for International Development, Washington, DC) and A. C. Mascarenhas (Dar es Salaam, University, Dar es Salaam, Tanzania). *Science,* vol. 214, Oct. 9, 1981, p. 139-145. 12 refs.

It is pointed out that in developing countries remote sensing is used to acquire statistics on crops and to locate petroleum and mineral deposits. To an ever greater extent, it is also being used for forest monitoring and subsurface water location. Among the problems related to Third World use of the technology are sensitivity about the dissemination of data with high spatial resolution, exploitation by multinational companies, absorptive capacity of countries for advanced technology, autonomy in acquiring resource information, and competing foreign policy interest of the industrialized world in the global search for raw materials. The attitude of Third World countries toward the use of remote sensing is seen as depending on the development model they adopt. C.R.

A81-49161 # Propulsion energy for tomorrow's aviation (Antriebsenergie für die Luftfahrt von morgen). V. M. Akimov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR). *(Grazhdanskaia Aviatsiia,* no. 2, 1980.) *Technisch-ökonomische Information der zivilen Luftfahrt,* vol. 17, no. 2, 1981, p. 68-71. In German. (Translation).

One of the objectives of the Central Institute for the Construction of Aircraft Engines in the USSR involves the study of the characteristics for the aircraft propulsion system to be used at the end of the 20th and the beginning of the 21st century. Conclusions reached in this study are discussed. Further improvements in the efficiency of new propulsion units will be possible on the basis of a high bypass ratio and better operational parameter values. It is pointed out that the design of engines of the new generation will require the solution of complex problems concerning gas dynamics, cooling, and materials. The efficiency of turbine and compressor must be further enhanced and the space remaining between moving and stationary parts in compressor and turbine must be reduced. It is expected that, as a result of these steps, it will be possible to obtain a further reduction in fuel consumption by about 10 to 12%. Attention is also given to approaches for increasing the production of aircraft fuels on a hydrocarbon basis, and possibilities for an employment of hydrogen as aircraft fuel. G.R.

A81-49451 Biogas and alcohol fuels production; Proceedings of the Seminar on Biomass, Energy for City, Farm, and Industry, Chicago, IL, October 25, 26, 1979. Edited by J. Goldstein. Emmaus, PA, JG Press, 1980. 246 p. $35.

Basic principles of anaerobic digestion are considered along with the status of the Imperial Valley Biogas Project, the Department of Energy program for the recovery of energy and materials from urban waste, the principles of alcohol production from wastes, the mechanical recovery of a refuse-derived cellulosic feedstock for ethanol production, and the production of ethanol from cellulosic biomass. Attention is given to on-farm alcohol fuel production, the current status and future role of gasohol production, methane generation from small scale farms, farmsite installations of energy harvester anaerobic digesters, biogas/composting and landfill recovery, farm-scale composting as an option to anaerobic digestion, designing a high-quality biogas system, and methane as fuel of the future. A description is presented of subjects which are related to landfill gas recovery, biogas purification with permselective membranes, and anaerobic digestion of marine biomass. Other topics studied include the application of biogas technology in India, biogas production in China, biogasification of organic wastes in the Republic of the Philippines, and economics and operational experience of full-scale anaerobic dairy manure digester. G.R.

A81-49452 Gasohol sourcebook - Literature survey and abstracts. Edited by N. P. Cheremisinoff and P. N. Cheremisinoff. Ann Arbor, MI, Ann Arbor Science Publishers, Inc., 1981. 223 p. $30.

A review is provided of biomass and bioconversion technology literature, giving particular attention to gasohol and related fuels. Literature cited and reviewed covers a variety of subjects such as properties of biomass, overviews of bioconversion technologies, toxic and hazardous properties of alcohols, and sources of biomass. Source listings and selected abstracts are provided back to 1965. Both U.S. government reports and journal publications are listed. Foreign publications are also included. A listing is presented of both U.S. and foreign patents on various subjects related to bioconversion technology and gasohol production. Ethanol and methanol production is considered along with automotive and other fuel uses, the production of chemical feedstocks, and the economics of alcohol production. G.R.

A81-49455 Nonpetroleum vehicular fuels; Proceedings of the Symposium, Arlington, VA, February 11-13, 1980. Symposium

sponsored by the Institute of Gas Technology. Chicago, Institute of Gas Technology, 1980. 377 p. $40.

National energy initiatives are considered along with a systems overview of new automotive fuels, questions of alternative fuels availability, gasohol as a fuel supplement, environmental implications of alternative fuel usage, propane as a high quality engine fuel for commercial applications, compressed natural gas vehicle fuel as a pragmatic alternative, and a gasohol utilization and test program. Engine systems and equipment are discussed, taking into account the engine/fuel couple as a priority research and development target in future research, engine development for alternate fuels for Army ground vehicles, intercity and urban gas turbine powered bus demonstration programs, liquefied petroleum gas carburetion, safety testing of liquefied petroleum gas and gas fueled vehicles, and the potential of electric and hybrid-electric vehicles. Alternative liquid fuels are also examined, giving attention to an alcohol fuels prospective, options for transportation fuels from synthetics, transportation fuels from solvent refined coal refinery, engine-fuel compatibility, methane powered vehicles, liquid methane, liquified natural gas and compressed natural gas fueling systems, and hydrogen as a vehicular fuel. G.R.

A81-49469 **Energy from biomass and wastes IV; Proceedings of the Symposium, Lake Buena Vista, FL, January 21-25, 1980.** Symposium sponsored by the Institute of Gas Technology. Chicago, IL, Institute of Gas Technology, 1980. 843 p. $60.

Attention is given to energy from biomass and wastes, the energy potential of sugar cane and sweet sorghum, the yields of short rotation Eucalyptus Grandis in high density plantings, maximizing forest biomass energy production by municipal wastewater irrigation, and large-scale biomass cogenerated power. Advanced systems concerning residential wood fired furnaces are considered along with environmental impacts of increased fuelwood use, metabolic control for microbial fuel production during thermophilic fermentation of biomass, anaerobic sludge digestion in the presence of lactobacillus additive, the enzymatic enhancement of solid waste bioconversion, and the gasification of organic solid wastes in cocurrent moving bed reactors. Other subjects discussed are related to the Simplex coal and biomass gasification process, molecular mechanisms underlying solar conversion and energy storage by the photocatalytic decomposition of water in photosynthesis, and the production of hydrogen from biomass and wastes. There is also a description of topics which are concerned with the economics of modest size pyrolysis systems providing substitute fuel for existing combustion systems, the gasification of solid waste linked with purification, refuse conversion to methane, the biothermal gasification of biomass, and some practical aspects affecting the operation of a commercial gas producer on biomass. G.R.

A81-49767 # **Experimental use of real time SAR imagery in support of oil exploration in the Beaufort Sea.** J. B. Mercer (Dome Petroleum, Ltd., Calgary, Alberta, Canada), R. T. Lowry, and S. K. Leving (Intera Environmental Consultants, Ltd., Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 143-152. 8 refs. Research supported by Dome Petroleum, Ltd.

SAR imagery, generated in real-time, has been used for the first time to support an Arctic marine operation. During the latter portion of Dome Petroleum's late season drilling program (November 1979) in the Beaufort Sea, the SAR-580 flew daily missions to provide near real-time 'snap shots' of the ice conditions in the vicinity of the operations. The aim of the program was to assist both the icebreaker support of the drillship and the subsequent navigation back to harbor. To provide the context for this SAR application, a review of Beaufort Sea ice conditions is presented along with a brief discussion of the problems and techniques of the interpretation of the SAR imagery. The downlink and operational performance of the SAR are described along with an outline of an improved system. B.J.

A81-49809 # **Detection of changes in a coal surface mining area by ratioing multidate Landsat digital data.** D. O. Ohlen (Technicolor Graphic Services, Inc., Sioux Falls, SD). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 581, 582.

Two procedures are compared for determining change in a coal surface mining area in southern Montana using ratioed multidate Landsat data. Subscenes of Landsat band 5 multispectral scanner data acquired in July 1976 and June 1977 are selected. Each subscene is geometrically corrected to a U.S. Geological Survey 7.5 minute topographic map based and resampled using a 100-meter square pixel. The first procedure used in determining the ranges of ratioed data associated with land cover change involves a comparison of a line printer output of pixel values of the ratioed data with the actual changes that occurred in land cover. The second procedure involves interactive manipulation of the minimum and maximum brightness values in a histogram of the ratioed data to determine which pixels become brighter or darker during the test period. Although the two procedures produce similar results, neither procedure gives results adequate for identifying changes produced by surface mining. C.R.

N81-28201 Tennessee Univ., Knoxville.
HIGH TEMPERATURE COMBUSTION OF PULVERIZED COAL Ph.D. Thesis
William Lee Holt 1981 182 p
Avail: Univ. Microfilms Order No. 8115263

Studies were made on the effects of mixing rate and residence time on the combustion of bituminous coal Nominal heating rates of 100,000 degrees K per second with final combustion temperatures on the other of 3000 K characterized the typical test conditions. The stoichiometry was nominally 0.90 with oxygen concentrations in the oxidant above 55 percent. The experimental results were compared to a theoretical coal combustion model involving a one step, first order Arrhenius reaction rate constant. This model proved to be adequate for the test conditions being studied. Conclusions were reached as to the behavior of pulverized coal under flame conditions such as those that might be experienced in an MHD coal combustor. Qualitative information is presented as to the behavior of the coal particles during combustion and subsequent burn-out of the carbon.
Dissert. Abstr.

N81-28274 California Univ., Berkeley.
LOW TEMPERATURE COAL LIQUEFACTION BY ZINC CHLORIDE AND TETRALIN Ph.D. Thesis
Frank Hershkowitz 1980 158 p
Avail: Univ. Microfilms Order No. 8113063

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 chromatography, 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 ZnCl2-catalyzed cleavage of crosslinking bonds in the coal.
Dissert. Abstr.

N81-28276# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
BEHAVIOR OF FUELS AT LOW TEMPERATURES Interim Report
E. A. Frame Sep. 1980 29 p refs
(Contract DAAK70-80-C-0001)
(AD-A100332; AFLRL-138) Avail: NTIS HC A03/MF A01 CSCL 21/4

In developing the filter/separator component of the Arctic Fuel Dispensing Equipment, MERADCOM is considering two options: (1) development of a completely new filter/separator or (2) modification of the current Military Standard filter/separator for use at low temperatures. This report contains test data on the low-temperature behavior of five test fuels - JP-4, JP-5, JP-8, DF-A, and DF-1 as well as two additional test fuels made by adding icing inhibitor (ethylene glycol monomethyl ether) to the DF-A and DF-1. Four additional fuels were obtained from Alaska (JP-4, Jet A-1, DF-A, and JP-5) and low temperature

behavior of these field samples was determine. This report contains (1) a brief summary of industry practice in handling fuels at low temperatures, (2) inspection properties of test fuels, (3) viscosities and conductivities of fuels at low temperatures, (4) fuel contaminant behavior at low temperatures, and (5) fuel system icing inhibitor effects at low temperatures. Author (GRA)

N81-28283# Gulf Research and Development Co., Pittsburgh, Pa.
METHYL ARYL ETHERS FROM COAL LIQUIDS AS GASOLINE EXTENDERS AND OCTANE IMPROVERS
G. M. Singerman Nov. 1980 35 p refs
(Contract DE-AC01-79CS-50022)
(DOE/CE-50022/1) Avail: NTIS HC A03/MF A01

A mixture of methyl aryl ethers derived from the phenols present in direct liquefaction coal liquids shows considerable promise as a gasoline blending agent and octane improver. The mixture of methyl aryl ethers was blended at five volume percent with a commercial unleaded gasoline. The properties and performance of the blend in a variety of laboratory and automobile tests is reported. The tests show that the mixture of methyl aryl ethers improves gasoline octane without degrading other gasoline properties. DOE

N81-28284# California Univ., Livermore. Lawrence Livermore Lab.
COAL GASIFICATION
Mar. 1981 28 p refs Transl. into ENGLISH from Congr. on the Uses of Coal in the Iron and Steel Ind., Mexico City, Jul. 1976; sponsored by ILAFA
(Contract W-7405-eng-48)
(UCRL-Trans-11686) Avail: NTIS HC A03/MF A01

The theoretical basis for gasification of coals and the various processes for the production of gases from coal, whether having high or low heating value are discussed. The latest methods were developed with a view to the three uses of coal: as a source of energy, as a raw material for the iron and steel is concluded that the process should be of interest as a means of making better use of the coal from southern Brazil. DOE

N81-28289# Pittsburg Univ., Pa. Dept. of Civil Engineering.
BIO-OXIDATION OF THIOCYANATES TYPICAL OF COAL CONVERSION EFFLUENTS Final Report
R. D. Neufeld, Lorraine Mattson, and Patricia Lubon 8 Jan. 1981 142 p refs
(Contract DE-AS02-77EV-04502)
(DOE/ET-04502/7; SETEC-CE-81-001) Avail: NTIS HC A07/MF A01

Data for the biological degradation fate kinetics of thiocyamate removal were developed as well as material balance information for the fate of sulfur and nitrogen resulting from such biodecomposition of aqueous thiocyanates. A literature review of thiocyanate biodegradation was conducted which indicates that while much biochemistry information is available, little information in the biological processing arena is known. Based on both batch and continuous culture experiments utilizing an activated sludge type of system with strictly thiocyanate degradating organisms, the specific utilization rate for SCN degradation was found to follow a substrate inhibition biokinetic relationship. The observed biomass sludge production rate was quantified, as a function of sludge age in the bioreactor. The major metabolic by products of SCN aerobic biodegradation are ammonia and sulfate, with such formation being stochiometric with SCN. DOE

N81-28293# Los Alamos Scientific Lab., N. Mex.
FLASH PYROLYSIS OF COAL THROUGH SOLAR HEATING
W. H. Beattie 1981 22 p refs Presented at the AS/ISES Ann. Conf., Philadelphia, 26-30 May, 1981 Submitted for publication
(Contract W-7405-eng-36)
(LA-UR-81-764; CONF-810509-4) Avail: NTIS HC A02/MF A01

A laboratory technique for studying flash pyrolysis by radiantly heating small stationary samples of powdered coal with the beam of a carbon dioxide laser is described. With this technique flux levels equivalent to those available from solar furnaces are attainable, experimental parameters are easily controllable, and experimental turn around time is short. The pyrolysis of a western subbituminous coal was studied with laser and solar heating. The pyrolysis products were a gas composed principally H2, CH4, CO, and CO2, tar, and char. Under laser heating, the gas yield increased with flux up to W/sq cm. Under conditions of complete pyrolysis, tar and gas yields were inversely proportional to each other and char yield was almost constant. Solar coal pyrolysis experiments at the White Sands Solar Furnace gave results in general agreement with the laser pyrolysis experiments, except that gas yields were higher. DOE

N81-28294# Oak Ridge National Lab., Tenn. Fossil Energy Program.
TECHNICAL AND ECONOMIC EVALUATION OF SELECTED COAL-LIQUEFACTION PROCESSES. PRELIMINARY SCREENING EVALUATION
R. Salmon, R. C. Forrester, III, S. P. N. Singh, J. F. Fisher, R. M. Wham, S. W. Thiel, and J. P. Meyer Apr. 1981 197 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7581) Avail: NTIS HC A09/MF A01

Preliminary scoping evaluations of ten conceptual coal liquefaction processes were made for the Department of Energy using available published information. Production costs calculated under a consistent set of economic criteria varied from $0.78 to $1.47/gal for gasoline in constant 1979 dollars. However, existing design documents showed little consistency as to status of process development, credibility of process design basis, completeness of design, or conservatism of cost estimation. It is concluded that a more complete and thorough design study of each process is necessary to achieve any degree of technical and economic consistency, and that it is therefore not possible to satisfy DOE's desire for consistent technical and economic comparisons in this type of preliminary scoping study. DOE

N81-28295# Sandia Labs., Albuquerque, N. Mex.
ROLE OF SITE CHARACTERISTICS IN THE CONTROL OF UNDERGROUND COAL GASIFICATION
B. E. Bader and R. E. Glass Mar. 1981 27 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-2664) Avail: NTIS HC A03/MF A01

Underground coal gasification (UCG) offers many potential economic and environmental advantages. Offsetting these advantages is the substantial lack of ability to control the UCG process. For example, only three elements of external process control were utilized. These are: (1) injected gas compositions; (2) injected gas flow rate; and (3) product gas pressure. Variation of these independent variables in UCG tests resulted in mixed indications of their effectiveness. Other possible elements of control are indicated based on the results of recent field tests and modeling efforts. These elements are associated with the selection of the specific site where the process is conducted and with the design of the test itself. The results of previous UCG field tests indicated that the conditions that exist in the coal seam and overburden before the start of the combustion process may dominate all other factors. These conditions are the geochemical characteristics, such as faulting and groundwater hydrology, as well as the details of the test layout, well completions, and linking method. DOE

N81-28296# Booz-Allen and Hamilton, Inc., Palo Alto, Calif.
ASSESSMENT OF INTERNATIONAL TAR SANDS RECOVERY AND UPGRADING PROCESSES
Dec. 1980 373 p refs Prepared for California Univ., Livermore. Lawrence Livermore Lab.
(Contract W-7405-eng-48)
(UCRL-15323) Avail: NTIS HC A16/MF A01

Foreign technologies that might aid in the future development of heavy oil deposits in the United States are analyzed. This information on foreign technology developments would aid in formulating and directing policy decisions on future research programs within the United States. Emphasis of the study is on post-1978 developing technologies. The scope includes sizing the resource base and reviewing and evaluating past, present, and planned research and field developments on processes for mining, producing, extracting, and upgrading very heavy oils recovered from tar sands. The characteristics and location of the world's principal tar sands resources are presented. Production methods, both above ground and in-situ, factors inherent in choosing between methods, and the commercial and pilot application of those methods are discussed. The factors are presented which affect the process selection for upgrading bitumen and very heavy oils so they can be piplined and/or refined to a desired mix of consumer products. DOE

N81-28297# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

DESIGN REPORT: SMALL-SCALE FUEL ALCOHOL PLANT
1980 130 p
(Contract DE-AC07-76ID-01570)
(IDO-10088-Vol-1) Avail: NTIS HC A07/MF A01

The objectives of the report are to provide potential alcohol producers with a reference design and provide a complete, demonstrated design of a small scale fuel alcohol plant. This report describes a small scale fuel alcohol plat designed and constructed for the DOE by EG and G Idaho, Inc., an operating contractor at the Idaho National Engineering Laboratory. The plant is reasonably complete, having the capability for feedstock preparation, cooking, saccharification, fermentation, distillation, by product dewatering, and process steam generation. An interesting feature is an instrumentation and control system designed to allow the plant o run 24 hours per day with only four hours of operator attention. Where possible, this document follows the design requirements established in the DOE publication Fuel From Farms, which was publishd by February 1980. DOE

N81-28418*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FOUR BAND DIFFERENTIAL RADIOMETER FOR MONITORING LNG VAPORS Final Report, Dec. 1978 - Jun. 1981
J. J. Simmonds 26 Jun. 1981 35 p refs
(MIPR-Z-70099-8-822868A)
(NASA-CR-164637; JPL-PUB-81-56) Avail: NTIS HC A03/MF A01 CSCL 14B

The development by JPL of a four band differential radiometer (FBDR) which is capable of providing a fast rate of response, accurate measurements of methane, ethane, and propane concentrations on the periphery of a dispersing LNG cloud. The FBDR is a small, low power, lightweight, portable instrument system that uses differential absorption of near infrared radiation by the LNG cloud as a technique for the determination of concentration of the three gases as the LNG cloud passes the instrument position. Instrument design and data analysis approaches are described. The data obtained from the FBDR prototype instrument system deployed in an instrument array during two 40 cubic meter spill tests are discussed. A.R.H.

N81-28452# Department of Energy, Morgantown, W. Va. Valve Testing and Development Projects.
TEST AND EVALUATION OF TWO SIGMON CORPORATION 6-INCH TYPE K BALL VALVES METC SOA TEST VALVE NO. A-4 AND METC SOA TEST VALVE NO. B-4 FOR LOCKHOPPER SERVICE IN COAL CONVERSION
John F. Gardner 28 Feb. 1981 78 p refs
(DOE/METC-SP-129) Avail: NTIS HC A05/MF A01

Two 6-inch Sigmon Corporation type K blocking ball valves were evaluated. Significant difficulties were encountered when performing tests. Problems included excessive leakage rates, galling of valve seats and balls, and a broken valve stem. In the tested configuration, the subject test valves are not recommended for severe service block and seal applications in coal conversion. DOE

N81-28501# Texas Univ. at Arlington. Center for Energy Studies.
OFFSHORE OIL: AN OVERVIEW
Ian R. Manners Jun. 1980 110 p refs
(Policy-Study-11) Avail: NTIS HC A06/MF A01

The decline of traditional offshore oil producing regions and the emergence of newer regions is discussed as well as techniques for deepwater production and offshore exploration. The mobile rig fleet, outer continental shelf frontiers, and exploration licensing are discussed. The hydrocarbon potential of seven nations lying outside the major offshore producing regions of the Middle East, the North Sea, and the United States is assessed. The countries profiled are Australia, Argentina, Brazil, Chile, India, Indonesia, and Mexico. A.R.H.

N81-28508# Adams (Samuel S.) and Associates, Boulder, Colo.
GEOLOGY AND RECOGNITION CRITERIA FOR URANIFEROUS HUMATE DEPOSITS, GRANTS URANIUM REGION, NEW MEXICO Final Report
S. S. Adams and A. E. Saucier (SEDI-MET, Inc., Albuquerque, N. Mex.) Jan. 1981 306 p refs Prepared for Bendix Field Engineering Corp., Grand Junction, Colo.
(Contract DE-AC13-76GJ-01664)
(GJBX-2(81)) Avail: NTIS HC A14/MF A01

The geology of the uraniferous humate uranium deposits of the Grants Uranium Region, northwestern New Mexico, summarized. The geologic characteristics of the uraniferous humate deposits of the Grants Uranium Region are not common in the world, neither are they bizarre or coincidental. The influence of structural control on the location and accumulation of the host sediments is supported considerable data. The host sediments possess numerous important characteristics which influenced the formation of uraniferous humate deposit. Ilmenite magnetite distribution within potential host sandstones is the simplest and most useful regional alteration pattern related to this type of uranium deposit. A method is presented for organizing geologic observation into recognition criteria. It is concluded that the potential of the United States for new districts similar to the Grants Uranium Region is low. DOE

N81-28503# Science Applications, Inc., Morgantown, W. Va.
QUANTITATIVE ANALYSIS OF THE ECONOMICALLY RECOVERABLE RESOURCE
C. V. Pulle and A. P. Seskus May 1981 108 p refs
(Contract DE-AM21-78MC-08216)
(DOE/MC-08216-157) Avail: NTIS HC A06/MF A01

Economically recoverable gas in the Appalachian Basin. Estimates were obtained for a probability distribution, associated with estimates where geologic and production uncertainties prevail. Well productivity on a county and regional basis is lognormally distributed, and the total recoverable gas is normally distributed. With smaller well spacings the estimate is substantially increased, and advanced technology, such as foam fracturing, has the potential of significantly increasing gas recovery. The lognormal distribution of well productivity even in smaller areas, of intense exploration appropriate. The lognormal distribution, represents the small number of wells with relatively very high productivity. DOE

N81-28512 Miami Univ., Fla.
PRINCIPLES OF MANAGEMENT OF MUNICIPAL SOLID WASTE ANAEROBIC BIOCONVERSION FACILITIES Ph.D. Thesis
Jairo Francisco Lascarro 1980 159 p
Avail: Univ. Microfilms Order No. 8114776

A full scale proof of concept plant for the anaerobic conversion of municipal solid waste to methane rich gas was constructed in Pompano Beach, Florida. This facility provided the opportunity to develop baseline management principles and to improve the understanding of this technology. Engineering data and technical concepts were derived from the operation of this plant with a view that it will help in resolving the uncertainties related with this process. Some of the fundamental problems associated with the technical operation of this process are investigated. A summary of economic data is included to emphase those factors which might affect the future development of this technology. Some of the major federal acts associated with this technology are listed to anticipate issues that may hinder the smooth progress of this technology. Dissert. Abstr.

N81-28530# Oak Ridge National Lab., Tenn.
FOSSIL ENERGY PROGRAM Progress Report for November 1980
L. E. McNeese Jan. 1981 118 p
(Contract W-7405-eng-26)
(ORNL/TM-7635) Avail: NTIS HC A06/MF A01

Increased utilization of coal and other fossil fuel alternatives as sources of clean energy is reported. The following topics are discussed: coal conversion development, chemical research and development, materials technology, component development and process evaluation studies, technical support to major liquefaction projects, process analysis and engineering evaluations, fossil energy environmental analysis, flue gas desulfurization, solid waste disposal, coal preparation waste utilization, plant control development, atmospheric fluidized bed coal combustor for cogeneration, TVA FBC demonstration plant program technical support, PFBC systems analysis, fossil fuel applications assessments, performance assurance system support for fossil energy projects, international energy technology assessment, and general equilibrium models of liquid and gaseous fuel supplies. DOE

N81-28532# Sandia Labs., Albuquerque, N. Mex.
GEOTHERMAL DRILLING AND COMPLETION TECHNOLOGY DEVELOPMENT PROGRAM PLAN
Samuel G. Varnado, James R. Kelsey, and Donald L. Wesenberg Feb. 1981 94 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0380) Avail: NTIS HC A05/MF A01

A long-range plan for the development of new technology that will reduce the cost of drilling and completing geothermal wells is presented. The goals of this program are to develop the technology required to reduce the cost of drilling and completing geothermal wells by 25% in the near term and by 50% in the long term. Efforts under this program to date have resulted in new roller bit designs that will reduce well costs by 2% to 4%, new drag bits that have demonstrated marked increases in penetration rate, and the field verification of the effectiveness of inert drilling fluids in reducing drill pipe corrosion. DOE

N81-28535# New Zealand Energy Research and Development Committee, Auckland.
FEASIBILITY OF A GEOTHERMAL DISTRICT HEATING SCHEME
J. J. Lorentz and M. V. Mountfort 1980 47 p refs
(NZERDC-55) Avail: NTIS (US Sales Only) HC A03/MF A01; DOE Depository Libraries

The present development and exploitation of geothermal energy use in Rotorua and Taupo are reviewed with reference to the future development of a Geothermal District Heating (GDH) scheme. Other aspects which affect the future viability of a GDH scheme include: heat load densities for the Rotorua City area and the Taupo Borough area, energy usage patterns in Rotorua and Taupo, and household energy consumption in Rotorua and Taupo. In addition, the results of three market surveys are summarized: of nongeothermal users in residential areas of Rotorua and Taupo, of geothermal users in residential areas of Rotorua, and of non geothermal users in industrial and commercial areas of Rotorua and Taupo. The conclusions drawn from the market surveys were used to formulate recommendations for the futue investigations, and to prepare the terms of reference for a further study project. DOE

N81-28540# Hirai (W. A.) and Associates, Inc., Hilo, Hawaii.
HYDROELECTRIC POWER IN HAWAII. A RECONNAISSANCE SURVEY
Feb. 1981 205 p refs Sponsored in part by Hawaii State Dept. of Planning and Economic Development
(Contract DE-FC49-80R-910031)
(DOE/R9-10031/T2) Avail: NTIS HC A10/MF A01

Hydropower resources in the State of Hawaii are assessed. Hydropower resources on all islands total about 50 megawatts of potential generating capacity. Combined with the 18 megawatts of existing hydropower capacity, hydropower resources potentially could generate about 307 million kilowatt-hours of electric energy annually. This represents about 28 percent of the present combined electricity needs of the Neighbor Islands - Kauai, Molokai, Maui, and the Big Island. The island of Oahu, however, has only small hydropower resources, and could only generate a negligible portion of its electricity needs from this energy source. Existing and potential hydropower capacities are summarized, and annual outputs for each island are estimated. DOE

N81-28575# Institute of Gas Technology, Chicago, Ill. Energy Conversion Systems Group.
APPLICATIONS OF FUSION THERMAL ENERGY TO INDUSTRIAL PROCESSES
Ronald M. Bowman, Bassam J. Jody, and Kuang C. Lu 1980 20 p refs Presented at the 3d Miami Intern. Conf. on Alternative Energy Sources, Miami Beach, Fla., 15-17 Dec. 1980
(Contract W-31-109-eng-38)
(CONF-801210-24) Avail: NTIS HC A02/MF A01

The feasibility of applying fusion thermal energy as process heat in the iron-steel industry, petrochemical industry, cement industry, and in the production of acetylene from coal via calcium carbide are discussed. These four industries were selected for analysis because they require massive amounts of energy. This preliminary study concludes that the production of synthetic fuels using fusion heat appears to be the most promising method of storing and transporting this heat. Of the four industries studied, the iron-steel and the petrochemical industries appear to be the most promising because they consume substantial amounts of hydrogen and oxygen as feedstocks. These can be produced from water using the high temperature fusion heat. The production of hydrogen and oxygen using fusion heat will also reduce the capital investment required for these industries. These two industries also consume tremendous amounts of heat at temperatures which can be delivered from a fusion blanket via chemical heat pipes. DOE

N81-28592# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
GEOTHERMAL ENERGY FOR HAWAII: A PROSPECTUS
Winifred W. S. Yen and Daniel S. Iacofano Jan. 1981 97 p refs
(Contract W-7405-eng-48)
(LBL-12184) Avail: NTIS HC A05/MF A01

An overview of geothermal development is provided for contributors and participants in the process: developers, the financial community, consultants, government officials, and the people of Hawaii. Geothermal energy is described along with the issues, programs, and initiatives examined to date. Hawaii's future options are explored. Included in appendices are: a technical glossary, legislation and regulations, a geothermal directory, and an annotated bibliography. DOE

N81-28594# Los Alamos Scientific Lab., N. Mex.
GEOTHERMAL RESOURCE BASE OF THE WORLD: A REVISION OF THE ELECTRIC POWER RESEARCH INSTITUTES ESTIMATE
M. J. Aldrich, A. W. Laughlin, and D. T. Gambill Apr. 1981 60 p refs
(Contract W-7405-eng-36)
(LA-8801-MS) Avail: NTIS HC A04/MF A01

Calculating methods for the geothermal resource base of a country show that modifications are needed for the assumptions used in the calculation. The modifications include: (1) separating geothermal belts into volcanic types with a geothermal gradient; (2) using the actual mean annual temperature of a country; and (3) making separate calculations for the resource stored in water/brine and that stored in rock. It is indicated that the method for geothermal resource base calculations yields reasonable values. DOE

N81-28653# Cincinnati Univ., Ohio. Lab. of Sedimentology.
SEDIMENTOLOGY OF GAS-BEARING DEVONIAN SHALES OF THE APPALACHIAN BASIN
Paul Edwin Potter, J. Barry Maynard, and Wayne A. Pryor Jan. 1981 46 p refs
(DOE/METC-114) Avail: NTIS HC A03/MF A01

Sedimentology of the Devonian shales and its relationship to gas, oil, and uranium are reported. Information about the gas bearing Devonian shales of the Appalachian Basin is organized in the following sections: paleogeography and basin analysis; lithology and internal stratigraphy; paleontology; mineralogy, petrology, and chemistry; and gas oil, and uranimum. E.A.K.

N81-28657# Los Alamos Scientific Lab., N. Mex.
REMOTE CHARACTERIZATION OF TIGHT GAS FORMATIONS WITH A NEW NMR LOGGING TOOL
J. A. Jackson, J. A. Brown, and T. R. Crawford 1981 18 p refs Presented at the Joint SPE/DOE Symp. on Low Permeability Gas Reservoirs, Denver, 27-29 May 1981
(Contract W-7405-eng-36)
(LA-UR-81-735; CONF-810518-4) Avail: NTIS HC A02/MF A01

A new nuclear magnetic resonance logging technique was developed. The tool has operating and measurement advantages in tight western gas sand formations over existing nuclear magnetic logging tools. The advantages are: elimination of the need to condition borehole fluids prior to logging a hole; higher sensitivity per unit sample volume; shorter instrumental dead time; and potential for greater formation penetration. The new technique has been laboratory tested in tool geometry. DOE

N81-28682# Battelle Pacific Northwest Labs., Richland, Wash.
WIND ENERGY RESOURCE ATLAS. VOLUME 12: PUERTO RICO AND US VIRGIN ISLANDS
H. L. Wegley, D. L. Elliott, W. R. Barchet, and R. L. George Jan. 1981 93 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3195-WERA-12) Avail: NTIS HC A05/MF A01

The Puerto Rico/US Virgin Island atlas assimilates three collections of wind resource data: one for the region as a whole and one each for both the Commonwealth of Puerto Rico and the US Virgin Islands. For the two subregions, features of the climate, topography and wind resource are discussed in greater detail than is provided in the regional discussion, and the data locations on which the assessment is based are mapped. Variations, over several time scales, in the wind resource at selected stations in both subregions are shown on graphs of monthly average and interannual wind speed and power, and hourly average wind speed for each season. Other graphs present

speed, direction and duration frequencies of the wind at these locations. DOE

N81-28684# Battelle Pacific Northwest Labs., Richland, Wash.
PRACTICAL METHOD FOR ESTIMATING WIND CHARACTERISTICS AT POTENTIAL WIND ENERGY CONVERSION SITES
R. M. Endlich, F. L. Ludwig, C. M. Bhumralkar, and M. A. Estoque Aug. 1980 165 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3808) Avail: NTIS HC A08/MF A01

A method is developed to compute local winds for use in estimating the wind energy available at any potential site for a wind turbine. The method uses the terrain heights for an area surrounding the site and a series of wind and pressure reports from the nearest four or five national Weather Service stations. An initial estimate of the winds in the atmospheric boundary layer is made, then these winds are adjusted to satisfy the continuity equation. In this manner the flow is made to reflect the influences of the terrain and the shape of the boundary layer top. Descriptions of the computer programs, instructions for using them, and complete program listings are included. DOE

N81-28986# Westinghouse Electric Corp., Pittsburgh, Pa. Dept. of Fusion Power Systems.
FEASIBILITY OF RECYCLING THORIUM IN A FUSION-FISSION HYBRID/PWR SYMBIOTIC SYSTEM
J. M. Josephs (Cornell Univ., Ithaca, N.Y.) 31 Dec. 1980 54 p refs
(Contract DE-AC02-77ET-51010)
(DOE/ET-51010/9) Avail: NTIS HC A04/MF A01

A study was made of the economic impact of high levels of radioactivity in the thorium fuel cycle. The sources of this radioactivity and means of calculating the radioactive levels at various stages in the fuel cycle are discussed and estimates of expected levels are given. The feasibility of various methods of recycling thorium is discussed. These methods include direct recycle, recycle after storage for 14 years to allow radioactivity to decrease, shortening irradiation times to limit radioactivity build up, and twhe use of the window in time immediately after reprocessing where radioactivity levels are diminished. An economic comparison is made for the first two methods together with the throwaway option where thorium is not recycled using a mass energy flow model developed for a CTHR (Commercial Tokamak Hybrid Reactor), a fusion fission hybrid reactor which serves as fuel producer for several PWR reactors. DOe

N81-29042# Argonne National Lab., Ill. Energy and Environment Systems Div.
APPLICATION OF A METHODOLOGY FOR EVALUATION OF INTERTECHNOLOGY TRADEOFFS: AN ILLUSTRATIVE CASE STUDY
R. G. Whitfield, W. A. Buehring, M. J. Jusko, and T. D. Wolsko Nov. 1980 49 p refs
(Contract W-31-109-eng-38)
(ANL/EES-TM-127) Avail: NTIS HC A03/MF A01

The problem of selecting the best research and development for developing long term energy technologies that use coal is discussed. Best is defined in terms of 11 attributes, or measures of performance. Uncertainties were determined for the many, complex outcomes that result from each strategy, and the information was systematically structured for evaluation. Preferences for the various outcomes were quantified by assessing a multi-attribute utility function over the 11 single attributes. The best alternative was chosen using maximization of expected utility as a guide. Extensive sensitivity analyses showed that one strategy, evolutionary development, was best over a wide range of plausible assumptions. DOE

N81-29043# Bendix Field Engineering Corp., Grand Junction, Colo.
IMPORTANCE OF RESOLUTION FOR HELIUM DETECTORS USED IN URANIUM EXPLORATION
A. Zaikowski and E. H. Roberts Feb. 1981 19 p refs
(GJBX-38(81)) Avail: NTIS HC A02/MF A01

A small mass spectrometer of the 4He detector type used in uranium exploration was modified to enable magnetic scanning of its mass spectrum. Spectra obtained from the instrument allow determination of interferences from adjacent mass peaks. Hydrogen outgassed from the system or produced by molecular dissociation can be a principal extraneous species. If not thoroughly removed from a system, it can contribute to the ion current of the 4He mass peak. Correlations of 4He with soil gas moisture found in prior studies may not be due to true variation in 4He but may be ascribable to artifacts resulting from H2 contributions to 4He. Such artifacts can be corrected for by converting field instruments to a scanning mode. DOE

N81-29159# Environmental Protection Agency, Ann Arbor, Mich. Test and Evaluation Branch.
EVAPORATIVE AND EXHAUST EMISSIONS OF TWO AUTOMOBILES FUELED WITH VOLATILITY ADJUSTED GASOHOL
David C. Lawrence and Daniel J. Niemczak Dec. 1980 28 p refs
(PB81-164824; EPA-AA-TEB-81-12) Avail: NTIS HC A03/MF A01 CSCL 21D

The results of a vehicle emission test program conducted by the U.S. EPA in July 1980 are presented. The program was designed to investigate the effects of using various gasohol blends on vehicle evaporative and exhaust emissions. Particular emphasis was directed towards a blended gasohol whose volatility characteristics were adjusted to match as closely as possible those of a baseline gasoline. Two vehicles received triplicate tests on each of four fuels. The analysis also included a gas chromatograph characterization of the SHED vapors for ethanol concentrations and a comparison of carbon balance fuel economy versus volumetric fuel economy. GRA

N81-29219# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
INTERNAL OXIDATION AND SULFIDATION OF IRON-BASED BINARY ALLOYS M.S. Thesis
P. J. Risse May 1981 79 p refs
(Contract W-7405-eng-48)
(LBL-12785) Avail: NTIS HC A05/MF A01

Internal oxidation and sulfidation are addressed as one aspect of the coal gasification corrosion problem. By using different gas mixtures of H2S/H2O/H2/Ar the activities of the oxidants (oxygen and sulfur) are controlled to the point that iron, in the iron based binary alloys (Fe-1% Al, 5% Al, 1% Cr, 5% Cr), appears as a noble metal. The oxidants then diffuse into the noble iron matrix and interact, via precipitation, with the less noble elements, which allows depth of penetration analysis and morphology characterization to be performed. In the latter analysis, continuous subscales were formed both at the relatively high P sub S2 and at a low P sub 02, leaving a narrow range of potentials where the theories of Wagner are applied. The depth of penetration analysis yielded permeabilities (solubility-diffusivity) and effective diffusivity coefficients for the oxidants. DOE

N81-29222# Oak Ridge National Lab., Tenn. Fossil Energy Program.
CORROSION OF HIGH TEMPERATURE MATERIALS IN AFBC ENVIRONMENTS. PART 1: (1500-H TESTS)
R. H. Cooper, T. G. Godfrey, and J. H. DeVan Jun. 1981 39 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7734/P1) Avail: NTIS HC A03/MF A01

Candidate heat exchanger tube materials were tested for times to 1500 h in a small scale atmospheric fluidized bed combustor (AFBC) operated by the FluiDyne Corporation of Minneapolis, Minnesota. The materials included: alloys 800H and 600; types 304, 310, and 316 stainless steel; and aluminized alloy 800 and type 310 stainless steel. These air cooled tubes were exposed to the AFBC environment with wall temperatures ranging from 810 to 8750C, a Ca/S molar ratio of 3.3 to 5.3, 2.5 to 3.5% excess 02, and a fluidizing velocity of 0.7 m/s. Tubes were removed for examination after 500 h of exposure and at the conclusion of the 1500 h test. In general, the materials performed well with moderate fireside scale formation and slight intergranular corrosion. The notable exception was catastrophic corrosion of three alloy 600 tubes shortly after resumption of the test following the 500 h segment. DOE

N81-29247# General Technology Applications, Inc., Arlington, Va.
APPLICATION OF GENERAL TECHNOLOGY APPLICATIONS, INCORPORATED (GTA) BLENDING PROCESS TO ANTIMISTING FUEL ADDITIVES Final Report, Aug. 1980 - May 1981
J. C. Trippe, Paul Waters, and Albert Hadermann May 1981 28 p refs

(Contract DTFA-03-80-C-00070)
(AD-A100692; FAA-CT-81-51) Avail: NTIS HC A03/MF A01 CSCL 21/4

This program examines the applicability of a proprietary blending process to blending antimisting additives in JET A aviation fuel. The first phase of the program covers use of the process with a high molecular weight polyisobutylene. The second phase covers the use of the process with Imperial Chemical Industries, Ltd's proprietary polymer, FM-9. The results of the program indicate that high molecular weight polyisobutylene can be blended rapidly with JET A using the proprietary process and that the resulting blend demonstrates antimisting behavior within minutes. There was no evidence that the proprietary process is effective in the blending of FM-9 in JET A. Author (GRA)

N81-29248# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
MILITARY FUELS REFINED FROM PARAHO-II SHALE OIL Interim Report, Jun. 1979 - Nov. 1980
J. N. Bowden, E. C. Owens, D. w. Naegeli, and L. L. Stavinoha Mar. 1981 95 p refs
(Contracts DAAK70-78-C-0001; DAAK70-80-C-0001; DA Proj. 1L7-62733-AH-20)
(AD-A101069; AFLRL-131) Avail: NTIS HC A05/MF A01 CSCL 21/4

Shale-derived JP-5, JP-8, aviation turbine fuels and marine diesel fuel were analyzed for compliance with military specifications and evaluated for storage stability, corrosion tendencies, additive response, compatibility with petroleum fuels and microbiological growth susceptibility. The shale fuels behaved very much like petroleum-derived fuels. Turbine combustor evaluation showed a likeness to petroleum-derived Jet A fuel. Performance tests of the shale fuels conducted in four diesel engines also indicated a similarity with the same tests performed with petroleum-derived fuels. Author (GRA)

N81-29256# Institute of Gas Technology, Chicago, Ill.
PREPARATION OF A COAL-CONVERSION-SYSTEMS TECHNICAL DATA BOOK, PART 1 Annual Report, 1 May 1979 - 30 Apr. 1980
Mar. 1981 514 p refs
(Contract DE-AC01-76FT-10255)
(DOE/ET-10255/1-Pt-1) Avail: NTIS HC A22/MF A01

The SURFIMP program of Prausnitz, et al., was used to compute the vapor liquid equilibrium equilibria (VLE) of the NH3-CO2-H2S-H2O system and was compared with the experimental results of IGT, Badger and Silver, and Cardon and Wilson. The results indicate that a better correlation is needed. The salting out coefficients of carbon dioxide by sodium chloride and calcium chloride were correlated with temperature. Thermodynamic properties of furan, tetrahydrofuran, naphthalene, and tetralin are presented in both the English and SI units. Combustion characteristics of low and medium Btu gases and results of experimental evaluations of low Btu gases on utility boiler type burners and industrial burners are stated. The emissions of pollutants from the combustion are discussed. The IGT heating value correlation is evaluated using coal and char data analyzed at IGT for the HYGAS program. The standard deviation of the prediction, using the heating value correlation, is about 85 Btu/lb. DOE

N81-29258# Mueller Associates, Inc., Baltimore, Md.
ETHANOL ENERGY YIELD PER GALLON AND POTENTIAL PETROLEUM DISPLACEMENT
May 1981 25 p refs
(Contract DE-AC05-79CS-56051)
(DOE/CE-56051/3) Avail: NTIS HC A02/MF A01

If the entire respective 1974 and 1975 corn crops had been converted to ethanol for use as gasohol, anywhere from about 224,000 to 333,000 barrels per day (3430 to 5100 million gallons per year) of petroleum (equivalent) could have been displaced if no premium fuels were involved in any way in the processing and transportation of ethanol. The USDA applied a methodology to estimate that current uncultivated lands could produce 17 billion gallons per year of ethanol. Although lacking a link between the quality of these lands and the Farm Production Regions in which they occur, these 17 billion gallons may displace from 97,800 to 444,000 barrels per day (1,500 to 6,800 million gallons per year) of petroleum (equivalent) exclusive of any premium fuels associated with corn processing and ethanol distribution. DOE

N81-29261# Gulf Research and Development Co., Pittsburgh, Pa. Dept. of Chemistry and Minerals.
SOLVENT REFINED COAL (SRC) PROCESS. FLASHING OF SRC-II SLURRY IN THE VACUUM COLUMN ON PROCESS DEVELOPMENT UNIT P-99 Interim Report, Feb. - Jun. 1980
J. A. Gray and S. T. Mathias Oct. 1980 223 p refs
(Contract DE-AC05-76ET-10104)
(DOE/ET-10104/2) Avail: NTIS HC A10/MF A01

This report presents the results of 73 tests on the vacuum flash system of Process Development Unit P-99 performed during processing of three different coals: the second batch, fourth shipment (low ash batch) of Powhatan No. 5 Mine (LR-27383), Powhatan No. 6 Mine (LR-27596), and Ireland Mine (LR-27987). The objective of this work was to obtain experimental data for use in confirming and improving the design of the vacuum distillation column for the 6000 ton/day SRC-II Demonstration Plant. The 900 F distillate content of the bottoms and the percent of feed flashed overhead were correlated with flash zone operating conditions for each coal, and the observed differences in performance were attributed to differences in the feed compositions. Retrogressive reactions appeared to be occurring in the 900 F + pyridine soluble materials leading to an increase in the quantity of pyridine insoluble organic matter. DOE

N81-29262# Department of Energy, Pittsburgh, Pa. Energy Technology Center.
HYDROLIQUEFACTION OF COAL WITH SUPPORTED CATALYSTS: THE 1980 STATUS REVIEW
L. M. Polinski, G. J. Stiegel, and R. E. Tischer Jun. 1981 124 p refs
(DOE/PETC/TR-81/2) Avail: NTIS HC A06/MF A01

The objectives of the program were to determine catalyst deactivation kinetic models and catalyst deactivation modes for supported Co-Mo and Ni-Mo catalysts used primarily in coal liquefaction via the H-COAL process. Emphasis was on developing methods to increase catalyst usage by determining how to decrease catalyst replacement rates in the process and how to increase catalyst poisoning. An important conclusion reached via model analysis and verified by experiment is that larger diameter catalysts resist poisoning deactivation much more than smaller catalysts over extended periods of time. If this trend can be verified, it gives a powerful tool for reducing catalyst replacement rate in the H-COAL ebullated bed system by factors of 2 or more. A second conclusion is that poisoning of catalysts occurs by several possible mechanisms or modes. DOE

N81-29263# Colorado School of Mines, Golden. Dept. of Chemical and Petroleum-Refining Engineering.
MECHANISMS AND KINETICS OF COAL HYDROGENATION Quarterly Progress Report, Jan. - Mar. 1981
R. M. Baldwin and M. W. Furlong May 1981 64 p refs
(Contract DE-AC22-79ET-14881)
(DOE/ET-14881/T1) Avail: NTIS HC A04/MF A01

Colorado School of Mines is engaged in an experimental program to develop comprehensive models for the effects of coal composition upon the kinetics and mechanisms of coal hydrogenation, for the effects of mineral matter additives upon kinetics and mechanisms of coal hydrogenation, and for the kinetics and mechanisms of the of the hydrogenation of coal derived products such as preasphaltense and asphaltenses. Experimental work was completed on a suite of bituminous coals, this completing the initial phase of the coal reactivity study. Eleven of the 14 coals of the suite were successfully run in duplicate. Conversion of THF solubles was correlated by pseudo-second order kinetics. The resulting kinetic rate constants correlated with H/C ratio, mean-mix vitrinite reflectance, and a specially defined fraction of reactive macerals. Experimental work on the first phase of the disposal catalyst studies was completed. DOE

N81-29266# Pennsylvania Univ., Philadelphia.
ONE-DIMENSIONAL, THREE-PHASE MULTICOMPONENT NUMERICAL SIMULATION OF UNDERGROUND COAL GASIFICATION
S. M. FarouqAli and M. L. Pasha [1981] 40 p refs
(Contract DE-AS21-76MC-08018)
(DOE/MC-08018/T1) Avail: NTIS HC A03/MF A01

The modeling of the process of underground coal gasification in case of a permeable, porous coal bed is presented. In our earlier reports, we have modeled the gasification process by stream method. In all of the previous reports we assumed that

the coal bed consists of 100% carbon. In this simulator, it is assumed that the coal may consist of ash and tar and may produce gases (CO2, CO, H2O, and CH4) as a result of pyrolysis. The numerical simulator was written in FORTRAN IV. The mathematical formulation consists of thirteen equations containing thirteen unknown variables. The equations were divided into three different groups. The equations in each group were solved simultaneously. This program is the result of several other programs written in the early stages of this investigation. All the programs written earlier were rejected because of the development of instability at the last node of the coal bed. This was very dominating in the energy balance equation. To avoid this, two solution approaches for the energy equation were used, one by back substitution, the other by direct solving of the energy equation, once the pressure of the system is determined. DOE

N81-29267# Arizona State Univ., Tempe. Coll. of Engineering and Applied Sciences.
CONVERSION OF WOOD RESIDUES TO DIESEL FUEL
James L. Kuester 1981 19 p refs Presented at the 4th Ann. Wood Energy Program and Contractor Rev. Meeting, Washington, D.C., 9-12 Feb. 1981
(Contract DE-AS02-76CS-40202)
(COO-2982-67; CONF-810237-1) Avail: NTIS HC A02/MF A01

The general scheme for the conversion of wood residues to diesel fuel is presented. The basic approach is indirect liquefaction, i.e., thermal gasification followed by catalytic liquefaction. This approach results in separation of the oxygen in the biomass feedstock, i.e., oxygenated compounds do not appear in the liquid hydrocarbon fuel product. The process is capable of accepting a wide variety of feedstocks. Potential products include medium quality gas, normal propanol, paraffinic fuel, and/or high quality octane gasoline. A flow diagram of the continuous laboratory unit is presented. DOE

N81-29278# Bentz (Edward J.) and Associates, Inc., Springfield, Va.
FACTORS THAT AFFECT THE US MARKET DEMAND AND UTILIZATION OF METHANOL FROM COAL WITHIN THE TRANSPORTATION SECTOR, 1980 - 2000
Edward J. Bentz, Eliahu Salmon, Albert Fry, and Michael Stone Oct. 1980 336 p refs Sponsored by National Alcohol Fuels Commission
(PB81-156457; NAFC-80-13) Avail: NTIS HC A15/MF A01 CSCL 05G

This report is intended solely as an identification and description of selected factors that affect the market for coal methanol in the transportation sector in the period 1980 to 2000. Specific issues and objectives of the report include: (1) potential U.S. market demand, and utilization of methanol from coal within the transportation sector 1980 to 2000; (2) potential impacts of coal methanol fuel technologies; (3) identification and description of key regulatory concerns in the development, usage, and commercialization of coal methanol fuels; and impacts of transportation of coal methanol facilities, and on the utilization and cost of coal methanol fuel. GRA

N81-29279# ICF, Inc., Washington, D. C.
METHANOL FROM COAL: PROSPECTS AND PERFORMANCE AS A FUEL AND AS A FEEDSTOCK
Dec. 1980 204 p
(PB81-169237; NAFC-80-23) Avail: NTIS HC A10/MF A01 CSCL 07A

Methanol from coal was compared with other coal-based synthetic liquids as fuels for automobiles and electric utilities. In addition, methanol from coal is considered as a substitute for the methanol from natural gas now used by the petrochemical industry. The plantgate product cost estimates used throughout the report are presented and explained. Energy uses considered include: Automobile fuels, fuels for electric utilities, and petrochemical feedstocks. GRA

N81-29412# Battelle Pacific Northwest Labs., Richland, Wash.
WIND MEASUREMENT SYSTEMS AND WIND TUNNEL EVALUATION OF SELECTED INSTRUMENTS
J. V. Ramsdell May 1981 79 p ref
(Contract DE-AC06-76RL-01830)
(PNL-3435) Avail: NTIS HC A05/MF A01

Wind tunnel tests of seven relatively inexpensive wind measurement systems were conducted to evaluate the accuracy and reliability of instruments for use in small wind energy conversion system siting studies. Documentation consists of graphs and tables relating system and system component performance to wind speed. Instrument system performance under ideal conditions is described; tests in the atmosphere are required to evaluate performance under realistic conditions. DOE

N81-29452# Galaxy, Inc., Washington, D.C.
STATE-OF-THE-ART OF EUROPEAN R AND D ON COAL-BURNING DIESEL ENGINES: A BRIEF SURVEY
Robert Ware Straus and Gottfried VonBismarck Mar. 1981 56 p
(Contract DE-AC03-79SF-10538)
(DOE/SF-10538/T7) Avail: NTIS HC A04/MF A01

European R and C managers, officials and senior exports with experience in the area of coal-based fuels for diesel engines were interviewed as to the state of the art of coal-burning diesels with specific emphasis on the coal-dust engine, about which highly controversial information had recently been published in Germany. This brief survey allows the following conclusions: activities on coal-burning diesel are reported for Germany, Denmark and Switzerland; in the UK relevant work has recently been stopped. Experts and officials are generally extremely skeptical about the technical data and substance of the widely publicized claims of the BLR. The coal-dust engine appears as fundamentally technically feasible, especially in the area of stationary and low speed applications, but hardly economical. Significant development work is necessary for high speed engines suitable for vehicles. The current development programs indicate coal-oil slurries and other forms of coal suspensions (especially if made from processed, i.e., ash-free coal) may be a promising fuel for diesel engines, in addition to liquid fuels from coal conversion. DOE

N81-29477# National Bureau of Standards, Washington, D.C. Corrosion and Electrodeposition Group.
THE USE OF THE SLOW STRAIN RATE TECHNIQUE FOR THE EVALUATION OF STRUCTURAL MATERIALS FOR APPLICATION IN HIGH TEMPERATURE GASEOUS ENVIRONMENTS Final Report
C. E. Johnson and G. M. Ugiansky Jan. 1981 93 p refs
(Contract EA-77-A-01-6010)
(PB81-179152; NBSIR-81-2191) Avail: NTIS HC A05/MF A01 CSCL 11F

The slow strain rate technique, an accelerated test for determining the performance of structural materials in simulated coal gasification environments was evaluated. Seven alloys, Types 309, 310, 310S, 347 and 446 stainless steels; Incoloy 800; and Inconel 671, were tested at temperatures from 370 to 1040 C at strain rates rom 0.0001 to 10 the minus 7 powers in H2S plus water, gaseous mixtures of CO, CO2, CH2, CH4, H2S, and H2O, and H2O, and in nominally inert environments of He and Ar. It is concluded that the slow strain rate technique is an effective method for evaluating the performance of structural materials in the evaluated temperature gaseous environments. GRA

N81-29514# Dynatech R/D Co., Cambridge, Mass.
ASSESSMENT OF SECONDARY CROP RESIDUES Final Report
E. Ashare, A. P. Leuschner, C. E. West, and B. Langton Mar. 1981 295 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-98175-2) Avail: NTIS HC A13/MF A01

The feasibility of converting secondary agricultural residues to energy in the form of either methane gas or ethyl alcohol is assessed. Secondary agricultural residues are defined as those residues resulting from biomass processing to produce primary products; e.g., whey from cheese processing; vegetable processing wastes; residues from paper pulping; etc. The industries for which data was compiled include vegetable, fruit, seafood, meat, poultry, and dairy processing and the pulp, paper, and paperboard industry. The data collected include raw product input, final processed product output, residue types, and quantity, residue concentration, biodegradability, seasonality of production, and geographic distribution of processing facilities. DOE

N81-29515# Bechtel Corp., San Francisco, Calif.
WESTERN SUBBITUMINOUS COALS AND LIGNITES Final Report

J. D. Ruby and H. Huettenhain Apr. 1981 202 p refs
(EPRI Proj 1030-1.1)
(EPRI-CS-1768) Avail: NTIS HC A10/MF A01

Reserves, production trends, and characteristics of low rank coals are described. Possible methods for upgrading, including selective mining, cleaning, drying, agglomeration, and ash modification, are discussed. Currently available technology and research and development requirements for upgrading are identified. Information gaps, particularly in the areas of characterization, washability data, and upgrading methods are identified. Upgrading of these coals by physical cleaning is possible and can result in transportation benefits, uniformity of quality, an increase in recoverable reserves through nonselective mining, and probable improvement in ash-fouling characteristics. Improvement in the characteristics of these coals through drying and ash modification by sodium reduction is discussed. DOE

N81-29553# Battelle Pacific Northwest Labs., Richland, Wash.
BENCH-SCALE RESEARCH IN BIOMASS LIQUEFACTION IN SUPPORT OF THE ALBANY, OREGON EXPERIMENTAL FACILITY
Douglas C. Elliott Mar. 1981 30 p Presented at the 12th Thermochem. Conversion Contractors' Meeting, Washington, D.C., 18-19 Mar. 1981
(Contract DE-AC06-76RL-01830)
(PNL-SA-9430; CONF-810360-2) Avail: NTIS HC A03/MF A01

The liquefaction of solid materials (wood, newsprint, animal manure) by beating to produce useful liquid fuels was investigated. Highlights of work performed include: (1) catalyst mechanism studies; (2) analytical reports on TR8 and TR9 product oils; (3) liquid chromatography/mass spectroscopy analysis of wood oil; (4) batch conversion tests on bottom material; (5) vapor pressure studies; and (6) product evaluation. It was confirmed that the key process parameters and the effects of varying operating conditions are in support of biomass liquefaction. DOE

N81-29556# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
SENSITIVITY OF GEOTHERMAL RESERVOIR BEHAVIOR TO RELATIVE PERMEABILITY PARAMETERS
G. S. Bodvarsson, M. J. OSullivan, and C. F. Tsang Dec. 1980 16 p refs Presented at the 6th Workshop on Geothermal Reservoir Eng., Stanford, Calif., 16-18 Dec. 1980
(Contract W-7405-eng-48)
(LBL-12040; CONF-801233-8) Avail: NTIS HC A02/MF A01

Three problems in geothermal reservoir behavior are considered: (1) the sensitivity of the total kinematic viscosity, v sub t, and the flowing enthalpy, h sub f, to variations in the relative permeability functions; (2) the determination of v sub t and h sub f from well test data, following which a method is suggested to use these results together with theoretical plots of the relative permeability functions versus h sub f to deduce the general shape of the relative permeability functions; and (3) the effect of the relative permeability functions on the pressure decline and flowing enthalpy build up during a constant rate production test. It is concluded that the liquid cutoffs are the most important characteristics; relative permeability parameters are determined from field data; and the rise in flowing enthalpy gives information on relative permeability curves. DOE

N81-29558# California Univ., Berkeley. Lawrence Berkeley Lab.
MARINE KELP: ENERGY RESOURCE IN THE COASTAL ZONE
Ronald L. Ritschard and Kendall F. Haven Nov. 1980 25 p refs Presented at the 2nd Symp. on Coastal and Ocean Management, Miami, Fla., 17-20 Nov. 1980
(Contract W-7405-eng-48)
(LBL-12224; CONF-801193-1) Avail: NTIS HC A02/MF A01

The relationship on the marine biomass concept and coastal zone management plans is discussed. An ocean farm system is described. The analysis of the ocean farm system includes a decription of the types of impacts that might occur if large scale operations become available, such as the production of environmental residuals, conflicts with the fishing and shipping industries and other legal/institutional impacts. DOE

N81-29575# Systems Technology Corp., Xenia, Ohio.
EVALUATION OF MIXING SYSTEMS FOR BIOGASIFICATION OF MUNICIPAL SOLID WASTE
Jun. 1981 85 p
(Contract DE-AC05-76CS-20100)
(DOE/CE-20100/1) Avail: NTIS HC A05/MF A01

Two mixing systems were tested for the efficiencies prevention of the formation of fibrous mats and stringers during the anaerobic digestion of a slurried mixture of preprocessed municipal solid waste and sewage sludge in the production of methane gas. The first system was a mechanical agitation, a vessel centered rotary shaft with four blades at each of two levels to drive the slurry downward. The second system included three equidistantly placed gas gun assemblies that each produced bubbles at a constant rate to draw the slurry upward. The microbial culture was healthy in most tests, however, the mixing systems were not effective in preventing excessive fibrous mat and stringer formations. The energy recovered was only 50% of the energy available in the solid waste, and only four times greater than the mixing energy expended for that test. The solids accumulations were generally the same for the two mixing systems when they had common test conditions. In all tests, the percent solids for the top level were higher than those for the middle and bottom levels. DOE

N81-29669# Pacific Northwest Lab., Richland, Wash.
TREATMENT OF BIOMASS-GASIFICATION WASTEWATER
J. V. Maxham Mar. 1981 43 p refs Presented at 12th Biomass Thermochem. Conversion Contractors Meeting, Washington, D.C. 18 Mar. 1981
(Contract DE-AC06-76RL-01830)
(PNL-SA-9388; CONF-810360-3) Avail: NTIS HC A03/MF A01

During conversion, wastewaters are generated that will require treatment prior to reuse in the production process or discharge to the environment. Development of cost-effective wastewater treatment technologies is necessary at the pilot plant stage of production technolgy development. The technical feasibility and cost effectiveness of several promising process technologies for the treatment of biomass gasification wastewater (BGW) were assessed by conducting bench-scale treatability studies. In addition to conventional treatment process options, process technologies were investigated that promise to dramatically reduce treatment time, cost energy consumption, and/or sludge production while preserving the simplicity of operation and mechanical reliability of conventional treatment process options. DOE

N81-29702# Sandia Labs., Albuquerque, N. Mex.
DRILLING, INSTRUMENTATION AND SAMPLING CONSIDERATION FOR GEOSCIENCE STUDIES OF MAGMA-HYDROTHERMAL REGIMES
Richard K. Traeger, Samuel G. Varnado, Anthony F. Veneruso, Vance L. Behr, and Alfonso Ortega May 1981 52 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0800) Avail: NTIS HC A04/MF A01

Drilling, diagnostic, and sampling technologies were reviewed. A strawman drill hole is used for identifying scientific and technological limitations. DOE

N81-29703# IEA Coal Research, London (England).
GEOPHYSICAL EXAMINATION OF COAL DEPOSITS
L. J. Jackson Apr. 1981 116 p refs
(ICTIS/TR-13) Avail: NTIS (US Sales Only) HC A06/MF A01; DOE Depository Libraries

Geophysical techniques for the solution of mining problems and as an aid to mine planning are reviewed. Techniques of geophysical borehole logging are discussed. The responses of the coal seams to logging tools are easily recognized on the logging records. Cores for laboratory analysis are cut from selected sections of the borehole. In addition, information about the density and chemical composition of the coal may be obtained. Surface seismic reflection surveys using two dimensional arrays of seismic sources and detectors detect faults with throws as small as 3 m depths of 800 m. In geologically disturbed areas, good results have been obtained from three dimensional surveys. Smaller faults as far as 500 m in advance of the working face may be detected using in seam seismic surveying conducted from a roadway or working face. Small disturbances are detected by pulse radar and continuous wave electromagnetic methods either

from within boreholes or from underground. Other geophysical techniques which explicit the electrical, magnetic, gravitational, and geothermal properties of rocks are described. DOE

N81-29712# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
REVIEW OF REMOTE-SENSOR POTENTIAL FOR WIND-ENERGY STUDIES
William H. Hooke Mar. 1981 182 p refs
(Contract DE-AI06-79ET-23151)
(DOE/ET-23151/80/1) Avail: NTIS HC A09/MF A01

Systems such as radars, lidars, and acoustic echo sounders are potential alternatives to the cup - and propeller anemometers routinely used in wind energy siting. These systems can be used most effectively in the lattermost stages of the siting process - the site development phase, necessary only for the siting of large wind-energy conversion systems (WFCS) of WECS clusters. For this particular application four techniques appear to be operational. They are, in rough order of increasing expense and operating demands: optical transverse wind sensors; acoustic Doppler sounders; time-of-flight and continuous wave (CW) Doppler lidar; and frequency-modulated, continuous wave (FM-CW) Doppler radar. DOE

N81-29713# Battelle Pacific Northwest Labs., Richland, Wash.
CANDIDATE WIND TURBINE GENERATOR SITE Annual Data Summary, Jan. - Dec. 1980
W. F. Sandusky and D. S. Renne Apr. 1981 126 p
(Contract DE-AC06-76RL-01830)
(PNL-3739) Avail: NTIS HC A07/MF A01

Summarized hourly meteorological data for fourteen candidate and wind turbine generator sites are presented. These data are collected for the Department of Energy for the purpose of evaluating the wind energy potential at these sites and are used to assist in selection of potential sites for installation and testing of large wind turbines in electric utility systems. For each site, data are given in eight tables and one figure. Use of information from these tables, with information about specific wind turbines, should allow the user to estimate the potential for wind energy production at each site. DOE

N81-29929# Battelle Pacific Northwest Labs., Richland, Wash. Dept. of Physical Sciences.
ACCURATE MASS/METASTABLE ION ANALYSIS OF HIGHER-MOLECULAR-WEIGHT NITROGEN COMPOUNDS IN COAL LIQUIDS
B. W. Wilson, Anthony P. Toste, Richard A. Pelroy, Barbara Vieux, and David Wood Mar. 1981 21 p refs Presented at the 20th Ann. Hanford Life Symp., Richland, Wash., 19 Oct. 1980
(Contract DE-AC06-76RL-01830)
(PNL-SA-8852; CONF-801039-7) Avail: NTIS HC A02/MF A01

Mutagenically active subfractions from heavy-end SRC-II coal distillate were analyzed by high resolution mass spectrometry. Molecular ion species, having the proper elemental compositions for putative primary aromatic amines thought to be the active constituents in these fractions were then subjected to metastable ion energy analysis. Features of the ion energy spectra thus obtained were compared to those of authentic standards for nitrogen-containing compounds including alkylated and non-alkylated aza arenes, carbazoles and primary aromatic amines. A compound identified amino benzpyrene was found to be a major constituent of the subfraction with the highest mutagenic activity, and absent in those with little or no genetic response. DOE

N81-30103# Federal Aviation Administration, Atlantic City, N.J.
AIRCRAFT RESEARCH AND TECHNOLOGY FOR ANTIMISTING KEROSENE CONFERENCE
Jun. 1981 260 p Proceedings held at Atlantic City, N.J. 18-19 Feb., 1981
(AD-A101347; FAA-CT-81-181) Avail: NTIS HC A12/MF A01 CSCL 01/2

Contents: Antimisting Fuel Engineering and Development Program; Wing Spillage Test, Flammability Comparison Test Apparatus, Large-Scale Aircraft Crash Test of Antimisting Fuel, The Use of Antimisting Kerosene in Turbofan Jet Engines, The Development of ICI'S FM-9 Antimisting Aviation Fuel, Cryogenic Blending Polymer Additives in Fuel, Economic Aspects of Conversion to Antimisting Fuels, UK Programme on Safety Fuels, Fundamental Studies of Antimisting Fuels, Degradation and Characterization of Antimisting Kerosene, Antimisting Fuel Test Correlation Analysis, and KS/DC-10 Fuel System Simulator. GRA

N81-30234# Los Alamos Scientific Lab., N. Mex.
LASER-INDUCED BREAKDOWN SPECTROSCOPY: DETECTING DOSIUM AND POTASSIUM IN COAL GASIFIERS
T. R. Loree and L. J. Radziemski 1981 30 p refs Presented at the Symp. on Instr. and Control for Fossil Energy Processes, San Francisco, 8 Jun. 1981
(Contract W-7405-eng-36)
(LA-UR-81-1526; CONF-810607-2) Avail: NTIS HC A03/MF A01

A real-time monitor of trace quantities of elements present in hostile environments such as coal gasifier process streams is developed. With laser-induced breakdown spectroscopy, the ability to probe a real process stream and achieve appropriate levels of detectability for sodium and potassium with real-time response is demonstrated. DOE

N81-30254# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
STRESS-CORROSION CRACKING STUDIES IN COAL-LIQUEFACTION SYSTEMS
V. B. Baylor and I. R. Kaiser 1981 34 p refs Presented at the Intern. Corrosion Forum, Toronto, Ontario, 6-10 Apr. 1981; sponsored by the National Association of Corrosion Engineers
(Contract W-7405-eng-26)
(CONF-810402-9) Avail: NTIS HC A03/MF A01

Coal liquefaction plants with 6000 ton/d capacity are currently being planned as a step toward commercial production of synthetic fossil fuels. These plants demonstrate the large scale viability of the solvent refined coal (SRC) process, which was used since 1974 in two operating pilot plants: a 50 ton/d unit at Fort Lewis, Washington, and a 6 ton/d plant in Wilsonville, Alabama. Experience in these plants has shown that austenitic stainless steels are susceptible to stress corrosion cracking associated with residual stresses from cold working or welding. The corrodants responsible for the cracking are not yet positively identified but are suspected to include polythionic acids and chlorides. In order to screen candidate materials of construction for resistance to stress corrosion cracking, racks of stressed U-bend specimens in welded and as-wrought conditions were exposed at the Wilsonville and Fort Lewis SRC pilot plants. DOE

N81-30284# Massachusetts Inst. of Tech., Oak Ridge, Tenn. School of Chemical Engineering Practice.
HYDRODYNAMICS OF COAL-LIQUEFACTION DISSOLVER CONFIGURATIONS
C. F. Irwin, A. J. Sincali, and E. W. Wong Jun. 1981 72 p refs
(Contract W-7405-eng-26)
(ORNL/MIT-326) Avail: NTIS HC A04/MF A01

The hydrodynamics of two proposed dissolver configurations for the 63.6 kg/s (6000 tpd) SRC-I demonstration plant were examined. Correlations were used to predict the flow patterns, holdups, pressure drops, bubble size distribution, and axial mixing in the dissolvers and piping. Calculations on the performance of dissolver internals revealed slug flow and related pressure fluctuations may present serious control problems. The dissolver internals will be subject to extreme erosion by solids. Hydrogen mass transfer in the bubbly flow regime, expected in the dissolver, is not rate limiting. Liquid axial mixing is significant and will affect the conversion and selectivity. It is recommended that the pressure fluctuations be estimated by dynamic modeling, that the internals be redesigned to reduce the potential for erosion and coking, that the validity of the assumptions be evaluated at system temperature and pressure, and that experimental programs be initiated to correlate flow patterns, gas holdups, and axial dispersion in large diameter pipes and columns with high gas densities and in the presence of solids. DOE

N81-30285# Decision Analysis Corp., Annandale, Va.
ANALYSIS OF ALTERNATIVE-FUEL PRICE TRAJECTORIES
31 Dec. 1980 84 p refs
(Contract DE-AC01-80RG-10446)
(DOE/RG-10446/T1) Avail: NTIS HC A05/MF A01

Findings are presented from a study to acquire, analyze,

and report alternative published price projections including both oil and coal price trajectories. Comparisons of key assumptions underlying the price projections are reported and the applicability of the fixed annuity formula as used in the alternative cost calculation is demonstrated. Graphic presentations of all updated coal and oil price forecasts are included. DOE

N81-30286# Sandia Labs., Albuquerque, N. Mex.
PROCESS FOR EXTRACTING USEFUL, PRIMARILY COMBUSTIBLE GASES, BY IN-SITU GASIFICATION OF UNDERGROUND FOSSIL-FUEL BEDS
P. Ljuengstroem Feb. 1981 7 p Transl. into ENGLISH of Swedish Patent no. 130,291 (Appl. no. 8536/1946, 30 Sep. 1946)
(SAND-81-6003) Avail: NTIS HC A02/MF A01

A process is described for overcoming shortcomings, so that the calorie content of the fuel beds can be recovered in a work-saving and economically favorable manner, even if the fuel-bearing beds lie deep under the surface or are not very thick. A smaller portion of the fuel bed is heated electrically and thus brought into a gas-permeable state, whereupon this portion is used to introduce oxygen (air) through the fuel bed, as well as to remove the gases generated by burning the remaining portion of the fuel bed. The process according to the invention is carried out by drilling a group of holes down from the ground surface and inserting electric heating elements in some of them. They feed electrical energy into the fuel bed and induce heating, which creates an advancing front of porous fuel mass. Oxygen (air) is then introduced through one or more of the holes in the group so that the surrounding zones of the fuel bed are made to burn and the combustible gases generated are removed through one of more of the other holes in the group. DOE

N81-30293# Oak Ridge National Lab., Tenn.
OVERVIEW OF COAL CONVERSION
Bruce R. Clark 27 Mar. 1981 25 p Presented at the 70th Two Year College Chemistry Conf., Atlanta, 27 Mar. 1981
(Contract W-7405-eng-26)
(CONF-810362-1) Avail: NTIS HC A02/MF A01

The structure of coal and the processes of coal gasification and coal liquefaction are reviewed. Coal conversion technology is examined as a possible vehicle in providing a significant amount of synthetic fuel within the next few years. Particular emphasis is given to the efforts of both government and private sectors in the development of this technology to hedge against ever diminishing petroleum supplies, especially from foreign sources. The reactions of coal products, and the physics and chemistry involved in the various stages of coal conversion processes are also considered. DOE

N81-30294# Midwest Research Inst., Golden, Colo.
DEMONSTRATION OF DISSOCIATED METHANOL AS AN AUTOMOTIVE FUEL: SYSTEM PERFORMANCE
J. G. Finegold, M. E. Karpuk, J. T. McKinnon, and R. Passamaneck Apr. 1981 5 p refs Presented at Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC02-77CH-00178)
(SERI/TP-731-1178; CONF-810509-26) Avail: NTIS HC A02/MF A01

Testing of a system for providing hydrogen rich gases to an internal combustion engine is described. The endothermic dissociation of methanol on board the vehicle is described. The dissociation of methanol absorbs heat from the engine exhaust and increases the lower heating value of the fuel by 22%. The engine thermal efficiency is increased by raising the compression ratio and burning with excess air. Higher vehicle efficiency than that of cars burning pure alcohol or alcohol blends is obtained. DOE

N81-30296# Oak Ridge National Lab., Tenn. Fossil Energy Program Office.
PYROLYSIS AND PHYSICAL PROPERTIES OF COAL BLOCKS
P. R. Westmoreland, R. C. Forrester, and J. B. Gibson Jun. 1981 186 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7313) Avail: NTIS HC A09/MF A01

Interactions between the various physical properties of coal and its pyrolysis were characterized by studying the heating of 150-mm-diameter cylindrical blocks of Wilcox lignite, Wyodak subbituminous coal, Hanna bituminous coal, and Pittsburgh bituminous coal. In the various coals, block pyrolysis caused gasification and cracking reactions and changes in char reactivity and in swelling, none of which is observed in powder pyrolysis. These changes were interpreted as having resulted from internal temperature gradients and flow patterns. To aid in an evaluation of this interpretation, physical and transport properties of coals were reviewed, measured, and correlated. Data on thermal diffusivity and conductivity of lignite were of particular interest. DOE

N81-30299# Engineering Societies Commission on Energy, Inc., Washington, D. C.
SYNETHETIC FUELS SUMMARY
Mar. 1981 64 p refs
(Contract DE-AC01-77ET-10679)
(DOE/ET-10679/T10; FE-2468-82-A) Avail: NTIS HC A04/MF A01

The Federal government's experience in synfuels, the market potential of synfuels, the US energy resources base, and the numerous technologies available are examined. Technologies and energy resources are reviewed and compared to provide the facts needed to understand existing energy-related problems. An overview of synfuel technologies and markets is given. DOE

N81-30300# Institute of Gas Technology, Chicago, Ill.
UPGRADING HIGH-NITROGEN NATURAL GAS BY SELECTIVE MEMBRANE PERMEATION
C. D. Landahl and D. L. Klass 1981 11 p refs Presented at the 90th AICHE National Meeting, Houston, Tex., 5-9 Apr. 1981 Sponsored in part by InterNorth, Inc., Omaha
(CONF-810417-7) Avail: NTIS HC A02/MF A01

The technical feasibility of membrane separation was examined for high nitrogen natural gas. An extensive screening of commercial and developmental membranes revealed only a few that are selective for nitrogen. Polyacrylonitrile (PAN) exhibited the highest nitrogen methane separation factors of the membranes tested. However, the permeation rates for PAN are too low for a practical separation system. Evaluation of membranes of PAN with vinyl and other polymers indicated that permeation rates could be increased while still maintaining separation efficiency of PAN in bilayer membranes. The experimental methods and results of this work and the potential value of the composite PAN membrane system are discussed. DOE

N81-30302# Argonne National Lab., Ill.
CHEMICAL AND BIOLOGICAL CHARACTERIZATION OF HIGH-BTU COAL GASIFICATION. THE HYGAS PROCESS, 1
V. C. Stamoudis, S. Bourne, D. A. Haugen, M. J. Peak, C. A. Reilly, J. R. Stetter, and K. Wilzbach 1980 39 p refs Presented at the 20th Hanford Life Sci. Symp. 'Coal Conversion and the Environment: Chem., Biomed., and Ecol. Considerations, Richland, Wash., 19-23 Oct. 1980
(Contract W-7405-eng-38)
(CONF-801039-12) Avail: NTIS HC A03/MF A01

The relationships between mutagenic activity and chemical composition for fractions prepared from process stream materials obtained from a high-Btu coal gasification pilot plant in which the HYGAS process is employed were examined. Fractionation procedures included fractional distillation; extraction of acidic, basic, and neutral components; liquid/liquid partitioning; and column chromatography on silica gel. A large number of organic compounds in the fractions have been identified by fused silica, capillary column gas chromatography, and gas chromatography/mass spectrometry (GC/MS). Some fractions contain components that are mutagenic as indicated by the Ames salmonella/microsome mutagenicity assay. Fractionation and GC/MS analysis indicate that the mutagenic components are relatively nonvolatile and that they may include neutral polycyclic aromatic hydrocarbons (PAHs) as well as more polar components such as primary aromatic amines, azaarenes, and hydroxy-PAHs. It is tentatively concluded that the health and environmental risks due to commercialization of the HYGAS would be relatively low. DOE

N81-30303# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
UPGRADING OF COAL-HYDROCARBONIZATION LIQUIDS
Hubert G. Davis, John Potter, and Lou Batta Mar. 1981 20 p refs Presented at the Conf. on Coal Pyrolysis, Palo Alto, Calif., 25-26 Feb. 1981; sponsored by Electric Power Research Inst.
(Contract W-7405-eng-48)

(LBL-12463; CONF-810252-1) Avail: NTIS HC A02/MF A01

In the mid-sixties, Union Carbide seriously considered building a 5000 ton/day plant to hydrocarbonize Wyoming subbituminous coal. The objective was the production of phenol and cresylic acids, with fuel byproducts. The work on upgrading the crude products is discussed briefly in the light of the earlier interest in chemical products and the current interest in synfuels. The original attraction of the process as applied to low rank coal was the substantial yield of phenols. Today it might be the volatile nature of the liquid product. This offers the possibility of converting a high proportion of the crude product to gasoline. DOE

N81-30304# Mound Lab., Miamisburg, Ohio.
INSTRUMENTATION FOR REAL-TIME DATA ANALYSIS AND CONTROL OF SYNTHETIC-FUEL TECHNOLOGIES
R. E. Zielinski, M. K. Agarwal, and P. W. Seabaugh 1981 15 p refs Presented at the Symp. on Instrumentation and Control for Fossil Energy Processes, San Francisco, 8 Jun. 1981
(Contract DE-AC04-76DP-00053)
(MLM-2838(OP); CONF-810607-5) Avail: NTIS HC A02/MF A01

Instrumentation and a sample handling system designed for real-time analysis and control of Underground Coal Gasification Field Test in a 900 foot deep, seven foot thick coal seam worked well in capturing all the data to accurately analyze the process and adequately identify necessary process changes. This instrumentation can be modified for application to other coal conversion processes and can also be modified to ensure automatic control for process optimization. DOE

N81-30306# Ames Lab., Iowa.
CORN COB GASIFICATION AND DIESEL ELECTRIC GENERATION
J. J. OToole, T. E. Wessels, B. C. English (Iowa State Univ., Ames), and R. J. Blobaum (Blobaum (Roger) and Associates, Des Moines) 1981 10 p refs Presented at the 8th Energy Technol. Conf., Washingon, D.C., 9-11 Mar. 1981
(Contract W-7405-eng-82)
(IS-M-323; CONF-810315-12a) Avail: NTIS HC A02/MF A01

A program designed to evaluate the collection and transportation costs of corn cobs for the fueling of downdraft gasifiers in the production of low Btu gas is described. The major use of this gas is to fuel diesel/electric generating systems in the many municipalities which can be retrofitted for this purpose. DOE

N81-30307# Argonne National Lab., Ill. Chemical Engineering Div.
STUDY OF INSTRUMENTATION NEEDS FOR PROCESS CONTROL AND SAFETY IN COAL FLUIDIZED-BED COMBUSTION SYSTEMS
C. L. Herzenberg, K. E. Griggs (Fluor Power Services, Chicago), R. F. Henry, and W. F. Podolski Feb. 1981 183 p refs
(Contract W-31-109-eng-38)
(ANL/CEN/FE-80-15) Avail: NTIS HC A09/MF A01

A study was conducted to evaluate the current state of the art of instrumentation for planned and operating fluidized bed combustion systems. This study is intended to identify instrumentation needs and serve as a data base for projects to develop this instrumentation. A considerable number of needs for measurements for which presently available instrumentation is not suitable were reported by respondents. The identified deficiencies are presented with the associated physical parameter ranges for FBC processes. Techniques and instrumentation under development, as well as some available alternative instruments, are discussed briefly. Mechanisms for technical information exchange on instrumentation for fossil energy applications are identified. Development of instruments to meet the identified measurement deficiencies is recommended in order to ensure the feasibility of automatic control of large scale fluidized bed combustion systems and to advance the state of the art of fluidized bed combustion technology. DOE

N81-30310# Argonne National Lab., Ill.
COAL-BASED INDUSTRIAL-FUELS ASSESSMENT
R. S. Bennett, H. J. Takach, W. H. Seward, R. S. Opalanko, and K. E. Wilzbach 1980 16 p refs Presented at the Ann. Meeting of the Air Pollution Control Assoc., Montreal, 22-27 Jun. 1980
(Contract W-31-109-eng-38)
(CONF-800608-6) Avail: NTIS HC A02/MF A01

The results of a study to identify the economic, environmental, and energy impacts of possible new source performance standards (NSPS) are presented for industrial steam generators on potential use of coal and coal derived fuels in such steam generators. In addition, the same impacts for distillate and residual fuel oils were identified for comparative purposes. This assessment will allow for substantive input to assist in responding to the NSPS that will be proposed by EPA. This program utilized a system level approach where the industrial boiler and its fuel supply were considered from the standpoint of a potential industrial user. DOE

N81-30311# Cornell Univ., Ithaca, N. Y. Dept. of Agricultural Economics.
ETHANOL PRODUCTION IN SOUTHWESTERN NEW YORK: TECHNICAL AND ECONOMIC FEASIBILITY Final Report
Robert J. Kalter Jan. 1981 313 p refs Sponsored by New York State Energy Research and Development Authority
(PB81-188914; NYSERDA-81-3) Avail: NTIS HC A14/MF A01 CSCL 21D

The development of one or more centralized ethanol conversion facilities in the southwestern portion of New York State is discussed. Likely to be commercially feasible if either locally produced cheese whey and/or imported corn are used as a feedstock, development is shown to be highly profitable under a broad range of economic conditions and technical considerations. Four plant designs ranging in annual production capacity from 1.675 to 27.5 million gallons of ethanol (utilizing alternative feedstocks) are investigated. Maximum profitability per unit production are obtained from a 2.5 million gallon plant using only whey. GRA

N81-30404# Air Products and Chemicals, Inc., Allentown, Pa.
GAS/SLURRY FLOW IN COAL-LIQUEFACTION PROCESSES (FLUID DYNAMICS IN 3 PHASE FLOW COLUMNS) Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1980
David H. S. Ying, R. Sivasubramanian, and Edwin N. Givens Dec. 1980 52 p refs
(Contract DE-AC01-79ET-14801)
(DOE/FT-14801/12) Avail. NTIS HC A04/MF A01

The 6000 T/D SRC-I demonstration plant will employ vertical tubular reactors feeding slurry and gas concurrently upward. This reactor is essentially an empty vessel with only a distributor plate located near the inlet. Because the commercial plant represents a considerable scale-up over either Wilsonville or Ft. Lewis, this program is addressing the need for additional data on the behavior of three phase systems in large vessels. Parameters are being studied at conditions that relate directly to the projected demonstration plant operating conditions. Air/water/sand three phase flow system in both a 5-inch diameter and a 12-inch diameter column is used in this cold-flow simulation study program. DOE

N81-30450# General Electric Co., St. Petersburg, Fla.
PERFORMANCE OF AIR-COOLED POWER PLANTS USING GAS FROM COAL Final Report
S. D. Shemo May 1981 154 p refs Sponsored by EPRI
(EPRI Proj. 986-3)
(EPRI-AP-1844) Avail: NTIS HC A08/MF A01

The thermal performance and water use of various power plants using coal gasification systems integrated with combustion turbines and under minimum water use conditions are determined. The gasifiers considered are the oxygen blown gasifier, the oxygen blown slagging gasifier, and air blown gasifiers. These gasifiers are each integrated with simple combustion turbine cycles, regenerative combustion turbine cycles and combined cycles. The performance of these dry cooled integrated plants is compard to that of wet cooled integrated gasification combined cycle systems and conventional coal fired plants. DOE

N81-30497*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SAFETY EVALUATION METHODOLOGY FOR ADVANCED COAL EXTRACTION SYSTEMS
Wayne F. Zimmerman 15 Jul. 1981 107 p refs
(Contracts NAS7-100; DE-AI01-76ET-12548)
(NASA-CR-164703; JPL-Pub-81-54) Avail: NTIS HC A06/MF A01 CSCL 08I

Qualitative and quantitative evaluation methods for coal extraction systems were developed. The analysis examines the soundness of the design, whether or not the major hazards have been eliminated or reduced, and how the reduction would be accomplished. The quantitative methodology establishes the approximate impact of hazards on injury levels. The results are weighted by peculiar geological elements, specialized safety training, peculiar mine environmental aspects, and reductions in labor force. The outcome is compared with injury level requirements based on similar, safer industries to get a measure of the new system's success in reducing injuries. This approach provides a more detailed and comprehensive analysis of hazards and their effects than existing safety analyses. E.A.K.

N81-30500# Georgia Univ., Athens. Dept. of Microbiology.
MICROBIOLOGICAL ASPECTS OF OIL PRODUCTION
W. R. Finnerty 1981 18 p refs
(Contract DE-AS09-80ER-10683)
(DOE/ER-10682/2) Avail: NTIS HC A02/MF A01

Reservoir microbiology is discussed. One oil release technique is an anaerobic fermentation within a reservoir. Biopolymers and polysaccharides have application in EOR. Hydrocolloids and surfactants of microbial origin are listed and their possible application mentioned. An example of the appapplication of bioengineering principles is bacterial desulfurization. DOE

N81-30501# D'Appolonia (E.) Consulting Engineers, Inc., Pittsburgh, Pa.
EVALUATION OF HOT DRY ROCK EXPLORATION TECHNIQUES IN THE ATLANTIC COASTAL PLAIN: A TEST SITE ON THE DELMARVA PENINSULA OF MARYLAND AND VIRGINIA
Apr. 1981 26 p refs
(Contract W-7405-eng-36)
(LA-8800-MS) Avail: NTIS HC A03/MF A01

The findings favor the HDR exploration program that is outlined for locating a deep test hole in an area with presumed HDR potential (higher than normal heat flow). Six potential sites for extracting HDR energy were identified within the Cris-Wall area. Each site is thought to have temperatures at the basement rock surface in excess of 75 C and to be at least 1 km away from the nearest fault. DOE

N81-30502# Rice Univ., Houston, Tex. Dept. of Geology.
METHODS DEVELOPMENT AND APPLICATIONS EVALUATIONS OF NURE AERIAL RECONNAISSANCE SURVEY DATA FOR URANIUM RESOURCE EVALUATION: BEEVILLE/BAY CITY AND CRYSTAL CITY QUADRANGLES, TEXAS Final Report
John A. S. Adams, Sam F. Harrill, and J. E. Oddo Apr. 1981 115 p refs Prepared for Bendix Field Engineering Corp., Grand Junction, Colo.
(Contracts DE-AC08-76NV-01183; DE-AC13-76GJ-01664)
(GJBX-69(81)) Avail: NTIS HC A06/MF A01

The NURE open-file reports on the aerial gamma spectrometric, hydrologic, and stream-sediment surveys of some 50,000 square kilometers of land area in south Texas were studied in regard to their utility in identifying regions of high or higher favorability for uranium deposits. Substantial agreement was found between the NURE aerial data and the ground and helicopter data as regards the general radioelement distributions in the stratigraphic units studied. The vehicle-mounted gamma-ray spectrometer used systematically gave some 30 percent higher thorium concentration estimates when compared with those from the NURE aerial data. The NURE aerial data are adequate in number to characterize the major stratigraphic units, but they may not be quantitative enough for detailed comparisons from one quadrangle to another, and the optimum sampling area for each formation is not known. DOE

N81-30503# New Mexico Inst. of Mining and Technology, Socorro.
DISPLACEMENT OF OIL BY CARBON DIOXIDE Final Report
F. M. Orr, Jr. and J. J. Taber May 1981 167 p refs
(Contract DE-AS21-78ET-12082)
(DOE/ET-12082/9) Avail: NTIS HC A08/MF A01

Factors influencing CO2 flooding are reported. Procedures are given for an experiment in which equilibrium phase compositions can be measured rapidly and continuously. Results of displacements of crude oil from slim tubes, cores and mixing cells are presented and interpreted in terms of detailed measurements of the phase behavior and fluid properties of the CO2 crude oil mixtures. Direct evidence is presented of the efficiency with which a CO2 rich liquid phase can extract hydrocarbons from a crude oil. A simple one dimensional process simulator for CO2 flooding applications is described. Simulation results are compared with experimental data from slim tube displacements. Comparison of displacement results, phase behavior measurements, and model calculations provides strong evidence that the high displacement efficiency which can be obtained when pressure is high enough and viscous fingering is controlled is the result of efficient extraction of a broad range of hydrocarbons by a dense CO2 rich phase which is a liquid if the temperature is below about 50 C (130 F). DOE

N81-30504# Gulf Universities Research Consortium, Bellaire, Tex.
SURVEY OF ACTIVITY IN THE AREA OF INSTRUMENTATION FOR RESERVOIR DESCRIPTION FOR ENHANCED OIL RECOVERY Final Report
May 1981 77 p refs
(Contracts DE-AC01-76ET-10145; EX-76-C-01-2025)
(DOE/ET-10145/64; GURC-173) Avail: NTIS HC A05/MF A01

The state-of-the-art and progress in the types of instrumentation applied to reservoir description are reviewed. Sources of reservoir information are cores, wire line logs and well tests. The new techniques involve geophysics, geochemistry and tracer testing for oil recovery, the instrumentation must be capable to measure smaller scale effects with great accuracy. Computer simulation utilizing geological detail project the behavior of the EOR processes selected for the reservoir. DOE

N81-30505# Los Alamos Scientific Lab., N. Mex.
SEASAT SATELLITE INVESTIGATION OF THE STRUCTURE OF WESTERN NEBRASKA AND ITS APPLICATION TO THE EVALUATION OF GEOTHERMAL RESOURCES
J. Stix 1981 20 p refs Presented at the Intern. Symp. of Remote Sensing of Environ., Ann Arbor, Mich., 11-15 May 1981
(Contract W-7405-eng-36)
(LA-UR-81-1454; CONF-810557-1) Avail: NTIS HC A02/MF A01

Seasat synthetic aperture radar (SAR) satellite imagery was used to interpret the structural framework and the geothermal potential of an area in western Nebraska. Lineaments were mapped from the imagery and then compared to known structure. It was found that Seasat does record surface manifestations of subtle basement structures, particularly faulting. Four areas with geothermal potential were delineated using Seasat and other data. It is concluded that Seasat imagery is a useful reconnaissance exploration tool in the interpretation of regional structure within areas of little topographic relief. DOE

N81-30554*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Chemical and Biological Processes Section.
ADVANCED DEVELOPMENT: FUELS
Kumar Ramohalli *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 257-261 ref Sponsored by DOE
Avail: NTIS HC A13/MF A01 CSCL 10A

The solar thermal fuels and chemicals program at Jet Propulsion Laboratory are described. High technology is developed and applied to displace fossil fuel (oil) use in the production/processing of valuable fuels and chemicals. The technical and economic feasibility is demonstrated to extent that enables the industry to participate and commercialize the product. A representative process, namely Furfural production with a bottoming of acetone, butanol and ethanol, is described. Experimental data from all solar production of furfural is discussed. Estimates are given to show the attractiveness of this process, considering its flexibility to be adaptable to dishes, troughs or central receivers. Peat, lignite and low rank coal processing, heavy oil stripping and innovative technologies for process diagnostics and control are mentioned as examples of current projects under intensive development. S.F.

N81-30605# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
PERFORMANCE MATCHING AND PREDICTION FOR SERRAZZANO GEOTHERMAL RESERVOIR BY MEANS OF

NUMERICAL SIMULATION
K. Pruess, O. Weres, R. Schroeder, R. Marconcini (ENEL, Firenze), and G. Neri (ENEL, Firenze) Oct. 1980 51 p refs Presented at the 2nd, DOE-ENEL Workshop for Cooperative Res. in Geothermal Energy, Berkeley, Calif., 20-24 Oct. 1980
(Contract W-7405-eng-48)
(LBL-12174; CONF-801098-2) Avail: NTIS HC A04/MF A01

The simulator SHAFT79 was applied to field wide distributed parameter simulation of the vapor dominated geothermal reservoir at Serrazzano, Italy. Using a three dimensional geologically accurate mesh and detailed flow rate data from 19 producing wells, a period of 15.5 years was simulated. The reservoir model used is based on field measurements of temperatures and pressures, laboratory data for core samples, and available geological and hydrological information. The main parameters determined during development of the simulation are permeabilities and much of the initial conditions. DOE

N81-30621# National Center for Resource Recovery, Washington, D. C.
WASTE-TO-ENERGY COMPENDIUM Final Report
Apr. 1981 125 p refs Prepared in cooperation with Edgerton, *Germeshausen and Grier, Inc., Idaho Falls, Idaho*
(Contract DE-AC01-76CS-20167)
(DOE/CE-20167/05) Avail: NTIS HC A06/MF A01

A survey is made of 35 waste energy recovery projects throughout the U.S. Included are nine refuse derived fuel (RDF) production facilities, six RDF user facilities, two combined RDF production user facilities, and 18 mass burning facilities with energy recovery. Only those facilities that are fully operational or those in advanced stages of startup and shakedown are surveyed. Information is provided on processing capacities, operation and maintenance problems, equipment specifications, capital and operating costs, and the current status of each facility. In addition, process flow schematic are provided for each of the nine RDF production plants and both RDF production user plants. DOE

N81-30627# Public Technology, Inc., Washington, D. C.
STATUS REPORT ON ENERGY RECOVERY FROM MUNICIPAL SOLID WASTE: TECHNOLOGIES, LESSONS AND ISSUES. INFORMATION BULLETIN OF THE ENERGY TASK FORCE OF THE URBAN CONSORTIUM
1980 62 p refs
(Contract DE-FG02-78IR-05106)
(DOE/IR-05106/T6) Avail: NTIS HC A04/MF A01

Focus is on technologies and issues significant to currently operating energy recovery systems in the US - waterwall incineration, modular incineration, refuse derived fuels systems, landfill gas recovery systems. Some basic conclusions are presented concerning the state of the art of energy from waste. Plants in shakedown or under construction, along with technologies in the development stages, are briefly described. Sources of additional information and a bibliography are included. DOE

N81-30644# California Univ., Livermore. Lawrence Livermore Lab.
GEOTHERMAL INJECTION MONITORING PROJECT
L. Younker, P. Kasameyer, A. Smith, E. Didwall, J. Hanson, D. Helm, W. Murray, and J. Hearst Apr. 1981 52 p refs
(Contract W-7405-eng-48)
(UCID-19066) Avail: NTIS HC A04/MF A01

Background information is provided on the geothermal brine injection problem and each of the project tasks is outlined in detail. These tasks are evaluation of methods of monitoring the movement of injected fluid, preparation for an eventual field experiment, and a review of groundwater regulations and injection programs. DOE

N81-30650# Polytechnic Inst. of New York, Brooklyn.
HYDROPOWER UTILIZATION IN NEW YORK STATE Final Report
Rubin S. Brown and Alvin S. Goodman Sep. 1980 93 p
(PB81-194219; NYSERDA-80-10) Avail: NTIS HC A05/MF A01 CSCL 10B

A master inventory of hydropower sites in New York is reported. It includes: data on site identification, potential capacity, initial cost, cost per kWh and category class for development. Background information on the methodologies used to structure the inventory of hydropower sites and to rank selected site entries by development categories. An explanation of the economic assessment utilized in these projects is included. GRA

N81-30652# Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.
HYDROPOWER POTENTIAL OF THE NEW YORK STATE BARGE CANAL
Alvin S. Goodman and Rubin S. Brown New York New York State Energy Research and Development Authority Sep. 1980 124 p refs Sponsored by New York State Energy Research and Development Authority
(PB81-182347; NYSERDA-80-25) Avail: NTIS HC A06/MF A01 CSCL 10B

The physical characteristics of the canal system as it relates to hydropower development were studied. The hydropower potential of the canal system was determined, including an inventory of existing and proposed hydropower plants. The remaining unrealized potential of the canal system was evaluated. Various sites were selected for further investigation on the basis of the unrealized potential of the barge canal system. Preliminary estimates of the engineering and economic feasibility of developing hydropower at these sites were also studied. GRA

N81-30662# Chevron Resources Co., San Francisco, Calif.
BEOWAWE GEOTHERMAL AREA EVALUATION PROGRAM Final Report, 1 Nov. 1978 - 31 Jul. 1980
J. L. Iovenitti Mar. 1981 218 p
(Contract DE-AC08-78ET-27101)
(DOE/ET-27101/1) Avail: NTIS HC A10/MF A01

Several exploration programs were conducted at the Beowawe Geothermal Prospect, Lander and Eureka County, Nevada. A shallow temperature hole program, a mercury soil sampling survey, and a self potential survey were conducted to select the optimum site for an exploratory well. A 5927 foot exploratory well was drilled running geophysical logs. A drill stem test was conducted along with a short term flow test. Basic data collected are summarized. DOE

N81-30725# Holmes and Narver, Inc., Las Vegas, Nev. Energy Support Div.
GEOTHERMAL INDUCED SEISMICITY PROGRAM PLAN
Mar. 1981 21 p
(Contract DE-AC08-76NV-00020)
(HN-00020-1094) Avail: NTIS HC A02/MF A01

The program calls for baseline seismic monitoring in regions of known future geothermal development, continued seismic monitoring and characterization of earthquakes in zones of geothermal fluid production and injection, modeling of the earthquake-inducing mechanism, and in situ measurement of stresses in the geothermal development. The Geothermal Induced Seismicity Program (GISP) will have as its objectives the evaluation of the seismic hazard, if any, associated with geothermal resource exploitation and the devising of a technology which, when properly utilized, will control or mitigate such hazards. DOE

N81-30727# Sandia Labs., Albuquerque, N. Mex.
APPLICATIONS OF REFLECTION SEISMICS TO MAPPING COAL-SEAM STRUCTURE AND DISCONTINUITIES
T. L. Dobecki and L. C. Bartel 1981 7 p refs Presented at the Conf. on the Ground Control in Mining, Morgantown, W. Va., 27 Jul. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1069C; CONF-810714-1) Avail: NTIS HC A02/MF A01

Three US field projects were reviewed. Each project employed its own particular seismic technique, recording system, and seismic energy source although all are considered state-of-the-art, high resolution, digital seismic surveys. Project 1 (thin, Pennsylvania coal) sought detection of sand channels using dynamite and standard in-line (2-D) seismic technique. Project 2 (thick, Wyoming underground coal gasification) involved a gas-explosion (Dinoseis) source with areal (3-D) acquisition methods. Project 3 (thick Washington underground coal gasification) employed a shotgun-type source and standard in-line methods. Each project was successful in accomplishing its own particular objective; however, data quality and interpretation seem to be more a function of thickness of the target seam, complexity of the overburden, and processing contractor than a seismic source, acquisition scheme (2-D versus 3-D), or recording instrumentation. DOE

N81-30729# Los Alamos Scientific Lab., N. Mex.
LOCATION, AGE, AND ROCK TYPE OF VOLCANIC ROCKS YOUNGER THAN 5 MILLION YEARS IN ARIZONA AND NEW MEXICO
M. J. Aldrich, Jr. and A. W. Laughlin Apr. 1981 24 p refs
(Contract W-7405-eng-36)
(LA-8820-MS) Avail: NTIS HC A02/MF A01

As part of the assessment of the Hot Dry Rock geothermal energy potential of Arizona and New Mexico, a compilation of the locations and ages of volcanic rocks less than 5 million years was made. The locations of those rocks less than 3 million years are shown on a map of the region. The compilation is presented as a tabulation. The table is organized first by state and secondly by latitude and longitude within each state. Rock type, age and error, method of dating, and original reference are given. DOE

N81-30731# Texas Univ., Austin. Bureau of Economic Geology.
STRUCTURE OF THE PRESIDIO BOLSON AREA, TEXAS, INTERPRETED FROM GRAVITY DATA
J. R. Mraz and G. R. Keller 1980 23 p refs Prepared in cooperation with Texas Univ. at El Paso
(Contracts DE-AS05-76ET-28388; EY-76-S-05-5106)
(DOE/ET-28388/T1) Avail: NTIS HC A02/MF A01

The structure and tectonism of a region was studied. The integrated geophysical geology of the Presidio area, Texas, using gravity measurements and deep drilling data was examined. New gravity data were combined with existing data to construct simple Bouguer anomaly maps of the Presidio area, and two dimensional computer modeling of gravity profiles was used to derive earth models. These data outline the major geologic features of the area that are dominated by the effects of Tertiary block faulting and volcanism. The main feature was the Presidio Graben, which is approximately 1.5 km deep near Ruidosa, Texas. It was found that hot springs associated with the Presidio Graben derive their heat from deep circulation along its boundary faults. However, some gravity anomalies indicate the presence of late Tertiary intrusions which provide heat for the hot springs. DOE

N81-30749# GEOMET, Inc., Gaithersburg, Md.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE NORTHEAST REGION
K. E. Pickering, J. M. Vilardo, and J. T. Schakenbach Jun. 1980 191 p refs Prepared for Battelle Pacific Northwest Labs.
(Contract DE-AC06-76RL-01830)
(PNL-3452) Avail: NTIS HC A09/MF A01

Techniques developed to assess the wind energy resource in the Northeast are described. Wind data locations were identified and the data obtained were screened to determine their usefulness. Summarizied data were processed and wind power values were estimated for all data locations. Upper air data were used to estimate wind power on mountaintops and ridge crests. Additional information on the wind resource was gained through a survey of wind-deformed vegetation. Maps of annual and seasonal wind power classes were constructed from the computed wind power values along with the aid of landform and shaded relief maps. DOE

N81-30750# Western Scientific Services, Inc., Fort Collins, Colo.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE NORTH CENTRAL REGION
D. L. Freeman Mar. 1981 84 p refs Prepared for Battelle Pacific Northwest Labs.
(Contract DE-AC06-76RL-01830)
(PNL-3667) Avail: NTIS HC A05/MF A01

The development of a regional wind energy resource atlas for the North Central Region, which consists of North Dakota, South Dakota, Nebraska, Minnesota, and Iowa is discussed. A description of observational and analytical techniques used in the development of the North Central region's wind energy resource atlas is given. DOE

N81-30751# Environmental Research and Technology, Inc., Concord, Mass.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE GREAT LAKE REGION
D. L. Paton, A. Bass, and D. G. Smith Feb. 1981 132 p refs Sponsored by DOE Prepared for Battelle Pacific Northwest Lab., Richland, Wash.
(Contract DE-AC06-76RL-01830)
(PNL-3668) Avail: NTIS HC A07/MF A01

A supplement to the wind energy resources atlas for the Great Lakes region is presented. It incudes a detailed discussion of the methodologies and data employed to complete the atlas. A summary of the regional annual average wind power is given, highlighting the major wind resource areas. DOE

N81-30752# GEOMET, Inc., Gaithersburg, Md.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE SOUTHEAST REGION
J. Zabransky Jan. 1908 138 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3669) Avail: NTIS HC A07/MF A01

Techniques developed to assess the wind energy resource in the Southeast are described. Wind data locations were identified and the data obtained were screened. Summarized data were processed and wind power values were estimated for all data locations. Upper air data were used to estimate wind power on mountaintops and ridge crests. Maps of annual and seasonal wind power classes were constructed from the computed wind power values along with the aid of landform and shaded relief maps. It is concluded that various topographic and landform features can be associated with high or low wind power. DOE

N81-30753# Western Scientific Services, Inc., Fort Collins, Colo.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE SOUTHERN ROCKY MOUNTAIN REGION
D. L. Freeman and S. R. Anderson Apr. 1981 97 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3671) Avail: NTIS HC A05/MF A01

The development of a regional wind energy resource atlas for the Southern Rocky Mountain region, which consists of Arizona, Colorado, New Mexico, and Utah is discussed. Observational and analytical techniques used in the development of the Southern Rocky Mountain region's wind energy resource atlas are described. DOE

N81-30754# Global Weather Consultants, Inc., San Jose, Calif.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE SOUTHWEST REGION
R. L. Simon and G. T. Norman Dec. 1980 43 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3672) Avail: NTIS HC A03/MF A01

The methodology used to generate the resource assessment and the results obtained are discussed in a manner useful and instructive to other professionals in the wind resource assessment field. DOE

N81-30755# Hawaii Univ., Honolulu. Dept. of Meteorology.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN HAWAII AND PACIFIC ISLANDS REGION Final Report
T. A. Schroeder Aug. 1980 42 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3673; UHMT-80-04A) Avail: NTIS HC A03/MF A01

The procedures utilized in preparing the Wind Energy Resource Atlas for Hawaii and Pacific Islands Region are contrasted with those used in other regional assessments. Techniques generally paralleled those of the northwest wind resource assessment. Quality of data bases differed drastically between Hawaii and the Pacific Islands. Research data sets constituted a primary data source for Hawaii, but such sets were nonexistent for the Pacific Islands. Forest Service data had minor impact in Hawaii; none in the Pacific Islands. Many Pacific Island anemometers are poorly exposed since limited open spaces exist on small atolls. DOE

N81-30756# Nevada Univ., Reno. Atmospheric Sciences Center.
ICING ON WIND-ENERGY SYSTEMS
Thomas Hoffer, Tony Reale, and Ashraf Elfigi Jan. 1981 74 p refs
(Contract DE-AC06-79ET-23170)
(DOE/ET-23170/80/1) Avail: NTIS HC A04/MF A01

Procedures for analyzing data to determine the maximum possible icing to be expected at specified locations are reported. The procedures for predicting maximum glaze ice and rime are presented in separate sections. Models that simulate the maximum

possible ice building on an exposed surface using the rainfall and cloud water data as input are presented. The maximal dynamic and static icing loads, comparative icing values based on actual field conditions simulations are shown. Assumptions of droplet splashing and water drainage for the glaze cases and atmospheric mixing during orographic lifting for rime cases are included. DOE

N81-30757# New Mexico State Univ., University Park. Physical Science Lab.
ASSESSING THE LOCAL WIND FIELD AT SIERRA GRANDE MOUNTAIN IN NEW MEXICO WITH INSTRUMENTATION
K. M. Barnett and R. D. Reynolds 1958 116 p refs Sponsored by DOE Prepared for Battelle Pacific Northwest Labs., Richland, Wash.
(PNL-3623) Avail: NTIS HC A06/MF A01

Operation of an instrumented wind speed and direction measurement data acquisition program at several locations on the mountain is described. Operating problems are discussed, a cost estimate presented, and data obtained during the six month program analyzed. Estimated energy output of a large wind energy conversion system (WECS) located on the eastern side of the peak is presented. Changes in methodology for similar measurement operations at potential WECS sites are recommended. DOE

N81-31324# California Univ., Livermore. Lawrence Livermore Lab.
FLAME PROPAGATION IN GASEOUS FUEL MIXTURES IN SEMICONFINED GEOMETRIES
P. A. Urtiew 7 Apr. 1981 37 p refs
(Contract W-7405-eng-48 oi MF)
(UCID-19000) Avail: NTIS HC A03/MF A01

Work on flame propagation in gaseous fuels contained in semiconfined geometries is reported. Parameters that have an effect on flame propagation, flame acceleration, and the transition from deflagration to detonation are described. Turbulence-producing obstacles in the flow path are the primary cause of acceleration of the flame front. DOE

N81-31379 Rice Univ., Houston, Tex.
CONVERSION OF METHANOL AND LIGHT OLEFINS TO GASOLINE OVER A SHAPE SELECTIVE CATALYST ZSM-5 Ph.D. Thesis
Frank Shaw-Shyong Hwu 1981 154 p
Avail: Univ. Microfilms Order No. 8116969

The product distribution over a broad range of space velocities indicates the reaction sequence: methanol, reversible reaction dimethyl and ether yields C2-C5 olefins yields parafins and aromatics. Monomethyl aliphatics predominate over both straight-chain and dimethyl hydrocarbons. Aromatics consist mainly of toluene and xylene mixtures. At 368 C, compositions of butene isomers are in thermodynamic equilibrium, over the range of residence times investigated. Equilibrium composition of xylenes is not established until tau = 1440 mg-sec/cc; p-xylene is kinetically favored at short residence. Dissert. Abstr.

N81-31380*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFRARED SPECTROSCOPY FOR THE DETERMINATION OF HYDROCARBON TYPES IN JET FUELS
Constance S. Buchar Aug. 1981 10 p refs
(NASA-TM-82674; E-957) Avail: NTIS HC A02/MF A01 CSCL 21D

The concentration of hydrocarbon types in conventional jet fuels and synfuels can be measured using a computerized infrared spectrophotometer. The computerized spectrophotometer is calibrated using a fuel of known aromatic and olefinic content. Once calibration is completed, other fuels can be rapidly analyzed using an analytical program built into the computer. The concentration of saturates can be calculated as 100 percent minus the sum of the aromatic and olefinic concentrations. The analysis of a number of jet fuels produced an average standard deviation of 1.76 percent for aromatic types and one of 3.99 percent for olefinic types. Other substances such as oils and organic mixtures can be analyzed for their hydrocarbon content. Author

N81-31389# Exxon Research and Engineering Co., Florham Park, N.J.
EDS COAL LIQUEFACTION PROCESS DEVELOPMENT, PHASE 4. CONSTRUCTION OF EXXON COAL LIQUEFACTION PILOT PLANT Final Report
Mar. 1981 160 p Sponsored in part by DOE, Exxon Co., EPRI, Japan Coal Liquefaction Development Co., Phillips Coal Co., ARCO Coal Co., Ruhrkohle AG, and Agip S.P.A.
(Contract DE-AB01-77ET-10069)
(DOE/ET-10069/T4; FE-2893-66) Avail: NTIS HC A08/MF A01

Completion of the Exxon Coal Liquefaction Pilot Plant Program began in 1975 is detailed. The final cost of the plant was an increase of 7.3 percent over the original cost outlook. DOE

N81-31390# United Technologies Research Center, East Hartford, Conn.
EVOLUTION OF FUEL NITROGEN DURING THE VACUUM THERMAL DEVOLATILIZATION OF COAL
J. D. Freihaut and D. J. Seery 1981 18 p refs
(Contract DE-AC21-78ET-10744)
(DOE/ET-10744/T3) Avail: NTIS HC A02/MF A01

The results of an investigation of the evolution of fuel nitrogen during the vacuum thermal decomposition of coal are presented. Results are shown for variations with coal characteristics and apparent thermal history. Apparent heating rates of 75 C/sec to 2000 C/sec and final temperatures of 500 C to 1780 C were utilized. a variety of coals were investigated ranging in rank from lignite to anthracite. The results indicate that nitrogen distribution in the volatiles is a sensitive function of the chemical characteristics of the parent coal. This distribution of nitrogen in the light gas, tar and char products of vacuum devolatilized coal is highly dependent on rank of the parent coal. Variations in nitrogen evolution with coal characteristics are most readily apparent in several aspects: (1) the coal nitrogen released with the tar species; (2) the release of nitrogen contained in primary tars as HCN upon secondary thermal decomposition reactions of the primary tars; and (3) the retention of nitrogen in the char species. DOE

N81-31391# Auburn Univ., Ala.
ROLE OF NON-FERROUS COAL MINERALS AND BY-PRODUCT METALLIC WASTES IN COAL LIQUEFACTION
D. Garg, F. K. Schweighardt, E. N. Givens, J. H. Clinton, A. R. Tarrer, J. A. Guin, C. W. Curtis, and S. M. Huang Jun. 1980 110 p Prepared in cooperation with Air Products and Chemicals, Inc., Trexlertown, Pa.
(Contract DE-AC22-79ET-14806)
(DOE/ET-14806/T4) Avail: NTIS HC A06/MF A01

The thermal behavior of various minerals and metallic by product wastes was evaluated by thermal gravimetric analysis and differential thermal analysis in the presence of hydrogen, nitrogen, and air. A number of minerals were screened for catalytic activity toward coal liquefaction in a tubing bomb reactor. The catalytic activity of the minerals was assessed by comparing the product distributions both in the presence of minerals and their absence. The use of a Bronson Sonifier was initiated in March to accelerate and improve the solvent separation technique. The addition of lime to the reaction mixture practically killed the liquefaction reaction. The addition of dolomite, rutile, illite, quartz, zircon, and calcite to the reaction mixture showed no signicant improvement over that of a no additive run. The addition of zinc oxide and ilmenite showed slight improvement. Robena pyrite and Co-Mo-Al showed significant improvment in coal conversion and production of benzene solubles and gases. Iron oxide (Fe203) gave the highest conversion of coal and production of benzene solubles among all the minerals tested. DOE

N81-31392# Southwest Research Inst., San Antonio, Tex. Mobile Energy Div.
OPTIMIZATION OF ACCELERATED STABILITY-TEST TECHNIQUES FOR DIESEL FUELS Final Report
Leo L. Stavinoha and Steven R. Westbrook Jun. 1981 68 p refs
(Contract DE-AC19-79BC-10043)
(DOE/BC-10043/25) Avail: NTIS HC A04/MF A01

The formation of deleterious products in middle distillate fuels was studied. The results were applied to the development of more reliable test methods for fuel stability. Eight accelerated stability tests were chosen and evaluated using a set of six test fuels. Correlations of accelerated stability test results were then related to test results obtained at a storage temperature of 430 C (1100 F), which is generally regarded as showing good correlation with long-term ambient storage. Testing of eight fuels having a wide range of stabilities provided data which, when

mathematically correlated, allowed for a number of observations. Total insolubles, as opposed to total gum values, were judged to be more acceptable for data correlation in that total gum values could not be reliably corrected for initial gum values.DOE

N81-31396# Union Carbide Corp., Tarrytown, N.Y.
COTHANE, METHANE FROM WASTE CO Final Technical Report
J. A. Rabo, A. C. Frost, L. F. Elek, A. P. Risch, and C. L. Yang Dec. 1980 117 p refs
(Contract DE-AC03-78CS-40177)
(DOE/CS-40177/T2) Avail: NTIS HC A06/MF A01

As the result of early efforts in the fields of catalysis, coal gasification, and methanation, Union Carbide developed a process for the direct concentration and conversion of CO in dilute waste streams to high quality methane (SNG). This two bed, two step process was dubbed COthane, a contraction of the feed carbon monoxide (CO) and the product methane. The objectives of this contract were to develop the COthane process up to the large pilot plant stage, to develop an improved catalyst, and to estimate the cost of methane produced by this process. The process development studies yielded all of the design parameters required to design a large scale pilot plant, the catalyst development program produced a catalyst with promising stability, and the economic studies showed that methane production cost would generally be more than $6/MM Btu. Because this cost is above those for natural gas, further work on this project was suspended until risng natural gas prices catch up with the more slowi,' rising COthane production cost. DOE

N81-31397# New Hampshire Univ., Durham.
ALTERNATE FUELS MANUFACTURED FROM HIGH TEMPERATURE SOLAR THERMAL SYSTEMS Technical Annual Progress Report, 1 Apr. 1980 - 31 Mar. 1981
1981 15 p refs
(Contract DE-AC02-79ET-21067)
(DOE/ET-21067/2) Avail: NTIS HC A02/MF A01

A feasibility study of three modes of transportation of coal and lignite is discussed. These modes are railroads, barges and slurry pipe lines. Geographical aspects and estimated costs of transporting coal are considered. The size and capacity of solar gasification plants are discussed, and locations are considered. Economic feasibility assessments for hybrid and direct solar units with respect to export potential are discussed. A bench scale fluidized-bed coal gasification unit is described, and its heat and material balances are tabulated. DOE

N81-31398# Rolls-Royce Ltd., Derby (England).
A UNITED KINGDOM VIEW ON FUTURE FUELS
A. B. Wassell 1981 7 p refs
(PNR-90068) Avail: NTIS HC A02/MF A01

It is noted that the quality of aviation fuel is expected to deteriorate as the available liquid hydrocarbon fuels become increasingly scarce. The characteristics of the fuel which are the most important from engine operational considerations are discussed. A reduction in the fuel thermal stability is likely to be the most serious problem both for fuel control and distribution systems. The aromatic content increase will require a complete design reoptimization to avoid visibility of the exhaust plume. Higher nitrogen oxide emissions will require more complex combustion systems. The increasing carbon production will lead to shorter combustor life. Exhaust visibility problems experienced between startup and ground idle are also discussed. It is shown that no single parameter will be sufficient to define fuel quality, and that design philosophies will probably be required.
Author (ESA)

N81-31399# New York State Dept. of Health, Albany. Div. of Labs. and Research.
METHANE PRODUCTION RATE STUDIES AND GAS FLOW MODELING FOR THE FRESH KILLS LANDFILLS Interim Report
C. O. Kunz and A. H. Lu Nov. 1980 83 p refs
(PB81-196552; NYERDA-80-21) Avail: NTIS HC A05/MF A01 CSCL 21D

Gas flow models were developed based on measurements of the pressure differential between landfill gas and atmospheric pressure that would enable the rate of gas production to be estimated. Two landfill gas flow models were developed; a static model and a dynamic model. GRA

N81-31400# Northrop Services, Inc., Research Triangle Park, N. C.
IMPACT OF GASOHOL ON AUTOMOBILE EVAPORATIVE AND TAILPIPE EMISSIONS
John M. Lang and Frank M. Black Apr. 1981 14 p refs Presented at the Intern. Congr. and Exposition, Detroit, 23-27 Feb., 1981
(Contract EPA-68-02-2566)
(PB81-199952; EPA-600/J-81-137) Avail: NTIS HC A02/MF A01 CSCL 21D

National interest growing in the use of gasohol, a blend of ethanol and unleaded gasoline, as an alternate fuel to gasoline, is discussed. In order to assess its viability as a transportation fuel, gasohol's impact on vehicle emissions, fuel economy, and driveability are considered, along with the cost of production and the physical compatibility of ethanol with gasoline. GRA

N81-31401# Bureau of Mines, Pittsburgh, Pa. Research Center.
DIRECT METHOD DETERMINATION OF THE GAS CONTENT OF COAL: PROCEDURES AND RESULTS
W. P. Diamond and J. R. Levine Mar. 1981 42 p refs
(PB81-196735; BM-RI-8515; BMRI-1981) Avail: NTIS HC A03/MF A01 CSCL 08I

The explosion hazard of methane-air mixtures has become an increasingly serious mine planning problem and an advance assessment of methane gas potential can therefore be essential for a safe and economic mine development program. As part of its coal mine health and safety program. The Bureau of Mines has developed a simple, inexpensive test to measure the methane content of coal samples obtained from exploration cores. The gas content of coal per unit weight as determined by the direct method test can be used as a basis for a preliminary estimate of mine ventilation requirements, and to determine if degasification of the coalbed in advance of mining should be considered. GRA

N81-31609# California Dept. of Conservation, Sacramento. Div. of Mines and Geology.
RESOURCE ASSESSMENT OF LOW- AND MODERATE-TEMPERATURE GEOTHERMAL WATERS IN CALISTOGA, NAPA COUNTY, CALIFORNIA. REPORT OF THE SECOND YEAR, 1979 TO 1980 OF THE US DEPARTMENT OF ENERGY - CALIFORNIA STATE-COUPLED PROGRAM FOR RESERVOIR ASSESSMENT AND CONFIRMATION
L. G. Youngs, C. Forrest Bacon, Rodger H. Chapman, Gordon W. Chase, Chris T. Higgins, Hasmukhrai H. Majmundar, and Gary C. Taylor 10 Nov. 1980 522 p refs
(Contract DE-FG03-79ET-27035)
(DOE/ET-27035/T1) Avail: NTIS HC A22/MF A01

Statewide assessment studies included updating and completing the USGS GEOTHERM File for California and compiling all data needed for a California Geothermal Resources Map. The Calistoga effort was comprised of a series of studies involving different disciplines, including geologic, hydrologic, geochemical and geophysical studies. DOE

N81-31611# Los Alamos Scientific Lab., N. Mex.
HOT DRY ROCK GEOTHERMAL POTENTIAL OF ROOSEVELT HOT SPRINGS AREA: REVIEW OF DATA AND RECOMMENDATIONS
Jennifer East May 1981 46 p refs
(Contract W-7405-eng-36)
(LA-8751-HDR) Avail: NTIS HC A03/MF A01

The Roosevelt Hot Springs area in west-central Utah possesses several features indicating potential for hot dry rock (HDR) geothermal development. The area is characterized by extensional tectonics and a high regional heat flow of greater than 105 mW/m(2). The presence of silicic volcanic rocks as young as 0.5 to 0.8 Myr and totaling 14 km(3) in volume indicates underlying magma reservoirs may be the heat source for the thermal anomaly. Several hot dry wells have been drilled on the periphery of the geothermal field. Information obtained on three of these deep wells shows that they have thermal gradients of 55 to 600C/km and bottom in impermeable Tertiary granitic and Precambrian gneissic units. The Tertiary granite is the preferred HDR reservoir rock because Precambrian gneissic rocks possess a well-developed banded foliation, making fracture control over the resevoir more difficult. Based on a fairly conservative estimate of 160 km(2) for the thermal anomaly present at Roosevelt Hot Springs, the area designated favorable for HDR geothermal exploration may be on the order of seven;

times or more than the hydrogeothermal area currently under development. DOE

N81-31645# Republic Geothermal, Inc., Santa Fe Springs, Calif.
CO2 AND CARBONATE CHEMISTRY APPLIED TO GEOTHERMAL ENGINEERING. GUIDANCE FOR INTERPRETING AND USING CHEMICAL DATA ABOUT GEOTHERMAL RESOURCES
Donald E. Michels Jan. 1981 32 p refs
(Contract W-7405-eng-48)
(LBL-11509) Avail: NTIS HC A03/MF A01

The chemistry of high HCO3 resources is emphasized because they present complications about data interpretation, development of vapor, and potential for scale deposition. Solubility of CO2 and its exsolution from liquids is treated according to the context presented by geothermal resources. Contrasts between this approach and the treatment of CO2 solubility in physical chemistry and other geochemical contexts are presented. Dimensional units for solubility coefficients different from those of physical chemists are presented to favor engineering application. The effects of CO2 on wellbore flow, initiation of flashing, and depth of the 2-phase zone are described and illustrated with examples. DOE

N81-31662# Systems Science and Software, La Jolla, Calif.
BACA GEOTHERMAL DEMONSTRATION PROJECT. EQUATION-OF-STATE FOR WATER-CARBON DIOXIDE MIXTURES: IMPLICATIONS FOR BACA RESERVOIR
J. W. Pritchett, M. H. Rice, and T. D. Riney Feb. 1981 57 p refs Prepared for Union Geothermal Co. of New Mexico and Public Service Co. of New Mexico
(Contract DE-FC03-78ET-27163)
(DOE/ET-27163/8) Avail: NTIS HC A04/MF A01

An equation of state package for water carbon dioxide mixtures was constructed. The thermodynamic state of the Baca reservoir fluid was examined for temperature, pressure and CO2 content for bracket conditions existing at the production depth of the wells in the Redondo Creek area. It is shown that the reservoir fluid may be either all liquid or two phase at various well locations and depths, depending on the CO2 content. It is also shown that the CO2 content at reservoir conditions cannot be reliably inferred from pressure/temperature measurements made on flowing wells. The equation of state package is incorporated into a general purpose geothermal reservoir simulator and calculations show that the CO2 content of the produced fluid is less than or greater than that of the reservoir fluid. The characteristics of the produced fluid are sensitive to the CO2 content in the reservoir. DOE

N81-31667# Lockman and Associates, Monterey Park, Calif.
FEASIBILITY OF DIRECT ON-SITE CONVERSION OF LANDFILL GAS TO ELECTRICAL ENERGY AT SCHOLL CANYON LANDFILL, CALIFORNIA Final Report
Ronald J. Lofy Jun. 1981 55 p
(Contract DE-AC01-79CS-20237)
(DOE/CE-20237/1) Avail: NTIS HC A04/MF A01

The technical and economic feasibility of direct onsite conversion of landfill gas into electrical energy for distribution through the municipal company's distribution grid is described. The various approaches are evaluated. Each system looked at the preliminary collection system layout, type of processing, and conversion equipment required, conversion efficiencies, total system costs, total energy output per input landfill gas, and overall economic comparisons between alternatives. This led to the selection of the internal combustion engine. The legal constraints on interdepartmental transfers of money and resources, city procedures for coordination between the public works department and public services, procedures for facility operation, and an environmental assessment of each alternative were investigated. DOE

N81-31791# AeroVironment, Inc., Pasadena, Calif.
ASSESSING THE LOCAL WINDFIELD WITH INSTRUMENTATION
T. G. Zambrano Oct. 1980 281 p refs Prepared for Battelle Pacific Northwest Labs., Richland, Washington
(Contract DE-AC06-76RL-01830)
(PNL-3622) Avail: NTIS HC A13/MF A01

A technique for the initial screening and evaluation of potential sites for wind energy conversion systems (WECS) was examined. The siting exercise involved measurements of winds along the surface and winds aloft using a relatively new instrument system, the tethered aerodynamic lifting anemometer (TALA) kite; notation of ecological factors such as vegetation flagging, soil erosion and site exposure, and verification of an area best suited for wind energy development by establishing and maintaining a wind monitoring network. The siting exercise was carried out in an approximately 100 square mile region. It is shown that a comprehensive site survey involves field measurements, ecological survey, and wind monitoring is an effective tool for preliminary evaluation of WECS sites. DOE

N81-31792# Battelle Pacific Northwest Labs., Richland, Wash.
SOME ASPECTS OF FLUCTUATING VERTICAL WIND SHEARS
J. C. Doran May 1981 29 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3771) Avail: NTIS HC A03/MF A01

Fluctuating vertical shears of wind speed were measured using an array of towers. The statistical distributions of these shears are compared with Fichtl's formulas. A comparison of Fichtl's formula for the standard deviation of the fluctuating shears with the more empirical one by Ramsdell shows that the latter is consistent with the former. The probability of occurrence of extreme shears in speed is discussed. Fluctuating shears in speed is discussed. Fluctuating shears two or more times larger than the mean values are shown to be readily obtainable, and their likelihood increases as the mean measuring height increases if (RADICAL) Z is held fixed. DOE

N81-32089# EMCON Associates, San Jose, Calif.
FEASIBILITY STUDY: UTILIZATION OF LANDFILL GAS FOR A VEHICLE FUEL SYSTEM, ROSSMAN'S LANDFILL, CLACKAMUS COUNTY, OREGON
Jan. 1981 206 p refs Sponsored in cooperation with Cal. Recovery Systems, Inc. and Gas Recovery Systems, Inc.
(Contract DE-FG01-80RA-50366)
(DOE/RA-50366/T1) Avail: NTIS HC A10/MF A01

The technical and economic feasibility of recovering the methane generated in the landfill for the refueling of vehicles is examined. The expected methane yield and the development of a conceptual gas gathering system, gas processing, compressing, and storage systems, and methane fueled vehicle systems are among the factors addressed. Cost estimates made for each area of study are given. Reasoning that gasoline prices will continue to rise and that approximately 18,000 vehicles in the US have been converted to operate on methane, a project is proposed to use this landfill as a demonstration site to produce and process methane and to fuel a fleet (50 to 400) vehicles with the gas produced in order to obtain performance and economic data on the systems used from gas collection through vehicle operation. DOE

N81-32216# Solar Turbines International, San Diego, Calif.
MECHANISMS OF FOULING, SLAGGING AND CORROSION BY PULVERIZED COAL COMBUSTION Quarterly Technical Progress Report, 11 Mar. - 30 Jun. 1981
M. E. Gulden, L. L. Hsu, and A. R. Stetson Jul. 1981 52 p refs
(Contract DE-AC22-81PC-40272)
(DOE/PC-40272/T1; SR81-R-4930-05; QTPR-1) Avail: NTIS HC A04/MF A01

Progress is reported on a program in which the objective is to conduct a mechanisms of fouling, slagging and corrosion in pulverized coal combustors by employing. Emphasis is on design and construction of the combustion test rig. All design phases are complete. Construction of the diffuser and test sections is also complete. DOE

N81-32223# State Univ. of New York at Buffalo. School of Engineering and Applied Science.
CATALYTIC COMBUSTION OF SYNTHETIC FUELS Annual Report, 1 Aug. 1980 - 31 Jul. 1981
Lawrence A. Kennedy and Eli Ruckenstein 1981 20 p refs
(Grant DE-FG22-80PC-30220)
(DE81-027555; DOE/DC-30220/T2) Avail: NTIS HC A02/MF A01

During the period August 1, 1980 to July 31, 1981, the efforts on this project were directed towards three goals: (1) catalyst development; (2) preliminary measurements of fuel bound nitrogen conversion; and (3) design of a droplet injector

and vaporization section for use with synthetic liquids. Chromium oxides, magnesium oxide, cobalt oxides, manganese oxides, and iron oxides were examined for possible use as stable catalysts. As a result of the experiments, Cr2O3:CO3O4 mixtures with concentrations greater than 3% were chosen for catalyst in the Task II experiments. The reduction of nitrogen oxide emission from combustion sources is currently an area of major interest. The objective of the experiment was to study the oxidation of a nitrogen bound fuel over a binary transition metal oxide catalyst. Argon-oxygen is the oxidizing gas. Propane doped with nitrogen gas will also be tested in the catalytic combustor. DOE

N81-32225# Department of Energy, Morgantown, W. Va. Energy Technology Center.
COMBUSTION OF WESTERN COAL IN A FLUIDIZED BED
W. T. Abel, R. L. Rice, J. Y. Shang, D. G. Turek, and W. J. Ayers Jul. 1981 32 p refs
(DE81-028103; DOE/METC-RI/178) Avail: NTIS HC A03/MF A01

Subituminous coals amount to over 25% of the Nation's coal reserves and are located in dry areas. Fluidized-bed combustion (FBC) offers a clean stack gas without additional water requirement. A western subituminous coal from the Rosebud mine in Montana was burned in the 18-in diameter FBC unit at the Morgantown Energy Technology Center to investigate its potential as an FBC fuel. In this study, bed temperature ranged from about 1450 to 1670 F and fluidizing air velocity ranged from 2.6 to 4 t per second. The investigation included operating characteristics, SO2 emission with and without added limestone, distribution of solids and solid components throughout the system; other pertinent data are reported. Sulfur retention was greatest at lower bed temperatures (14500 F). It was concluded that: sulfur dioxide emission can be kept below the EPA limit of 1.2 lb/10(6) Btu without any added sorbent for bed temperatures below 1500 F; more stringent limits may require the addition of limestone. The NO/sub x/ emission limit of 0.6 lb NO2/10(6) Btu is met with excess air up to 25% and bed temperatures to 16700 F. DOE

N81-32226# Air Products and Chemicals, Inc., Allentown, Pa.
CRYOGENIC METHANE SEPARATION/CATALYTIC HYDROGASIFICATION PROCESS ANALYSIS Quarterly Report
J. Klosek 13 Feb. 1981 9 p refs
(Contract DE-AC01-78ET-10325)
(DOE/ET-10325/T6) Avail: NTIS HC A02/MF A01

Combinations of acid gas removal, methane separation for the Exxon Catalytic Coal Gasification, and the Rockwell/Cities Service Hydrogasification processes were investigated with emphasis on the effect of variations of design parameters on the treatment cost of the SNG produced. Heat and material balance and equipment sizing was completed for the cryogenic methane separation. The overall material balance is presented in a table. Preliminary designs for MEA and DEA gas removal systems were established. The SNG product compressor train was simulated for the case where sufficient SNG fuel is withdrawn from the product compressors to fire the dryer reactivation heater. Acid gas removal and cryogenic separation equipment was resized to accommodate Exxon's request for a two-train plant design. DOE

N81-32227# Air Products and Chemicals, Inc., Allentown, Pa.
CRYOGENIC METHANE SEPARATION/CATALYTIC HYDROGASIFICATION PROCESS ANALYSIS Quarterly Report
J. Klosek May 1981 39 p refs
(Contract DE-AC01-78ET-10325)
(DOE/ET-10325/T8) Avail: NTIS HC A03/MF A01

The objective of this coordinated research program is optimization of the Rockwell/Cities Service Short Residence Time Hydrogasification (SRTH) and the Exxon Catalytic Coal Gasification (CCG) processes in the acid gas removal and cryogenic areas. Progress reports of eight subtasks are presented along with process flowsheets, heat and material balances and economic evaluation, summarized in tables. Each subtask studied the effect of variation of a key design parameter on the treatment cost of the SNG produced. DOE

N81-32229# Los Alamos Scientific Lab., N. Mex.
CHEMICAL-EQUILIBRIUM CALCULATIONS FOR AQUEOUS GEOTHERMAL BRINES
Jerry F. Kerrisk May 1981 22 p refs
(Contract W-7405-eng-36)
(DE81-026802; LA-8851-MS) Avail: NTIS HC A02/MF A01

Results from four chemical-equilibrium computer programs, REDEQL.EPAK, GEOCHEM, WATEQF, and SENECA2, were compared with experimental solubility data for some simple systems of interest with geothermal brines. Seven test cases involving solubilities of CaCO3, amorphous SiO2, CaSO4, and BaSO4 at various temperatures from 25 to 300 C and in NaCl or HCl solutions of 0 to 4 molal were examined. Significant differences between calculated results and experimental data occurred in some cases. These differences were traced to inaccuracies in free-energy or equilibrium-constant data and in activity coefficients used by the programs. Although currently available chemical-equilibrium programs can give reasonable results for these calculations, considerable care must be taken in the selection of free-energy data and methods of calculating activity coefficients. DOE

N81-32232# Los Alamos Scientific Lab., N. Mex.
APPLICATION OF CRYOGENIC SPECTROSCOPY TO THE DETERMINATION OF IMPURITY CONCENTRATION IN COAL GASIFIERS
R. F. Holland and G. P. Quigley 1981 18 p refs Presented at the Symp. on Instrumentation and Control for Fossil Energy Processes, San Francisco, 8-10 Jun. 1981
(Contract W-7405-eng-36)
(DE81-025410; CONF-810607-9; LA-UR-81-1736) Avail: NTIS HC A02/MF A01

A number of small molecules are soluble at low-to-moderate concentrations in the ir-transparent liquefied rare gases. As part of an effort to develop methods to measure concentrations of minor constituents in product gases from coal gasifiers, measurements were made of the infrared spectral absorbance of solutions produced by sampling cryogenically a mixture of gases and dissolving the sample in liquid xenon. Observations thus far include CO2, CO, CH4, and H2 as major constituents and NO2, NO, NH3, N2O, SO2, and COS as minor constituents in the mixture. For low concentrations in the cold solutions, solute absorption bands are narrow, with widths at half-maximum absorbance of 1 to 10 per cm compred with approximately 30 to 100 per cm for the gas phase. The band-narrowing enhances peak absorbance and reduces spectral overlapping for easier analysis of complex mixtures. In the sampling, we remove most CO and CH4, so that only the CO2 interferes with the spectrum of minor constituents. DOE

N81-32267# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
CORROSION AND STRESS CORROSION CRACKING IN COAL LIQUEFACTION PROCESSES
V. B. Baylor and J. R. Keiser 1980 56 p refs Presented at the Canadian Council of ASM Conf. on Materials to Satisfy the Energy Demand, Harrison, UK, 11 May 1980
(Contract W-7405-eng-26)
(CONF-8005172-1) Avail: NTIS HC A04/MF A01

The liquefaction of coal to produce clean burning synthetic fuels was demonstrated at the pilot plant level. However, some significant materials problems must be solved before scale up to commercial levels of production can be completed. Failures due to inadequate materials performance were reported in many plant areas; in particular, stress corrosion cracking was found in austenitic stainless steels in the reaction and separation areas and several corrosion observed in fractionation components. In order to screen candidate materials of construction, racks of U-bend speciments in welded and as-wrought conditions and unstressed surveillance coupons were exposed in pilot plant vessels and evaluated. Failed components were analyzed on site and by subsequent laboratory work. DOE

N81-32289*# Spectra Research Systems, Inc., Huntsville, Ala.
TECHNOLOGY AND DEVELOPMENT REQUIREMENTS FOR ADVANCED COAL CONVERSION SYSTEMS Final Report
Aug. 1981 151 p refs
(Contract NAS8-34264)
(NASA-CR-161853; SRS/SE-TR81-102) Avail: NTIS HC A08/MF A01 CSCL 21D

A compendium of coal conversion process descriptions is presented. The SRS and MC data bases were utilized to provide information paticularly in the areas of existing process designs

and process evaluations. Additional information requirements were established and arrangements were made to visit process developers, pilot plants, and process development units to obtain information that was not otherwise available. Plant designs, process descriptions and operating conditions, and performance characteristics were analyzed and requirements for further development identified and evaluated to determine the impact of these requirements on the process commercialization potential from the standpoint of economics and technical feasibility. A preliminary methodology was established for the comparative technical and economic assessment of advanced processes. T.M.

N81-32296# Research Triangle Inst., Research Triangle Park, N. C.

VEGETABLE OILS AS AN ON THE FARM DIESEL FUEL SUBSTITUTE: THE NORTH CAROLINA SITUATION Final Report

Hendrick J. Harwood Jun. 1981 70 p refs
(DE81-903452; NCEI-0032; FR-41U-1671-4) Avail: NTIS HC A04/MF A01

The state-of-the-art of using vegetable oil as a diesel fuel alternative is reviewed. Particular emphasis has been placed on using vegetable oil in farm vehicles as an emergency fuel which may be produced on-farm. The following are reviewed: the mechanical feasibility, on-farm fuel production, and economic analysis. DOE

N81-32301# Pritchard Corp., Kansas City, Mo.

EVALUATION OF THE USE OF UCG GAS TO PRODUCE 4000 BPD AND 12,000 BPD OF METHANOL WITH CONVERSION TO M-GASOLINE

[1981] 150 p
(Contract DE-AC01-80ET-14372)
(DOE/ET-14372/T1) Avail: NTIS HC A07/MF A01

It is possible to convert an existing ammonia plant into a methanol facility. Existing ammonia and methanol plants which contain equipment that might be utilized with UCG all use natural gas for feedstock. The processing steps in these plants can be divided into unit operations which are described. The product price analysis shows that significant economies of scale exist for the larger of the two facility sizes considered in this study. The economies of scale are evident for both the methanol/M-gasoline and methanol-only facilities. Compared to current market prices, the calculated product prices for the 4000 BPD and 12,000 BPD methanol-only facilities are within the range of *competitiveness with the prices of conventionally produced* methanol. The product prices calculated for the 12,000 BPD methanl/4910 BPD M-gasoline facility are, under the most optimistic assumptions, 50 percent higher than the current market price for unleaded gasoline. DOE

N81-32302# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Technical Div.

NATURAL GAS AND METHANE AS VEHICLE FUELS AT SRP

J. L. Steimke 9 Mar. 1981 11 p refs
(Contract DE-AC09-76SR-00001)
(DPST-80-634) Avail: NTIS HC A02/MF A01

The practicality of altering the 700 gasohol-consuming vehicles in the Savannah River Fleet to run on compressed gas or methane is examined. Pipeline natural gas would be purchased or water hyacinths could be grown in ponds at SRP and anaerobically digested to generate methane. Conversion of vehicles to natural gas using a kit, safety considerations, fuel characteristics of natural gas, and costs of converting to natural gas fuel are briefly discussed. The production procedures for hyacinths, the mass that would be required, the water acreage and fertilizers needed, harvesting and transport expenses, operation and performance of the digester, and yields from the digester are also discussed briefly. In sum, it is economically attractive to fuel plant vehicles with natural gas and technically feasible to utilize hyacinths to generate methane, but expensive. DOE

N81-32303# Gulf Research and Development Co., Pittsburgh, Pa. Chemical and Materials Div.

SOLVENT REFINED COAL (SRC) PROCESS: SELECTED PHYSICAL, CHEMICAL, AND THERMODYNAMIC PROPERTIES OF NARROW BOILING RANGE COAL LIQUIDS FOR THE SRC-2 PROCESS Interim Report, Mar. 1980 - Feb. 1981

J. A. Gray Apr. 1981 224 p refs
(Contract DE-AC05-76ET-10104)
(DE81-025929; DOE/ET-10104/7) Avail: NTIS HC A10/MF A01

Physical, chemical, and thermodynamic properties of coal liquids as a function of boiling range via the pseudocomponent approach are needed for process design now that various direct coal liquefaction processes are being scaled to semi-commercial size. Products from the SRC-II processing of a high volatile bituminous coal were distilled into narrow boiling fractions with average boiling points ranging up to 9690 F. Fractions boiling below 7500 F typically spanned a 500 F interval, while the others were slightly wider boiling and overlapped somewhat. Liquid density, thermal conductivity and viscosity were measured at temperatures to 4500 F, and specific heat was determined at temperatures near the boiling point of each fraction. Other property determinations included molecular weight, pour point, elemental analyses, water content and solubility and hydrocarbon types. Both organic oxygen content and water solubility showed a pronounced maximum for the fraction having an average boiling point of 3840 F. DOE

N81-32304# Rockwell International Corp., Canoga Park, Calif. Environmental and Energy Systems Div.

COAL-HYDROGASIFICATION PROCESS DEVELOPMENT Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981

L. P. Combs, L. S. Breese, N. J. Patel, M. P. Garey, and W. T. Lee Jul. 1981 36 p refs
(Contract DE-AC01-78ET-10328)
(DOE/ET-10328/33) Avail: NTIS HC A03/MF A01

Principal IPDU-related activities concerned advance procurement of components and equipment for eventual facility construction and the addition of a benzene recovery loop to the product gas system. Equipment specifications and envelope control drawings were prepared for components needed for the benzene recovery loop. Facility design modifications to accommodate this system addition are being worked upon. Development of a computer code for modeling the fluid mechanics, particle dynamics, and coal pyrolysis chemistry within an entrained flow coal FHP reactor was continued. Most of the effort was devoted to: incorporating the expanded coal particle pyrolysis and chemical kinetic reaction model into the entrained flow reactor model; modifying the numerical solution method to one more suitable for the expanded set of model differential equations; debugging the computer code; and evaluating computer run options for most reliable and economical computation. Attention was also directed to comparing conversions calculated by the new FHP reactor model with experimental conversions from ten selected hydrogasification and hydroliquefaction tests having a broad range of reactor residence times. DOE

N81-32306# New York State Energy Research and Development Authority, New York.

LOW/MEDIUM Btu COAL GASIFICATION ASSESSMENT PROGRAM FOR SPECIFIC SITES OF TWO NEW YORK UTILITIES. EXECUTIVE SUMMARY

Dec. 1980 31 p refs
(Contract DE-FG01-79RA-20223)
(DE81-027682; DOE/FE-20223/1) Avail: NTIS HC A03/MF A01

The technical and economic aspects of coal gasification to supply low or medium Btu gas to two power plant boilers were investigated. This includes the following: select a coal based on its availability, mode of transportation and delivered cost to each power plant site; investigate the effects of burning low and medium Btu gas in the selected power plant boilers based on efficiency, rating, and cost of modifications and make recommendations for each; review the technical feasibility of converting the power plant boilers to coal derived gas; and identify coal gasification systems that are compatible with the selected coals. The technical feasibility of designing a coal gasification facility to meet the constantly changing fuel demands of a power plant are reviewed. Gas cleanup systems that are available and compatible with the gasification systems; and capable of reducing the total sulfur emission levels to that required by environmental regulations are identified and regulatory and financial aspects of conversion to a coal derived gas were considered. Cost estimates for each of the coal gasification systems, for the boiler modifications, and for each of the synthetic gas fired options are given and compared to the case of continued oil-firing. DOE

N81-32308# California Univ., Livermore. Lawrence Livermore Lab.
HIGH-PRESSURE SOLVENT EXTRACTION OF METHANE FROM GEOPRESSURED BRINES: TECHNICAL EVALUATION AND COST ANALYSIS
R. Quong, H. H. Otsuki, and F. E. Locke Jul. 1971 29 p refs
(Contract W-7405-eng-48)
(UCID-19090; DE81-027837) Avail: NTIS HC A03/MF A01

Solvent extraction is proposed as a means of recovering dissolved methane from geopressured-geothermal brines at high pressures. The assessment shows that additional investment in a high pressure solvent extraction plant proceding direct injection disposal of brines into isolated aquifers can be profitable. The technical and economic issues are discussed, and compared with other injection methods such as complete depressurization for methane recovery followed by conventional mechanical pumping. The contributions of hydraulic (pressure) energy recovery and geothermal power production are also assessed. For deep injection into the producing formation, it is concluded that methane extraction processes are not applicable, insofar as maintenance of high surface pressures provides no clear-cut energy benefits. As a first step in the evaluation of solvent extraction, the solubility of a promising solvent candidate, n-hexadecane, was measured in 15 wt % NaCl solutions at temperatures 2 Diesel fuel, was also measured. DOE

N81-32310# Rockwell International Corp., Canoga Park, Calif. Environmental and Energy Systems Group.
MHD COAL COMBUSTOR TECHNOLOGY Final Report
Sep. 1980 213 p refs
(Contract DE-AC22-78ET-11054)
(DE81-025513; DOE/ET-11054/T1) Avail: NTIS HC A10/MF A01

The design, performance, and testing of a 20-MW coal combustor for scaleup to 50 MW for use in an MHD generator are described. The design incorporates the following key features: (1) a two-stage combustor with an intermediate slag separator to remove slag at a low temperature; (2) a first-stage pentad (four air streams impinging on one coal stream) injector design with demonstrated efficient mixing; (3) a two-section first-stage combustion chamber; the first stage using a thin slag-protected refractory layer and the second section using a thick refractory layer; (4) a refractory lining in the slag separator to minimize heat losses; (5) a second-stage combustor; (6) a dense-phase coal feed system to minimize cold carrier gas entering the first-stage combustors; (7) a dry seed injection system using pulverized K_2CO_3 with a 1% amorphous, fumed silicon dioxide additive; and (8) a performance evaluation module of rugged design based on an existing, successfully-fired unit. DOE

N81-32312# Oak Ridge National Lab., Tenn. Fossil Energy Materials Program Office.
ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT FOSSIL ENERGY MATERIALS PROGRAM PLAN FOR FY 1981
R. A. Bradley, comp. and R. R. Judkins, comp. Jul. 1981 179 p refs
(Contract W-7405-eng-26)
(DE81-025776; ORNL/TM-7612) Avail: NTIS HC A09/MF A01

Background, technical issues, and needed fossil energy programs are discussed. The major focus is on coal mining, cleaning, beneficiation, and handling; MHD; and information storage and technology transfer. DOE

N81-32313# Aluminum Co. of America, Alcoa Center, Pa.
PULVERIZED COAL FIRING OF ALUMINUM-MELTING FURNACES Annual Technical Progress Report, Jul. 1979 - Jun. 1980
C. E. West and D. L. Stewart, Jr. 1980 30 p refs
(Contract DE-AC01-78CS-40037)
(DOE/CS-40037/T3; ATPR-2) Avail: NTIS HC A03/MF A01

Progress is reported on the demonstration program of an efficient, environmentally acceptable coal firing process suitable for implementation on melting furnaces in the aluminum industry. Specific tasks reported on are: design of Burner A; purchase of stack gas sampling instrumentation; process equipment and layout; purchase of process equipment; fabrication of Burner A; installation of process equipment; design of slag handling system and fabrication of slag handling system. The status report on Phase I data deliverables and amendment/modification to the contract are given. DOE

N81-32314# Colorado School of Mines, Golden. Dept. of Chemical and Petroleum Refining Engineering.
PHASE-EQUILIBRIUM PROPERTIES OF COAL-DERIVED LIQUIDS Technical Progress Report, Jan. - Jun. 1981
V. F. Yesavage and A. J. Kidnay 1 Jul. 1981 11 p
(Contract DE-FG22-89PC-30230)
(DE81-027106; DOE/PC-30230/T2) Avail: NTIS HC A02/MF A01

On July 1, 1980, work was initiated on a program for experimental vapor liquid equilibrium measurements on coal derived liquids. During the last six months design of the equilibrium flash vaporization system was completed and all major equipment was delivered. Most of the construction work of the system was also completed. Construction and evaluation of the equipment should be completed by the end of the summer. Work was also started on the gas-liquid chromatography analytical procedures. Coal derived liquids are a new and vital class of industrial compounds for which there are limited thermodynamic data. The principal investigators have conducted a program in the measurement and correlation of the enthalpy of coal derived liquids. Programs have also been undertaken to measure volumetric properties and K values of light gas-model compounds systems and to measure new points, vapor pressures and hydrogen solubilities in model compound and coal derived liquid systems. The objective of the present study is to measure equilibrium K values of coal derived liquids and model compounds representative of coal liquids, and to use the results in the development of engineering correlations. DOE

N81-32315# Rockwell International Corp., Canoga Park, Calif. Environmental and Energy Systems Div.
FLASH HYDROLIQUEFACTION OF COAL Quarterly Technical Progress Report, 30 Sep. 1980 - 31 Dec. 1981
A. Y. Falk Jul. 1981 40 p refs
(Contracts DE-AC22-89PC-30018; DE-AC22-76ET-10144)
(DE81-026607; QTPR-1; DOE/PC-30018/T1) Avail: NTIS HC A03/MF A01

The effectiveness of the reactor concept was demonstrated. It is clear that substantial liquid yields and high overall conversions are possible. Overall carbon conversions as high as 64 percent were obtained. Overall conversions of this level are required for balanced plant operation (complete carbon utilization) if the residual char is gasified to generate the process hydrogen. Carbon conversions to liquid products as high as 38 percent were obtained. The reactor is also sufficiently versatile to produce high carbon conversions to gases as well, with conversions as high as 62 percent having been obtained. A high-pressure product recovery system was designed and installed as part of the 1 TPH system. Forty reactor tests were conducted utilizing the new high pressure product recovery system. The new systems functioned well after an initial shakedown, and they allow for better separation and recovery of the products. DOE

N81-32317# Conoco Coal Development Co., Library, Pa.
RECYCLE SLURRY-OIL CHARACTERIZATION Quarterly Report, 1 Jan. - 31 Mar. 1981
F. P. Burke and R. A. Winschel Jun. 1981 52 p refs
(Contract DE-AC22-80PC-30027)
(DE81-025230; DOE/PC-30027/9; QR-2) Avail: NTIS HC A04/MF A01

Measurement of recycle slurry and process oil characteristics are used to evaluate the relationship between coal liquid properties and process performance. Areas of process performance investigated include the following: changes in the slurry recycle and process oil stream compositions during start-up; the manner in which the process reaches steady state operation during start-up; the composition of the recycle and process oil stream during stable operation; the changes in recycle oil composition in response to planned variations in process variables; changes in recycle oil composition which cause or result from unplanned upsets in process operation; differences operating conditions; and differences in recycle and process oil compositions s a function of process feed materials. DOE

N81-32323# Avco-Everett Research Lab., Mass.
VOLATILE PRODUCTION DURING PREIGNITION COAL HEATING Quarterly Progress Report, Jan. - Mar. 1981
May 1981 24 p refs

(Contract DE-AC22-89PC-30291)
(DE81-024321; DOE/PC-30291/T1) Avail: NTIS HC A02/MF A01

Design and fabrication of the experimental system is complete. Mirror design was finalized and optical configurations established for irradiation of the test section. Diagnostic development was necessary for temperature measurement; an upgraded design of a two color pyrometer was made, and is being tested. The computer code for laser heating of the coal particles was rewritten in order to make it more cost effective and efficient. This is being used to assess the consequences of experimental operating conditions upon data output and evaluation of optimal operating conditions. DOE

N81-32324# Institute of Gas Technology, Chicago, Ill.
RELATION OF COAL PROPERTIES TO GASIFICATION REACTIVITY AND THE EFFECT OF ALKILI METAL CATALYSTS ON THE KINETICS OF COAL GASIFICATION Final Report, Jan. 1972 - Mar. 1978
Satyendra P. Nandi and James L. Johnson Nov. 1980 142 p refs
(Contract GRI-5010-322-0026)
(PB81-215212; GRI-78/0048) Avail: NTIS HC A07/MF A01 CSCL 21D

Chars derived from a large number of coal and coal maceral concentrates, varying in rank from anthracite to lignite, have been gasified in hydrogen, steam hydrogen, and synthesis gas mixtures in a thermobalance apparatus at temperatures from 1400 to 1700 F and pressures from 4 to 69 atmospheres. The reactivity factors for different coals were analyzed for possible correlation with such properties as elemental composition, petrographic properties, development of internal surface area and porosity during gasification, and concentration of exchangeable cations (sodium and calcium). A direct correlation between relative reactivity factor and the carbon content of the parent coal was established. GRA

N81-32447# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT AND DEMONSTRATION OF AN ELECTRIC HEAT PUMP FOR WASTE-HEAT RECOVERY IN INDUSTRY. DESIGN AND ANALYSIS REPORT AND ANALYSIS REPORT
W. C. Moreland, J. S. Eder, and R. W. Wolfe 30 Mar. 1981 160 p refs
(Contract DE-AC01-77CS-40327)
(DE81-028751; TR-2; DOE/CS-40327/T1) Avail: NTIS HC A08/MF A01

The output capacity of the unit is 30 x 10 to the 6th power Btu/h in the form of process steam delivered at 50 psig with 20 F superheat (318 F). A functional description of the heat pump system is given along with a thermodynamic analysis of the cycle. The various subsystems, controls, and major components are also described and a safety analysis presented. A general discussion of the important considerations involved when considering the application of a heat pump to an industrial process is given. Additional information includes an analysis of the hot gas by-pass and control of the intercooler; pressure drops in methanol piping and heat exchangers; and typical liquid nitrogen storage system information. DOE

N81-32448# Lehigh Univ., Bethlehem, Pa.
SOLID CIRCULATION AROUND A JET IN A FLUIDIZED-BED GASIFIER Final Report
Hugo S. Caram and Babu Patrose Apr. 1981 45 p refs
(Contract DE-FG01-78ET-13384)
(DOE/ET-13384-T2) Avail: NTIS HC A03/MF A01

Particle circulation in the jet region of a fluidized bed gasifier is analyzed. Particle velocities were measured at corresponding points within a jet in the two dimensional bed, using the optical fiber probe and a Laser Doppler Velocimeter (LDV). The probe measurements compare well with the LDV results in the main jet region. Particle velocities were also measured with the probe in the dense phase region of the fluidized bed where measurements were not possible using LDV. The resulting flow maps clearly indicate solids circulation patterns around jets and identify dead zones formed on the distributor plate. The entering gas jet was modeled assuming that the dense phase is entrained into the gas stream. The solid particles are then conveyed upwards along the jet penetration distance. Typical conditions for a fluidized bed combustor were used and the model includes the reactions between carbon and carbon monoxide. The results indicate that considerable reaction occurs in the gas jets entering the reactor and that they should be considered in any careful analysis of its operation. DOE

N81-32584# Energy Resources Exploration, Inc., Albuquerque, N. Mex.
GEOTHERMAL RESOURCE VERIFICATION FOR AIR FORCE BASES
Philip R. Grant, Jr. Sandia Labs. Jun. 1981 53 p refs Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789; AF Proj. 2054)
(AD-A102640; SAND-81-7123) Avail: NTIS HC A04/MF A01 CSCL 10/2

Geothermal energy offers a potential alternative to oil and gas for supplying the stationary energy requirements of military installations. However, because of the past dominance of oil and gas, procedures for estimating geothermal energy potential have not been well defined nor well tested. This report summarizes the various types of geothermal energy, reviews some legal uncertainties of the resource and then describes a methodology to evaluate geothermal resources for applications to U.S. Air Force bases. Estimates suggest that exploration costs will be $50-300,000, which, if favorable, would lead to drilling a $500,000 exploration well. Successful identification and development of a geothermal resource could provide all base, fixed system needs with an inexpensive, renewable energy source.
Author (GRA)

N81-32589# California Univ., Berkeley. Energy and Environment Div.
GEOPRESSURED GEOTHERMAL RESOURCE OF THE TEXAS AND LOUISIANA GULF COAST: A TECHNOLOGY CHARACTERIZATION AND ENVIRONMENTAL ASSESSMENT
Anthony Usibelli, Peter Deibler, and Jayant Sathaye Dec. 1980 259 p refs
(Contract W-7405-eng-48)
(DE81-028905; LBL-11539) Avail: NTIS HC A12/MF A01

Two aspects of the Texas and Louisiana Gulf Coast geopressured geothermal resource: the technological requirements for well drilling, completion, and energy conversion, and the environmental impacts of resource exploitation are examined. The information comes from the literature on geopressured geothermal research and from interviews and discussions with experts. The technology characterization section emphasizes those areas in which uncertainty exists and in which further research and development is needed. The environmental assessment section discusses all anticipated environmental impacts and focuses on the two largest potential problems which are subsidence and brine disposal.
DOE

N81-32591# Midwest Research Inst., Golden, Colo. Agriculture Group.
BIOMASS FEEDSTOCKS FOR PETROCHEMICAL MARKETS: AN OVERVIEW AND CASE STUDY
Silvio J. Flaim, Andrew M. Hill (Pace Co. Consultants and Engineers, Inc.), and Dan Lippe May 1981 108 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-027281; SERI/TR-734-762) Avail: NTIS HC A06/MF A01

A method of analysis was developed identifying several target chemicals for potential biomass feedstock substitution. An overview of the petroleum/petrochemical industries is presented and a general discussion of refinery trends. A case study of methanol production for formaldehyde manufacturing is presented. The technical, economic, and market implications of producing biomass-derived methanol for formaldehyde manufacturing appear highly favorable. General discussions of market and economic factors (e.g., supply and demand) for all petrochemicals with emphasis on the identified target chemicals are presented. DOE

N81-32593# Pennsylvania Univ., Philadelphia. School of Public and Urban Policy.
ECONOMIC ANALYSIS OF GEOPRESSURED RESOURCES: SITE SPECIFIC CONSIDERATION OF GEOPRESSURED METHANE GAS AT BRAZORIA Final Report, 1 Mar. 1980 - 28 Feb. 1981
Apr. 1981 98 p refs
(Contract DE-AS08-80NV-10089)

(DE81-027193; DOE/NV-10089-1) Avail: NTIS HC A05/MF A01

The project quantitatively evaluates the relative effectiveness of a number of financial incentives and other public policy initiatives designed to accelerate the commercialization of geopressured resources. Results are reported including: a review of current estimates of important resource parameters at the Austin Bayou Project, initial cash flow simulations of development of the Austin Bayou Prospect, sensitivity analysis of these simulations and evaluation of the uncertainties impact on measures of profitability and investment decision analysis, and a brief review of the well-testing program. DOE

N81-32603*# United Technologies Research Center, East Hartford, Conn.

CATALYTIC COMBUSTION WITH INCOMPLETELY VAPORIZED RESIDUAL FUEL Final Report

Thomas J. Rosfjord Mar. 1981 65 p refs

(Contract DEN3-152; DE-AI01-77ET-10350)

(NASA-CR-165161; DOE/NASA/0152-1;

OTRC-R81-914/24-18) Avail: NTIS HC A04/MF A01 CSCL 10A

Catalytic combustion of fuel lean mixtures of incompletely vaporized residual fuel and air was investigated. The 7.6 cm diameter, graded cell reactor was constructed from zirconia spinel substrate and catalyzed with a noble metal catalyst. Streams of luminous particles exited the rector as a result of fuel deposition and carbonization on the substrate. Similar results were obtained with blends of No. 6 and No. 2 oil. Blends of shale residual oil and No. 2 oil resulted in stable operation. In shale oil blends the combustor performance degraded with a reduced degree of fuel vaporization. In tests performed with No. 2 oil a similar effect was observed. E.A.K.

N81-32656# Agua Caliente Trailer Park, Nev.

GEOTHERMAL HEATING FOR CALIENTE, NEVADA Final Report

Ferg Wallis and John Schaper (Grover C. Dils Medical Center, Caliente, Nev.) Feb. 1981 29 p Submitted for publication

(Contract DE-FG03-78SF-01975; Grant EM-78-G-03-1975)

(DE81-027821; DOE/SF-01975/T1) Avail: NTIS HC A03/MF A01

Geothermal heating for a trailer park and a hospital is discussed. The results from test wells for the trailer park indicate sustainable temperatures of 1400 to 1600 F. Three wells were drilled to supply all 53 trailers with domestic hot water heating, 11 trailers with space heating and hot water for the laundry from the geotherma resources. System payback in terms of energy cost-savings is estimated at less than two years. A geothermal well was drilled for the hospital and the hot water piped through a heat changer to preheat air for space heating. This geothermal preheater served to convert the existing forced air electric furnace to a booster system. It is estimated that the hospital will save an average of $5300 in electric bills per year, at the current rate of $.0275/KWH. This represents a payback of approximately two years. Subsequent studies on the geothermal resource base in Caliente and on the economics of district heating indicate that geothermal may represent the most effective supply of energy for Caliente. DOE

N81-32673# Oklahoma State Univ., Stillwater. Engineering Energy Lab.

SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 8: WIND ENERGY

William L. Hughes, R. G. Ramakumar, and Dan D. Lingelbach Apr. 1981 143 p refs Prepared in cooperation with Univ. of Central Florida, Orlando

(DE81-029009; DOE/CS-30278/T10) Avail: NTIS HC A07/MF A01

A historical perspective of wind energy utilization, and the potential uses of wind were examined and the economic costs and technical difficulties of using it. The statistical characteristics of the wind for a moderate to high wind area in the United States are discussed. Information on average available energy on an annual basis is presented along with approximately monthly variations. An extensive variety of types of windmills, and a sampling of these varieties is discussed. Data on efficiencies and power coefficients for a variety of turbines are also presented. DOE

N81-32881*# Intergraph Corp., Huntsville, Ala.

IGDS/TRAP INTERFACE PROGRAM (ITIP). SOFTWARE USER MANUAL (SUM)

Steve Jefferys, Wendell Johnson, Robert Lewis, and Ralph Rich 18 Sep. 1981 39 p

(Contract NAS8-34279)

(NASA-CR-161857) Avail: NTIS HC A03/MF A01 CSCL 09B

This specification establishes the requirements, concepts, and preliminary design for a set of software known as the IGDS/TRAP Interface Program (ITIP). This software provides the capability to develop at an Interactive Graphics Design System (IGDS) design station process flow diagrams for use by the NASA Coal Gasification Task Team. In addition, ITIP will use the Data Management and Retrieval System (DMRS) to maintain a data base from which a properly formatted input file to the Time-Line and Resources Analysis Program (TRAP) can be extracted. This set of software will reside on the PDP-11/70 and will become the primary interface between the Coal Gasification Task Team and IGDS, DMRS, and TRAP. The user manual for the computer program is presented. Author

N81-33246* National Aeronautics and Space Administration. Pasadena Office, Calif.

COAL DESULFURIZATION Patent

George C. Hsu, inventor (to NASA) (JPL, California Inst. of Technology, Pasadena). Issued 27 Mar. 1981 5 p Filed 16 Feb. 1978 Supersedes N78-33164 (16 - 24, p 3185) Sponsored by NASA

(NASA-Case-NPO-14272-1; US-Patent-4,146,367;

US-Patent-Appl-SN-878253; US-Patent-Class-44-1R;

US-Patent-Class-44-2; US-Patent-Class-201-17) Avail: US Patent and Trademark Office CSCL 07D

Organic sulfur is removed from coal by treatment with an organic solution of iron pentacarbonyl. Organic sulfur compounds can be removed by reaction of the iron pentacarbonyl with coal to generate CO and COS off-gases. The CO gas separated from COS can be passed over hot iron fillings to generate iron pentacarbonyl.

Official Gazette of the U.S. Patent and Trademark Office

N81-33255# Aerojet Energy Conservation Co., Sacramento, Calif.

COMBUSTION ENHANCEMENT AND POLLUTANT CONTROL RESEARCH WITH ACOUSTICALLY INDUCED MIXING Technical Progress Report, Mar. - Jun. 1981

R. J. Faeser and M. I. Rudnicki Jul. 1981 22 p refs

(Contract DE-AC22-81PC-40270)

(DE81-027016; DOE/PC-40270/1) Avail: NTIS HC A02/MF A01

An experimental research program was initiated to evaluate the possibility that beneficial effects can result when acoustic energy is impressed on the combustion zone of pulverized coal furnaces. Those benefits include the reduction in NO/sub x/ generation, the increase in combustion intensity, and the increase in turndown ratio (maximum flow/minimum flow). The postulated reason for these possible benefits is the fine stirring action of high frequency acoustic waves. The first three month period of this program was devoted to the formulation of a test plan, the design of the 5 lb/hr coal rate combustor with acoustic driver attachments, and the specification of the test facility. DOE

N81-33258# Occidental Research Corp., Irvine, Calif.

CONTROLLED FLASH PYROLYSIS Quarterly Technical Progress Report, Jan. - Mar. 1981

K. Durai-Swamy, S. C. Che, C. B. Chen, R. Jain, S. S. Kim, and H. VonSchonfeldt Apr. 1981 31 p refs

(Contract DE-AC22-80PC-30264)

(DE81-024384; DOE/PC-30264/06; QTPR-2) Avail: NTIS HC A03/MF A01

Six baseline tests were made in the Controlled Flash Pyrolysis unit with a coal feed rate of about 2 kg/h. Preliminary material balance and yield data for these tests are presented. A laboratory scale (1 gm/min.) reactor was set up to get once through pyrolysis data. Free radical studies on coal pyrolysis began using an Electron Spin Resonance spectrometer. DOE

N81-33270# Science Applications, Inc., Canoga Park, Calif. Combustion Science and Advanced Technology Dept.

PERFORMANCE MODELING OF ADVANCED GAS BURNER SYSTEMS: CATALOGUE OF EXISTING INTERCHANGE-

ABILITY METHODS Final Report
P. T. Harsha, R. B. Edelman, and D. H. France 1980 132 p refs Sponsored by Gas Research Inst.
(PB81-217622; SAI-80-024-CP; GRI-80/0021) Avail: NTIS HC A07/MF A01 CSCL 21B

The catalogue includes worked examples to illustrate the application of each of the approaches. It was assembled both to provide an up to date compilation of interchangeability methods and to provide the foundation for the establishment of the basic phenomena involved in both interchangeability and fuel effects on gas utilization in general. GRA

N81-33306*# National Aeronautics and Space Administration. Pasadena Office, Calif.
PRESSURE LETDOWN METHOD AND DEVICE FOR COAL CONVERSION SYSTEMS *Patent Application*
James M. Kendall, Sr. (JPL, California Inst. of Technology Pasadena) and John V. Walsh, inventors (to NASA) (JPL, California Inst. of Technology, Pasadena) Filed 30 Apr. 1981 18 p
(Contract NAS7-100)
(NASA-Case-NPO-15100-1; US-Patent-Appl-SN-259211) Avail: NTIS HC A02/MF A01 CSCL 21D

A pressure letdown device for a pressure dissipating system for a coal gasification reactor is described. The letdown device accepts a polyphase fluid at an entrance pressure and entrance velocity and discharges the fluid from the device at a discharge pressure substantially equal to the entrance temperature and entrance velocity. The device consists of a series of pressure letdown stages including a plurality of coaxially nested symmetrical baffles. The number of apertures or ports for each baffle plate is unique with respect to the number of apertures in each of the other baffles. The mass rate of flow for each port is a function of the area of the port, the pressure of the fluid as applied to the port, and a common pressure ratio established across the ports. NASA

N81-33309# United Technologies Corp., South Windsor, Conn. Power Systems Div.
CHARACTERIZATION OF THE PERFORMANCE OF ADIABATIC REFORMERS OPERATED WITH LOGISTIC FUELS Final Technical Report
J. A. S. Bett, R. R. Lesieur, A. P. Meyer, and H. J. Setzer 30 Jul. 1981 35 p ref
(Contract DAAK70-80-C-0115)
(AD-A103622; PSD/UTC-FCR-3404) Avail: NTIS HC A03/MF A01 CSCL 18/9

United Technologies Corporation, in cooperation with the Electric Power Research Institute, has developed an adiabatic steam reformer capable of processing sulfur-containing fuels for commercial fuel cell power plants. No. 2 fuel oil and various coal-derived liquids have recently been successfully reformed to hydrogen using advanced catalyst formulations. The objective of this program is to determine the performance of the adiabatic reformer when operated with military logistic fuels. The test data will form the basis for system evaluation of the use of the adiabatic reformer in Army 'SLEEP' power plants using military logistic fuels. A two-inch diameter adiabatic reformer capable of supplying the hydrogen required for a 2.5 kW to 6 kW power plant was loaded with advanced metal oxide and nickel catalysts. It ran over 1400 hours; 840 hours with No. 2 fuel oil as reference fuel, 350 hours on unleaded gasoline, and 216 hours on diesel fuel. The performance of the reformer on No. 2 fuel oil (for calibration against previous tests) closely matched previous tests both with respect to fuel conversion and carbon formation characteristics. After an initial decay period of about 200 hours, the performance remained stable for the remaining 1200 hours of test. The reformer operated at conditions set as design goals for a commercial fuel cell power plant. With unleaded gasoline, the tendency for carbon formation was greatly reduced; even at the lowest values for oxygen to carbon ratio in the process steam no carbon was detected. Operating parameters were defined for each of the fuels. The effect of steam/carbon ratio, pressure and fuel flow rate on fuel conversion was determined. GRA

N81-33312# Utah Univ., Salt Lake City. Dept. of Mining and Fuels Engineering.
CHEMISTRY AND CATALYSIS OF COAL LIQUEFACTION, CATALYTIC AND THERMAL UPGRADING OF COAL LIQUID, AND HYDROGENATING OF CO TO PRODUCE FUELS Quarterly Progress Report, Jan. - Mar. 1981
Wendell H. Wiser Jun. 1981 56 p refs
(Contract DE-AC22-79ET-14700)
(DOE/ET-14700/6) Avail: NTIS HC A04/MF A01

Topics covered include: (1) coal cluster solubilization; (2) carbon-13 NMR investigation of coal derived liquids (CDL) and coal; (3) catalysis and mechanism of coal liquefaction; (4) fundamental chemistry and mechanism of pyrolsis of bituminous coal; (5) catalytic hydrogenation of CDL and related polycyclic aromatic hydrocarbons; (6) denitrogenation and deoxygenation of CDL and related N- and O- compounds; (7) catalytic cracking of hydrogenated CDL and related hydrogenated compounds; (8) hydropyrolysis (thermal hydrocracking) of CDL; (9) systematic structural-activity study of supported sulfide catalysts for coal liquids upgrading; (10) diffusion of polyaromatic compounds in amorphous catalyst supports; (11) catalyst research and development; and (12) characterization of catalysts and mechanistic studies. DOE

N81-33314# Oklahoma State Univ., Stillwater. School of Chemical Engineering.
CATALYSTS FOR UPGRADING COAL-DERIVED LIQUIDS Quarterly Report, 1 Apr. - 30 Jun. 1981
B. L. Crynes 16 Jul. 1981 21 p ref
(Contract DE-AC22-79ET-14876)
(DE81-028332; DOE/ET-14876/T4) Avail: NTIS HC A02/MF A01

Five catalysts were analyzed for pore size distributions of characterize their properties for selection for future experimentation. Also, several coal liquid feedstocks were obtained and were analyzed in preparation for future studies. Four experimental runs were conducted in the Catalyst Life test Unit using a 30 wt % SRC in process solvent mixture. These runs were conducted using a Shell 324 catalyst (NiO-MoO3) at a temperature of 3990 C and a pressure of 13.9 MP. The purpose of these runs was to obtain conditioned catalysts in order to assess the coking and deactivation response. Hydrodenitrogenation and hydrogenation of the catalysts decayed over the interval of study of these four experimental runs. Experimental time was from 1 up to 160 hours of oil catalyst contact. DOE

N81-33317# Battelle Pacific Northwest Labs., Richland, Wash.
ENHANCEMENT OF METHANE PRODUCTION IN THE ANAEROBIC DIGESTION OF MUNICIPAL SEWAGE SLUDGE
DOE Jun. 1981 151 p refs
(Contract DE-AC01-76CS-20300)
(DE81-027246; DOE/CS-20300/1) Avail: NTIS HC A08/MF A01

The effect of powdered activated carbon and other additives on digester performance was evaluated in this report. The objectives of the project include optimizing the carbon addition process for maximum methane production, identifying anciliary benefits, establishing design criteria for application at full scale facilities, asessing technical and economic feasibility, and estimating the impact of the technology on a nationwide basis. Results indicate that the actual feasibility of carbon addition technique would produce beneficial effects only at those sites where digesters are operating poorly. DOE

N81-33318# Public Service Electric and Gas Co., Newark, N.J.
DEVELOPMENT OF A CASE STUDY FOR THE CINNAMINSON LANDFILL METHANE RECOVERY OPERATION
Gerald W. Schirra, Thomas E. Sharp, and Douglas C. Nielson (Wehran Energy Corp.) Feb. 1981 67 p
(Contract W-31-109-eng-38)
(DE81-029988; ANL/CNSV-TM-73) Avail: NTIS HC A04/MF A01

The development, construction, and operation of a methane recovery plant on the site of a sanitary landfill are described. The project was undertaken in 2 phases. At the end of the 1st phase, 250,000 cu ft/day of gas (heating value of 600 Btu cu ft) was being produced by the facility and consumed by a nearby industry. At the end of phase 2, 600,000 cu ft/day was being produced (heating value of 561 Btu/cu ft. DOE

N81-33458# Sandia Labs., Albuquerque, N. Mex.
DESIGN AND USE OF DENSITY GAUGES FOR FOSSIL-ENERGY PROCESSES
D. G. Sample, M. G. Thomas, and J. K. Linn Jun. 1981 24 p

refs Presented at the Symp. on Instrumentation and Control for Fossil Energy Processes, San Francisco, 8 Jun. 1981
(Contract DE-AC04-76DP-00789)
(DE81-023306; SAND-81-1347C; CONF-810607-6) Avail: NTIS HC A02/MF A01

A density gauge has been designed to function as a catalyst level detector in the H-Coal 1 inch bench reactor. The system utilizes a Cs137 source and a BiGe scintillator as a detector. The source/detector systems are encompassed in a yoke which can be maneuvered over approximately 1/3 of the reactor height. Both catalyst level and bed uniformity can be measured. The system, as tested, can distinguish coal slurry and roughly 5% catalyst by volume. DOE

N81-33586# Stanford Univ., Calif. Petroleum Research Inst.
NUMERICAL MODELING OF THERMAL RECOVERY PROCESSES SUPRI-TR-12
M. Soliman, W. E. Brigham, and R. Raghaven Jun. 1981 130 p refs
(Contracts DE-AC03-76ET-12056; E(04-3)-1265)
(DE81-025642; DOE/ET-12056/12) Avail: NTIS HC A07/MF A01

Forward combustion in a simulated laboratory combustion tube was investigated. A mathematical model was developed that includes the thermal, thermodynamic, and hydrodynamic aspects of the process. Oil is assumed to burn directly. A fully implicit scheme is used in a simultaneous technique which seems to be much faster than the Gottfried model. The model yields spatial distributions of pressure and temperature and saturations and concentrations of all important components (oil, water, oxygen, inert gas, and steam). Finally, it gives production rates, cumulative production, and instantaneous and cumulative WORs and GORs. The developed model can also simulate other thermal recovery processes, such as hot water flooding and steam injection. DOE

N81-33648# Georgia Inst. of Tech., Atlanta.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 10: SOLAR TECHNOLOGY ASSESSSMENT: BIOMASS
Albert P. Sheppard, Jerry L. Birchfield, and Jack M. Spurlock Apr. 1981 59 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30478)
(DE81-029011; DOE/CS-30278/T11-Vol-10) Avail: NTIS HC A04/MF 01

The technical status of various biomass fuels, and needed national action and research are summarized. Fuels discussed include biomass liquid fuels from agricultural feedstocks (alcohol), liquid fuels from cellulosic feedstocks, energy from wood, and nonwoody biomass converted to gaseous fuels. DOE

N81-33657# Maurer Engineering, Inc., Houston, Tex.
EVALUATION OF EQUIPMENT AND METHODS TO MAP LOST CIRCULATION ZONES IN GEOTHERMAL WELLS
William J. McDonald, Patrick A. Leon, and Gerard Pittard May 1981 208 p refs Prepared for Sandia National Labs.
(Contract DE-AC04-76DP-00789)
(DE81-769405; SAND-80-7057) Avail: NTIS HC A10/MF A01

Methods to locate, characterize, and quantify lost circulation zones are studied. Twenty-five methods of mapping and quantifying lost circulation zones were evaluated, including electrical, acoustical, mechanical, radioactive, and optical systems. The structured, numerical evaluation plan, used as the basis for comparing the 25 tools, and the resulting among the tools is presented. DOE

N81-33663# Bergbau-Forschung G.m.b.H., Essen (West Germany).
INVESTIGATION OF THE USE OF COAL WASTE AS RAW MATERIAL FOR THE PRODUCTION OF ALUMINUM Final Report
Lothar Kuehn, Theodor Schieder, Milan Belsky (Vereinigte Aluminium-Werke AG), Juergen Lotze (Vereinigte Aluminium-Werke AG), and Guenter Winkhaus (Vereinigte Aluminium-Werke AG) Bonn Bundesministerium fuer Forschung und Technologie Nov. 1980 56 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-112; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 11,80

Coal wastes, containing on the average 25% Al2O3, represent an important domestic raw material potential for the aluminium industry. Reliable data on the occurrence and composition of wastes from major coal mining areas in the Federal Republic of Germany were collected. The behavior of wastes during extraction with acids was investigated. Possible uses of residual silica are outlined. There exist basic process concepts for the extraction of alumina from the wastes, using experience in the processing of kaolinite. However, transfer to a technical scale requires several years of further development. Author (ESA)

N81-33668# Technical Research Centre of Finland, Helsinki. Fuel and Lubricant Research Lab.
SIMULTANEOUS THERMAL ANALYSIS OF SOLID FUELS
Jussi Ranta and Timo Nyroenen Jul. 1980 87 p refs In FINNISH; ENGLISH summary
(VTT-34; ISBN-951-38-1125-2; ISSN-0355-3590) Avail: NTIS HC A05/MF A01

Different solid fuels, coal, woods, peat grades, and by-products, and organic wastes were studied by thermoanalysis. An atlas for thermal analyses was prepared which compares the different fuel properties. Thermal gravimetry curves derivate thermal gravimetry curves (combustion rate), differential thermal analysis curves, and gas analysis curves. The method enables calculations of ignition temperatures, combustion rates, reaction related temperatures, temperatures of evolving gases, reaction rates, action energies, and frequency factors. Author (ESA)

N81-33674# Johns Hopkins Univ., Laurel, Md. Applied Physics Lab.
GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN UNITED STATES. TECHNICAL ASSISTANCE REPORT NO. 6, GEOTHERMAL SPACE HEATING AND CONDITIONING: MCGUIRE AIR FORCE BASE, NEW JERSEY
F. K. Hill and R. vonBriesen 30 Dec. 1980 44 p refs
(Contracts DE-AI01-79ET-27025; EX-76-A-36-1008)
(PB81-212375; JHU/APL/QM-80-190) Avail: NTIS HC A03/MF A01 CSCL 13A

The feasibility of space heating and cooling 200 multifamily on-base housing units using nonreversible heat pumps and ground water from 1000 ft. depth was studied. The 200 housing units are a part of the 1452 main base multifamily housing complex which is heated from a high temperature and pressure water line. The main system will be converted from natural gas to coal in 1984. Relative cost, amortization periods, and fossil fuel projections are compared. GRA

05

ENERGY CONVERSION

Includes photovoltaic, thermoelectric, geothermal, ocean thermal, and wind energy conversion. Also includes nuclear reactors and magnetohydrodynamic generators.

A81-40899 # **18:1 pressure ratio axial/centrifugal compressor demonstration program.** J. K. Schweitzer (United Technologies Corp., Government Products Div., West Palm Beach, FL) and J. W. Fairbanks (U.S. Department of Energy, Office of Coal Utilization, Washington, DC). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1479.* 11 p. Contract No. DE-AC05-76OR-05035.

The results of a component technology demonstration program to design and test an advanced axial/centrifugal compressor for industrial gas turbine applications are presented. Objectives were to demonstrate 18:1 pressure ratio at 90% polytropic efficiency with 80% fewer parts as compared to current industrial gas turbine compressors. The compressor design approach utilizes low-aspect-ratio/highly loaded axial compressor blading combined with a centrifugal backend stage to achieve the 18:1 design pressure ratio on a single spool in only seven stages. Demonstrated design point performance was 91.5% polytropic efficiency at 14% stall margin and 70 lbm/sec flow. This represents the highest known demonstrated performance in this pressure ratio and flow class. The results are particularly significant in that they were accomplished at axial compressor aerodynamic loading levels approximately 15% above current production engine design practice. (Author)

A81-41028 # **Selection of turbine parameters for steam-hydrogen engine schemes (Osobennosti vybora parametrov turbin dvigatelei parovodorodnykh skhem).** N. N. Bykov and M. A. Chekalov. *Aviatsionnaia Tekhnika,* no. 1, 1981, p. 13-18. In Russian.

The problem of turbine parameter selection for steam-hydrogen schemes is investigated analytically. It is shown that specific characteristics of such schemes, combined with differences in the physical properties of combustion gases and hydrogen, make parameter selection criteria for steam-hydrogen engines essentially different from those for conventional gas turbines. Some of these differences are examined. V.L.

A81-41080 Thermodynamics of the r..gnetic equilibria of a semi-collisionless plasma. E. Minardi (EURATOM and Max-Planck-Institut für Plasmaphysik, Garching, West Germany). *Journal of Plasma Physics,* vol. 25, June 1981, p. 413-441. 38 refs.

A statistical model of the collisionless or semi-collisionless equilibria of a magnetically confined plasma is presented which allows the calculation of the entropy and of the thermodynamic potentials as functionals of the collective equilibrium quantities. The entropy principle enables the identification of the magnetic equilibria which are preferentially chosen by the plasma. Stability criteria are derived by declaring unstable an equilibrium which admits in its neighbourhood an accessible equilibrium with higher entropy. The requirement of thermodynamic stability imposes considerable restrictions on the magnetic configuration, on the pressure distribution, and on the velocity distribution function. New conditions for magnetic stability are derived and known results reinterpreted. The theory points towards the force-free configurations, in the case of a current carrying plasma subject to certain physical constraints, or towards the minimum-B configurations, in the general case of arbitrary beta, as the most stable states from the thermodynamic point of view. The formalism is applied to identify the most promising lines to be pursued experimentally in order to achieve magnetic stability in a thermonuclear device. (Author)

A81-41083 The bumpy Z-pinch. T. H. Jensen and M. S. Chu (General Atomic Co., San Diego, CA). *Journal of Plasma Physics,* vol. 25, June 1981, p. 459-464.

The 'bumpy Z-pinch' is a magnetic configuration with potential usefulness for fusion reactors. A conceptually simple version of the configuration is axisymmetric. It contains regions of closed and open field lines. In the region of closed field lines, the field line topology is much like that of a tokamak; these regions link the region of open field lines around the axis of symmetry. Assuming that the plasma spontaneously maintains an equilibrium as described by Taylor (1974), it is possible to maintain indefinitely the regions of closed field lines by driving an axial current through the plasma in the region of open field lines. The ratio between the total axial driven current and the total poloidal current in each of the tokamak-like regions can, in principle, be made arbitrarily small, which means that the load impedance can be arbitrarily large. In addition, the configuration has the inherent virtue similar to that of the spheromak that the tokamak-like part of the plasma does not link any material coils. (Author)

A81-41120 Utility-sized Madaras wind plants. D. H. Whitford and J. E. Minardi (Dayton, University, Dayton, OH). *International Journal of Ambient Energy,* vol. 2, Jan. 1981, p. 3-21. 5 refs. Contract No. EY-76-S-01-2554.

An analysis and technological updating were conducted for the Madaras Rotor Power Plant concept, to determine its ability to compete both technically and economically with horizontal axis wind turbine generators currently under development. The Madaras system uses large cylinders rotating vertically atop each regularly spaced flatcar of a train to propel them, by means of Magnus-effect interaction with the wind, along a circular or oval track. Alternators geared to the wheels of each car generate electrical power, which is transmitted to a power station by a trolley system. The study, consisting of electromechanical design, wind tunnel testing, and performance and cost analyses, shows that utility-sized plants greater than 228 MW in capacity and producing 975,000 kWh/year are feasible. Energy costs for such plants are projected to be between 22% lower and 12% higher than horizontal axis turbine plants of comparable output. O.C.

A81-41121 Heat pumps using heat from lakes and the sea. B. L. Davin, J. Nordling, and K. Sandart (Scandiaconsult International AB, Stockholm, Sweden). *International Journal of Ambient Energy,* vol. 2, Jan. 1981, p. 41-45.

A study is presented on heat pump designs and processes in which lake or sea water both enters and leaves the heat exchanger used in the liquid state, so that only sensible (rather than liquid-solid phase transition, or latent) heat is extracted. Among the factors that must be considered in meeting these criteria are: (1) water temperature should not fall below 3 C, in order to avoid icing, and its average temperature should be as high as possible; (2) sufficient quantitites of water should be available at the lowest required temperature level, thereby eliminating the use of the smaller lakes as sources; (3) the corrosion risks of salinity must be weighed against its advantageous depression of the freezing point; and (4) biofouling must be prevented on all heat-transfer surfaces. Detailed performance and economic figure comparisons are given for 100 kW, 1 MW, and 10MW plants. O.C.

A81-41127 # **Hydroelectric power from ocean waves.** K. Raghavendran (NGEF-AEG Engineering Co., Ltd., Bangalore, India). *Institution of Engineers (India), Journal, Electrical Engineering Division,* vol. 61, Feb. 1981, p. 169-172.

This paper describes a system which converts the variable energy of ocean waves into a steady supply of energy in a conventional form. The system consists of a set of floats and Persian wheels located off-shore and a storage reservoir on the shore. The floats oscillate vertically as the waves pass below them and turn their respective Persian wheels which lift sea water to a height and deliver to the reservoir through an interconnecting pipeline. The head of water in the reservoir operates a hydraulic turbine which in turn works a generator to supply electricity. Due to the recurrent wave action, water is maintained at the optimum level in the reservoir to ensure continuous power supply. (Author)

A81-41250 Rimmed polyblade wind turbine. P. S. Smith and O. J. M. Smith (California, University, Berkeley, CA). *Sunworld,* vol. 5, Mar. 1981, p. 40-47.

An introduction is given to the design, construction and performance of the rimmed polyblade wind turbine (RPWT), a structurally simple wind-driven generator producing electrical power

synchronized with that of utility grids. The structure of the turbine is essentially that of a bicycle wheel, with thin, NASA GA(w)-2 airfoils threaded over the spokes. Only the rim is in compression, yielding a structure stable enough to withstand gale winds. Among the topics discussed are: (1) the generator-driving turbine wheel; (2) the airfoils; (3) the 230-volt, 3-phase induction generator; (4) the weathervaning tail control; (5) control circuitry; (6) power factors compensation; (7) towers and construction methods; (8) performance; (9) efficiency; and (10) range of applications. O.C.

A81-41277 # Unusual structures observed in X-ray emission from laser-irradiated targets. M. J. Herbst, R. R. Whitlock, and F. C. Young (U.S. Navy, Naval Research Laboratory, Washington, DC). *Physical Review Letters,* vol. 47, July 13, 1981, p. 91-94. 15 refs. Research supported by the U.S. Department of Energy and U.S. Navy.

X-ray images of laser-irradiated solid targets show spicular structures in the blowoff plasma. Higher density is inferred in the structures, which seem to follow the fluid flow from the target. An explanation involving localized fast-electron production is offered. (Author)

A81-41280 Electron dynamics associated with stochastic magnetic and ambipolar electric fields. R. W. Harvey, M. G. McCoy, J. Y. Hsu, and A. A. Mirin (General Atomic Co., San Diego; California, University, Livermore, CA). *Physical Review Letters,* vol. 47, July 13, 1981, p. 102-105. 19 refs. Contract No. DE-AT03-76ET-51011.

Molvig et al. (1978) and Wiley and Hinton (1980) have proposed mathematical descriptions of the combined effect of the stochastic magnetic field and ambipolar electric field on the electron distribution function. In the current investigation, a transport operator is derived from the guiding-center kinetic equation, moment equations are obtained, and the equations are computationally solved for the electron distribution. The electron velocity distribution function at various plasma radii is shown in a graph. Another graph shows the streamlines of electron flow and the characteristics of the transport operator. The transport operator is coupled with Fokker-Planck and Ohmic-heating terms to compute the distribution function. The emerging physical characteristics indicate the possible importance of the ambipolar potential and plasma boundary physics in determining overall plasma confinement. G.R.

A81-41374 Subsonic flow in the channel of a diagonal MHD generator. N. P. Isakova and S. A. Medin (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR). *(Teplofizika Vysokikh Temperatur,* vol. 18, Nov.-Dec. 1980, p. 1279-1287.) *High Temperature,* vol. 18, no. 6, May 1981, p. 956-962. 9 refs. Translation.

A numerical analysis is presented of the local and integral characteristics of a two-dimensional subsonic flow in a MHD generator channel with diagonally connected electrodes. It is shown that the parameter distribution inhomogeneity is dependent on the electrical loading, and the largest flow deviations occur at the open and short circuits. A comparison is made with a Faraday type channel with regard to the main integral characteristics. Data from the two-dimensional analysis are compared with those from a one-dimensional flow model. K.S.

A81-41528 Radiation damage in titanium alloys. S. M. L. Sastry, J. E. O'Neal (McDonnell Douglas Research Laboratories, St. Louis, MO), and J. W. Davis (McDonnell Douglas Astronautics Co., St. Louis, MO). In: Titanium '80 science and technology; Proceedings of the Fourth International Conference on Titanium, Kyoto, Japan, May 19-22, 1980. Volume 1. Warrendale, PA, Metallurgical Society of AIME, 1980, p. 651-662. 24 refs. Contract No. EG-77-C-02-4247.

Titanium alloys are among materials being considered for the first wall and blanket structure of a fusion reactor. A description is presented of the crystallographic features of the neutron-radiation-induced defect structure, radiation-induced precipitation of nonequilibrium phases, and annealing of damage microstructure determined by transmission electron microscopic examination of variously heat-treated alpha-beta, alpha, and beta-titanium alloys irradiated to a fluence of 3 x 10 to the 21st neutrons/sq cm. It was found that high-energy neutron irradiation of Ti-6Al-4V results in extensive defect clusters, prismatic loops along with fine, ellipsoidal, 10-20 nm beta precipitates. The beta precipitates redissolve upon annealing the irradiated alloy at 650 C. The causes of beta precipitation were identified to be radiation-enhanced diffusion and radiation-induced segregation of the undersized beta stabilizing element, vanadium, to the defect clusters. G.R.

A81-41728 Vehicle testing of Cummins turbocompound diesel engine. M. C. Brands, J. R. Werner, J. L. Hoehne (Cummins Engine Co., Inc., Columbus, IN), and S. Kramer (U.S. Department of Energy, Washington, DC). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810073.* 23 p.

The performance characteristics and fuel consumption of two turbocompound diesel engines designed for heavy-duty vehicles (Class VIII) are investigated. Results of fuel consumption testing for one engine showed a 14.8% improvement as compared to data of a production NTC-400, used as a baseline. The second engine accumulated 50,000 miles on a cross-country route without malfunction, and tank mileage revealed a 15.92% improvement over the production NTC-400, which was operating on the same route. It is concluded that the turbocompound engine provides increased thermal efficiency, reduced exhaust emissions, lowered noise levels, and improved driveability, while maintaining present standards of durability. An advanced turbocompound engine with further improved fuel economy will be ready for vehicle testing in 1982. E.B.

A81-41729 The automotive Stirling engine - Prime mover for a nonresidential heat pump. B. Goldwater (Mechanical Technology, Inc., Latham, NY). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810087.* 12 p.

The concept of an automotive Stirling Engine Derivative Heat Pump (ASEDHP) product is analyzed from a technological and economical point of view. The status of the Stirling engine technical progress, problem areas and development activities is presented with emphasis on the work needed to ensure heat pump success. The system is described in detail and a performance estimate is given. The critical factors influencing the possible market penetration are discussed, and the analysis shows that a large potential market in excess of 900,000 installed tons per year of refrigeration is estimated. E.B.

A81-41730 Variable stroke power control for Stirling engines. B. Ziph and R. J. Meijer (Stirling Technology, Inc., Ann Arbor, MI). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810088.* 10 p.

A simple method is described for implementing variable stroke power control for Stirling engines by using a variable swashplate activated by a hydraulic stroke converter. It is shown that the high part-load efficiency achieved endows the engine with the capability of developing high torque at low speed without the need for a torque converter and complicated transmissions, while the operating efficiency at high speed is maintained. The hardware making up the system and the operating principles are described in detail. E.B.

A81-41731 The power control system for the Ford-Philips Stirling engine. J. E. Fenton and D. Kosacheff (Ford Motor Co., Dearborn, MI). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810089.* 10 p. 9 refs.

A reliable power control system was developed for the Stirling engine. This control system provides a stable engine speed and an engine speed-accelerator pedal position relationship similar to a spark ignition engine allowing a driver to operate a Stirling-powered vehicle in a conventional manner. (Author)

A81-41733 * Heat engine requirements for advanced solar thermal power systems. L. D. Jaffe and H. Q. Pham (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810454.* 10 p. Research supported by the U.S. Department of Energy and NASA.

Requirements and constraints are established for power conversion subsystems, including heat engine, alternator and auxiliaries, of

dish concentrator solar thermal power systems. In order to be competitive with conventional power systems, it is argued that the heat engine should be of less than 40 kW rated output, in a subsystem with an efficiency of at least 40% at rated output and at least 37% at half power. An interval between major overhauls of 50,000 hours is also desirable, along with minor maintenance and lubrication not more than four times a year requiring no more than one man-hour each time, and optimal reliability. Also found to be important are the capability for hybrid operation using heat from a solar receiver, fuel-fired combustor or both simultaneously, operation at any attitude, stability to transients in input power and output loading, operation at ambient temperatures from -30 to 50 C, and compatibility with environmental and safety requirements. Cost targets include a price of $180/kWe, and operation, maintenance and replacement costs averaging $0.001/kWh for 30 years of operation. A.L.W.

A81-41767 # Computational study of the implosion dynamics on light ion beam fusion. S. Higaki, S. Ido, K. Imasaki, S. Miyamoto, T. Yabe, K. Nishihara, S. Nakai, and C. Yamanaka (Osaka University, Osaka, Japan). *Osaka University, Technology Reports,* vol. 31, Mar. 1981, p. 73-80. 5 refs.

Light ion beam-driven fusion pellet implosion dynamics were studied by means of one-dimensional hydrodynamic simulation codes. Starting from rough estimates of implosion efficiency in the tamper model, it is shown that beam energy has an optimum value of 10 MeV, yielding implosion efficiency on the order of 0.17. Parameter studies for various power pulses indicate the power shaping that results in the greatest pellet gain. The optimum deuterium fuel density was found to be 28.6 mg/cu cm, where proton beam energy is 50 TW in 40 nsec. O.C.

A81-41855 Generation of high-frequency electrical pulses by means of a shaped-charge explosion. V. M. Titov and G. A. Shvetsov. *(Fizika Goreniia i Vzryva,* vol. 16, Sept.-Oct. 1980, p. 47-56.) *Combustion, Explosion, and Shock Waves,* vol. 16, no. 5, Mar. 1981, p. 522-529. 15 refs. Translation.

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.

A81-41881 Experimental investigation of the electrical conductivity of a two-phase stream. A. P. Vasil'ev (Orenburgskii Politekhnicheskii Institut, Orenburg, USSR). *(Inzhenerno-Fizicheskii Zhurnal,* vol. 39, Oct. 1980, p. 649-653.) *Journal of Engineering Physics,* vol. 39, no. 4, Apr. 1981, p. 1083-1087. 9 refs. Translation.

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.

A81-41988 Electrical characteristics of MHD generators with solid electrodes and linear potential distribution on end inserts. G. P. Bazarov, V. A. Bitiurin, E. N. Kufa, and S. A. Medin. *(Magnitnaia Gidrodinamika,* Oct.-Dec. 1980, p. 107-114.) *Magnetohydrodynamics,* vol. 16, no. 4, Apr. 1981, p. 414-419. 9 refs. Translation.

A numerical analysis is used to study the local and integral characteristics of the end sections of Faraday-type MHD generators with solid electrodes and sectioned metallic end strips. The characteristics are investigated in relation to the length of the strips, their position relative to the decreasing magnetic field, and the mode of channel loading for a linear distribution of potential on the strips. It is shown that there exist optimal dimensions of end strips and optimal positions relative to the magnetic field. The characteristics of channels with different end configurations are examined. B.J.

A81-42055 The Darrieus wind turbine for electrical power generation. M. L. Robinson (Department of Defence, Weapons Systems Research Laboratory, Salisbury, Australia). *Aeronautical Journal,* vol. 85, June 1981, p. 244-255. 22 refs.

Aspects of wind as an energy source and the momentum theory of wind turbines are briefly examined. Types of Darrieus wind turbine are described; attention is given to a turbine with airfoil blades curved in troposkein form, and a turbine with straight blades of fixed or variable pitch. The Darrieus vertical-axis wind turbine is then considered with regard to aerodynamics, annual energy output, structures, control systems, and energy storage. Brief reviews of selected Darrieus wind turbine projects are given, including those at Magdalen Islands, Canada, Sandia Laboratories, Reading University, and Australia and New Zealand. P.T.H.

A81-42057 # Investigation of the effect of the geometry of the electrodes on the characteristics of Faraday-type MHD channels with inhomogeneous flows (Issledovanie vliianiia geometrii elektrodov na kharakteristiki Faradeevskikh MGD-kanalov s neodnorodnymi potokami). V. K. Tiutin and V. D. Tsar'kov. *Magnitnaia Gidrodinamika,* Apr.-June 1981, p. 97-104. 10 refs. In Russian.

A numerical solution of the two-dimensional problem of the distribution of electric potential and current density in Faraday-type MHD generator channels, with allowance for flow inhomogeneity, is used to study the electrical properties of channels of rectangular and circular cross sections with various electrodes. It is shown that the characteristics of such channels can be improved by the use of rectangular channels with ridge-shaped electrodes, and also by the use of circular channels with circumferentially situated electrodes. The optimal dimensions of such electrodes are determined, and attention is given to the characteristics of MHD channels with ridge-shaped electrodes and modular side walls. F.G.M.

A81-42441 Arrays of three-dimensional wave-energy absorbers. G. P. Thomas and D. V. Evans (Bristol, University, Bristol, England). *Journal of Fluid Mechanics,* vol. 108, July 1981, p. 67-88. 9 refs. Research supported by the Science Research Council.

The behavior of a single linear array of five equally spaced semi-immersed spheres, absorbing energy in a single mode from a regular wave train, is studied both for optimal tuning and for constrained body displacement amplitudes. This is extended to consideration of two parallel rows of such devices. Finally, the spheres are replaced by identical bodies of a particular geometry, containing a strong angular variation, which are studied using a thin-ship approximation. (Author)

A81-42497 # Tandem-disk theory - With particular reference to vertical axis wind turbines. J. V. Healey (Belfast, Queen's University, Belfast, Northern Ireland). *Journal of Energy,* vol. 5, July-Aug. 1981, p. 251-254. 7 refs.

The effect of blade shape on the performance of straight-blade turbines is investigated, and an attempt is made to establish the tandem disk system as a model for vertical axis wind turbines. Two unknowns are chosen as independent parameters, and expressions for the windspeeds and power coefficients are obtained in terms of these parameters. Pressure is varied between the two disks, and the power coefficient for the tandem disk model is evaluated. The range of validity of the momentum theory is determined, although with some difficulty, for the single-disk and tandem models. Finally, the theory can be alternatively combined with the blade-element theory, which yields two additional equations, thus resolving the indeterminacy. D.L.G.

A81-42498 # Comparison of field and wind-tunnel Darrieus wind-turbine data. R. E. Sheldahl (Sandia Laboratories, Albuquerque, NM). *Journal of Energy,* vol. 5, July-Aug. 1981, p. 254-256. 6 refs. Research supported by the U.S. Department of Energy.

A 2-m-diam Darrieus vertical axis wind turbine with NACA-0012 airfoil blades was tested in the field and in a 4.6 x 6.1-m low speed wind tunnel for a direct comparison. Comparisons were made with field data of equivalent chord Reynolds number, and at equivalent rotational field. Maximum values of the power coefficients compared favorably, and an examination of performance coefficients showed complete agreement between wind tunnel and field data. Due to excellent agreement in the first two comparisons, no further field testing was done, and the accuracy of the wind-tunnel test data was believed verified. D.L.G.

A81-42776 **Small turbofan engines - Their impact on general aviation aircraft.** L. R. l'Anson and W. F. Schneider (Avco Corp., Avco Lycoming Div., Stratford, CT). *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 7-10, 1981, Paper 810622.* 15 p.

The application of small turbofan engines to general aviation aircraft is evaluated with consideration given to the selection of engine cycle parameters, such as fan pressure ratio, bypass ratio and exhaust system. Gas power produced by a gas generator to thrust or flight power for propulsion of a fixed wing aircraft is discussed with emphasis on relating conversion efficiency to specific thrust, bypass and jet velocity ratios, and performance benefits achievable with a mixed exhaust system. The 8.4 bypass ratio fan is found to offer the best fuel economy, with a higher take-off thrust than the low bypass ratio fan, resulting in a 5 percent shorter take-off field length. Fixed flow exhaust improves conversion efficiency and reduces specific fuel consumption by 3 percent. Finally, for cruise speeds above 0.6 Mach number, the power sizing criterion is cruise, providing excess power for OEI climbout, with a resulting increase in propulsion system weight and drag. D.L.G.

A81-42909 **Chemical engine using metal hydride.** K. Nomura, A. Suzuki, and S. Ono (National Chemical Laboratory for Industry, Yatabe, Ibaraki, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2.
Oxford and New York, Pergamon Press, 1981, p. 943-946. 11 refs.

A brief review is presented of a moving picture showing the operation and the process of improvement of the second and the third chemical engine which uses LaNi5 as the energy conversion medium. The high and low temperature heat sources are 75 C and 20 C. The theoretical efficiency is 14.8% in the ideal hydride cycle, and the experimental efficiency is about 6.7%, which is very high for such a low grade heat source. K.S.

A81-43592 # **An interpretive overview of the United States Magnetic Fusion Program.** J. F. Clarke (U.S. Department of Energy, Office of Energy Research, Washington, DC). *IEEE, Proceedings,* vol. 69, Aug. 1981, p. 869-884.

During the 1950s and 1960s attempts made to control the fusion process were largely unsuccessful. Nonetheless, considerable progress was made during these decades because the science of plasma physics, as it applies to fusion plasmas, was nurtured by the attempts to overcome each experimental difficulty. By the early 1970s, both the science and technology of magnetic fusion had matured to the point that a systematic assault on the fusion problem could be attempted. Critical experimental facilities were constructed during the period from 1973 through 1977. The period since 1977 has represented a period of completion and exploitation of the facilities begun in the previous five years. The scientific and technological results achieved during this period have been sufficiently promising to justify the passage of the Magnetic Fusion Energy Engineering Act of 1980, which sets as national policy a shift from a concentration on scientific feasibility of magnetic fusion to the demonstration of engineering feasibility and the construction of a fusion demonstration power plant by the end of the century. G.R.

A81-43672 * **Design and fabrication of a composite wind turbine blade.** R. A. Brown (Boeing Engineering and Construction, Seattle, WA) and R. G. Haley (Boeing Aerospace Co., Seattle, WA). In: Materials 1980; Proceedings of the Twelfth National Technical Conference, Seattle, WA, October 7-9, 1980.
Azusa, CA, Society for the Advancement of Material and Process Engineering, 1980, p. 1095-1103. Contract No. NAS3-20058.

The design considerations are described which led to the combination of materials used for the MOD-I wind turbine generator rotor and to the fabrication processes which were required to accomplish it. It is noted that the design problem was to create a rotor for a 2500 kW wind turbine generator. The rotor was to consist of two blades, each with a length of 97.5 feet and a weight of less than 21,000 pounds. The spanwise frequency is 1.17-1.45 Hz, and the chordwise frequency 2.80-2.98 Hz. The design life of the blade is 30 years, or 4.35 x 10 to the 8th cycles. The structures of the spars and trailing edges are described, and the adhesive bonding system is discussed. C.R.

A81-43779 **Magnetic field due to helical currents on a torus.** W. N.-C. Sy (Australian National University, Canberra, Australia). *Journal of Physics A - Mathematical and General,* vol. 14, Aug. 1981, p. 2095-2112. 20 refs.

By means of coordinate transformations on different forms of the Biot-Savart law, general expressions are derived for both the magnetic vector potential and the magnetic field in two systems of toroidal coordinates. For the cases of interest, it is shown that the integrations can be performed exactly in proper toroidal coordinates, whereas approximations are necessary in quasi-toroidal coordinates. Different forms of helical windings are discussed. The results are applied to the calculation of a stellarator magnetic field of arbitrary polarity l, produced by a distribution of helical current filaments on a torus. The components of the magnetic field are given in terms of infinite series. In the intermediate region, away from the external separatrices and the central region, simple analytic expressions for the magnetic surfaces are obtained. (Author)

A81-43805 **Explanation of the expulsion of impurities from tokamak plasmas by neutral-beam injection.** K. H. Burrell, T. Ohkawa, and S. K. Wong (General Atomic Co., San Diego, CA). *Physical Review Letters,* vol. 47, Aug. 1981, p. 511-515. 23 refs. Contract No. DE-AT03-76ET-51011.

Neutral-hydrogen-beam injection parallel to the plasma current (co-injection) has been observed to produce smaller concentrations of both naturally occurring and injected impurities than counter-injection. We explain this result by considering the effect of plasma rotation on radial impurity transport. This rotation effect could be the basis of an impurity-control technique for tokamak fusion reactors. (Author)

A81-43807 **Use of radiative line broadening by an intense laser field as a plasma diagnostic.** L. Schlessinger (R & D Associates, Marina del Rey; Pacific Sierra Research Corp., Santa Monica, CA) and J. Wright (R & D Associates, Marina del Rey, CA; Illinois, University, Urbana, IL). *Physical Review Letters,* vol. 47, Aug. 1981, p. 519-522. 6 refs. Contract No. W-7405-eng-48.

In laser-fusion applications the laser electric field can reach large values near the critical surface. We propose a method of determining the strength of these electric fields experimentally. The idea is to use the fact that an intense laser field splits bound-bound radiative transition lines into a band of lines, the width of the band depending on the laser intensity. By seeding a target locally with a low-Z material it should be possible to obtain information on the strength of the laser electric field at different positions in the plasma. (Author)

A81-43820 **Ocean wave energy conversion.** M. E. McCormick (U.S. Naval Academy, Annapolis, MD). New York, Wiley-Interscience, 1981. 255 p. 288 refs. $40.

The book provides a review of ocean wave mechanics and an introduction to wave energy conversion. Physical and mathematical descriptions are given of the nine generic wave energy conversion techniques along with their uses and performance characteristics. A number of electro-mechanical energy conversion techniques are described. Attention is also given to the possible environmental effects associated with wave energy conversion. C.R.

A81-44050 **Measurement of MHD combustion-gas temperatures and potassium number densities in the presence of cold boundary layers.** K. Onda, Y. Kaga, and K. Kato (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan). *Journal of Quantitative Spectroscopy and Radiative Transfer,* vol. 26, Aug. 1981, p. 147-156. 11 refs. Research supported by the Ministry of International Trade and Industry.

A81-44532 **Variational moment solutions to the Grad-Shafranov equation.** L. L. Lao, S. P. Hirshman, and R. M. Wieland (Oak Ridge National Laboratory, Oak Ridge, TN). *Physics of Fluids,* vol. 24, Aug. 1981, p. 1431-1441. 9 refs. Contract No. W-7405-eng-26.

A variational method is developed for approximate solutions to the Grad-Shafranov equation, in which the surfaces of the constant poloidal magnetic flux are obtained by solving a few ordinary differential equations (which are moments of the Grad-Shafranov

equation) for the Fourier amplitudes of the inverse mapping. The analytic properties and solutions of the moment equations are considered. Specific calculations using the Impurity Study Experiment and Engineering Test Facility/International Tokamak Reactor geometries are performed numerically, and found to agree with standard two-dimensional equilibrium code calculations. The main advantage of the variational moment method is shown to be its reduction of computational time in accurate two-dimensional equilibria calculations. O.C.

A81-44544 Proton beam-target interaction at pellet fusion power densities. E. Peleg and Z. Zinamon (Cornell University, Ithaca, NY; Weizmann Institute of Science, Rehovot, Israel). *Physics of Fluids,* vol. 24, Aug. 1981, p. 1527-1531. 15 refs. Research supported by the U.S. Department of Energy and U.S. Navy.

A calculation is presented of the interaction of a proton beam at pellet fusion power density with initially solid targets, taking radiative losses and radiation conduction into account at the initial stage of the interaction process when the target is not yet optically thin. To demonstrate the basic physical processes, a step function beam pulse of 1 MV and 100 MA/sq cm is assumed; the distribution of the particle angles of incidence extends from 0 to 37 deg with the normal to the target surface. The targets are initially plane foils of gold and copper at solid densities and thicknesses of 15 and 20 microns, respectively. Plane parallel flow is assumed, so that the one-dimensional hydrodynamic equations of motion are solved. Shock waves are handled by the von Neumann-Richtmyer artificial viscosity method (Nardi et al., 1978). Radiative heat transfer is treated in the conduction approximation. Both energy deposition and conduction calculations are performed between hydrodynamic steps, using the time-splitting technique. It is shown that radiation conduction has the effect of extending the high-temperature region in pellet fusion targets beyond the actual deposition regions. K.S.

A81-44714 Superconductivity and its devices. D. S. Forbes (Chattanooga State Technical Community College, Chattanooga, TN). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 439-443. 33 refs.

Among the more important developments that are discussed are cryotrons, superconducting motors and generators, and high-field magnets. Cryotrons will create faster and more economical computer systems. Superconducting motors and generators will cost much less to build than conventional electric generators and cut fuel consumption. Moreover, high-field magnets are being used to confine plasma in connection with nuclear fusion. Superconductors have a vital role to play in all of these developments. Most importantly, though, are the magnetic properties of superconductivity. Superconducting magnets are an integral part of nuclear fusion. In addition, high-field magnets are necessary in the use of accelerators, which are needed to study the interactions between elementary particles. (Author)

A81-45167 # Generalized equations for the energetic parameters of a thermoelectric cooler with heat exchange at a section of the longitudinal thermoelectric arm surface (Obobshchennye uravneniia energeticheskikh parametrov termoelektricheskogo okhladitelia s teploobmenom na chasti bokovoi poverkhnosti vetvei). A. I. Griadunov, N. B. Giul'mamedov, and R. Kh. Nadzhafov (Akademiia Nauk Azerbaidzhanskoi SSR, Institut Fiziki, Baku, Azerbaidzhan SSR). *Geliotekhnika,* no. 3, 1981, p. 25-30. In Russian.

A set of equations is derived for the thermal capacity of a thermoelectric converter with heat exchange along a section of the longitudinal surface of the thermoelectric arm. From a consideration of the heat balance equations on the working surfaces of the converter for cases of adiabatically insulated arms and heat transfer along portions of the longitudinal surfaces of the arms, expressions are obtained for the dimensionless cooling and heating capacities of the device as a function of the dimensionless feed current. The equations may be used for the optimization of thermoelectric converter parameters. A.L.W.

A81-45449 A new generation of windmills devised for developing countries (Une nouvelle génération d'éoliennes conçues pour les pays en développement). M. Brémont and J. P. Requier (Institut Universitaire de Technologie, Dakar, Senegal). *Entropie,* vol. 17, no. 97, 1981, p. 201-214. 11 refs. In French.

Four generations of windmills have been developed with the objective of maximum operation reliability for the developing Sahel area. Major applications include water pumping from rivers or canals, grain grinding, refrigeration, and production of electricity. Major types of wind collectors (horizontal-axis slow and rapid collectors, and vertical axis slow and rapid collectors) are reviewed. Optimization is discussed in terms of electronic or electromechanical adaptation between generators and the different collectors. Windmills, with multiple applications in mind, have been built in Senegal and have been used in the Sahel area. It is concluded that such windmills can easily be built in any developing country. K.S.

A81-45450 French work on ocean thermal energy conversion (Travaux français sur l'énergie thermique des mers). P. Marchand (Centre National pour l'Exploitation des Océans, Paris, France). *Entropie,* vol. 17, no. 97, 1981, p. 215-223. 12 refs. In French.

The ocean is discussed as a world-wide potential source of renewable energy, with special attention given to the 'deposit' of ocean thermal energy, which is determined by the temperature difference existing between surface water and that at a depth of 1000 m. A brief history of work done in France is presented, and mention is made of the work of d'Arsonval (1881), Claude and Boucherot (1926), and of projects, such as those at Abidjan and Guadeloupe. Attention is given to the French ocean thermal energy sites, to the Empain-Schneider closed-cycle studies, and the open-cycle floating ocean thermal energy station, with a discussion of thermodynamic considerations and cold water pipes. Problems and prospects are reviewed. K.S.

A81-45451 Geothermal energy and the production of electricity (Géothermie et production d'électricité). J. Varet (Bureau de Recherches Géologiques et Minières, Orléans, France). *Entropie,* vol. 17, no. 97, 1981, p. 224-233. In French.

Geothermal production of electricity, about 2,500 MW throughout the world, is considered. The types of geothermal resources are reviewed. A geothermal field can be used for the production of electricity only if the layer, a porous and permeable stock located at depths of 500 and 1500 m, is carried by a magmatic source at high temperatures. Prospecting and development of high energy geothermal energy are discussed, including feasibility studies and the construction of electric power stations. Once the existence of a field is determined, exploitation can begin, consisting of drilling, steam collecting and purifying, and the construction of turboalternator power plants. An example, the Bouillante-Guadeloupe geothermal power station, is presented. Production sites across the globe are reviewed, and electrical energy costs are discussed. K.S.

A81-45907 Power output of segmented MHD Faraday generators with Hall voltage compensation. D. T. Trung and H. K. Messerle (Sydney, University, Sydney, Australia). *Energy Conversion and Management,* vol. 21, no. 2, 1981, p. 97-103. 5 refs.

Compensation methods are considered for the performance deterioration of a segmented MHD Faraday generator due to Hall voltage effects. Current flow through the generator, and the effect of compensating voltages, are analyzed by means of a simple network analogue. Practical segmentation ratios are found to be less than 0.2, a limit which is shown to be well below that required for the minimization of Hall effects due to electrode length. It is determined that Hall effect compensation can yield a significant increase in generator power only at the expense of a large recirculation of power and internal losses, calling for a substantial increase in the rating of associated inverter equipment. O.C.

A81-45908 Potential drops inside MHD generators. M. S. Sodha, G. V. R. Raju, and B. Gupta (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management,* vol. 21, no. 2, 1981, p. 105-114. 11 refs. Research supported by the Council of Scientific and Industrial Research.

A theoretical evaluation is made of the potential drops in various regions of MHD generators, taking ambipolar diffusion, the temperature dependence of mobility and thermal conductivity into account. After deriving an expression for the temperature distribution near the electrodes, potential drop theoretical values are compared with experimental results and found to be in significant

agreement. It is concluded that the inclusion of ambipolar diffusion is neccessary in the theoretical calculation of potential drops in MHD generators. A detailed graphic presentation is made of experimental data. O.C.

A81-46242 # **Energy for space applications.** J. P. Mullin. *American Astronautical Society, Goddard Memorial Symposium on International Space Technical Applications, 19th, Arlington, VA, Mar. 26, 27, 1981, Paper 81-083.* 14 p.

The current NASA Space Power Research and Technology Program, which is conducted to advance the technology base to meet the future energy needs of space technology, is reviewed. Major directions of the program in meeting short-term energy needs include the provision of high power levels at low cost for near-earth applications, and very high performance levels for future geosynchronous and planetary missions. Far-term projects are aimed at opportunities with the potential for radical change from currently accepted technologies. Specific technologies under consideration include photovoltaic energy conversion, chemical energy conversion and storage, and thermal-to-electric conversion, as well as power system management and distribution and advanced energetics. A.L.W.

A81-46348 **Fuel Cells. III - Gas-permeable non-porous oxygen electrodes.** M. A. Parrish (Lambson, Ltd., Castleford, Yorks., England). *Materials in Engineering,* vol. 2, June 1981, p. 208-214. 36 refs.

Consideration is given the permeation of oxygen through an essentially homogeneous polymer membrane in a three-stage process comprising: (1) the absorbing and dissolving of the gas by the membrane on that side which is exposed to the higher pressure; (2) the diffusion of the gas through the membrane towards the opposite face; and (3) final desorption of the gas from the opposite face. Attention is given the performance of an experimental fuel cell employing Silastic 2432 methyl silicon rubber, with a variety of catalysts. Detailed performance data are given. It is concluded that the ideal polymer membrane electrode must be extremely oxygen-permeable, electronically conductive, catalytic towards oxygen electroreduction, as well as inexpensive and easily fabricated. O.C.

A81-46397 **Calcium thionyl chloride high-rate reserve cell.** E. Peled, A. Meitav, and M. Brand (Tel Aviv University, Tel Aviv, Israel). *Electrochemical Society, Journal,* vol. 128, Sept. 1981, p. 1936-1938. 9 refs.

The goal is to assess the high-rate capability of a reserve type calcium-Ca(AlCl4) thionyl chloride cell and to demonstrate its excellent safety features. The good discharge performance at a discharge time of 10-15 min, together with the excellent safety features of the cell, is seen as warranting further investigations of this system as a candidate for high-rate multicell reserved and non-reserved battery applications. A test is described proving that it is practically impossible to 'charge' this cell. C.R.

A81-46472 **A photogalvanic cell utilizing the photodissociation of iodine in solution.** K. L. Stevenson and W. F. Erbelding (Indiana University; Purdue University, Fort Wayne, IN). *(ACS, Chemical Institute of Canada, Mexican Chemical Society, Mexican Institute of Chemical Engineering, and Mexican Pharmaceutical Association, Chemical Congress, 2nd, Las Vegas, NV, Aug. 24-29, 1980). Solar Energy,* vol. 27, no. 2, 1981, p. 139-141. 9 refs. Research supported by the U.S. Department of Energy.

A photogalvanic cell by which visible light is converted into electricity through the photodissociation of iodine in aqueous and non-aqueous solution is described. The aqueous system mechanism is theorized to involve the formation of an I2(-) or I radical, which becomes reduced at the transparent, illuminated electrode. The efficiency of the system is found to be very sensitive to (1) formal concentrations of I2, (2) wavelength, and (3) on electrode material; with the highest efficiency, 0.03%, observed in a cell containing an indium-tin oxide electrode at 4047 A, and 9FI2, 3FNaI in acetonitrile. O.C.

A81-46550 **Shrouded wind turbine research in Israel.** O. Igra (Negev, University, Beersheba, Israel). *International Journal of Ambient Energy,* vol. 2, Apr. 1981, p. 85-96. 14 refs.

Experimental results are presented which demonstrate that enclosing a turbine inside a specially designed shroud will increase its power output by a factor of two; with the prospect of augmentation factors as high as four resulting from the use of coaxial annular, trailing flaps and boundary layer laminarization techniques such as surface suction. The power-augmenting characteristics of shrouds are due to (1) the inviscid wake-recovery effect, which produces a sub-atmospheric pressure region at the shroud exit plane, and (2) the conversion of kinetic energy to a rise in pressure inside the rear part of the shroud. Preliminary economic studies indicate that the shrouded turbine would have lower specific power costs than conventional turbines in at least two power-rating regimes. O.C.

A81-46785 **Theory of a free-field conduction propulsion unit.** V. I. Khonichev and V. I. Iakovlev. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Sept.-Oct. 1980, p. 109-118.) *Journal of Applied Mechanics and Technical Physics,* vol. 21, no. 5, Mar. 1981, p. 666-673. 6 refs. Translation.

An analysis was made of the effectiveness of a conducting MHD motor with a free field using a flat plate finite width model. The variational problem of determining the optimal potential distribution on the plate with maximum efficiency was solved. It was shown that the consideration of the end effects determines some of the unknown characteristics of the system. A.T.

A81-46787 **MHD generator of electrical energy working on the gasification products of lignites.** V. A. Derevianko, V. S. Slavin, and V. S. Sokolov. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Sept.-Oct. 1980, p. 129-138.) *Journal of Applied Mechanics and Technical Physics,* vol. 21, no. 5, Mar. 1981, p. 682-689. 14 refs. Translation.

An investigation is presented of an MHD generator of electrical energy fueled by gasification products of lignite coals using the T-layer effect which eliminates caustic additives. A quasi-one-dimensional theory of linear MHD processes is constructed on the basis of MHD equations; a design of an industrial generator is discussed. A.T.

A81-46824 # **Thermodynamics of the separation-injection cycle of a liquid-metal MHD converter (Termodinamika separatsionno-inzhektornogo tsikea MGD-preobrazovatelia na zhidkikh metallakh /MGDPZhM/).** V. A. Dzhamardzhashvili and I. T. Alad'ev (Gruzinskii Nauchno-Issledovatel'skii Institut Energetiki and Gidrotekhnicheskikh Sooruzhenii, Georgian SSR). *Akademiia Nauk Gruzinskoi SSR, Soobshcheniia,* vol. 102, May 1981, p. 397-400. 12 refs. In Russian.

A81-47120 **Estimating power from wind.** R. D. Diab (Natal, University, Durban, Republic of South Africa). *South African Journal of Science,* vol. 77, Mar. 1981, p. 126-129. 12 refs.

Estimates of both available and usable power in the wind have been obtained using a number of different techniques. It is suggested that, in an unchanging large-scale synoptic situation, it may be permissible to approximate power in the wind by mean statistics. The study also presents a way of determining usable power in the wind by discrete gust analysis. (Author)

A81-47235 **Energy-conversion systems with organic media (Energieumwandlungsanlagen mit organischen Medien).** D. Wolf, G. Schmidt (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany), and S. Haaf (Linde AG, Cologne, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 94-103. In German.

The considered energy-conversion systems are intended for employment as subsystems of solar power stations of the low-power range. The systems are to convert heat energy into mechanical energy and electrical energy. The operational efficiency of energy-conversion systems for the considered applications is particularly important because of the high investment costs for the solar collectors. This efficiency depends to a large degree on a suitable selection of the operational medium and the design of the thermal engine. It is found that organic media have advantages compared to water for the lower temperature range up to 400 C. These advantages are related to an increase in conversion efficiency, and greater

rotational speed. The latter factor ensures the feasibility of an implementation of the required machine parameter values. Suitable organic compounds for operational temperatures below and above 200 C are listed separately. Attention is also given to the advantages of a use of turbines as heat engines and the design data of an energy conversion system currently operating as subsystem of a solar power station in India. G.R.

A81-47238 Economical aspects for large wind energy converters (Wirtschaftlichkeit grosser Windenergiekonverter). H. Selzer (ERNO Raumfahrttechnik GmbH, Bremen, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 142-148. In German.

The reported analysis concerning the economic feasibility of large wind energy converters (WEC) takes into account studies conducted by Timm (1978) and Jarass (1978), and information obtaied in connection with the development of a 2 MW wind energy converter, called Aeolus. Calculations regarding energy-balance aspects in the case of Aeolus show that the energy needed for the manufacture of the WEC will be produced by the WEC from wind energy within 2 to 3 months. In case of a series production of WEC, electric energy could be produced from wind energy at a price of 0.06 DM/KWh. It is pointed out that approximately 65 man-years are needed to produce one large WEC. G.R.

A81-47247 Aerodynamic rotor design of the GROWIAN large-scale wind energy converter (Aerodynamische Rotorauslegung der grossen Windkraftanlage GROWIAN). G. Huss and R. Pernpeintner (M.A.N. - Neue Technologie, Munich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 406-415. In German.

Aerodynamic rotor design for a wind energy plant is examined with reference to rotor blade geometry, number of rotor blades, design top-speed ratio, nominal rotor speed, hub height, and installed generator rating per rotor cycle. The selection and optimization of these parameters for the GROWIAN large-scale wind energy converter is examined taking representative wind data from the North German coastal area as an example. Particular attention is given to the relationship between the aerodynamic rotor design and the expected annual energy production of the system. B.J.

A81-47248 Differences in the control of wind energy converters in grid and isolated operation (Unterschiede bei der Regelung von Windenergiekonvertern im Netz- und Inselbetrieb). G. Cramer, P. Drews, S. Heier, W. Kleinkauf, and R. Wettlaufer (Kassel, Gesamthochschule, Kassel, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 416-428. In German.

Different requirements imposed on the control system for different modes of operation are examined for horizontal axis converters with adjustable rotor blades. The appropriate control structures are developed, and the dynamic behavior of complete plants is described using digital simulation. B.J.

A81-47249 Development of fast rotors with flapping hinges and geometrical pitch-angle setting in an extremely light construction (Schnelläufer-Entwicklung mit Schlaggelenken und geometrischer Blattverstellung in extremer Leichtbauweise). H.-D. Goslich, J. Valett, and W.-H. Kunstmann (Hans-D. Goslich Ingenieurbüro, Hamburg, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 429-440. In German.

Theoretical studies have led to reductions in the force and weight of flapping hinge rotors for use in wind energy systems. A very simple construction and thus easy to maintain, the hinge geometry makes it possible to operate the rotor in any mode, with excellent cost and weight to power ratio. Maximum power supply is possible at very high wind speeds (theoretically 55 m/s) along with idling under the same conditions. The system design makes it possible to employ very large rotor dimensions. B.J.

A81-47251 Dynamic analysis of vertical axis wind turbine blades. L. F. Jesch and R. T. Crossland (Birmingham, University, Birmingham, England). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 450-457. 11 refs.

The angle of attack, thrust coefficient, and Reynolds number variations for each element of a blade in every rotational position of a vertical axis rotor are analyzed by a computer model, using the finite element technique. The thrust coefficient is shown to have four distinct peaks when plotted against the angular position of the shaft. These values oscillate rapidly between positive maxima and negative minima in a complete cycle. The amplitude and frequency of the thrust variations, caused by changes in aerodynamic lift of the rotating blade, are different for every elemental position and are dependent on operating conditions. J.F.

A81-47252 Vertical axis wind mill models - Design testing and evaluation. K. S. Shishodia, K. L. Kumar, and P. L. Sah (Indian Institute of Technology, New Delhi, India). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 458-467.

Vertical axis windmill model designs are tested in a wind tunnel of dimensions 75 cm x 45 cm. The number of airfoil section blades on the windmill are varied from four to eight, and the orientation angle of the blades to the radial lines is changed from 0 to 90 deg. The models are tested at a subsonic low Mach number at wind speeds of 3.6 and 5.1 m/sec and the measurements are used to determine the optimum number of blades and their orientation for optimum power. Results showed that the eight-bladed windmill is more efficient than the four-bladed model. Moreover, the windmill is shown to provide maximum power at 30 deg. Finally, a table of wind speed distributions for windy coastal and non-coastal locations in India is given. J.F.

A81-47253 Regulation and monitoring systems of vertical-axis wind energy converters (Anmerkungen zum Steuerungs- und Überwachungssystem von Windenergiekonvertern mit vertikaler Achse). H. J. Scholz and K. Simhan (Bremen, Universität, Bremen, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 468-479. In German.

The definition of regulation and monitoring systems for vertical-axis wind energy converters is still in the preliminary stage. This necessitates a free programmable regulation and monitoring system capable of a flexible response to failure. The broad principles underlying such systems are discussed with reference to the 2.5-kW wind energy converter at the University of Bremen and the draft design of the 60-kW converter planned by ERNO, Bremen. B.J.

A81-47500 International Conference on MHD Electrical Power Generation, 7th, Massachusetts Institute of Technology, Cambridge, MA, June 16-20, 1980, Proceedings. Volumes 1, 2 & 3. Conference sponsored by the Symposia on the Engineering Aspects of Magnetohydrodynamics, Inc., UNESCO, and IAEA. Edited by A. M. Dawson (MIT, Cambridge, MA) and D. Overlan. Cambridge, MA, Massachusetts Institute of Technology, 1981. Vol. 1, 449 p.; vol. 2, 450 p.; vol. 3, 234 p.

The first volume of this conference on magnetohydrodynamics (MHD) for electrical power generation covers: (1) MHD pilot plants; (2) MHD generator experiments and modeling; (3) the performance of various MHD generator types; (4) MHD channel design considerations; (5) MHD channel materials considerations; (6) MHD system components, heat recovery and emissions; and (7) MHD oxidizers and inverters. The second volume deals with (8) MHD system magnets and combustors; (9) MHD field, flow and chemical processes; (10) MHD fluid dynamics; (11) MHD electrical power plant design; (12) current transfer and diagnostics; and (13) MHD power plant systems considerations. O.C.

A81-47527 Cryogenic processes and equipment in energy systems; Proceedings of the Conference, San Francisco, CA, August 19-21, 1980. Conference sponsored by ASME, AIChE, and International Institute of Refrigeration. Edited by W. M. Toscano, R. C. Longsworth, F. J. Zimmermann, and C. F. Gottzmann. New York,

American Society of Mechanical Engineers, 1980. 199 p. $40.

Among the topics on the application of cryogenic technologies to energy systems covered are (1) cryogenic processes and equipment in synthetic fuel plants, such as the integration of gas purification and separation plants in the Sasol II 'oil from coal' complex, depressuring analysis for cryogenic plant safety, large tonnage oxygen plants, and the turbomachinery limitations of large air separation plants; and (2) cryogenic technology for liquefied natural gas production, storage, transportation and handling, including aspects of cryotank frost heave prevention, computer modeling of massive LNG spills from storage tanks, and minimum-work, multistage cascade refrigeration cycles. Also covered are the applications of cryogenic technology to electrical systems, including large cryopumps for fusion power systems, the characterization of superfluid helium transfer, semiconductor electronics at liquid helium temperature, and MHD superconducting magnets. O.C.

A81-47530 Heat transfer in ocean thermal energy conversion /OTEC/ systems; Proceedings of the Winter Annual Meeting, Chicago, IL, November 16-21, 1980. Meeting sponsored by the American Society of Mechanical Engineers. Edited by W. L. Owens (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). New York, American Society of Mechanical Engineers (Heat Transfer Symposia Series. HTD Volume 12), 1980. 76 p. $16.

Among the topics discussed are: condensation heat transfer on long vertical, axially ridged tubes; tests of the Applied Physics Laboratory of Johns Hopkins University (APL/JHU) folded-tube, Ocean Thermal Energy Conversion (OTEC) heat exchanger; the design of a 1.0-MW OTEC heat exchanger for ocean testing; and convective vaporization and condensation in serrated-fin channels. Also considered are: heat tranfer studies of an improved heat transfer monitor for OTEC; an analysis of the mist lift process for mist flow, open-cycle OTEC; the heat transfer characteristics of working fluids for OTEC; and a comparison of major OTEC power system characteristics. O.C.

A81-47579 # The gust generator at the Institute for Aerodynamics and Gasdynamics of Stuttgart University (Der Böengenerator am Institut für Aerodynamik und Gasdynamik der Universität Stuttgart). G. A. Walter and F. X. Wortmann (Stuttgart, Universität, Stuttgart, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-029.* 21 p. In German.

The gust generator is to be used for the production of reproducible temporal and spatial gusts with variable frequency, amplitude, and spectral distribution. The gusts produced are to be employed in the study of the dynamical characteristics of models of wind turbines. Such studies will make it possible to compare theoretical results, obtained on the basis of a numerical investigation of gust problems, with experimental data. The gust generator represents, therefore, an important tool for verifying the correctness of existing computer programs, theories, and assumptions. The gust generator provides also functional control information concerning different control concepts. The design of the gust generator is discussed, taking into account the test section, the blower, the vanes, and the diffusor. G.R.

A81-47716 Accuracy of the net method of calculating the electrical characteristics of the channel in a MHD generator. A. A. Blitshtein, Iu. P. Gusev, V. I. Pishchikov, and S. I. Pishchikov (Akademiia Nauk SSSR, Institut Vysokikh Temperatur; Moskovskii Energeticheskii Institut, Moscow, USSR). *(Teplofizika Vysokikh Temperatur,* vol. 19, Jan.-Feb. 1981, p. 158-163.) *High Temperature,* vol. 19, no. 1, July 1981, p. 123-127. 8 refs. Translation.

The integral electrical parameters of the channels in MHD generators are calculated by using electric networks consisting of active and passive components, which translate the MHD channel gasdynamic conditions into electrical-engineering language, where each set of the gasdynamic conditions corresponds to a set of parameters in the net model (Yoshida et al., 1977; Blitshtein et al., 1979). To obtain reliable results for channels with substantial wall inhomogeneity in the plasma parameters, the calculation error is determined by the number and dimensions of the net cells in the transverse direction, and a simplified model is used to estimate the error magnitude. Results are compared with those of a study made on the effects of the longitudinal and transverse scales on the integral characteristics of the channel. It is concluded that the results on the current flow transverse to the channel can be used for the preliminary evaluation of the minimum necessary number of layers along the y-axis and the transverse layer dimensions in calculating the integral electrophysical characteristics of a MHD generator channel. K.S.

A81-47717 Numerical study of unsteady processes in a Faraday MHD generator. G. N. Vinogradova and V. P. Panchenko (Akademiia Nauk USSR, Institut Atomnoi Energii, Moscow, USSR). *(Teplofizika Vysokikh Temperatur,* vol. 19, Jan.-Feb. 1981, p. 164-171.) *High Temperature,* vol. 19, no. 1, July 1981, p. 127-133. 10 refs. Translation.

A numerical study is presented on the unsteady processes occurring in a Faraday MHD generator with a high power-conversion efficiency. A supersonic MHD generator operating with an equilibrium plasma and designed to convert energy in a system using a thermonuclear reactor is considered, and the steady operating modes are established for cases when an ohmic load is connected, disconnected, or reduced. A magnetic field is assumed to be generated by a suitable profiling of the external magnetic field, and the working medium is modeled by an ideal gas. Partial differential equations are solved numerically by using a central difference predictor-corrector scheme. The study can be applied to problems (e.g., transient times, nominal parameter maximal values and rates of change, methods of regulating the generator and switching it on and off) arising during the design of MHD generators. K.S.

A81-48219 # Magnetohydrodynamic boundary layer on a wedge. B. N. Rao and M. L. Mittal (Indian Institute of Technology, Bombay, India). *ASME, Transactions, Journal of Applied Mechanics,* vol. 48, Sept. 1981, p. 656-659. 8 refs.

The effects of the Hall and ionslip currents on the gas-dynamic boundary layer are investigated in view of the increasing prospects for using the MHD principle in electric power generation. The currents are included in the analysis using the generalized Ohm's law (Sherman and Sutton, 1964), and the resulting two nonlinear coupled equations are solved using a modification in the method suggested by Nachtsheim and Swigert (1965), Dewey and Gross (1967), and Steinheuer (1968). Solutions are presented for the incompressible laminar boundary-layer equations in the absence and the presence of the load parameter, and for the pressure gradient parameter for flow separation. K.S.

A81-48232 Study of the dynamics of a standard wave power plant. G. I. Denisenko, A. S. Tsybenko, and S. A. Lavrikov (Kievskii Politekhnicheskii Institut, Kiev, Ukrainian SSR). *(Problemy Prochnosti,* Jan. 1981, p. 27-31.) *Strength of Materials,* vol. 13, no. 1, Sept. 1981, p. 25-30. 5 refs. Translation.

Waterwave power plant dynamic processes are examined. Equations of motion are derived for such a system; a computation algorithm is constructed illustrated by an example of utilization of sea wave energy. A.T.

A81-48314 # Engineering approach to the development of geothermal power stations. T. Iwamizu (Kyushu Tokai University, Japan). *Periodica Polytechnica, Mechanical Engineering,* vol. 25, no. 1, 1981, p. 19-46.

Measurements are studied for a hot-water type geothermal discharge, and the well characteristics are defined. These investigations, it is pointed out, formed the basis for an engineering approach to the development of the world's first 50 MW geothermal power station with a double-flash-cycle system. C.R.

A81-48315 # Vertical axis wind turbine designed aerodynamically at Tokai University. Y. Kato, K. Seki, and Y. Shimizu (Tokai University, Tokyo, Japan). *Periodica Polytechnica, Mechanical Engineering,* vol. 25, no. 1, 1981, p. 47-56.

The advantages of the vertical axis wind turbine over conventional propeller-type wind turbines are listed, among them the fact that the turbine is free from the gyroscopic loading accompanied by wind direction tracking. Special attention is given to the straight-wing type vertical axis turbine, which is thought to be particularly advantageous. Also discussed are the characteristics of the blade. It is pointed out that each blade has an asymmetric airfoil in cross section

that is specially designed to extract wind energy as efficiently as possible. C.R.

A81-48350 Computational partitioning for real-time simulation using a parallel-sequential computer system. R. M. Johnson (Montana State University, Bozeman, MT). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 293-298. 12 refs. Contract No. ET-78-C-01-3087.

The use of a parallel-sequential computer combination for the real-time simulation of an MHD/steam power plant is discussed. The discussion focuses on the modeling approach, description of the simulation facility, and problem partitioning for real-time simulation. Tradeoffs in modeling accuracy vs computational speed and possible hardware modifications for increasing the system capabilities are examined. V.L.

A81-48354 Computer simulation of cored brick regenerative heat exchangers. T. A. Ameel and H. W. Townes (Montana State University, Bozeman, MT). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 311-315. 7 refs. Contract No. ET-78-C-01-3087.

A computer model has been developed to simulate the thermal response of a cored brick regenerative heat exchanger to be used in magnetohydrodynamic energy conversion processes. The model uses a set of finite-difference equations to simulate the heat exchange core between gas and ceramic; the equations calculate the temperature variation of the gas and ceramic along the axis of the heat exchange. The insulation and steel shell are thermally coupled to the core by a second set of finite-difference equations. The physical properties of the core, insulation, and gas are curvefit as functions of temperature, and the vertical gaps between insulator layers, causing thermal resistance in the heat exchange, are also represented. The time, burner operation, and intermediate cooldown cycles necessary to reach cyclic, steady-state operating conditions from room temperature are determined during the start-up simulation; the response of the insulation to changes in core temperature was studied during the steady-state simulation; the time required to reduce the core and insulation temperature to safe operating levels was determined during the shut-down simulation. It was concluded that at least 16 hours are necessary for the heat exchanger to reach cyclic, steady-state conditions, and that during a power failure, a back-up power source will be needed for at least 27 hours to insure the safety of the facility. J.F.

A81-48355 Dynamic simulation of MHD topping cycles. R. Johnson and D. Bartle (Montana State University, Bozeman, MT). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 316-320. 12 refs.

Combined Cycle MHD (magnetohydrodynamics)/steam power plants show promise of achieving high efficiency in coal energy conversion to electricity. The plants are composed of an MHD topping cycle operating in the combustion gas temperature range of 3000-2000 K and a bottoming cycle consisting of a modified steam power plant in the steam temperature range of 810 - 300 K. This paper describes the model and some results of simulating the dynamic performance of a combustor-nozzle-channel-diffuser (CNCD) MHD topping cycle on a general purpose ditigal computer. (Author)

A81-48405 # Dam-Atoll for concentration and conversion of ocean wave energy. T. P. Higgins and C. P. Sherburne (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). *American Institute of Aeronautics and Astronautics, Marine Systems Conference, 6th, Seattle, WA, Sept. 14-16, 1981, Paper 81-2074.* 5 p.

A simple wave energy conversion device has recently been patented by Lockheed. The Dam-Atoll concept uses passive structure and the principle of wave refraction as the primary elements to convert wave energy into usable energy. Each unit can provide 1 to 2 MW in an area of adequate wave energy resource. Plans have been formulated for additional development work which could provide operational systems in the latter part of this decade. (Author)

A81-48525 Control policies for wind-energy conversion systems. I. K. Buehring (Exeter, University, Exeter, Devon, England) and L. L. Freris (Imperial College of Science and Technology, London, England). *IEE Proceedings, Part C - Generation, Transmission and Distribution,* vol. 128, pt. C, no. 5, Sept. 1981, p. 253-261. 11 refs. Research supported by the Science Research Council of England.

Wind energy is usually converted into electrical energy through a wind rotor driving a generator. It is well known that maximum conversion efficiency occurs when the wind rotor is loaded in such a way that its rotational speed is allowed to fluctuate in sympathy with wind-speed variations. In the paper, the wind-rotor/generator dynamics are investigated for a number of control policies, and it is shown that the system response is a function of wind speed. Owing to this relationship, control strategies based on static optimum matching premises are unlikely to be optimal under continuously changing conditions. To prove this hypothesis, the aerogenerator dynamics were simulated on an analogue computer, and, for a given recorded windspeed sample, the energy delivered was measured for a number of control strategies. The results indicate that, for the wind sample used and aerogenerator simulated, sophisticated control policies do not necessarily result in maximum energy yield. An attempt is made to interpret this paradox in terms of the system dynamics. (Author)

A81-48939 Intense ion beams. V. M. Bystritskii and A. N. Didenko (Tomskii Politekhnicheskii Institut, Tomsk, USSR). *(Uspekhi Fizicheskikh Nauk,* vol. 132, Sept. 1980, p. 91-122.) *Soviet Physics - Uspekhi,* vol. 23, Sept. 1980, p. 576-593. 125 refs. Translation.

A review is presented of the theory and experimental results on intense ion beam generation. The problems of generating intense ion beams in different reflex systems, the dynamics of charge flux accumulation, and the formation of the anode plasma are reviewed. Attention is given to magnetically insulated diode systems, their fundamental characteristics, and those of the ion beams that they generate. Intense ion beam shaping, neutralization, transport, and focusing are discussed. Applications are given, and include high-power neutron pulses and inertial controlled thermonuclear fusion. It is concluded that the stationary analytical modes that have been studied give good qualitative agreement with experimental data. Individual problems, such as the motion of the electrode plasma in the AC gap and the role of electrons scattered by the anode require further study. K.S.

A81-49394 # Convective and radiative heat transfer in MHD radiant boilers. K. H. Im and R. K. Ahluwalia (Argonne National Laboratory, Argonne, IL). *Journal of Energy,* vol. 5, Sept.-Oct. 1981, p. 308-314. 10 refs.

A combined convection-gas radiation, two-zone flow model is formulated for study of the heat transfer characteristics of MHD radiant boilers. The radiative contributions of carbon dioxide, water vapor, potassium atoms, and slag particles are included in the formulation, and are determined by solving the radiation transport equation using the P1 approximation. The scattering and absorption cross sections of slag particles are calculated from Mie theory. The model is used to analyze the scale-up of heat transfer in radiant boilers with refractory thickness, wall emissivity, and boiler size under conditions of a gas composition and slag particle spectrum typical of coal-fired MHD combustion. A design procedure is suggested for sizing radiant boilers so as to achieve the required heat extraction rate and to provide a flow residence time that is adequate for decomposition of NO(x) to acceptable levels. (Author)

A81-49395 # Heat transfer scaling laws for MHD channels and diffusers. R. K. Ahluwalia and K. H. Im (Argonne National Laboratory, Argonne, IL). *(Symposium on Engineering Aspects of Magnetohydrodynamics, International Conference on Magnetohydrodynamic Electrical Power Generation, 7th, Cambridge, MA, June 16-20, 1980.) Journal of Energy,* vol. 5, Sept.-Oct. 1981, p. 315-320. 7 refs.

A quasi-three-dimensional flow model is used to study the convective and radiative heat transfer characteristics of coal-fired MHD channels and diffusers. The radiative contributions of carbon dioxide, water vapor, potassium atoms, and slag particles are all included in the model. The scale-up of heat transfer with the size of

MHD channels and diffusers is characterized as an aid to extrapolation of experimental heat transfer measurements. The scale-up of radiation with the channel or diffuser size, centerline temperature, wall temperature, boundary layer thickness, gas pressure, and average size and number density of slag particles is investigated. Generalized plots of gas emissivity and absorptivity are provided for use in estimating radiative heat transfer in MHD channels and diffusers. (Author)

A81-49478 * Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Conference sponsored by the U.S. Army, U.S. Air Force, U.S. Navy, NASA, U.S. Department of Energy, and Communications Satellite Corp. Pennington, NJ, Electrochemical Society, Inc., 1981. 290 p. $30.

Fuel systems are considered along with thermal batteries, primary batteries, lithium primary batteries, lithium/sulfur dioxide primary batteries, lithium/oxychloride primary batteries, high temperature secondary batteries, advanced secondary batteries, and nickel secondary batteries. Attention is given to a Ni-Fe battery with gas recombination device and state-of-charge indication, the development of the nickel-iron battery system for electric vehicle propulsion, improved lead-acid batteries, the behavior of the lead-acid batteries used to start the military vehicles at low temperatures, a life cycle energy analysis of the lead-acid battery, and the anodic corrosion of fiber reinforced lead composites for use in lead-acid submarine batteries. A description is presented of the key physical characteristics for predicting Zr powder burn times, the production of zirconium metal powder for rapid rise time thermal battery application, and high rate lithium-iron disulfide batteries. G.R.

A81-49480 Present status of advanced acid fuel cell electrolytes. A. A. Adams and G. W. Walker (U.S. Army, Mobility Equipment Research and Development Command, Fort Belvoir, VA). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 6-9. 12 refs.

In connection with the multitude of different fuels that are projected for a use in fuel cells, fuel cell electrolytes compatible with a broad range of fuels are needed. The overall objectives of recent advanced acid electrolyte programs have been related to an improvement of fuel cell performance and an extension of the range of useable fuels. The desired objectives are to be obtained by replacing phosphoric acid with new acid electrolytes. Most of the investigations have focused on the use of organic 'superacids', i.e., those organic acids which are similar to inorganic acids, having demonstrated high acid strength and high ionic conductivity. The use of organic acids offers a unique opportunity to prepare an acid with the desirable characteristics required for the fuel cell environment. Studies in half-cells were conducted with trifluoromethanesulfonic acid monohydrate, while perfluoroethanedisulfonic acid was employed in investigations with full cells. G.R.

A81-49481 Accelerated testing of fuel cell components in 2 x 2 inch fuel cells. A. J. Coleman, A. A. Adams, J. A. Joebstl, and G. W. Walker (U.S. Army, Mobility Equipment Research and Development Command, Fort Belvoir, VA). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 9-13.

A description is presented of diagnostic procedures which can be used to predict failure modes and assess the effects of these failures on fuel cell performance. Some straightforward diagnostic techniques have been used to evaluate fuel cells assembled with a variety of matrix and electrode combinations. These techniques included accelerated on-off cycling, thermal cycling with H2/CO mixtures, and automatic polarization measurements. Information has been obtained concerning the effects of electrolyte management and catalyst poisoning on performance and lifetime characteristics of 2 x 2 in. single cells. The use of on-off cycling has shown that short-term fuel cell performance is generally unaffected by load changes and cycle sequence in 2 x 2 in. cells when electrolyte management is adequate. Dynamic polarization curves can be used instead of point by point steady-state plots without any loss in accuracy. G.R.

A81-49483 The effect of DEB powder processing on thermal cell performance. R. Szwarc and R. D. Walton (General Electric Co., St. Petersburg, FL). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 26-29. 8 refs.

During the last twenty years, the system Ca/LiCl-KCl-$CaCrO_4$/Fe has provided the basis for thermal batteries designed for military applications. In connection with greater performance demands, investigations are being conducted concerning the effect of catholyte processing on thermal cell performance. The catholyte layer is composed of three components including the depolarizer (D), $CaCrO_4$, the electrolyte (E), LiCl-KCl eutectic, and the binder (B), finely divided SiO_2. The catholyte layer or DEB pellets are produced by blending these components, fusing, pulverizing the cake, and hydrostatically pressing the powder into pellets. A description is given of ten powders which were prepared for the reported study. It was found that the procedure used in powder processing affects the capacity, but not its voltage. Increasing the prebake temperature for $CaCrO_4$ from 400 to 600 C resulted in an increase in capacity. G.R.

A81-49484 Review of chloroaluminate systems for thermal battery applications. R. L. Vaughn and L. A. King (USAF, Frank J. Seiler Research Laboratory, Colorado Springs, CO). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 30-33. 20 refs.

The employment of the conventionally used LiCl-KCl electrolyte in production thermal batteries makes it necessary to employ operational temperatures in the range from 400 to 600 C. The use of such high temperatures has some operational advantages, but it causes also a number of problems related to heat stress and insulation requirements. In cases in which moderate current densities can be tolerated, it is possible to use much lower operational temperatures by employing an equimolar NaCl-$AlCl_3$ mixture as electrolyte. Single cell studies made over a temperature range from 175 to 275 C and a current density range from 15 to 150 mA/sq cm showed that LiAl was a suitable anode material, and chlorides of copper(II), iron(III), and molybdenum(V) were suitable cathode materials. Thermal batteries based on chloroaluminate electrolytes were successfully built and tested. Attention is given to the relevant characteristics of chloroaluminate electrolytes, the results of single cell research, and the current status of battery development. G.R.

A81-49485 Performance data for a lithium-silicon/iron disulfide, long-life, primary thermal battery. R. K. Quinn and A. R. Baldwin (Sandia Laboratories, Albuquerque, NM). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 34-39. 8 refs. Contract No. DE-AC04-76DP-00789.

A primary thermal battery based on the Li(Si)/LiCl-KCl/FeS_2 system has been developed. The battery, which has a volume of 400 cu cm, provides a current of 0.5 A at a voltage of 28 V for 60 minutes. A description is presented of the effects of various environmental tests on the performance of this battery. In order to simulate possible nuclear ordnance environments, batteries have been subjected to shock, rhythmic and random vibration, and longitudinal and lateral acceleration in the unactivated and activated state. The level and duration of these tests varied, but the performance remained good. The effects of variation in current density from open circuit to 1 A/sq cm, as well as various pulse loads, are examined. Also presented are results of stabilizing the batteries at temperatures in the range from -54 to 70 C as reflected in various performance parameters. G.R.

A81-49486 Accelerated aging of thermally activated batteries which utilize the Li/Si//LiCl-KCl/FeS_2 system. J. Q. Searcy and P. A. Neiswander (Sandia Laboratories, Albuquerque, NM). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 39-42.

The thermally activated Li(Si)/LiCl-KCl/FeS_2 batteries considered are intended for applications which require high reliability and a shelf life of 25 years. In order to determine the feasibility of achieving these requirements, an accelerated aging study was undertaken. The major objective of this work was to identify deleterious chemical reactions that could affect performance and reliability

during the 25 year shelf life. The approach used was to accelerate the aging of batteries by storage at elevated temperature, and then to examine and analyze materials from some batteries, while discharging others. The results of the study indicate that the reaction of Li(Si) with water outgassed from the various battery parts is deleterious to shelf life. No other deleterious effects were observed. G.R.

A81-49488 Batteries for air launched weapons. A. Attewell and P. Tattershall (Royal Aircraft Establishment, Farnborough, Hants., England). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 53-56.

Certain types of air launched ground attack weapons need a source of electrical energy and this may conveniently be provided by batteries. The requirements which the batteries have to satisfy in connection with such applications are examined, taking into account the particular characteristics of active primary batteries, reserve type primary batteries, thermal batteries, and liquid electrolyte reserve primary batteries. It is found that, if possible, a reserve type battery should be chosen whenever a battery is required to provide electrical power in an air-launched weapon. A thermal battery should be used unless long duration discharges are required, when a liquid electrolyte type is needed. If no means can be provided for activating a reserve system then, and only then, should active primary cells be considered. Several types are available and show promise of a long shelf life, but the performance of these must be examined, in depth, after real-time storage before they can be committed to project use. G.R.

A81-49489 Primary cells - A forecast of performance. H. Hazkany, E. Peled, and B. Raz (Tel Aviv University, Tel Aviv, Israel). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 56-58.

Of the several existing methods of exploratory forecasting the method of trend extrapolation has been chosen. This method is built upon the assumption that excepting technological revolution, technological characteristics develop in an orderly manner and that development trends are predictable. Attention is given to the Leclanché cell, the alkaline cell, the zinc silver oxide cell, the magnesium cell, the mercury cell, zinc-air cells, and Li cells. It is found that safe commercial high rate cells will have an energy density which is 10 to 20 percent lower than the value corresponding to the maximum capability of the technology. Cells with about 500-630 W-hr/kg are expected to penetrate the market at 1990. Low and high temperature performance and shelf life have almost reached the desirable levels and no vast improvement is expected or needed. Power density is expected to grow to the 500-1000 W/kg range (pulses), but safety problems must be resolved before commercialization. G.R.

A81-49490 Materials selection in Li/SO2 cells. H. Taylor and W. Lees (Duracell Laboratory for Physical Science, Burlington, MA). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 104-108. 10 refs. Research supported by the U.S. Department of Energy.

Attention is given to aspects of seal degradation in lithium systems, test methods, glass degradation, problems of tantalum corrosion, and the results of a number of experimental investigations. On the basis of the results of the evaluation study, a number of conclusions are presented. Whereas the hermetically sealed Li/SO2 cells made since 1975 significantly improved product reliability by eliminating SO2 leakage, corrosion of the glass seal components limited the longevity of this product under extremes of storage, typically to three months at 160 F. At this point, corrosion of the Ta positive terminal and/or loss of insulation resistance could occur resulting in decreased cell performance. Significantly improved product reliability has been realized by coating the glass seal with an inert material but even here instances of Ta corrosion can occur. Judicious selection of both the glass and metal components, particularly the positive termination, has overcome both problems without the necessity for any coating. G.R.

A81-49491 High rate discharge studies of Li/SO2 cells. S. Dallek, R. F. Bis, and F. M. Bowers (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 109-112. 8 refs.

Experimental D-size spirally-wound 3V 10 A-hr cells were used in the reported study. The cells were instrumented with four iron-constantan thermocouples. It was found that during a discharge of a thermally insulated cell, the greatest amount of heat builds up in the center of the cell. The heat build-up appears to be purely resistive in nature. Concerning the safe use of these cells, it has been demonstrated that at very high rates of discharge, e.g., 10 A, cells may vent violently and cause a fire. At this high rate of discharge, the internal cell temperature exceeded the melting point of the lithium anode which is in the form of an unsupported strip. Thus, contact of the highly reactive molten lithium with other reactive species in the cell is possible under these conditions and could result in a very exothermic chemical reaction. G.R.

A81-49492 Recent advances in Li/SO2 battery technology. R. E. Ralston (Duracell International, Inc., Lithium Systems Div., North Tarrytown, NY). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 112-115.

The areas of improvement discussed are related to cell closure-hermetic seals, improved glass-to-metal seals, and lithium-limited cell design. Attention is given to the design of a Li/SO2 cell which can safely withstand discharge below zero volts into voltage reversal. The design characteristics of an unbalanced cell, the new lithium-limited or balanced cell, and a high rate unbalanced design are compared in a table for the 'D' size cell. It is concluded that the improvements in cell closure, glass seal stability, and cell balance have resulted in storability, reliability, and abuse resistance characteristics which make the performance of today's Li/SO2 battery without equal among competitive primary batteries. However, the Li/SO2 cell must not be used in applications where extreme electrical or environmental conditions can push the system beyond its recommended limits. G.R.

A81-49502 45 kW-hr zinc-chloride load-leveling battery module - Recent performance improvements. R. D. Clubb, C. J. Warde, and P. Carr (Energy Development Associates, Madison Heights, MI). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 192-194. Research supported by the Energy Development Associates and Electric Power Research Institute.

The paper deals with the modification of a prototype 45 kW-hr zinc-chloride load-leveling battery module to reach the following performance targets: delivered energy of 50 kW-hr and electrochemical energy efficiency of 60%. The modifications included relocation of the sump to reduce heat transfer between the sump and the store, minimization of intercell electrolyte leakage, increasing the thickness of the busing, and rebuilding the gas/hydrate former pump. These modifications increased the delivered energy to a maximum of 53.6 kW-hr; the maximum electrochemical energy efficiency observed in the same series of experiments was 60.3%. V.L.

A81-49850 Resources for electric vehicles and their infrastructure; Proceedings of the Third International Conference, London, England, November, 1979. Conference supported by the European Electric Road Vehicle Association, IEA, Chartered Institute of Transport, et al. Stevenage, Herts., England, Peter Peregrinus, Ltd. (PPL Conference Publication, No. 16), 1980. 157 p. $23.50.

Topics discussed include the planned use of resources for electrical vehicles, the range and recharging infrastructure of transport systems, and future investments and planning. Particular attention is given to the availability of future fuels, the possible effects of economic changes upon future transport systems, and the operational requirements of an integrated transport system utilizing tramways, railways, and the metro. Consideration is also given to the development of a hybrid electric vehicle, the use of fuel cells in vehicles, and the production cost changes arising from a series production of electric vehicles. J.F.

A81-49874 Electric and hybrid vehicle progress; Proceedings of the International Congress and Exposition, Detroit, MI, February 23-27, 1981. Congress and Exposition sponsored by the

Society of Automotive Engineers. Warrendale, PA, Society of Automotive Engineers, Inc. (SAE Proceedings P-91), 1981. 188 p. $30.

The impacts of use-pattern on the design of electric and hybrid vehicles are considered along with a free piston engine-pump for an automotive propulsion system, the new breed of hybrid vehicles, the cost and potential of hybrid vehicles, hybrid vehicle test procedure development, the design studies of continuously variable transmissions for electric vehicles, and electronically commutated dc motors for electric vehicles. Attention is given to the development of a dc motor controller, voltage considerations for electric vehicle propulsion systems, the characterization of the near term electric vehicle (ETV-1) breadboard propulsion system over the SAE J227a Driving Schedule 'D', the zinc-chloride electric engine unit for a four-passenger electric vehicle, and aspects of electric vehicle battery management. A description is presented of performance testing and system evaluation of the DOE ETV-1 electric vehicle, an economical EV data compression system with sensors, the economics of electric vehicles, and the impact of technology development in economics of electric vehicles in fleet operations. Other topics considered are related to the operating experience of electric vehicles in city government fleet operations, EV technology and fleet experience, electric vans in regular commercial service, field test experience with electric vehicles, and the fuel economy potential of heat engine/flywheel hybrid vehicles. G.R.

A81-49896 **Methods of resynchronizing wind turbine generators.** P. C. Krause and O. Wasynczuk (Purdue University, West Lafayette, IN). *(Institute of Electrical and Electronics Engineers, Winter Meeting, Atlanta, GA, Feb. 1-6, 1981, Paper 81-WM-162-7.) IEEE Transactions on Power Apparatus and Systems,* vol. PAS-100, Oct. 1981, p. 4301-4307; Discussion, p. 4308. 12 refs. Contract No. DE-AS02-77ET-29100.

A method is described for resynchronizing wind turbine generators (WTG) which reduces the time for reestablishing normal operation following an electrical disturbance. The WTG studied has a blade speed of 17.55 rpm geared to a four-pole, 2.5 MW synchronous generator; the blades are upwind, horizontal axis propeller type, each 150 ft long with 45 ft of controllable tip length. Load rejection is used as the electrical disturbance. Several methods of reclosing are discussed, and arbitrary reclosing is discouraged. Reclosing when the voltage phase difference between WTG and the network is within prescribed limits is found to be acceptable, despite its requirements for high speed switching equipment with a complex control system. The safest approach is one which involves bringing the hub speed to a constant value and then reverting to the normal pitch control immediately following reclosing. Reclosing the WTG with sufficent damping of the soft shaft mode can be accomplished more smoothly than for a WTG in which the mode is lightly damped. It is also shown that satisfactory reclosing and reloading of a WTG is practical by modifying the proposed pitch control to include hub speed damping in both the high and low modes. J.F.

A81-49897 **Study of technical and economic feasibility of fuel cell cogeneration applications by electric utilities.** W. S. Ku (Public Service Electric and Gas Co., Newark, NJ) and R. A. Wakefield (Mathtech, Inc., Arlington, VA). *(IEEE, ASME, and ASCE, Joint Power Generation Conference, Charlotte, NC, Oct. 7-11, 1979.) IEEE, Transactions on Power Apparatus and Systems,* vol. PAS-100, Oct. 1981, p. 4309-4318.

A previous EPRI study showed significant potential penetrations of fuel cells into the future generation mixes of U.S. electric utilities. A new EPRI-sponsored study was conducted to investigate the possible additional benefits of operating these utility-owned fuel cells as cogeneration facilities. Three classes of applications were evaluated: residential and commercial buildings, industrial processes and utility power plants. Incremental breakeven capital costs between cogenerating and electric-only fuel cells were determined with respect to conventional thermal energy supply alternatives. The results showed that there are sufficient economic incentives for fuel cell cogeneration in all three classes of applications. (Author)

N81-28449# Sandia Labs., Albuquerque, N. Mex.
GUY CABLE DESIGN AND DAMPING FOR VERTICAL AXIS WIND TURBINES
Thomas G. Carne 1981 9 p refs Presented at the 2nd DOE/NASA Wind Turbine Dyn. Workshop, Cleveland, 24 Feb. 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2669C; CONF-810226-3) Avail: NTIS HC A02/MF A01

Design parameters affecting the support strength and the stiffness of the guy at the top of the turbine are discussed. Limiting the axial load which the guys apply to the tower, bearings, and foundations is an important objective of cable design. The lateral vibrations of the cables is considered. A graph of modal frequencies versus cable stiffness is presented. A technique for damping cable vibrations is mathematically analyzed and demonstrated with experimental data. DOE

N81-28485# Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
ANALYSIS OF STRONG NOCTURNAL SHEARS FOR WIND MACHINE DESIGN Final Report
L. Mahrt and R. C. Heald Nov. 1980 77 p refs
(Contract DE-AT06-79ET-23116)
(DOE/ET-23116/80-1) Avail: NTIS HC A05/MF A01

Wind shear data at wind turbine heights from several sites is reviewed and new data is documented in terms of total and component shear. A variety of atmospheric scenarios may combine to give large persistent shear. Among these, strong boundary layer stability is foremost. It occurs with strong nocturnal surface cooling, in low level frontal and subsidence inversions, and in thunderstorm outflows. Strong shears resulting from surface radiation inversions are evident over the High Plains where dry air and high altitude combine to result in strong radiational cooling. Terrain is also an important influence on shear but it is not well understood and is very site specific. DOE

N81-28516*# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
MOD-0A 200 kW WIND TURBINE GENERATOR DESIGN AND ANALYSIS REPORT Final Report
T. S. Anderson, C. A. Bodenschatz, A. G. Eggers, P. S. Hughes, R. F. Lampe, M. H. Lipner, and J. R. Schornhorst Aug. 1980 394 p refs
(Contracts DE-AB29-76ET-20370; DEN3-163)
(NASA-CR-165128; DOE/NASA/0163-2; AESD-TME-3052)
Avail: NTIS HC A17/MF A01 CSCL 10B

The design, analysis, and initial performance of the MOD-0A 200 kW wind turbine generator at Clayton, NM is documented. The MOD-0A was designed and built to obtain operation and performance data and experience in utility environments. The project requirements, approach, system description, design requirements, design, analysis, system tests, installation, safety considerations, failure modes and effects analysis, data acquisition, and initial performance for the wind turbine are discussed. The design and analysis of the rotor, drive train, nacelle equipment, yaw drive mechanism and brake, tower, foundation, electrical system, and control systems are presented. The rotor includes the blades, hub, and pitch change mechanism. The drive train includes the low speed shaft, speed increaser, high speed shaft, and rotor brake. The electrical system includes the generator, switchgear, transformer, and utility connection. The control systems are the blade pitch, yaw, and generator control, and the safety system. Manual, automatic, and remote control are discussed. Systems analyses on dynamic loads and fatigue are presented. J.M.S.

N81-28519*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PUMPING POWER CONSIDERATIONS IN THE DESIGNS OF NASA-REDOX FLOW CELLS Final Report
Mark A. Hoberecht Jun. 1981 12 p refs
(Contract DE-AI04-80AL-12726)
(NASA-TM-82598; DOE/NASA/12726-7) Avail: NTIS HC A02/MF A01 CSCL 10C

Pressure drop data for six different cell geometries of various flow port, manifold, and cavity dimensions are presented. The redox/energy/storage system uses two fully soluble redox couples as anode and cathode fluids. Both fluids are pumped through a redox cell, or stack of cells, where the electrochemical reactions take place at porous carbon felt electrodes. Pressure drop losses are therefore associated with this system due to the continuous flow of reactant solutions. The exact pressure drop within a redox flow cell is directly dependent on the flow rate as well as the various cell dimensions. Pumping power requirements for a specific set of cell operating conditions are found for various cell geometries once the flow rate and pressure drop are

determined. These pumping power requirements contribute to the overall system parasitic energy losses which must be minimized, the choice of cell geometry becomes critical. E.D.K.

N81-28543# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
THIN FILM BATTERY/FUEL CELL POWER GENERATING SYSTEM Final Report, 1 Apr. 1978 - 31 Mar. 1980
W. Feduska, A. O. Isenberg, J. E. Bauerle, E. F. Federmann, Y. Ichikawa, R. J. Ruka, E. J. Vidt, S. A. Zeitman, and G. E. Zymboly 30 Jun. 1980 216 p refs
(Contract DE-AC03-79ET-11305)
(DOE/ET-11305/T7: C-1197-17) Avail: NTIS HC A10/MF A01

Research on the design, development, and testing of a high temperature solid electrolyte (HTSOE) fuel cell is described. Development and refinement of fabrication processes for the porous support tube, fuel electrode, solid electrolyte, air electrode, and interconnection are included. Life testing was conducted of cell components and the stack. Stack performance was evaluated. DOE

N81-28544# Galaxy, Inc., Washington, D.C.
JAPANESE RESEARCH AND DEVELOPMENT OF FUEL CELLS
Feb. 1981 28 p
(Contract DE-AC03-79SF-10538)
(DOE/SF-10538/T6) Avail: NTIS HC A03/MF A01

An overview of the Japanese fuel cell program is presented including an historical background of Japanese research and development of fuel cells, the research and development in the Moonlight Project, and a description of the current status of activities of private companies which expect to purchase fuel cells. DOE

N81-28555# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
BASELINE DESIGNS OF MOORED AND GRAZING 40-MW OTEC PILOT PLANTS. VOLUME A: DETAILED REPORT
J. F. George and D. Richards Jun. 1980 270 p refs Prepared jointly with ABAM Engineers, Tacoma and Glosten (L. R.) and Associates, Inc., Seattle 2 Vol.
(Contracts DE-AI01-77ET-20343; N00024-78-C-5384)
(JHU/APL-SR-80-1-Vol-A) Avail: NTIS HC A12/MF A01

Baseline designs of two types of floating Ocean Thermal Energy Conversion (OTEC) pilot plants are presented. Both designs feature floating concrete hull structures that house up to 40 MW sub e (net) of OTEC power systems. One plant is designed for moored operation at an island site, and use underwater cables to transmit electric power to a shore-based utility company. The other plant is self-propelled and cruises slowly through tropical waters, using the OTEC electric power to produce an energy intensive product onboard, where it is stored for later transshipment to market. DOE

N81-28556# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
BASELINE DESIGNS OF MOORED AND GRAZING 40-MW OTEC PILOT PLANTS. VOLUME B: ENGINEERING DRAWINGS
Jun. 1980 270 p Prepared jointly with ABAM Engineers, Tacoma and Glosten (L. R.) and Associates, Inc., Seattle 2 Vol.
(Contracts DE-AI01-77ET-20342; N00024-78-C-5384)
(JHU/APL-SR-80-Vol-B) Avail: NTIS HC A12/MF A01

Baseline design data are presented for two types of floating Ocean Thermal Energy Conversion (OTEC) pilot plants: (1) a moored plant that uses underwater cables to transmit electric power to a shore-based utility company, and (2) a cruising plantship that uses the OTEC electric power to produce an energy-intensive product onboard, where it is stored for later transshipment to market. Engineering drawings of the hull, cold-water pipe, ship outfitting and machinery, OTEC power system, electrical system, and folded-tube heat exchangers are provided. DOE

N81-28580# Institute of Gas Technology, Chicago, Ill.
STATUS OF MOLTEN CARBONATE FUEL CELL TECHNOLOGY
L. G. Marianowski and John B. OSullivan 1981 16 p refs Presented at the 8th Energy Technol. Conf. and Exposition, Washington, D.C., 9-11 Mar. 1981 Sponsored in part by General Electric Co., DOE, Electric Power Research Inst. and the Gas Research Inst.
(CONF-810315-8) Avail: NTIS HC A02/MF A01

A molten carbonate fuel cell integrated with a coal gasification power plant is one of the most promising coal-using technologies because of its high efficiency acceptable cost, and environmental acceptability. The high temperature heat available from the fuel cell may be used in a bottoming cycle and/or industrial cogeneration applications; however, for the molten carbonate system to achieve these goals, continued developmental work is required which must take account of the operating conditions of the application. The progress made in improving cell performance and life and in producing inexpensive cell components is discussed. The status, direction, and priority of future research and engineering efforts is also discussed. DOE

N81-28598# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
ENERGY RESEARCH. SCIENTIFIC STATUS REPORT Status Report, 1980 [FORSCHUNGSBEREICH ENERGETIK. WISSENSCHAFTLICHER BERICHT - STAND 1980]
Hans Joachim Holtz, ed. 1981 107 p refs In GERMAN
Original contains color illustrations
Avail: NTIS HC A06/MF A01

The first work group reports on solar thermal power stations, solar energy resources, tubular collector designs, and heliostat designs, low pressure Cs diodes, cermet emitters, and thermionic converters as well as hydrogen storage and cryoadsorbents are also discussed. Applications of gas dynamic CO lasers, plasma physics, and Lyman transitions of hydrogen atoms are covered. The RIT-10 RF thruster system, thruster components, and the detection of oil breakdown in aircraft engines are touched on as well. Activities of the second group include studies of HF vibrational relaxation in a shock tube, hydrogen production, thermal decomposition of SO2, and flame quenching and exhaust hydrocarbons in a combustion chamber. The energy of diatomic molecules, local temperature measurements in flames, laser Raman spectroscopy, and absolute transition probabilities and particle densities from saturated fluorescence excitation are also dealt with. Investigations of the third group involve analytical mass modeling of chemical rocket stages for space flight, development of chemical propulsion modules and a propulsor platform for low altitude payload delivery. Author (ESA)

N81-28599# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Aerodynamics.
A PRELIMINARY THEORETICAL STUDY OF DOUBLE BLADE TWO-DIMENSIONAL AERODYNAMICS FOR APPLICATIONS TO VERTICAL AXIS WIND TURBINES Final Report
Erling Weibust 21 Apr. 1981 69 p refs
(Contracts PE-450-01; NE-5061-451)
(FFA-TN-AU-1635) Avail: NTIS HC A04/MF A01

A NASA model for computing the subsonic, viscous, attached flow around multielement airfoils was used to determine the amount of energy lost when using double blades rather than single ones. The resulting tangential force for the double or single blade configuration used as a criterion is found. Radial spacing, toe-in toe-out angle and tangential displacement (stagger) were varied to see how tagential force is affected. The greatest tangential force values are found to be achieved for maximum allowable radial spacing, which is determined by structural considerations, and is assumed to be on the order of 1.5 c. At this rather large distance, stagger as well as toe-in toe-out angle only gives slight improvements as long as the flow separation effects (stall region) are not considered. A large part of the energy is captured at relatively high wind speeds when the flow on the blades is partly separated (stalled). Author (ESA)

N81-28600# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
SAFETY AND WIND ENERGY CONVERSION SYSTEMS WITH HORIZONTAL AXIS (HA WECS)
Sigge Eggwertz, Ingemar Carlsson, Anders Gustafsson, Magnus Linde, Christer Lundemo, Bjoern Montgomerie, and Sven-Erik Thor 19 Mar. 1981 170 p refs
(Contract NE-5061)
(FFA-TN-HU-2229) Avail: NTIS HC A08/MF A01

Hazards imposed by a wind energy conversion system on the general public and on the operator personnel by complete collapse, by separation of fractured parts, or by pieces of ice (flying off) were calculated to provide a manual for safety evaluations. Land based large scale turbine systems with horizontal axes situated in areas with sparse population are considered.

Blade material is assumed to be steel, aluminum alloy or fiber reinforced plastics; the tower being built of steel or reinforced concrete. Primary structure, function and failure modes are identified. Statistical information of loads and load combinations, strength properties of materials and geometry deviation are provided. A simplified method of risk analysis is described. The object and function of a safety system, both hardware and software, is reviewed, considering the effects of inspection and repair. The probability of being hit is evaluated, provided a fracture occurs and a risk zone is established. Author (ESA)

N81-28922# California Univ., Livermore. Lawrence Livermore Lab.

PRELIMINARY DESIGN OF A TANDEM-MIRROR-NEXT-STEP FACILITY

C. C. Damm, J. N. Doggett, R. H. Bulmer, W. S. Neef, G. W. Hamilton, A. E. Sherwood, S. Szybalski, B. M. Boghosian, G. A. Carlson, and R. W. Moir 18 Dec. 1980 120 p refs

(UCRL-53060) Avail: NTIS HC A06/MF A01

The Tandem-Mirror-Next-Step (TMNS) facility is designed to demonstrate the engineering feasibility of a tandem-mirror reactor. The facility is based on a deuterium-tritium (D-T) burning, tandem-mirror device with a fusion power output of 245 MW. The fusion power density in the central cell is 2.1 MW/m(3), with a resultant neutron wall loading of 0.5 MW/m(2). Overall machine length is 116 m, and the effective central-cell length is 50.9 m. The magnet system includes end cells with yin-yang magnets to provide magnetohydrodynamic (MHD) stability and thermal-barrier cells to help achieve a plasma Q of 4.7 (where Q = fusion power/injected power). Neutral beams at energies up to 200 keV are used for plasma heating, fueling, and barrier pumping. Electron cyclotron resonant heating at 50 and 100 GHz is used to control the electron temperature in the barriers. Based on the resulting engineering design, the overall cost of the facility is estimated to be just under $1 billion. Unresolved physics issues include central-cell beta-limits against MHD ballooning modes (the assumed reference value of beta exceeds the current theory derived limit), and the removal of thermalized alpha-particles from the plasma. GRA

N81-28988# California Univ., Livermore. Lawrence Livermore Lab.

FLEXIBILITY OF MFTF-B FOR THERMAL-BARRIER MODIFICATIONS AND AXISYMMETRIC UPGRADES

K. I. Thomassen 25 Mar. 1981 25 p refs

(Contract W-7405-eng-48)

(UCID-18948) Avail: NTIS HC A02/MF A01

Flexibility in MFTB-B is achieved partly by using the margins in particle and energy control designed into the machine and partly by making modest changes based on results obtained in TMX Upgrade. This latter flexibility is permitted by the schedule for vessel construction and component fabrication. The changes one might expect were determined by an examination of the processes involved in creating a thermal barrier and by speculating on the range of outcomes from TMX Upgrade experiments. DOE

N81-29040# California Univ., Livermore. Lawrence Livermore Lab.

ADVANCED VEHICLE OF THE DOE ELECTRIC AND HYBRID VEHICLE PROGRAM

Lawrence G. OConnell Dec. 1980 37 p refs Presented at the Elec. and Hybrid Vehicle Advan. Technol. Seminar, Pasadena, Calif., 8 Dec. 1980

(Contract W-7405-eng-48)

(UCRL-85390; CONF-801232-5) Avail: NTIS HC A03/MF A01

The performance requirements for and the technical or economic barriers which must be overcome in the development and production of advanced electric vehicles (EV) or hybrid-electric vehicles are discussed. The technologies compared include EV's using battery exchange, hybrid EV's using batteries and a small heat engine, roadway powered EV's, EV's with aluminum air batteries, and EV's with fuel cells. DOE

N81-29363# InterTechnology Solar Corp., Warrenton, Va.

RESEARCH AND DEVELOPMENT OF THE OSMO-HYDRO POWER HEAT ENGINE Final Report

25 Nov. 1980 212 p refs

(Contract DE-AC05-78ET-15346)

(DOE/ET-15346/T1; ITC/Solar-251180) Avail: NTIS HC A10/MF A01

The osmo-hydro power or pressure-retarded osmosis heat engine is possible means for producing economical electric power from low-temperature heat sources. The engine utilizes semipermeable membranes to cause the permeation of a solvent from a dilute low-pressure solution to a concentrated high-pressure solution. The potential energy thus acquired is converted to useful energy by means of a turbogenerator. The process can be considered as one in which the free energy of mixing is converted to useful power. By appropriate application of a heat source and a heat sink, the original dilute and concentrated solutions are recovered, thus completing the heat engine cycle. DOE

N81-29365# Department of Energy, Washington, D. C. Office of Nuclear Reactor Programs.

US CENTRAL STATION NUCLEAR ELECTRIC GENERATING UNITS: SIGNIFICANT MILESTONES Status Report, 1 Jan. 1981

Mar. 1981 41 p

(DOE/NE-0030/1(81)) Avail: NTIS HC A03/MF A01

Construction and operational milestones are tabulated for U.S. nuclear power plants. Data are presented on nuclear steam supply system orders. A schedule of commercial operation through 1990 is given. DOE

N81-29443# Westinghouse Electric Corp., Concordville, Pa. Combustion Turbine Systems Div.

GAS TURBINE COMBUSTOR PERFORMANCE ON SYNTHETIC FUELS Final Report

S. M. DeCorso, P. W. Pillsbury, G. Bauserman, P. R. Mulik, M. J. Ambrose, and T. R. Stein (Mobil Research and Development Corp.) Jun. 1981 223 p refs Sponsored by EPRI

(EPRI Proj. 989-1)

(EPRI-AP-1623-Vol-2) Avail: NTIS HC A10/MF A01

The effects of burning coal- and shale-derived synthetic liquid fuels in state-of-the-art gas turbine combustors was determined. Ten types of coal-derived liquid fuels from the SRC-I, SRC-II, EDS, and H-Coal processes, and three hydrogenated shale oil fuels were utilized. The main conclusion was that synthetic fuels burned approximately as expected from extrapolation of the combustion results obtained with petroleum fuels. Synthetic fuels with hydrogen content greater than approximately 10% (by weight) and nitrogen content less than approximately 0.35% should be satisfactory for engines of current design. A wider selection of synthetic fuels could be used in engines of a lower pressure ratio and/or turbine inlet temperature. Conversely, designs of higher turbine inlet temperature and/or pressure ratio would require tighter fuel specifications or the development of improved combustor cooling, smoke performance, and NO/sub x/ suppression. Author

N81-29449# General Electric Co., St. Petersburg, Fla. Gas Turbine Div.

DEVELOPMENT OF HIGH-TEMPERATURE TURBINE SUBSYSTEM TECHNOLOGY TO A TECHNOLOGY READINESS STATUS, PHASE 2 Quarterly Report, Jan. - Mar. 1981

M. W. Horner Apr. 1981 80 p

(Contracts DE-AC01-76ET-1034; EX-76-C-01-1806)

(DOE/ET-10340/T4) Avail: NTIS HC A05/MF A01

Progress in developing a technical readiness vehicle (TRV) for demonstrating the performance of a combined-cycle power plant with high-temperature, 2600 to 3000 F firing temperature, gas turbines using coal-derived gas fuel is reported. Work on the combined-cycle power plant and TRV design, component development, aerodynamics studies, simulation, and fuel gas cleanup systems is described. DOE

N81-29450# General Electric Co., St. Petersburg, Fla. Gas Turbine Div.

HIGH-TEMPERATURE TURBINE TECHNOLOGY PROGRAM. TURBINE SUBSYSTEM DESIGN REPORT: LOW-Btu GAS

M. W. Horner Dec. 1980 227 p

(Contracts DE-AC01-76ET-10340; EX-75-C-01-1806)

(DOE/ET-10340/T3) Avail: NTIS HC A11/MF A01

The updated turbine subsystem design for a coal-derived gas fuel (low-Btu) operation at 2600 F turbine firing temperature is described. A commercial integrated gasification combined cycle (IGCC) plant configuration would contain four gas turbines. These gas turbines utilize an existing axial flow compressor from the GE product line MS6001 machine. Trends in overall plant

performance improvement at higher pressure ratio and higher firing temperature are shown. It is shown that any improvement in overall plant thermal efficiency reflects about the same level of gain in cost of electricity (COE). The IGCC concepts are shown to be competitive in both performance and cost at current and near-time gas turbine firing temperatures of 1985 F to 2100 F. The savings that can be accumulated over a thirty year plant life for a water-cooled gas turbine in an IGCC plant as compared to a state-of-the-art coal-fired steam plant are estimated. A total of $500 million over the life of a 1000 MW plant is projected. Also, this IGCC power plant has significant environmental advantages over equivalent coal-fired steam power plants. DOE

N81-29453# *Sandia Labs., Albuquerque, N. Mex.*
GUY-CABLE DESIGN AND DAMPING FOR VERTICAL-AXIS WIND TURBINES
T. G. Carne May 1981 35 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-2669) Avail: NTIS HC A03/MF A01

Guy cables are frequently used to support vertial axis wind turbines since guying the turbine reduces some of the structural requirements on the tower. The guys must be designed to provide *both the required strength and the required stiffness at the top* of the turbine. The axial load which the guys apply to the tower, bearings, and foundations is an undesirable consequence of using *guys to support the turbine. Limitng the axial load so that it* does not significantly affect the cost of the turbine is an objective of cable design. The lateral vibration of the cables is another *feature of the cable design which needs to be considered.* These aspects of the cable design are discussed, and a technique for damping cable vibration is mathematically analyzed and *demonstrated with experimental data.* DOE

N81-29527*# Energy Research Corp., Danbury, Conn.
EVALUATION OF DISTRIBUTED GAS COOLING OF PRESSURIZED PAFC FOR UTILITY POWER GENERATION Quarterly Report, Mar. - May 1981
M. Farooque, H. Maru, and A. Skok May 1981 32 p refs
(Contracts DEN3-201; DE-AI03-80E7-17088)
(NASA-CR-165304; DOE/NASA/0201/3; QR-3) Avail: NTIS HC A03/MF A01 CSCL 10A

Two short stacks were pressure tested at 446 kPa (4.4 atm.) and the pressure gains were more than the theoretically predicted gains. Temperature profiles were observed to be independent of operating pressure. The pressure drop was found to be inversely proportional to operating pressure as expected. Continuous pressurized operation of a stack for 1000 hours verified the compatability of the fuel cell component design. A simple pressurization procedure was also developed. Six separate designs, covering two gas cooling schemes (DIGAS and separated) and two cooling channel geometries (straight through and treed), were analyzed on the net voltage output basis. Separated cooling with 5 cells per cooler was recognized to be the best among the designs considered. T.M.

N81-29528*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
***TESTS OF AN OVERRUNNING CLUTCH IN A WIND TURBINE* Final Report**
Robert C. Seidel and Henry G. Pfanner Jul. 1981 13 p refs
(Contract DE-AI01-76ET-20320)
(NASA-TM-82653; DOE/NASA/20320-32; E-914) Avail: NTIS HC A02/MF A01 CSCL 10A

An overrunning clutch that slipped freely under reverse torque was tested in the drive train of the Mod-0 wind turbine. In low variable wind conditions, the clutch engaged and disengaged *smoothly without perturbation or oscillations. The clutch permitted* the generator to be connected to the line using a relay instead of an automatic synchronizer. The alternator was connected to *the line when the rpm reached 95% of synchronous speed and* it motored to synchronous speed in about 0.15 seconds with a momentary power spike of 50 kW. The performance of the clutch *was the same with and without the fluid coupling. The ideal* power with the clutch was 5 to 7 kW compared to up to 50 kW without the clutch. The overrunning clutch merits *consideration in future wind turbine designs as a means of* simplifying the control system, increasing energy capture, and increasing the life of blades and electrical switch gear. A.R.H.

N81-29534# Southeastern Center for Electrical Engineering Education, Inc., St. Cloud, Fla.
ON-SITE FUEL CELL ENERGY SYSTEMS: THE US AIR FORCE FIELD TEST DEMONSTRATION PLAN Final Report, 30 Mar. - 30 Sep. 1980
Michael A. Aimone Dec. 1980 164 p refs
(Contract F33615-77-C-2059; AF Proj. 3145)
(AD-A100743; AFWAL-TR-80-2118) Avail: NTIS HC A08/MF A01 CSCL 10/2

The large scale application of fuel cell energy systems, electrochemical energy conversion devices, to facility operations, could result in significant benefits to the public and to the U.S. Air Force. This report summarizes the advantages and potential applications of fuel cells on an Air Force base, highlights the pertinent operational characteristics of a fuel cell, identifies the ongoing governmental and industrial programs that are aimed at commercializing this technology as early as the mid 1980's, and recommends and outlines a U.S. Air Force On-Site Fuel Cell Field Test Demonstration Program Plan. GRA

N81-29540# Regional Systems Services Group, Inc., Englewood, *Colo.*
ECONOMIC ANALYSIS OF WIND-POWERED FARMHOUSE AND FARM BUILDING HEATING SYSTEMS Final Report
R. W. Stafford, Frederick J. Greeb, Monica H. Smith, Craig DesChenes, and Norman L. Weaver Jan. 1981 360 p refs
(Contracts DE-AI01-76ET-20319; EX-76-A-29-1026)
(DOE/SEA-3408-20691/81/1) Avail: NTIS HC A16/MF A01

The break even values of wind energy for selected farmhouses *and farm buildings focusing on the effects of thermal storage* on the use of WECS production were evaluated. Farmhouse structural models include three types derived from a national *survey: an older, a more modern, and a passive solar structure.* The eight farm building applications include: (1) poultry layers; (2) poultry brooding/layers; (3) poultry broilers; (4) poultry turkeys; *(5) swine farrowing; (6) swine growing/finishing; (7) dairy; and* (8) lambing. The farm buildings represent the spectrum of animal types, heating energy use, and major contributions to national *agricultural economic values. All energy analyses are based on* hour by hour computations which allow for growth of animals, sensible and latent heat production, and ventilation require*ments.* DOE

N81-29543# Midwest Research Inst., Golden, Colo. Ocean Systems Program Branch.
OCEAN ENERGY CONVERSION SYSTEMS REPORT Annual Report
Mar. 1981 192 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-634-1011) Avail: NTIS HC A09/MF A01

Alternative power cycle concepts to the closed-cycle Rankine are evaluated and those that show potential for delivering power in a cost effective and environmentally acceptable fashion are explored. Concepts are classified according to the ocean energy resource: thermal, waves, currents, and salinity gradient. The lift of seawater entrained in a vertical steam flow provides potential energy for a conventional hydraulic turbine conversion system. Quantification of the process and assessment of potential cost must be completed to support concept evaluation. Exploratory development is completed in thermoelectricity and 2-phase nozzles for other thermal concepts. Wave energy concepts are evaluated by analysis and model testing with emphasis on pneumatic turbines and wave focussing. Several conversion approaches to ocean current energy are being evaluated. DOE

N81-29550# Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy and Composites Lab.
EVALUATION OF ALLOYS FOR FUEL CELL HEAT EXCHANGES Final Report
R. A. Perkins and S. J. Vonk Apr. 1981 113 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 1041-3)
(EPRI-EM-1815) Avail: NTIS HC A06/MF A01

The results are presented of an investigation to evaluate the behavior of commercial stainless steels, superalloys, and aluminide coatings in both clean (sulfur-free) and raw (1% H2S) gas representative of the Texaco slagging gasifier atmosphere are 1400 to 18000 F (1033 to 12550 K). The goal was to determine which, if any, of these materials is suitable for use in a high temperature heat exchanger operating on intermediate Btu coal gasification atmospheres. It has been found that none of the commercially available alloys or coatings are suitable for

use in the raw (1% H2S) gas, even at temperatures as low as 14000 F (10330 K). Materials that are resistant to attack either have a limited life (< 5000 h) or cannot be fabricated as large size heat exchanger components. It is concluded that structural high temperature alloys must be coated for use in the raw gas and that the best coating or cladding materials are Ni-46Cr (IN671 type alloy) and MCrAl with 25 to 40% Cr and 30 to 40% Al (where M is Ni, Co, or Fe or some combination thereof). Heat exchanger components can be clad with Ni-46Cr but the alloy must be modified to improve its reliability and performance in coal conversion atmospheres. DOE

N81-29572# Carnegie-Mellon Univ., Pittsburgh, Pa.
CONCURRENT STUDIES OF ENHANCED HEAT TRANSFER AND MATERIALS IN OCEAN THERMAL HEAT EXCHANGERS
Robert R. Bothfus Apr. 1981 78 p refs
(Contracts DE-AS02-76FT-20281; E(11-1)-2641)
(DOE/ET-20281/2) Avail: NTIS HC A05/MF A01

Vertical shell and tube condensors and evaporators with axially ridged tubes produce high heat fluxes under OTEC conditions. Shell side pressure drop is inconsequential and there are only minimal problems associated with the operation of large exchangers. Yet the cost effectiveness of ridged tube units is reduced by added material and labor costs to the point where the possible advantages of these exchangers must lie in such areas as ease of cleaning and decreased buoyancy. Units built from vertically ridged plates or sheets give promise of reducing fabricating costs while retaining the thermal and hydrodynamic benefits of ridged tubes. The dynamics of closed OTEC power cycles are dominated by the dynamics of the evaporator and condenser. Mathematical modeling of several candidate exchangers shows the OTEC cycle to be stable and bypass valve control to be a relatively fast and smooth method of turbine speed control. DOE

N81-29584# Midwest Research Inst., Kansas City, Mo. Solar Energy Research Inst.
INDUSTRIAL APPLICATIONS OF SOLAR-WIND HYBRID SYSTEMS
T. S. Jayadev and J. Henderson 1980 20 p refs
(Contract EC-77-C-01-4042)
(SERI/TP-36-096) Avail: NTIS HC A02/MF A01

Two applications of solar wind hybrid systems, designed to supply both process heat and electricity, are described for a meat packing plant and a concrete block manufacturing plant. The solar pond operates as both a heater/preheater and an elevated temperature heat souce for an electrically driven process heat pump. Electricity from the wind turbine can be used to meet any of the three loads: plant electrical demand, operation of the heat pumps, and resistive heating in the solar pond. Performance of the system is discussed. A wind system model is presented in an appendix. Some specifications and cost assessments of the systems are tabulated. DOE

N81-29589# Systems Control, Inc., Palo Alto, Calif.
OPERATION OF SMALL WIND TURBINES ON A DISTRIBUTION SYSTEM. EXECUTIVE SUMMARY
D. Curtice and James Patton Mar. 1981 26 p Prepared for Rockwell International Corp., Golden, Colo.
(Contract DE-AC04-76DP-03533)
(RFP-3177-1) Avail: NTIS HC A03/MF A01

This study analyzed technical interconnection problems associated with the dispersed wind turbine (WT) application scenario: WTs connected on distribution systems producing ac power directly or dc power fed into an inverter, without storage systems, feeding back surplus power whenever the wind is blowing. Its specific objectives included analysis of: utility personnel safety; distribution system and WT protection equipment; WTs' effects on distribution feeder voltage and regulation equipment, and line losses; and development of a method to analyze utility load-frequency control problems with load patterns produced by customer demand and the WT's intermittent power output. DOE

N81-29590# Systems Control, Inc., Palo Alto, Calif.
OPERATION OF SMALL WIND TURBINES ON A DISTRIBUTION SYSTEM Final Report
D. Curtice and James Patton Mar. 1981 190 p refs Prepared for Rockwell International Corp., Golden, Colo.
(Contract DE-AC04-76DP-03533)
(RFP-3177-2) Avail: NTIS HC A09/MF A01

This study analyzed technical interconnection problems assosicated with the dispersed wind turbine WT application scenario: WTs connected on distribution systems producing ac power directly or dc power fed into an inverter, without storage systems, feeding back surplus power whenever the wind is blowing. Its specific objectives included analysis of: utility personnel safety; distribution system and WT protection equipment; WTs' effects on distribution feeder voltage and regulation equipment, and line losses; and development of a method to analyze utility load-frequency control problems with load patterns produced by customer demand and the WTs' intermittent power output. DOE

N81-29595# Acres American, Inc., Columbia, Md.
SMALL HYDRO PLANT DEVELOPMENT PROGRAM. VOLUME 1: TEXT
Oct. 1980 273 p refs
(Contract DE-AC07-76ID-01570)
(DOE/ID-01570/T21-Vol-1) Avail: NTIS HC A13/MF A01

The technical and economical feasibility of using pump (turbine) induction motor (generator) packages in lieu of standardized turbogenerator units in small hydro development projects was investigated. Turbine mode performance of pumps was simulated by a computer model and selected packages covering a major part of the head flow power range were compared to equivalent standardized turbogenerator units. Topics covered include: small hydro plant sizes and existing equipment; pump types and sizes; selection of generating equipment; performance evaluations of pump turbines and generators; and an economic evaluation of pump turbine induction motor (generator) equipment. DOE

N81-29596# RAND Corp., Santa Monica, Calif.
QUANTITATIVE EVALUATION OF OCEAN THERMAL ENERGY CONVERSION (OTEC): EXECUTIVE BRIEFING
Eugene C. Gritton, Richard Y. Pei, and Ronald W. Hess Aug. 1980 50 p refs
(RAND/R-2641-DOE) Avail: NTIS HC A03/MF A01

The results of an independent quantitative evaluation of Ocean Thermal Energy Conversion (OTEC) for central station applications are summarized. A central station power plant located in the Gulf of Mexico and delivering power to the mainland United States was emphasized. The evaluation of OTEC is based on three important issues: resource availability, technical feasibility, and cost. DOE

N81-29617# Main (Charles T.), Inc., Boston, Mass.
HALF MOON COVE TIDAL PROJECT. FEASIBILITY REPORT
Nov. 1980 136 p refs
(Contract DE-FC07-80ID-12089)
(DOE/ID-12089/T1) Avail: NTIS HC A07/MF A01

The project would be located in a small cove in the northern part of Cobscook Bay in the vicinity of Eastport, Maine. The basin impounded by the barrier when full will approximate 1.2 square miles. The average tidal range at Eastport is 18.2 feet. The maximum spring tidal range will be 26.2 feet and the neap tidal range 12.8 feet. The project will be of the single pool-type single effect in which generation takes place on the ebb tide only. Utilizing an average mean tidal range of 18.2 feet the mode of operation enables generation for approximately ten and one-half (10-1/2) hours per day or slightly in excess of five (5) hours per tide. The installed capacity will be 12 MW utilizing 2 to 6 MW units. An axial flow, or Bulb type of turbine was selected for this study. DOE

N81-29621# Physical Sciences, Inc., Woburn, Mass.
SOOT CONTROL FOR FUEL-CELL ANODES; TASK NO. 16 Final Topical Report, 1 Jul. - 30 Sep. 1980
David Ham, Paul Lewis, Greg Lord, and Evan Pugh Dec. 1980 41 p refs
(Contract DE-AM21-78MC-08450)
(DOE/MC-08450/T2) Avail: NTIS HC A03/MF A01

Conditions in which soot forms on stainless steel surfaces under conditions relevant to operation of a molten carbonate fuel cell power plant are reported. Results were obtained in two different experimental configurations. It is shown that all soot was formed on a catalytic surface and not in the gas phase. Soot formation was found to be rapid for dry gas mixtures which occur between a cold gas clean up region and a fuel cell

in proposed power plant designs. Equilibrium calculations are presented which show that, over certain temperature ranges, partial equilibrium might lead to more soot than full equilibrium among the gas components. Author (DOE)

N81-29625# Sandia Labs., Albuquerque, N. Mex. Applied Mathematics Div.
SOLSTOR DESCRIPTION AND USER'S GUIDE
E. A. Aronson, D. L. Caskey, and B. C. Caskey Mar. 1981 131 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-2330) Avail: NTIS HC A07/MF A01

The computer simulation code SOLSTOR is described. The code simulates energy systems in which electricity is generated by either a photovoltaic (PV) system or a wind turbine generator (WTG). Backup electricity is provided either from a utility grid or from a fuel burning generator. SOLSTOR minimizes the life cycle cost of providing energy by choosing the optimal solar or wind system component sizes. Rates for electricity purchased from the grid can include time-of-day(TOD) energy charges as well as time-of-day peak demand changes. Sell back to the grid of excess collected energy is also considered. DOE

N81-29629# Thermo Electron Corp., Waltham, Mass.
COAL-FIRED FURNACE FOR TESTING OF THERMIONIC CONVERTERS
Oct. 1980 22 p refs
(Contract DE-AC02-76ET-11292)
(TE-4258-81-81) Avail: NTIS HC A02/MF A01

The development of thermionic converter technology has progressed to make near-term applications such as the thermionic topping of a pulverized coal-fired central station powerplant. Up to now, thermionic converters have been flame tested using natural gas as fuel. A test furnace is required for evaluation of thermionic converters in a coal-fired environment. The design and costs of a facility which adapts a coal-fired furnace for thermionic converter testing are discussed. Such a facility would be exempt from air pollution regulations because of its low firing rate. DOE

N81-29945# Oak Ridge National Lab., Tenn. Fusion Energy Div.
PHYSICS OF FUSION-FUEL CYCLES
J. Rand McNally, Jr. 1981 28 p refs Presented at the Intern. Conf. on Plasma Sci., Sante Fe, N. Mex., 18-20 May 1981
(Contract W-7405-eng-26)
(CONF-810527-3) Avail: NTIS HC A03/MF A01

Nuclear fusion fuels for a magnetic fusion economy are evaluated taking into account the various technological impacts of the various fusion fuel cycles as well as the relative reactivity and the required beta's and temperature necessary for economic steady state burns. The physics of the various fusion fuel cycles (D-T, catalyzed D-D, D-He, D-Li, and the exotic fuels; He-He and the proton based fuels such as P-Li, P-Be, and P-B is reviewed including such items as (1) tritum inventory, burnup and recycle; (2) neutrons; (3) condensable fuels and ashes; (4) direct electrical recovery prospects; (5) fissile breeding, etc. The advantages as well as the disadvantages of the different fusion fuel cycles are discussed. The optimum fuel cycle from an overall standpoint of viability and potential technological considerations appears to be catalyzed D-D, which could also support smaller relatively clean, lean-D, rich-He-3 satellite reactors as well as fission reactors. DOE

N81-29994# Reynolds Metals Co., Sheffield, Ala. Energy Conversion Div.
MICROWAVE GASEOUS ELECTRODE DEVELOPMENT Final Report
M. S. Jones, Jr., K. Sathyanarayana, R. Mallavarpu, and V. Thiagarajan 31 Dec. 1980 68 p refs
(Contract DE-AC01-80ET-15619)
(DOE/ET-15619/T1) Avail: NTIS HC A04/MF A01

A microwave plasma torch was developed and tested at bench scale. The tests included: characterization of the plasma torch operating characteristics as gas composition, gas flow rate, and power input were varied; measuring the effects of magnetic fields on the plasma torch operation; measuring the effects on the plasma torch operation of an aerodynamic flow field past the exit of the torch (cold flow tests); and measurements to characterize the plasma gas temperature and electron temperature. The microwave plasma torch was installed in the anode wall of the RMC diagonal conducting wall MHD generator. Hot flow tests were conducted in the channel using unseeded combustion products, followed by tests using subsonic and supersonic flows seeded with up to 1.5 w/o potassium and magnetic fields up to 3.8 Tesla. Another concept using a microwave slot radiator to produce plasma in the MHD boundary layer was tested at the bench scale. Parameters necessary to sustain a discharge with the slot radiator open, similar to the microwave plasma torch, with argon flowing through the slots; and with the slots closed with a castable ceramic, the argon flowing past the outside of the slot were measured. DOE

N81-30198# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.
DEVELOPMENT AND DESIGN OF A LARGE WIND-TURBINE BLADE
Michael Hahn May 1980 26 p refs
(MBB-UD-301/80-OE) Avail: NTIS HC A03/MF A01

The implementation of the mold concept in the fabrication of large blade-structures which require special surface definition and design features is described. These blades are intended for large horizontal axis windmills. Fiber reinforced composite materials produce rotor blades of high aerodynamic quality with very different profiles. It is possible to vary the stiffness of a cross-section with a given contour. Lightning protection features incorporated are described together with the protection characteristics afforded by erosion resistant paint. In the attachment area, the laminate is thickened considerably. The loads are transferred by means of prestressed studs in combination with cylindrical nuts which fit into holes bored in the thickened laminate. Author (ESA)

N81-30513*# United Technologies Corp., South Windsor, Conn. Power Systems Div.
ADVANCED TECHNOLOGY LIGHTWEIGHT FUEL CELL PROGRAM Final Report, 31 Aug. 1979 - 28 Feb. 1981
R. E. Martin 18 Aug. 1981 95 p refs
(Contract NAS3-21293)
(NASA-CR-165417; FCR-3045) Avail: NTIS HC A05/MF A01 CSCL 10A

The potential of the alkaline electrolyte fuel cell as the power source in a multi hundred kilowatt orbital energy storage system was studied. The total system weight of an electrolysis cell energy storage system was determined. The tests demonstrated: (1) the performance stability of a platinum on carbon anode catalyst configuration after 5000 hours of testing has no loss in performance; (2) capability of the alkaline fuel cell to operate to a cyclical load profile; (3) suitability of a lightweight graphite electrolyte reservoir plate for use in the alkaline fuel cell; (4) long life potential of a hybrid polysulfone cell edge frame construction; and (5) long term stability of a fiber reinforced potassium titanate matrix structure. The power section tested operates with passive water removal eliminating the requirement for a dynamic hydrogen pump water separator thereby allowing a powerplant design with reduced weight, lower parasite power, and a potential for high reliability and extended endurance. It is concluded that two perovskites are unsuitable for use as a catalyst or as a catalyst support at the cathode of an alkaline fuel cell. E.A.K.

N81-30562*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEST RESULTS OF THE CHRYSLER UPGRADED AUTOMOTIVE GAS TURBINE ENGINE: INITIAL DESIGN Final Report
David Horvath, Guy H. Ribble, Jr., Edward L. Warren, and James C. Wood Jul. 1981 66 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-81660; DOE/NASA/51040-22; E-676) Avail: NTIS HC A04/MF A01 CSCL 10B

The upgraded engine as built to the original design was deficient in power and had excessive specific fuel consumption. A high instrumented version of the engine was tested to identify the sources of the engine problems. Analysis of the data shows the major problems to be low compressor and power turbine efficiency and excessive interstage duct losses. In addition, high HC and CO emission were measured at idle, and high NOx emissions at high energy speeds. T.M.

N81-30572# South Carolina Energy Research Inst., Columbia.
RESIDUAL ENERGY APPLICATIONS PROGRAM SYSTEMS ANALYSIS REPORT
P. W. Yngve Oct. 1980 228 p refs
(Contract DE-AC09-77ET-12866)
(DOE/ET-12866/3) Avail: NTIS HC A11/MF A01

Current DOE plans call for building an Energy Applied Systems Test (EAST) Facility at the Savannah River Plant in close proximity to the 140 to 150 F waste heat from one of several operating nuclear reactors. The waste water flow from each reactor, approximately 165,000 gpm, provides a unique opportunity to test the performance and operating characteristics of large-scale waste heat power generation and heat pump system concepts. This report provides a preliminary description of the potential end-use market, parametric data on heat pump and the power generation system technology, a preliminary listing of EAST Facility requirements, and an example of an integrated industrial park utilizing the technology to maximize economic pay back. DOE

N81-30590# Fisher (Evan D.), Bellaire, Mich.
WIND TO HEAT CONVERTER Final Technical Report
Evan D. Fisher 6 Mar. 1981 56 p
(Contract DE-FG02-79R5-10120)
(DOE/R5-10120/2) Avail: NTIS HC A04/MF A01

The feasibility of a wind driven machine which converts wind energy directly to heat was demonstrated through: the action of the impellor of a windmill driving; suitable shafting and gearing; and a rotary hydraulic brake which absorbs the power by converting the mechanical energy into heat. Resistance is created exclusively by fluid friction and agitation of the hydraulic oil circulated between the vaned members of the converter. A prototype model was constructed and erected on a hilltop site adjacent to a building. It is connected to the building's heating system and its performance is evaluated. DOE

N81-30615# Sandia Labs., Albuquerque, N. Mex. Advanced Energy Projects Div.
RECENT DARRIEUS VERTICAL-AXIS WIND TURBINE AERODYNAMICAL EXPERIMENTS AT SANDIA NATIONAL LABORATORIES
Paul C. Klimas 1981 8 p refs Presented at the 2nd DOE/NASA Wind Turbine Dyn. Workshop, Cleveland, 24 Feb. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1108C; CONF-810226-5) Avail: NTIS HC A02/MF A01

The aerodynamics of airfoils operating in the vertical axis wind turbine (VAWT) environment were examined. The experiments are intended to reduce VAWT cost of energy an increase system reliability. The experiments include: (1) chordwise pressure surveys; (2) circumferential blade acceleration surveys; (3) effects of blade camber; (4) pitch and offset; (5) blade blowing; and (6) use of sections designed specifically for VAWT application. DOE

N81-30645# New Mexico Univ., Albuquerque. Engineering Research Inst.
AUTOMATIC-CONTROL-ALGORITHM EFFECTS ON ENERGY PRODUCTION
Gerald M. McNerney 1981 9 p ref Presented at the DOE/NASA Wind Turbine Dyn. Workshop, Cleveland, 24 Feb. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1107C; CONF-810226-6) Avail: NTIS HC A02/MF A01

Algorithm control strategy for unattended wind turbine operation, a potentially important aspect of wind energy production is discussed. A computer model was developed, using actual wind time series and turbine performance data to simulate the power produced by the Sandia 17-m VAWT operating in automatic control. The model was used to investigate the influence of starting algorithms on annual energy production. The results indicate that, depending on turbine and local wind characteristics, a bad choice of a control algorithm can significantly reduce overall energy production. The model can be used to select control algorithms and threshold parameters that maximize long term energy production. DOE

N81-30647# Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht (West Germany). Zentralabteilung Technikum.
COMPARATIVE INVESTIGATIONS OF THE PERFORMANCE OF SMALL WIND ENERGY CONVERSION SYSTEMS
S. Fries, D. Borchers, and G. Petersen 1980 28 p Presented at UN/ECE Seminar on Technol. Related to New Energy Sources, Juelich, West Germany, 8-12 Dec. 1980
(GKSS-80-E-54) Avail: NTIS HC A03/MF A01

A full scale, two year test program is described for nine different 10 KW windmills at a site on the north Frisian island of Pellworm. The power plants include horizontal axis machines with two or three rotor blades (with or without blade pitch control), horizontal axis multiblade (16-to 18 blades) machines, and vertical axis machines. Electric power output, energy production, the ac frequency, the revolutions-per-minute of the converter, and the yaw angle for each horizontal axis machine are measured continuously. Wind speed, wind direction, air temperature, humidity, air pressure, and solar insolation and additional meteorological parameters for the description of climatic conditions on the site are monitored. Microprocessors are used for data processing and to control load resistances. The measurement of electric and nonelectric variables is described. Author (ESA)

N81-30903*# Virginia Associated Research Center, Newport News.
SOUND MEASUREMENTS OF THE MOD-2 WIND TURBINE GENERATOR
H. H. Hubbard, K. P. Shepherd (Bionetics Corp., Hampton, Va.), and F. W. Grosveld (Bionetics Corp., Hampton, Va.) Jul. 1981 30 p refs
(Contract NAS1-14970; Grant NAG1-166)
(NASA-CR-165752) Avail: NTIS HC A03/MF A01 CSCL 20A

Sound measurements were made for the MOD-2 wind turbine generator for wind conditions of 7.6 to 13.4 m/sec and for output power ratings of about 1 to 2 NW. Both broad band and narrow band data wre obtained for a range of distances and azimuth angles from the machine. The rotor sound spectra are random in character and peak in the frequency ranges 30 to 50 Hz and 800 to 1300 Hz. Both peaks are predictable from experience with helicopter rotors and propellers. Results suggest that the lower frequency peak is due to the effects of inflow turbulence and the higher frequency peak is due to the interactions of the turbulent boundary layers with the trailing edges of the blades. The boundary layer related sound is the dominant component in the audible frequency range and determines the detectability of the machine. It could be detected at a distance of 1350 m in the upwind direction where the background noise was 30 dB (A) and at distances in excess of 2100 m in the downwind direction. Discrete frequency sound components associated with the power generation equipment are measurable in the direction normal to the axis of rotation but are not believed to be significant for detection or community response. M.G.

N81-30973*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A PROGRAM-MANAGEMENT PLAN WITH CRITICAL-PATH DEFINITION FOR COMBUSTION AUGMENTATION WITH THERMIONIC ENERGY CONVERSION (CATEC)
James F. Morris, Owen S. Merrill (DOE, Washington, D.C.), and Harsha K. Reddy (The Aerospace Corp., Los Angeles) 1981 50 p refs Presented at Intern. Conf. on Plasma Sci., Santa Fe, N. Mex., 18-20 May 1981
(Contract EC-77-A-31-1062)
(NASA-TM-82670; E-950; DOE/NASA/1062-0) Avail: NTIS HC A03/MF A01 CSCL 20I

Thermionic energy conversion (TEC) is discussed. In recent TEC-topping analyses, overall plant efficiency (OPE) and cost of electricity (COE) improved slightly with current capabilities and substantially with fully matured technologies. Enhanced credibility derives from proven hot-corrosion protection for TEC by silicon-carbide clads in fossil fuel combustion products. Combustion augmentation with TEC (CATEC) affords minimal cost and plant perturbation, but with smaller OPE and COE improvements than more conventional topping applications. Risk minimization as well as comparative simplicity and convenience, favor CATEC for early market penetration. A program-management plan is proposed. Inputs, characteristics, outputs and capabilities are discussed. S.F.

N81-31404# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

PERFORMANCE ANALYSIS OF DEDICATED HEAT-PUMP WATER HEATERS IN AN OFFICE BUILDING
L. Morrison May 1981 13 p refs Presented at the 3rd Conf. on Waste Heat Management and Utilization, Miami, Fla., 11-13 May 1981
(Contracts DE-AC02-77CH-0017; EG-77-C-01-4042)
(SERI/TP-721-1198; CONF-810545-4) Avail: NTIS HC A02/MF A01

The performance of two generic dedicated heat pump water heaters (HPWHs) in supplying the domestic hot water (DHW) needs of a medium sized office building were evaluated. Data measurements and assumptions were made to compensate for a faulty flow meter. A stand alone heat pump plumbed to a conventional tank obtains a coefficient of performance (COP) of 2.4 but only delivers load water temperatures of about 41 C. An integral heat pump/tank unit was tested. Recirculating loop losses account for 75% of the energy delivered by the JPWHs. It is suggested that these losses be reduced by 75% if the recirculating loop were insulated. DOE

N81-31618# Tennessee Univ. Space Inst., Tullahoma. Energy Conversion Div.
DEVELOPMENT AND HEAT TRANSFER ANALYSIS OF DIRECT COAL FIRED MHD COMBUSTORS
G. D. Roy and R. C. Attig Jun. 1981 71 p refs
(Contract DE-AC02-79ET-10815)
(DOE/ET-10815/T4) Avail: NTIS HC A04/MF A01

The performance of the generator as a function of the combustor geometry and other factors (MHD combustor/generator interaction); knowledge of the heat flux distribution and the heat losses of various locations were studied. The heat loss in the coal combustor increases the cost of electricity and should thus be kept at a minimum. For higher conductivities, the thermal energy of the coal should be relesed as completely as possible. Since the resulting performance of the generator is the best criterion of combustor selection, detailed combustor/generator interaction testing was undertaken. Heat transfer was used as one diagnostic tool among others. Details of this testing and data analysis are presented. T.M.

N81-31554# Curtiss-Wright Corp., Wood-Ridge, N.J. Power Systems Div.
HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM. PHASE 2: TECHNOLOGY TEST AND SUPPORT STUDIES Technical Progress Report, 1 Mar. - 31 Mar. 1981
Apr. 1981 9 p refs
(Contract DE-AC01-76ET-10348)
(CW-WR-76-02086; FE-2291-86) Avail: NTIS HC A02/MF A01

The technology of a high temperature, multistage, power turbine subsystem was advanced to a technology readiness condition. Technical data required to complete the turbine subsystem designs were tested. DOE

N81-31627*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESULTS OF THE ETV-1 BREADBOARD TESTS UNDER STEADY-STATE AND TRANSIENT CONDITIONS
Noel B. Sargent and Miles O. Dustin Aug. 1981 16 p refs Presented at the Elec. Vehicle Council Symp. 6, Baltimore, 21-23 Oct. 1981
(Contract DE-A101-77CS-51044)
(NASA-TM-82667; E-944; DOE/NASA/51044-21) Avail: NTIS HC A02/MF A01 CSCL 10A

Steady state tests were run to characterize the system and component efficiencies over the complete speed-torque capabilities of the propulsion system in both motoring and regenerative modes of operation. The steady state data were obtained using a battery simulator to separate the effects on efficiency caused by changing battery state-of-charge and component temperature. Transient tests were performed to determine the energy profiles of the propulsion system operating over the SAE J227a driving schedules. T.M.

N81-31628*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
GENERAL REVIEW OF THE MOSTAS COMPUTER CODE FOR WIND TURBINES
John Dungundji and John H. Wendell Jun. 1981 75 p refs
(Grant NsG-3303; Contract DE-AI01-76ET-20320)
(NASA-CR-165385; DOE/NASA/3303-1; ASRL-TR-197-1)
Avail: NTIS HC A04/MF A01 CSCL 10A

The MOSTAS computer code for wind turbine analysis is reviewed, and techniques and methods used in its analyses are described. Impressions of its strengths and weakness, and recommendations for its application, modification, and further development are made. Basic techniques used in wind turbine stability and response analyses for systems with constant and periodic coefficients are reviewed. E.A.K.

N81-31629*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
AEROELASTIC ANALYSIS OF A TROPOSKIEN-TYPE WIND TURBINE BLADE
F. Nitzsche Hampton, Va. NASA. Langley Research Center Jul. 1981 12 p refs Presented at the Intern. Colloq. on Wind Energy, Brighton, England, Aug. 1981
(Grant NGL-05-020-243)
(NASA-CR-165764) Avail: NTIS HC A02/MF A01 CSCL 10B

The linear aeroelastic equations for one curved blade of a vertical axis wind turbine in state vector form are presented. The method is based on a simple integrating matrix scheme together with the transfer matrix idea. The method is proposed as a convenient way of solving the associated eigenvalue problem for general support conditions. E.A.K.

N81-31632*# Avco-Everett Research Lab., Mass.
CONCEPTUAL DESIGN STUDY OF POTENTIAL EARLY COMMERCIAL MHD POWERPLANT. REPORT OF TASK 2 RESULTS Final Report
Finn A. Hals Mar. 1981 247 p refs
(Contracts DEN3-51; DE-AI01-77ET-10769)
(NASA-CR-165235; DOE/NASA/0051-2) Avail: NTIS HC A11/MF A01 CSCL 10B

The conceptual design of one of the potential early commercial MHD power plants was studied. The plant employs oxygen enrichment of the combustion air and preheating of this oxygen enriched air to an intermediate temperature of 1200 F attainable with a tubular type recuperative heat exchanger. Conceptual designs of plant componets and equipment with performance, operational characteristics, and costs are reported. Plant economics and overall performance including full and part load operation are reviewed. The projected performance and estimated cost of this early MHD plant are compared to conventional power plants, although it does not offer the same high efficiency and low costs as the mature MHD power plant. Environmental aspects and the methods incorporated in plant design for emission control of sulfur and nitrogen are reviewed. E.A.K.

N81-31649# Oak Ridge National Lab., Tenn.
NET ENERGY OF SEVEN SMALL-SCALE HYDROELECTRIC POWER PLANTS Final Report
M. W. Gilliland, J. M. Klopatek, and S. G. Hildebrand Jul. 1981 119 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7694; ESD-PUBL-1678) Avail: NTIS HC A06/MF A01

The net energy results are expressed as the ratio of energy output to energy input. Two ratios were developed. In the first (R1), the energy output, expressed as electrically, was divided by the energy subsidy; in the second (R2), the energy output, expressed as the fossil fuel equivalent of electricity, was divided by the energy input. The results indicate that the energy output from the seven plants is 8.6 to 32.9 times greater than the energy input for the R1 case, and 26.3 to 101.4 times greater than the energy input for the R2 case. On the net energy criterion, the small scale plants are better than conventional peak load hydroelectric plants and similar to conventional base load hydroelectric plants. DOE

N81-31651# Lockheed Missiles and Space Co., Sunnyvale, Calif. Ocean Energy Systems.
OCEAN THERMAL ENERGY CONVERSION POWER SYSTEM DEVELOPMENT-2, PHASE 2 Final Design Report
1 Jun. 1981 160 p refs
(Contracts DE-AC02-78ET-21056; ET-78-C-01-3407)
(DOE/ET-21056/T3) Avail: NTIS HC A08/MF A01

The detailed design of the power system development is presented. The trade studies and related investigations are

reviewed. The design and functional requirements for the 10 MW(e) power system and the 0.2 MW(e) heat exchanger test articles are listed. The primary objectives of the total program are given. The major test article components and the related biofouling and corrosion countermeasures are discussed. Performance and diagnostic instrumentation and related data analysis, a proposed OTEC-1 test article installation, and a recommended plan for the conduct of the test program are presented. DOE

N81-31652# Acres American, Inc., Columbia, Md.
SMALL HYDRO PLANT DEVELOPMENT PROGRAM
Oct. 1980 322 p refs Prepared for Edgerton, Germeshausen and Grier, Idaho Falls, Idaho
(Contract DE-AC07-76ID-01570)
(DOE/ID-01570/T21-Vol-2-App-A-K) Avail: NTIS HC A14/MF A01

The technical and economic feasibility of using pump turbine - induction motor (generators) packages in lieu of standardized turbogenerator units in small hydro development projects was reported. The following topics are considered: (1) listing of Hydroelectric Power Resources by State; (2) Manufacturers' Data on Standardized Hydroturbines; (3) Inventory of Available Pumping Equipment; (4) Characteristics of Representative Pumps; (5) Survey of Pump Manufacturers and Engineering Firms; (6) Model Pump Mode and Turbine Mode Characteristics; (7) Prototype Turbine Mode Characteristics; (8) Pump (Turbine) Motor (Generator) Equipment Packages; (9) Manufacturers' Data on Components of Equipment Packages; (10) Overspeed Calculations; and (11) Economic Evaluation DOE

N81-32026*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH B-FIELD, LARGE AREA RATIO MHD DUCT EXPERIMENTS
J. Marlin Smith, Shih-Ying Wang, and J. L. Morgan 1981 14 p refs Presented at the Intern. Conf. on Plasma Sci., Santa Fe, N. Mex. 18-20 May 1981; Sponsored by IEEE
(Contract DE-AI01-77ET-10769)
(NASA-TM-82673; E-956; DOE/NASA/10769-10) Avail: NTIS HC A02/MF A01 CSCL 20I

Studies of the effect of area ratio variation on the performance of a supersonic Hall MHD duct were extended up to area ratios of 6.25/1. It is shown that for a given area ratio there is a combustion pressure above which the power generating region of the duct is shock free and the power output increases linearly with the square of the magnetic field. Below this pressure a shock forms in the duct which moves upstream with increasing magnetic field strength and results in a less rapid rise in power output. Author

N81-32035# Stanford Linear Accelerator Center, Calif.
STATUS OF THE US HEAVY ION FUSION PROGRAM
W. B. Herrmannsfeldt Apr. 1981 20 p refs Presented at the Workshop on the Application of the SNS to Heavy Ion Fusion, Abingdon, England, 23-26 Mar. 1981
(Contract DE-AC03-76SF-00515)
(SLAC-Pub-2722; CONF-810375-1) Avail: NTIS HC A02/MF A01

The US heavy ion fusion (HIF) program is reviewed. The political situation is discussed and then the technical justification for the interest in HIF is presented. This is followed by a brief description of the Argonne Program to develop the rf linac storage ring system for which the spallatron neutron source can contribute important data. The direction being taken by the Berkeley group to develop the induction linac system is described. DOE

N81-32087*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH-POWER BASELINE AND MOTORING TEST RESULTS FOR THE GPU-3 STIRLING ENGINE Final Report
Lanny G. Thieme Jun. 1981 37 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-82646; DOE/NASA-51040-31; E-902) Avail: NTIS HC A03/MF A01 CSCL 13F

Test results are given for the full power range of the engine with both helium and hydrogen working fluids. Comparisons are made to previous testing using an alternator and resistance load bank to absorb the engine output. Indicated power results are presented as determined by several methods. Motoring tests were run to aid in determining engine mechanical losses. Comparisons are made between the results of motoring and energy-balance methods for finding mechanical losses. T.M.

N81-32163# Stuttgart Univ. (West Germany). Inst. fuer Aerodynamik und Gasdynamik.
A GUST GENERATOR FOR WIND TURBINES [EIN BOEENGENERATOR FUER WINDTURBINEN]
F. X. Wortmann 9 Apr. 1979 8 p In GERMAN
(Contract BMFT-PLE-ET-4086-A)
(IAG-79-6) Avail: NTIS HC A02/MF A01

A gust generator is proposed which can be used to study the mechanical characteristics of full size experimental windpowered machines. In conjunction with a wind tunnel, the device would simulate gale force winds as well as variable winds normally encountered by windmill design machines in the course of their work cycle. The utility of such an apparatus is emphasized, its characteristics are detailed, and an estimate of its cost to build is given. Author (ESA)

N81-32214# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
ELECTRODE SURFACE CHEMISTRY Annual Report, FY 1980
Philip N. Ross, Jr. Sep. 1980 15 p
(Contract W-7405-eng-48)
(LBL-12638) Avail: NTIS HC A02/MF A01

Attempts were made to develop the physical and chemical understanding of oxygen-platinum-alloy ligand interaction necessary for the rational selection of alloying components. The experimental approach combines the study of the interaction of the oxygen molecule with bimetallic surface in vacuum and in aqueous solution in a single apparatus. This apparatus combines classical electrochemical methods together with the analytical methods of surface science: low energy electron diffraction; Auger electron spectroscopy; photoemission spectroscopy; and thermal desorption mass spectroscopy. DOE

N81-32224# General Electric Co., Philadelphia, Pa. Management and Technical Services Co.
OPERATION, MAINTENANCE AND MODIFICATION OF DOE/PETC TWO STAGE MHD PRESSURIZED COAL COMBUSTOR Final Activity Report, Jul. 1976 - 15 Nov. 1980
R. B. Bradfield 1980 131 p refs
(Contract DE-AC02-76PC-04049)
(DE81-025971; DOE/PC-04049/T1) Avail: NTIS HC A07/MF A01

The primary objective of the DOE/PETC program is to obtain definitive process information from the two stage 5 MW MHD pressurized coal combustor to allow scaling of the combustor to 50 MW thermal for the CDIF facility to be located in the Butte, Montana area. Activities are described according to the following phases: (1) facility preparation; (2) facility start-up and operating adjustment period; (3) process investigation operations; (4) major facility scroll combustor modification; (5) scroll combustor shakedown testing; (6) AVCO diagnostic test section redesign and installation; (7) scroll combustor testing with diagnostic test section installed; and (8) facility downmode. Diagrams and engineering drawings of the facility are included. DOE

N81-32300# Florida Power and Light Co., Miami.
BASELINE DATA ON UTILIZATION OF LOW-GRADE FUELS IN GAS-TURBINE APPLICATIONS. VOLUME 1: ECONOMIC COMPARISONS Final Report
R. J. Burgess Jun. 1981 132 p Sponsored by EPRI
(EPRI Proj. 1079-1)
(EPRI-AP-1882-Vol-1) Avail: NTIS HC A07/MF A01

The costs and operating factors of a combined cycle power plant when firing No. 2 fuel compared to firing a blended low sulfur residual fuel oil are described. Results are based on exclusively firing No. 2 oil in one 260 MW(e) unit comprised of two gas turbines, two heat recovery steam generators and a steam turbine, while firing the lower grade fuel in the twin 260 MW(e) unit under a similar load and weather conditions as practicable. Some operating problems with heavy fuel firing were resolved. These problems on heavy fuel included fuel filter plugging, flow divider failure, combustor and turbine deposition, apparent compressor surge, and oily fuels wash system effluent water. Though these circumstances tended to mask the exact cost differentials between operations on the two fuels, it is found

that a $2.00/bbl fuel price differential justifies using the lower grade fuel at all capacity factors when the plant is already equipped to handle heavy fuels. For a plant that is not equipped to fire heavy fuels, if a $12.5 million fuel cleaning system investment is made at a 23% levelized annual carrying charge, a @2.00/bbl fuel price differential breaks even at a 0.5 capacity factor despite the higher maintenance costs and fuel cleaning costs incurred when firing low grade fuel. DOE

N81-32307# Westinghouse Electric Corp., Large, Pa. Advanced Energy Systems Div.
EFFECT OF ALTERNATE FUELS ON THE PERFORMANCE AND ECONOMICS OF DISPERSED FUEL CELLS Final Report
J. J. Buggy, B. R. Krasicki, J. R. Lance, B. L. Pierce, and L. E. VanBibber Jul. 1981 187 p refs Sponsored by EPRI
(EPRI Proj. 1041-7)
(EPRI-EM-1936) Avail: NTIS HC A09/MF A01

An assessment of the effects of alternative fuels (natural gas, coal derived medium-Btu gas, methanol, ethanol, and naphtha) on the performance and economics of conceptual phosphoric acid fuel cell (PAFC) power plants is presented. Properties of typical examples of these fuels, PAFC requirements for preliminary specification for fuel processing systems, and vendor-supplied cost, performance, and operational data on fuel processing systems to define ten PAFC power plant configurations utilizing the five alternatives fuels are addressed. DOE

N81-32397*# United Technologies Corp., South Windsor, Conn. Power Systems Div.
THE 40-KW FIELD TEST POWER PLANT MODIFICATION AND DEVELOPMENT, PHASE 2 Annual Report, 1 Jul. 1978 - 30 Jun. 1979
15 Aug. 1980 129 p Sponsored in part by NASA and GRI
(Contracts DE-AC01-77ET-11302; ET-77-C-03-1471)
(NASA-CR-164794; FCR-2067) Avail: NTIS HC A07/MF A01 CSCL 10B

Progression on the design and development of a 40 KW fuel cell system for on-site installation for providing both thermal and electrical power is reported. Development of the steam reformer fuel processor, power section, inverter, control system, and thermal management and water treatment systems is described. DOE

N81-32448# Fluidyne Engineering Corp., Minneapolis, Minn.
MHD AIR-HEATER TECHNOLOGY DEVELOPMENT Technical Progress Program, 1 Jan. 1981 - 31 Mar. 1981
Apr. 1981 44 p refs
(Contract DE-AC01-80ET-15602)
(DE81-026605; DOE/ET-15602/T5) Avail: NTIS HC A03/MF A01

Technology development of the directly-fired high temperature air heater (HTAH) for magnetohydrodynamics power plants is reported. The selection of ceramic materials for the valve testing facility (VTF) and matrix test facility (MTF) and sample collection from the MTF were accomplished. Modifications performed to the VTF hot gas supply duct, preparation for the startup of VTF Test 4, and the design of modifications to the MTF are described. Preliminary investigations of performance and control studies of a 1000 MW power plant were begun. DOE

N81-32464# Oak Ridge National Lab., Tenn. Engineering Technology Div.
CRAWL SPACE-ASSISTED HEAT PUMPS
Ralph N. McGill 1981 10 p refs Presented at the DOE Heat Pump Contractors Program Integration Meeting, McLean, Va., 2-4 Jun. 1981
(Contract W-7405-eng-26)
(DE81-023221; CONF-810672-17) Avail: NTIS HC A02/MF A01

By means of field tests in real houses, it was found that the source air for the heat pump can be preheated (or precooled) by drawing the outdoor air through the crawl space before it is used by the heat pump. The outdoor air is warmed (or cooled) by flowing over the crawl space earth. Most of the data is from winter months; when one would expect the most benefit for heat pump performance. Generally, greater preheating occurs at lower outdoor air temperatures; and, the effect tapers off to virtually no gain at about 10 C. The preheating effect has been shown to be sustained for an entire winter season. Another experiment proved that the preheating does come, in great part, from the earth and not simply from the house above. Analysis had also led to the conclusion that the heat transfer mechanism is by simple conduction within the upper 0.3 m of the crawl space earth. DOE

N81-32517# Tectonics Research, Inc., Minneapolis, Minn.
TEST AND DEMONSTRATION OF A HERMETIC COMPRESSOR SEAL. PHASE 1: DEVELOPMENT OF A BRAUN LINEAR ENGINE-DRIVEN HEAT-ACTUATED HEAT PUMP
A. T. Braun 1981 5 p refs Presented at the DOE Heat Pump Contractors' Program Integration Meeting, McLean, Va., 2-4 Jun. 1981 Prepared for Oak Ridge National Lab.
(Contract W-7405-eng-26)
(DE81-024099; CONF-810672-12) Avail: NTIS HC A02/MF A01

A viable hermetic seal to advance the state of development, through analyses, simulation, design, fabrication and testing, of the key elements and components of the Braun linear engine/compressor was developed. The purpose was to develop: (1) a sound basis for a reliable light-commercial sized heat pump system; (2) evaluate integral heat recovery and defrost systems; (3) necessary controls; and (4) preliminary prototype heat pump system specifications. The concept, technical accomplishments, and future activities are summarized. DOE

N81-32630# Midwest Research Inst., Golden, Colo.
ADVANCED AND INNOVATIVE WIND ENERGY CONCEPT DEVELOPMENT: DYNAMIC INDUCER SYSTEM, EXECUTIVE SUMMARY
P. B. S. Lissaman, A. D. Zalay, and B. H. Hibbs May 1981 16 p Prepared in cooperation with AeroVironment, Inc., Pasadena, Calif.
(Contract DE-AC02-77CH-00178)
(SERI/TR-8085-1-T1) Avail: NTIS HC A02/MF A01

Concepts to improve the technical and economic performance of wind energy conversion systems (WECS) were examined. One technique for improving the cost-effectiveness of WECS is the use of tip vanes. Tip vanes are small airfoils attached approximately at right angles to the rotor tips with their span oriented approximately parallel to the local freestream. The performance benefits of the dynamic inducer tip vane system were demonstrated Tow-tests conducted on a three-bladed, 3.6-meter diameter rotor show that a dynamic inducer can achieve a power coefficient of 0.5, which exceeds that of a plain rotor by about 35%. DOE

N81-32631# Midwest Research Inst., Golden, Colo.
ADVANCED AND INNOVATIVE WIND ENERGY CONCEPT DEVELOPMENT: DYNAMIC INDUCER SYSTEM
P. B. S. Lissaman, A. D. Zalay, and B. H. Hibbs May 1981 89 p refs Prepared in cooperation with AeroVironment, Inc., Pasadena, Calif.
(Contract DE-AC02-77CH-00178)
(SERI/TR-8085-1-T2) Avail: NTIS HC A05/MF A01

The performance benefits of the dynamic inducer tip vane system was demonstrated Tow-tests conducted on a three-bladed, 3.6-meter diameter rotor show that a dynamic inducer can achieve a power coefficient (based pon power blade swept area) of 0.5, which exceeds that of a plain rotor by about 35%. Wind tunnel tests conducted on a one-third scale model of the dynamic inducer achieved a power coefficient of 0.62 which exceeded that of a plain rotor by about 70%. The dynamic inducer substantially improves the performance of conventional rotors and indications are that higher power coefficients can be achieved through additional aerodynamic optimization. DOE

N81-32633# Midwest Research Inst., Golden, Colo.
REPORT ON THE ELECTROFLUID DYNAMIC WIND GENERATOR Final Report, 1 Apr. 1979 - 31 Aug. 1980
John E. Minardi, Maurice O. Lawson, and Frank L. Wattendorf May 1981 48 p refs Prepared in cooperation with Dayton Univ. Research Foundation, Ohio
(Contracts DE-AC02-77CH-00178; DE-AS02-76ET-20258; EY-76-S-02-4130)
(DOE/ET-20258/T1; UDR-TR-80-108) Avail: NTIS HC A03/MF A01

In an EFD generator, charge particles of one polarity are seeded into a flowing neutral gas. Viscous interactions with neutral molecules drive the charged particles against an electrical potential

and produce dc power of low current density and very high voltage. Demonstration of an energy economic method of producing and distributing low mobility charged droplets is described. DOE

N81-32650# South Carolina Energy Research Inst., Columbia.
SOUTH CAROLINA APPLICATIONS FOR INDUSTRIAL WASTE-HEAT RECOVERY USING HEAT PUMPS AND RANKINE-CYCLE POWER-GENERATION SYSTEMS
F. J. McCrosson and K. A. Murray Jul. 1981 77 p refs
(Contract DE-AC09-77ET-12866)
(DOE/ET-12866/9) Avail: NTIS HC A05/MF A01

The industries include: textile finishing, pulp and paper, noncellulosic fibers, pressed and blown glass, hydraulic cement, and secondary nonferrous metals. Thermodynamic and economic calculations determined system outputs and after-tax rates of return. The number of applications and net system outputs for the United States and for South Carolina were estimated. DOE

N81-32660# San Diego Gas and Electric Co., Calif.
HEBER GEOTHERMAL BINARY DEMONSTRATION PROJECT Quarterly Technical Progress Report, 15 Sep. 1980 - 31 Mar. 1981
W. H. Hanenburg, R. G. Lacy, and G. D. YanDeMark Jun. 1981 32 p refs
(Contract DE-FC03-80RA-50239)
(DE81-027446; DOE/RA-50239/1; QTPR-1) Avail: NTIS HC A03/MF A01

Topics covered include progress made in the areas of wells and fluids production and injection systems. Power plant design and construction, power plant demonstration, and data acquisition and dissemination are discussed. DOE

N81-32670# Tudor Engineering Co., San Francisco, Calif.
FEASIBILITY REPORT ON THE POTENTIAL HYDROELECTRIC DEVELOPMENT AT COMBIE DAM
Oct. 1980 141 p Prepared in cooperation with Nevada Irrigation District, Grass Valley, Calif.
(Contract DE-FM07-80ID-49004)
(DE81-026670; DOE/ID-49004/1; WP-113-254-TC) Avail: NTIS HC A07/MF A01

The power plant would utilize flows which presently pass over the dam's spillway. The project would involve expanding the existing four foot diameter outlet on the southern gravity portion of the dam, installing a penstock and constructing a 3500 kilowatts (kW) power plant on the south bank of the river below the dam. The capital cost of the project, including interest during construction, would total approximately $4,500,000 in July 1980 Dollars. The unit capacity cost of the project at the 1980 price level would be $1,285 per kilowatt. The energy production unit cost would be 41.4 mills per kilowatt hour in 1980, and 56.3 mills per kilowatt hour in 1984. The primary conclusion is that the project is economically, environmentally and institutionally viable, and continued escalation of energy values will make this project even more attractive. DOE

N81-32673# Oklahoma State Univ., Stillwater. Engineering Energy Lab.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 8: WIND ENERGY
William L. Hughes, R. G. Ramakumar, and Dan D. Lingelbach Apr. 1981 143 p refs Prepared in cooperation with Univ. of Central Florida, Orlando
(DE81-029009; DOE/CS-30278/T10) Avail: NTIS HC A07/MF A01

A historical perspective of wind energy utilization, and the potential uses of wind were examined and the economic costs and technical difficulties of using it. The statistical characteristics of the wind for a moderate to high wind area in the United States are discussed. Information on average available energy on an annual basis is presented along with approximately monthly variations. An extensive variety of types of windmills, and a sampling of these varieties is discussed. Data on efficiencies and power coefficients for a variety of turbines are also presented. DOE

N81-32676# Jacobs Energy Research, Inc., Audubon, Minn.
HYDRAULIC WIND ENERGY CONVERSION SYSTEM
Jul. 1981 18 p ref
(Contract DE-FG02-80R5-10236)
(DE81-027122; DOE/R5-10236/2) Avail: NTIS HC A02/MF A01

The purpose of this research was to design, build and test a hydraulic wind energy system. This design used a three bladed turbine, which drove a hydraulic pump. The energy is transmitted from the pump through a long hose and into a hydraulic motor, whee the energy is used. This wind system was built and tested during the winter of 1980-1981. The power train included a five meter, three bladed wind turbine, a 9.8:1 ratio gearbox, a 1.44 cubic inch displacement pump with a small supercharge gear pump attached. The hydraulic fluid was pumped through a 70 ft, 3/4 in. I-D-high pressure flexhose, then through a volume control valve and into a 1.44 cubic inch displacement motor. The fluid was returned through a 7 ft, 1 in. I-D-flexhose. DOE

N81-32685# Argonne National Lab., Ill.
DEVELOPMENT OF A TUBULAR LITHIUM-IRON SULFIDE CELL
Y. W. Park (Korea Inst. of Science and Technology, Seoul) and H. Shimotake 1980 14 p refs Presented at the 15th Intersoc. Energy Conversion Eng. Conf., Seattle, 18-22 Aug. 1980
(Contract W-31-109-eng-38)
(DE81-023126; CONF-800806-47) Avail: NTIS HC A02/MF A01

Applications of the cell include power sources for electric-vehicle propulsion and stationary energy storage for load leveling in electric utility networks. Performance requirements for these applications are high specific energy, high volumetric energy density, and high specific power. A tubular cell design in which a cylindrical electrode surrounded by an annular shaped electrode of the opposite polarity was adopted to produce low-cost cells such as LeClanche cells and Ni-Cd cells. This design may offer low-cost alternatives to the current prismatic and cylindrical cell designs. The tubular Li/FeS cells currently being developed are discussed. DOE

N81-32693# Siemens A.G., Erlangen (West Germany). Forschungslab.
TWENTY kW FUEL CELL UNITS OF COMPACT DESIGN. PART 1: SUMMARY. PART 2: COMPACT FUEL CELL SET Final Report
Horst Gruene, Karl Hoehne, Karl Strasser, Botho Stuewe, and Hans Fetzer Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 614 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 5 Vol.
(BMFT-FB-T-80-055-Vol-1/2; ISSN-0340-7608) Avail: NTIS HC A99/MF A01

A 7kW compact hydrogen oxygen fuel cell was developed with considerably improved specific power capabilities. The unit, consisting of a total of 70 cells with alkali electrolytes, is described and details on catalysts, electrode construction, electrolyte regenerator and electromechanical and electronic control are included. Prototype tests show the attainment of the envisaged specific power. This is attributed to an increase in power density and to the particular design concept. While certain components need further improvements, the overall feasibility of economical manufacturing, due to the production methods employed, is demonstrated. Author (ESA)

N81-32694# Siemens A.G., Erlangen (West Germany). Forschungslab.
TWENTY kW FUEL CELL UNITS OF COMPACT DESIGN. PART 3: PRELIMINARY WORK FOR THE MANUFACTURE OF TEN SEVEN kW PROTOTYPE AGGREGATES IN THE KUNSTOFF UND PRESSWERK, REDWITZ Final Report
Dieter Weyl Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 39 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 5 Vol.
(BMFT-FB-T-80-056-Vol-3; ISSN-0340-7608) Avail: NTIS HC A03/MF A01

The production processes developed in the laboratory for the manufacturing of 7 kW fuel cell units were examined under factory conditions. The optimization of the production parameters of catalysts, electrodes, and plastic frames is described as well as production and assembly equipment. Experience gained in the manufacturing of the electrolyte regenerator and the control units is reported. In view of the progress made, it was decided

to manufacture of components for the prototype aggregates.
Author (ESA)

N81-32695# Siemens A.G., Erlangen (West Germany). Forschungslab.
TWENTY kW FUEL CELL UNITS OF COMPACT DESIGN. PART 4: ACCOMPANYING RESEARCH AND DEVELOPMENT Final Report
Konrad Mund Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 171 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 5 Vol.
(BMFT-FB-T-80-057-Vol-4; ISSN-0340-7608) Avail: NTIS HC A08/MF A01

Models describing the electrochemical kinetics at porous H2 and O2 electrodes using Raney nickel and silver catalysts were developed and their parameters determined by means of stationary and impedance measurements. A correct description of the hydrogen electrode with a Raney nickel catalyst is shown to encompass proper consideration of both diffusion in the pore electrolyte and surface diffusion. Impedance measurements yield a surface diffusion coefficient of 10 sub-8 sq cm sub-1. The addition of titanium to the catalyst results in decreased electrode polarization and higher stability. Highly active doped silver catalysts are shown to allow high current densities and diaphragm resistances as low as 3 ohm cm at the oxygen electrode. Service tests show adequate stability of the catalysts. Author (ESA)

N81-32697# Siemens A.G., Erlangen (West Germany). Forschungslab.
TWENTY kW FUEL CELL UNITS OF COMPACT DESIGN. PART 6: USE OF FUEL CELL AGGREGATES AND ENERGY CONVERSION. PART 7: CONCEPT AND DESIGN STUDIES FOR SPECIAL STANDBY POWER SUPPLIES Final Report
Ruediger Braun Bonn Bundesministerium fuer Forschung und Technologie Sep. 1980 71 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 5 Vol.
(BMFT-FB-T-80-059-Vol-6/7; ISSN-0340-7608) Avail: NTIS HC A04/MF A01

Dimensioning and circuit arrangement of fuel cell aggregates of different capacity built up from the basic 7 kW unit are discussed as well as the electrical design of dc and ac converters. Battery overlap, cold operation and water removal under reduced load conditions are considered. Two specific applications are studied: a 20kVA fully automated standby unit for hospitals; and a movable 1.5kVA standby unit. The former investigation is mainly concerned with the system information flow and automation. The latter aims at optimizing dimensions and weight. The role of fuel cells in improving the availability of public power supply systems is finally assessed. Author (ESA)

N81-33038# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 7: MHD APPENDIX (BIBLIOGRAPHY, PATENT DISCLOSURES, SUPPLEMENTARY DWGS) Final Report, 15 Oct. 1973 - 31 Dec. 1975
William E. Young Nov. 1980 62 p refs
(Contract DE-AC01-76ET-10805)
(DE-81026197; DOE/ET-10805/T1-Vol-7) Avail: NTIS HC A04/MF A01

The seven-section bibliography cites nearly 200 reports, memos, and technical papers, and includes not only those completed during the contract time frame, but some that lead up to and are subsequent to the contract period. A listing of 66 patent disclosures (and patents) and 27 assembly drawings, including reference to the associated details is included. DOE

N81-33056# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
KEY CONTRIBUTIONS IN MHD POWER GENERATION *Quarterly Technical Progress Report*, 1 Dec. 1979 - 29 Feb. 1980
J. F. Louis Sep. 1980 177 p
(Contract DE-AC01-79ET-15518)
(DE81-025174; DOE/ET-15518/4) Avail: NTIS HC A09/MF A01

Arcing phenomena in MHD generator open cycle MHD disk generator program electrode module development and testing and coal combustion studies are addressed. DOE

N81-33057# Stanford Univ., Calif. High Temperature Gasdynamics Lab.
HIGH-MAGNETIC-FIELD MHD-GENERATOR PROGRAM Quarterly Report, 1 Jan. - 31 Mar. 1981
C. H. Kruger, R. H. Eustis, M. Mitchner, S. A. Self, J. K. Koester, and T. Nakamura Apr. 1981 80 p refs
(Contract DE-AC01-80ET-15611)
(DE81-025560; DOE/ET-15611/T2) Avail: NTIS HC A05/MF A01

Channel phenomena which are important at high magnetic fields are investigated. Nonuniformity effects, boundary layers, hall field breakdown, the effects of electrode configuration and current concentrations, and studies of steady state combustion disk and linear channels in a 6 Tesla magnet of small dimensions were studied. A multi-channel fiber optics diagnostic system is described. A one dimensional model to describe the performance of a non-ideal MHD generator was developed. A two dimensional MHD computer code was developed which predicts the dependence on electrode and insulator dimensions of the onset of interelectrode Hall field breakdown. Calculations of the effects of nonuniformities on the flow and electrical behavior of baseload-sized disk generators were performed. DOE

N81-33059# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 2: MHD CHANNEL EXPERIMENTS Final Report, 15 Oct. 1973 - 31 Dec. 1975
William E. Young and Abner B. Turner Nov. 1980 822 p refs
(Contract DE-AC01-76ET-10805)
(DE81-026202; DOE/ET-10805/T1-Vol-2; FE-1540-29) Avail: NTIS HC A99/MF A01

An MHD generator facility for evaluating and developing hot channel materials and structures was constructed with about a 4.0 MW thermal rating and with a gas flow of 1.47 kg/second. A flexible design accommodated various internal sidewall and electrode constructions. The facility consisted of an indirect fired air preheater with air supplied from a 350 HP rotary compressor, a combustion system capable of producing a working gas equivalent in all respects to products of combustion of coal and air, fuel and gas supplies with adequate metering facilities, a mixing charger, provision for seed injection, an MHD generator duct with a conventional iron core magnet of 30,000 gauss maximum field, a back pressure valve to control duct pressure under all generating conditions, and a gas scrubbing system. Facility design and results from the hot run tests are presented. DOE

N81-33060# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS, VOLUME 3: ELECTRICAL PROPERTIES OF COAL COMBUSTION PRODUCT Final Report, 15 Oct. 1973 - 31 Dec. 1973
W. E. Young and Joseph Lempert Nov. 1980 60 p refs
(Contract DE-AC01-76ET-10805)
(DE81-026201; DOE/ET-10805/T1-Vol-3; FE-1540-29-Vol-3) Avail: NTIS HC A04/MF A01

Laboratory apparatus was assembled to produce a plasma identical in composition and properties to that resulting in an MHD system when coal and air are burned. This was accomplished with a combustion chamber in which benzene, char, sulfur, and seed mixtures were burned with electrically preheated air. The plasma entered a measuring section where temperatures were measured with iridium versus iridium-rhodium thermocouples, with pyrometers, and by means of line reversal. Measurements of electrical conductivity were made with current and voltage probes. Many difficulties were experienced in the operation and calibration of the equipment, however, some readings were obtained in the 19000 C to 20000 C range, averaging 10 to 20 mhos/meter - much higher than predicted theoretically, probably due to electrical leakage. Electrical measurements were made on the Waltz Mill passage during operation. Readings less than 1.0 mhos/meter were obtained which was not unexpected because the plasma temperature approximated 21000 C. DOE

N81-33061# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 4: DEVELOPMENT AND EVALUATION OF MATERIALS FOR MHD CHANNELS Final Report, 15 Oct. 1973 - 31 Dec. 1975
William E. Young and Barry R. Rossing Nov. 1980 69 p refs
(Contract DE-AC01-76ET-10805)
(DE81-026200; DOE/ET-10805/T1-Vol-4; FE-1540-29-Vol-4)
Avail: NTIS HC A04/MF A01

A small materials test facility is described for simulating hot wall MHD channel operation with 90% coal slag removal. It was concluded that a graded CeO2-ZrO2 composition offered a good possibility for a satisfactorily MHD electrode with a hot face surface temperature of 16000 C and a back face (platinized) temperature of 10000 C. It was also concluded that a larger materials tester with a rectangular cross section and provision for passing current through the electrodes would be desirable. Such an apparatus was built for a follow-on contract. DOE

N81-33062# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 5: COMBUSTION TECHNOLOGY, A REVIEW FOR DEVELOPMENT OF COAL BURNING EQUIPMENT FOR ADVANCED ENERGY CONVERSION SYSTEMS Final Report, 15 Oct. 1979 - 31 Dec. 1975
William E. Young and James A. Dilmore Nov. 1980 72 p refs
(Contract DE-AC01-76ET-10805)
(DE81-026199; DOE/ET-10805/T1-Vol-5; FE-1540-29-Vol-5)
Avail: NTIS HC A04/MF A01

The need to develop a line of combustors capable of burning coal or coal related fuels for a variety of applications associated with advanced power generating equipment was identified. Also required are coal preparation, handling, and feeding equipment necessary for operating the facility, as well as the completely instrumented test stand needed for evaluation and development. This facility, if constructed with government funds, could be made available to other contractors for evaluation and development. The design of a complete coal handling processing and feeding system for a coal combustor is described. Also, designs for two stage combustors for the ETF-1, ETF-2, and ETF-3 are given. DOE

N81-33063# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 6: COOPERATIVE EFFORT IN THE SOVIET U-02 MATERIALS TESTING FACILITY Final Report, 15 Oct. 1973 - 31 Dec. 1975
William E. Young and Edward W. Frantti Nov. 1980 453 p refs
(Contract DE-AC02-76ET-10815)
(DE81-026198; DOE/ET-10805/T1-Vol-6; FE-1540-29-Vol-6)
Avail: NTIS HC A20/MF A01

Five zirconia based materials and the cathode and anode electrode wall modules supplied by the U.S. were tested under MHD operating conditions. The materials were 88ZrO2-12YiO3, 82ZrO2-18CeO2, 50ZrO2-50CeO2, 25ZrO2-75CeO2 and 20ZrO2-78CeO2-2Ta2O5. Each of the five electrode materials had four different current densities established between the anode and cathode during the experiment which lasted a total of 127 hours; 100 hours under MHD power operational conditions. All except six electrode pairs performed satisfactorily during the entire test. These were the pairs which were designated to carry maximum or near maximum current density. Five pairs failed early in the life test and the sixth pair failed in the last several hours. Failure was not due to the electrode materials, however, but due to lead out melting described and the opeational parameters are given U-O2 facility is fully described and the operational parameters are given for each phase of the test. The electrode and insulating walls are described and the appropriate parameters that are used to predict the performance of the module are given. DOE

N81-33086# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. Geothermal Programs Office.
CONDENSING CURVES FOR A NUMBER OF MIXED-HYDROCARBON WORKING FLUIDS
O. J. Denmuth Jul. 1981 37 p refs
(Contract DE-AC07-76ID-01570)
(DE81-028654; EGG-GTH-5456) Avail: NTIS HC A03/MF A01

Condensing curves are presented for a number of two-component mixed hydrocarbon working fluids which are potentially usable in binary geothermal cycles. Performance of geothermal thermodynamic cycles incorporating these fluids were evaluated. Two figures summarizing the results of those evaluations are included. Heat rejection systems for advanced geothermal electric power plants utilizing mixed hydrocarbon working fluids are discussed in relation to the data. DOE

N81-33099# Jacobson (Daniel), Inc., Indianapolis, Ind.
HEAVY-DUTY ENGINES ANALYSIS, STUDY 3: APPLICATIONS OF GAS TURBINE ENGINES FOR HEAVY DUTY TRUCKS
D. H. Jacobson Jul. 1981 49 p refs Prepared for Argonne National Lab.
(Contract W-31-109-eng-38)
(DE81-028494; ANL/CNSV-TM-75) Avail: NTIS HC A03/MF A01

The operational acceptance, technical feasibility, economic viability, and benefits of introducing gas turbine power systems into commercial trucking operations was studied. The scope of the total program and the key elements and steps required to conduct an effective demonstration to production evaluation program are developed. The turbine engines available for near term installation in representative vehicles, including the development status, projected performance, delivery schedule, and cost estimates. The impact of technological advancement in the areas of ceramics, controls, transmissions and heat exchangers is also a factor in the projection of the full potential that is realized by the advanced propulsion system. DOE

N81-33171# Sandia Labs., Albuquerque, N. Mex.
AERODYNAMIC SIZING OF VERTICAL-AXIS WIND TURBINES FOR WIND FARMS
James K. Cole Aug. 1981 30 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029294; SAND-81-0979) Avail: NTIS HC A03/MF A01

This study addresses the issue of whether a large number of small turbines or a small number of large turbines will generate the most total power on a given wind farm. The effects of atmospheric boundary layer, turbine pedestal height, and turbine Reynolds number are evaluated for vertical-axis wind turbines (VAWTs) that are 17, 46, and 85 m in diameter. Results indicate that for realistic thicknesses of atmospheric boundary layers, increasing the size of the turbine increases the total power generated. Adding a pedestal may also increase the power generated. If the atmospheric boundary layer exceeds 100 m in thickness, a wind farm can generate up to 73% more power through the use of 85-m-dia VAWTs instead of 17-m-dia VAWTs. DOE

N81-33438# South Carolina Energy Research Inst., Columbia.
RESIDUAL-ENERGY-APPLICATIONS PROGRAM: SUPPORT AND INTEGRATION REPORT
F. J. McCrosson Nov. 1980 94 p refs
(Contract DE-AC09-77ET-12866)
(DE81-025479; DOE/ET-12866/6) Avail: NTIS HC A05/MF A01

The proposed government-owned EAST Facility at the Savannah River Plant in Aiken, South Carolina, would provide capabilities for development and confidence testing of industrial heat pumps, high temperature bottoming cycles, low temperature Rankine cycle power generation systems, and absorption chillers. This report describes support and integration activities that were performed during the contract year. The various elements that impact on the EAST Facility are discussed and an assessment of the EAST Facility mission is given. The report concludes with proposed milestones, schedule, and costs for design, construction, and operation of the facility. DOE

N81-33443# Science Applications, Inc., La Jolla, Calif.
USER'S MANUAL FOR THE DOEHPE (DOE HEAT PUMP EFFICIENCY) COMPUTER CODE
13 Aug. 1980 18 p refs
(Contract DE-AC03-79CS-10757)
(DE81-021562; SAI-444-80-479-LJ) Avail: NTIS HC A02/MF A01

The computer code used to generate air source heat pump seasonal and annual performance factors is documented. These factors as well as annual energy consumption for each of the six climatic regions in the US are calculated. The standard measurements of heat pump capacities, power inputs and heat pump description data are used as input data. The system description data is used to differentiate between single speed and dual speed compressors, as well as to account for different degradation coefficients, modes of operation (cooling and heating, or heating only), and defrosting systems (demand or time temperature control). For dual speed compressor models, the code differentiates between compressors which cycle on and off at high speed and compressors which alternate between low and high speeds to meet the building heating or cooling loads. DOEHPE also accomodates heat pump systems that do not have an air circulation fan on the indoor coil as part of the system. DOE

N81-33490# General Electric Co., Schenectady, N. Y. Gas Turbine Div.
DEVELOPMENT OF HIGH-TEMPERATURE TURBINE SUBSYSTEM TECHNOLOGY TO A TECHNOLOGY READINESS STATUS PHASE 2 *Quarterly Report, Apr. - Jun. 1981*
M. W. Horner Jul. 1981 62 p refs
(Contracts DE-AC01-76ET-10340; EX-76-C-01-1806)
(DE81-025444; DOE/ET-10340/111) Avail: NTIS HC A04/MF A01

A technology readiness vehicle (TRV) to demonstrate the performance of a combined cycle power plant with high temperature gas turbines using coal derived gas fuel was developed. Two major development tests were completed. The first stage composite nozzles were successfully cycled for a total of 617 thermal cycles. In the second test the sectoral combustor was fired first on a propane/steam mixture and then on a synthetic low-Btu (LBtu) gas. The combustor was tested on: the cold and fired flow tests over the operating range, the determination of the effect of varying primary/secondary fuel flow splits, the effects of fuel composition with varying propane/steam ratios, and the determination of the minimum operating (blow out limits) map. Modification of the rotor water delivery and distribution test rig was completed to provide a more positive locking attachment of the water commutator shaft to the test turbine wheel. DOE

N81-33492*# *National Aeronautics and Space Administration.* Lewis Research Center, Cleveland, Ohio.
RELIABILITY AND QUALITY ASSURANCE ON THE MOD 2 WIND SYSTEM
W. E. B. Mason and B. G. Jones (Boding Engineering and Construction Co., Seattle, Wash.) 1981 16 p refs Presented at 5th Biennial Wind Energy Conf. and Workshop, Washington, 5-7 Oct. 1981; sponsored by Solar Energy Res. Inst. and DOE
(Contract DE-AI01-79ET-20305)
(NASA-TM-82717; DOE/NASA/20305-6; E-1015) Avail: NTIS HC A02/MF A01 CSCL 14D

The Safety, Reliability, and Quality Assurance (R&QA) approach developed for the largest wind turbine generator, the Mod 2, is described. The R&QA approach assures that the machine is not hazardous to the public or to the operating personnel, is operated unattended on a utility grid, demonstrates reliable operation, and helps establish the quality assurance and maintainability requirements for future wind turbine projects. The significant guideline consisted of a failure modes and effects analysis (FMEA) during the design phase, hardware inspections during parts fabrication, and three simple documents to control activities during machine construction and operation. E.A.K.

N81-33602*# Lockheed Missiles and Space Co., Huntsville, Ala.
WIND FLOW CHARACTERISTICS IN THE WAKES OF LARGE WIND TURBINES. VOLUME 1: ANALYTICAL MODEL DEVELOPMENT
W. R. Eberle Sep. 1981 217 p refs
(Contracts DEN3-29; EX-76-I-01-1028)
(NASA-CR-165380; DOE/NASA/0029-1; LMSC-LOREC-D000008-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 10A

A computer program to calculate the wake downwind of a wind turbine was developed. Turbine wake characteristics are useful for determining optimum arrays for wind turbine farms. The analytical model is based on the characteristics of a turbulent coflowing jet with modification for the effects of atmospheric turbulence. The program calculates overall wake characteristics, wind profiles, and power recovery for a wind turbine directly in the wake of another turbine, as functions of distance downwind of the turbine. The calculation procedure is described in detail, and sample results are presented to illustrate the general behavior of the wake and the effects of principal input parameters. T.M.

N81-33615*# *Tennessee Technological Univ., Cookeville. Dept.* of Mechanical Engineering.
EVALUATION OF A WIND TURBINE ELECTRIC POWER GENERATOR Final Report, 1 Jun. 1980 - 15 Sep. 1981
William B. Swim 15 Oct. 1981 180 p
(Grant NAG8-007)
(NASA-CR-164879) Avail: NTIS HC A09/MF A01 CSCL 10A

A technical assessment of the aerodynamic performance of the wind wheel turbine (WWT) is reported. The potential of the WWT in utilizing wind as an alternate power source was evaluated. Scaling parameters were developed to predict the aerodynamic performance of WWT prototype sized to produce 3, 9, 30, and 100 kw outputs in a 6.7 m/sec wind. T.M.

N81-33619# Argonne National Lab., Ill.
TECHNICAL SUPPORT FOR OPEN-CYCLE MHD PROGRAM Progress Report, Jul. - Sep. 1979
G. F. Berry, ed. Jun. 1981 123 p refs
(Contract W-31-109-eng-38)
(DE81-027564; ANL/MHD-80-2) Avail: NTIS HC A06/MF A01

The support program for open cycle MHD which consists of developing the analytical tools needed for investigation of the performance of the major components in the combined cycle MHD/steam power system is described. The primary components of the systems, unique to MHD, and the integration of these analytical models into a mode for the entire power producing system are examined. The project includes modeling of the secondary combustor, generator, seed deposition, and formation and decomposition of NO. Costing models were developed to assess the effect of parameter changes on cost of electricity. Parametric studies are performed to evaluate the performance of the U-25B generator and to support the design of the US U-25B generator. DOE

N81-33621# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
ADVANCES IN THE SERI-DOE ELECTROCHEMICAL PHOTOVOLTAIC CELL PROGRAM
W. Wallace, Rommel Noufi, and Saiyen Deb May 1981 8 p refs Presented at the IEEE PV Specialists Conf., Orlando, Fla., 12-15 May 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-025908; SERI/TP-613-1224; CONF-810526-34) Avail: NTIS HC A02/MF A01

The electrochemical photovoltaic cell program to evaluate the photovoltaic energy conversion efficiency, stability and storage potential of amorphous and polycrystalline semiconductor/electrolyte systems is described. Technologies capable of the conversion of light energy into electrical energy either directly in regenerative electrochemical photovoltaic devices or indirectly in overall regenerative cyclic systems incorporating storage are described. The goal of the program is to develop and demonstrate the viability of low cost electrochemical photovoltaic cells competitive with solid state photovoltaic devices and photoelectrochemical storage systems competitive with battery connected photovoltaic array storage. DOE

N81-33625# Midwest Research Inst., Golden, Colo. Developing Countries Branch.
WIND POWER FOR DEVELOPING NATIONS
Amir S. Mikhail Jul. 1981 331 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE81-025792; SERI/TR-762-966) Avail: NTIS HC A15/MF A01

The global potential of wind energy conversion systems (WECS) was assessed. The cost effectiveness of WECS depends on the availability of the wind resource, system power performance, and the comparative cost of alternative energy sources. An overview of the global wind resource including observed zonal wind systems for each continent, available wind data, current wind maps, and ongoing studies to assess the global wind potential are presented. A methodology to obtain a match between machine and site characteristics for most cost effective power production is outlined. DOE

N81-33637# Aerodyne Research, Inc., Bedford, Mass. Center for Chemical and Environmental Physics.

CHARACTERIZATION OF OPEN-CYCLE COAL-FIRED MHD GENERATORS Quarterly Technical Progress Report, 1 Feb. - 31 Jul. 1980

J. Wormhoudt, V. Yousefian, M. Weinberg, C. Kolb, M. Martinez-Sanchez, W. Cheng, F. Bien, D. Dvore, W. Unkel, and G. Stewart Sep. 1980 64 p refs

(Contracts EX-76-C-01-2478; DE-AC01-76ET-10775)

(DOE/ET-10775/T1; QR-14; QR-15) Avail: NTIS HC A04/MF A01

The successful design of full-scale, open-cycle, coal-fired MHD generators for baseload electrical production requires a detailed understanding of the plasma chemical and plasma dynamic characteristics of anticipated combustor and channel fluids. Progress in efforts to model the efficiency of an open-cycle, coal-fired MHD channel based on the characterization of the channel flow as well as laboratory experiments to validate the modeling effort is detailed. In addition, studies related to understanding arcing phenomena in the vicinity of an anode are reported. DOE

N81-33639# Thermo Electron Corp., Waltham, Mass.

DOE ADVANCED THERMIONIC TECHNOLOGY PROGRAM Progress Report, Jan. - Mar. 1981

1981 58 p refs

(Contract DE-AC02-81ET-11291)

(DE81-027307; TE-4258-247-81; PR-46) Avail: NTIS HC A04/MF A01

Progress over a 3 month period in thermionic performance is reported. Significant accomplishments included: (1) continuing stable output from the combustion test of the one inch diameter hemispherical silicon carbide diode at an emitter temperature of 1730 K for a period of over 6400 hours; (2) demonstration of an additive oxygen effect in a research diode with a cesium graphite reservoir located in the collector; (3) preliminary testing of the four diode module; and (4) evaluation of a research diode with ZrO2-Mo cermet electrodes. DOE

N81-33646# Hawaii Univ., Honolulu. Natural Energy Inst.

SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 7: A REVIEW OF OTEC

Paul C. Yuen Apr. 1981 150 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.

(Contract DE-FC02-79CS-30278)

(DE81-029008; DOE/CS-30278/T6-Vol-7) Avail: NTIS HC A07/MF A01

The Ocean Thermal Energy Conversion (OTEC) principle is discussed along with general system and cycle types, specific OTEC designs, applications, and the ocean thermal resource. The historic development and present status of OTEC are reviewed. Power system components of the more technically advanced closed-cycle OTEC concept are discussed: heat exchangers, corrosion and biofouling countermeasures, working fluids, ammonia power systems, and on-platform seawater systems. Several open-cycle features are also discussed. A critical review of the ocean engineering aspects of the OTEC power system is presented. Major subsystems such as platform, cold water pipe, mooring system, dynamic positioning system and power transmission cable system are assessed for their relationships with the ocean environment and with each other. Nine available studies of OTEC costs are reviewed, and tentative comparisons are made between OTEC and traditional fuel costs. Environmental and social effects of OTEC development and international and national laws regulating OTEC plants are reviewed. DOE

N81-33667# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany). Neue Technologie.

FINAL PLANS FOR THE CONSTRUCTION OF GROWIAN Final Report

Friedrich Koerber Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 89 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-80-171; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18.50

A large scale wind energy converter, GROWIAN, with an installed electrical power of 3 MW was designed. The horizontal axis wind turbine employs a two blade rotor with teetered hub in downwind position. Electricity produced is fed directly into the grid. Power regulation is provided by electrically activated pitch variation. A planetary gear transfers rotation to a variable speed generator with a frequency controlled output to the grid. The nacelle and rotor are mounted on the ground and lifted on top of the tower by an internal hoist. Author (ESA)

N81-34027# Mississippi State Univ., Mississippi State. MHD Energy Center.

DIAGNOSTIC INSTRUMENTATION FOR THE UNITED STATES MAGNETOHYDRODYNAMIC/HEAT RECOVERY SEED RECOVERY DEVELOPMENT PROGRAM

David L. Murphree 1981 79 p refs Presented at the MHD/HRSR Scientists and Engr. of the People's Republic of China, 10-31 Jul. 1981

(Contract DE-AC02-80ET-15601)

(DE81-029944; DOE/ET-15601/T4) Avail: NTIS HC A05/MF A01

The diagnostic development program in direct support of the major magnetohydrodynamic/heat recovery seed recovery test facilities is described. These optical diagnostic systems are designed to characterize the internal operating environment of the MHD/HRSR components through non-intrusive, real-time, on-line analysis. The present stage of development of each instrument is discussed. A performance evaluation of these packaged, microprocessor-controlled, optical diagnostic systems is presented in relation to their field-operation. DOE

N81-34031# Westinghouse Electric Corp., East Pittsburgh, Pa. Fusion Power Systems Dept.

CONCEPTUAL DESIGN OF A COMMERCIAL TOKAMAK HYBRID REACTOR (CTHR) Final Report

Dec. 1980 286 p refs

(Contract DE-AC02-77ET-52043)

(DE81-028375; WFPS-TMS-80-012) Avail: NTIS HC A13/MF A01

This design was developed as a first generation commercial plant for the production of fissile fuel to support a significant number of client light water reactor (LWR) plants. The study was carried out in sufficient depth of indicate no insurmountable technical problems exist, assuming the physics of the fusion driver is verified, and has provided a basis for deriving cost estimates of the hybrid plant as well as estimates of the hybrid/LWR symbiotic system busbar electricity costs. This energy system has the potential to be optimized such that the net cost of electricity becomes competitive with conventional LWR plants as the price of U308 exceeds $100 per pound. DOE

N81-34034# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.

MHD-GENERATOR ELECTRODE DEVELOPMENT Quarterly Report, Jan. - 31 Mar. 1981

Frank D. Retallick, Laurence H. Cadoff, Donald L. Dietrick, James A. Dilmore, Edsel W. Frantti, Edgar L. Kochka, Jack A. Kuszyk, S. K. Lau, Joseph Lempert, and I. Lloyd Jun. 1981 80 p refs

(Contract DE-AC01-79ET-15529)

(DE81-028538; DOE/ET-15529/T2) Avail: NTIS HC A05/MF A01

The development of cold metallic electrodes which are alternatives to the continued use of platinum as an anode clad material is discussed. Results of laboratory screening tests are presented for materials previously tested and for other available commercial alloys. Results of anode arc tests are compared to observations from electrodes tested in an MHD generator. Laboratory electrochemical corrosion testing was conducted at

two temperatures in molten salts. Initial results from these tests are reported and analyzed. Fabrication of two commerical alloys with 7% platinum included was accomplished and electrochemical testing performed. A superior high temperature performance was noted. WESTF facility checkout and activation operations have been completed and fabrication of the base copper electrode test section is reported. Engineering and test planning activities in support of WESTF tests are reported. DOE

N81-34035# Argonne National Lab., Ill.
STARFIRE: A CONCEPTUAL DESIGN OF A COMMERCIAL TOKAMAK POWER PLANT
M. A. Abdou, C. C. Baker, D. DeFreece (McDonnell Douglas Astronautics Co., St. Louis), C. Trachsel (McDonnell Douglas Astronautics Co., St. Louis), D. Graumann (General Atomic Co.), and J. Kokoszenski (Ralph M. Parsons Co.) 1980 17 p refs Presented at the 8th Intern. Conf. on Plasma Phys. and Controlled Nuclear Fusion Research, Brussels, 1-10 Jul. 1980
(Contract W-31-109-eng-38)
(DE81-023528; CONF-800707-26; IAEA-CN-39/E-1) Avail: NTIS HC A02/MF A01

STARFIRE is a conceptual design for a commercial Tokamak power plant based on the deuterium/tritium/lithium fuel cycle. The emphasis of the study is on the simplicity of the engineering design, maintainability, lower electricity cost, and improved safety and environmental features. The reactor has a 7-m major radius and produces 1200 MW of electric power. STARFIRE operates in a steady-state mode with the plasma current driven by a lower hybrid RF system. The plasma purity control and exhaust system is based on the limiter/vacuum concept, which offers unique advantages for commercial power rectors. The blanket utilizes a solid lithium compound for tritium breeding and pressurized water as the coolant. DOE

N81-34103# *California Univ., Berkeley. Lawrence Berkeley* Lab. Materials and Molecular Research Div.
CHARACTERISTICS OF AN NH3-AIR FUEL CELL SYSTEM FOR VEHICULAR APPLICATIONS
Philip N. Ross, Jr. May 1981 9 p refs Presented at the 16th ASME Intersoc. Energy Conversion Eng. Conf., Atlanta, 9-14 Aug. 1981
(Contract W-7405-eng-48)
(DE81-023245; LBL-12754; CONF-810812-20) Avail: NTIS HC A02/MF A01

The use of hydrogen air alkaline fuel cell in a consumer vehicle application is examined. An indirect ammonia-air fuel cell system is described. The advantages of the alkaline fuel cell system relative to any acid fuel cell are higher power density (factor of 2 to 3) and lower cost components (factor of 2) resulting in significantly lower total cost (factor of 4 to 6). Laboratory scale examinations of the liquid anhydrous ammonia cracking reaction and the power characteristics of an alkaline fuel cell running on cracked ammonia and air were performed. Single cell testing indicated system thermal efficiencies of 34 to 44% can be achieved at power densities of 2600-1000 W/sq m using currently known electrode technology. DOE

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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.

A81-41344 **Energy transport (Energietransport).** K. Düring (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Brennstoff-Wärme-Kraft*, vol. 33, Apr. 1981, p. 156-161. 54 refs. In German.

The estimated investment requirements for the energy economy in West Germany are in the range from 365 to 430 billion DM in the next decade. Approximately 20 to 25% of this value are needed for energy transportation. A part of this sum is to be spent for the transport of coal or the further development of the means of transportation for this transport. Attention is given to questions of international energy transport, the transport of mineral oil, the transport of natural gas, details of coal transportation, the transport of electric energy, and the transport of heat energy over distances of 40 or 50 km. G.R.

A81-44297 # **Equipment for studying the heat and mass transfer in capillary channels of a heat-pipe evaporator (Stend dlia issledovaniia teplo- i massoperenosa v kapilliarnykh kanalakh model'noi zony ispareniia teplovoi truby).** A. N. Fomenko. *Akademiia Nauk Latviiskoi SSR, Izvestiia, Seriia Fizicheskikh i Tekhnicheskikh Nauk*, no. 3, 1981, p. 56-62. 10 refs. In Russian.

Equipment was constructed in order to study the effect of various factors on the heat and mass transfer process. At specific heat fluxes of less than 40-50 kW/sq m, the wall temperature and hence the temperature of the heat-transfer liquid in the channels are less than the saturation temperature at atmospheric pressure. It is experimentally shown that the geometric parameters of the rectangular capillary channel have a significant influence on the value of the heat loss coefficient. The boiling of the heat transfer liquid, however, exerted no appreciable effect on the heat loss and the stability of the evaporation zone of the heat pipe with a wick in the form of an open rectangular channel. The obtained heat loss coefficient can be used to design a heat pipe with a wick in the form of a rectangular channel. J.F.

A81-44298 # **Results of a study of heat and mass transfer in the rectangular capillary channels of a heat-pipe evaporator (Nekotorye rezul'taty issledovaniia teplo- i massoperenosa v priamougol'nykh kapilliarnykh kanalakh zony isparenia teplovoi truby).** A. N. Fomenko. *Akademiia Nauk Latviiskoi SSR, Izvestiia, Seriia Fizicheskikh i Tekhnicheskikh Nauk*, no. 3, 1981, p. 63-70. 8 refs. In Russian.

The presence of turbulence in a heat transfer liquid is noted during its evaporation from capillary channels; this process is conditioned by the thermal capillary convection. An analytical model of the heat and mass transfer during evaporation of the heat transfer liquid from the open capillary channels is presented. A general criterial relationship is obtained for calculating the heat loss during evaporation of the heat transfer liquid from the open rectangular capillary channels. This relationship can be used in the design of the heat pipe. J.F.

A81-45624 # **Disturbance of the ionosphere by intense microwave beams (Vozmushcheniia ionosfery moshchnymi puchkami SVCh radiovoln).** N. A. Mitiakov and S. A. Namazov (Nauchno-Issledovatel'skii Radiofizicheskii Institut, Gorki, USSR). *Radiofizika*, vol. 24, no. 6, 1981, p. 666-670. 11 refs. In Russian.

A satellite solar power station is capable of converting solar radiation into a beam of microwaves of a power of 10 to the 10th W at a frequency of 3000 MHz, which can be directed to any region on the earth's surface. Intense microwave radiation gives rise to significant heating of the ionospheric plasma and causes ionospheric disturbances. The results of non-Soviet research in this field are briefly discussed; an estimation of the stimulated thermal scattering of microwaves in the ionosphere is presented, and the possibility of stimulating the expected ionospheric disturbances using a high-power ground-based transmitter is considered. J.F.

A81-46460 **Solchem thermochemical power.** T. A. Chubb (U.S. Navy, Naval Research Laboratory, Washington, DC). *Sunworld*, vol. 5, May 1981, p. 90, 91. *Research supported by the U.S. Department of Energy, Solar Thermal Test Facility Users Association, Solar Energy Research Institute, and U.S. Navy.*

The operating principles of the Solchem thermochemical energy transport system are described. The concept, in which a pipe-linked field of parabolic-dish solar concentrators is used to convert a carbon dioxide and methane mixture into hydrogen, carbon monoxide and steam at each receiver-heat exchanger, allows the transfer of heat from the collectors in gaseous form to a central plant. The transfer gases remain relatively cool in the process, with heat energy being produced at the user site by a catalytically induced chemical reaction that re-converts the processed gases into methane and carbon dioxide. In recently conducted tests, energy delivery at 600 C was obtained while feed and return pipes remained at 100 and 160 C, respectively. The use of salt tanks for energy storage and steam generation is also discussed. O.C.

A81-48146 **Ammonia thermochemical energy transport in a distributed collector solar thermal power plant.** O. M. Williams (Australian National University, Canberra, Australia). *Solar Energy*, vol. 27, no. 3, 1981, p. 205-214. 17 refs.

A thermochemical energy transport system based on ammonia dissociation/synthesis is shown to have potential for reliable cost-effective operation in a distributed collector solar thermal power plant. Liquid ammonia returned to the central plant from a shaded absorber remains inherently separated from the synthesis gas mixture returned from an exposed absorber, enabling the maintenance of a centralized fluid control. Temporal characteristics of the ammonia-based solar thermochemical absorbers are developed by numerical analysis. Sources of energy loss are examined, and it is shown that flow rates to individual absorbers may cover a 12% range of variation without degradation to the overall energy transport efficiency. Operation of the absorber array is examined under conditions of extreme insolation variation due to a scattered cloud cover. The importance of minimizing the absorber thermal capacity is discussed in relation to the available energy required to restore operation after each cloud period. It is shown that the system is relatively immune to large energy losses in this area, compared to the alternative system where both the pipelines and absorbers must be reheated. J.F.

A81-48562 * **Laser power beaming for rocket propulsion and airbreathing propulsion.** A. Hertzberg (Washington, University, Seattle, WA). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record. New York, Institute of Electrical and Electronics Engineers, 1980, p. 421-434. 36 refs. Grant No. NAG3-16.

The developing technology of laser power beaming is introduced, and two systems are used as examples of the capabilities of the laser for beamed energy. In the first system, the potential of the laser to power flight systems ranging from hypersonic air-breathing launch vehicles to commercial jet transports is examined. Attention is given to the possibility of an air-breathing propulsion which offers the promise of a global air transportation network independent of kerosene and powered by solar energy. In addition, consideration is given to a new type of rocket propulsion based on the laser's ability to concentrate coherent laser energy to high power densities. Focused laser beams would heat the propellants directly to produce specific impulses approaching ion and MHD rocket levels, and would do so without the burden of a heavy electrical power supply. B.J.

A81-48563 **Lasers, microwaves and hybrid schemes for energy beaming - Options and issues.** J. D. G. Rather and P. A. Borgo (BDM Corp., McLean, VA). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record. New York, Institute of Electrical and Electronics Engineers, 1980, p. 436-442.

Several power beaming applications are considered, including beaming power from the earth to space for expanded civilian and space utilization, relaying power over the horizon via a secondary reflector in space, the ground-based solar option, and power generating plants in space. Consideration is given to such issues as technological feasibility, efficiency, cost effectiveness, time of availability, synergistic applications, and the uniqueness of the potential capabilities. B.J.

N81-28589# Institute for Telecommunication Sciences, Boulder, Colo.
EXAMINATION OF SOME HYPOTHETICAL SPS RECTENNA SITE WITHIN THE CONTIGUOUS UNITED STATES OF AMERICA. PART 1: PRECIPITATION EFFECTS ON HYPOTHETICAL SPS SITES IN THE USA. PART 2: POINT-TO-POINT MICROWAVE AND SERVICE MODE COMMUNICATIONS SYSTEMS NEAR FOUR HYPOTHETICAL SPS RECTENNA SITES IN THE CONTINENTAL UNITED STATES
E. J. Dutton and B. D. Warner May 1981 38 p refs
(Contract DE-AC01-80ER-10160)
(DOE/ER-10160/T4) Avail: NTIS HC A03/MF A01

THE EMC (electromagnetic compatibility) problems for the candidate SPS rectenna site in the Mojave Desert of California was studied. The precipitation effects at nine other hypothetical SPS rectenna sites and the licensed transmitter density at four proposed SPS rectenna sites were examined. The results of the precipitation study indicate that the transmission loss will not vary by more than 3% from site to site for the nine sites considered. Results of the licensed transmitter study for four sites support the contention that a strong correlation exists between population density and operational communications systems within a small area (150 Km x 150 Km). DOE

N81-29598# Sandia Labs., Livermore, Calif. Advanced Components Div.
HYDROGEN COMPATIBILITY OF STRUCTURAL MATERIALS FOR ENERGY STORAGE AND TRANSMISSION Final Report
W. R. Hoover, S. L. Robinson, R. E. Stoltz, and J. R. Spingarn May 1981 64 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-8006) Avail: NTIS HC A04/MF A01

An investigation of the transportation, a program which focused on the feasibility of using the natural gas pipeline network for hydrogen gas transmission is summarized. Dynamic and static tests were used: tensile, fracture toughness, and bursts tests of typical pipeline steels and welds, and sustained load tests on a model pipeline. The toughness of pipeline materials in hydrogen is degraded up to 30% and the burst strength of flawed pipes containing hydrogen decreases by 15 to 20%. Hydrogen assisted fatigue crack growth is rapid and there is sustained load cracking in the heat affected zones of welds. Hydrogen may be transported in the natural gas pipeline network, however, the maximum allowable working pressure will have to be decreased. The magnitude of the decrease was a direct bearing on the economic desirability of transporting hydrogen gas through natural gas pipelines. DOE

N81-31633*# Novar Electronics Corp., Barberton, Ohio.
SONIC SIMULATION OF THE SPS POWER BEAM Final Report
James H. Ott and James S. Rice 31 Mar. 1981 106 p refs
(Contract NAS9-16055)
(NASA-CR-161049) Avail: NTIS HC A06/MF A01 CSCL 10A

A Satellite Power System Microwave Transmission Simulator is described. The simulator generates and transmits a beam audible sound energy which is mathematically similar to the microwave beam which would transmit energy to Earth from a Solar Power Satellite. This allows areas such as power beam formation to be studied in a laboratory environment. L.F.M.

N81-31675# Institute for Telecommunication Sciences, Boulder, Colo.
ANALYSIS OF A PHASE-LOCKED LOOP TO SUPPRESS INTERFERENCE FROM A SOLAR POWER SATELLITE
J. R. Juroshek and F. G. Stewart Feb. 1981 24 p refs Sponsored in part by DOE
(PB81-193781; NTIA-Rept-81-63) Avail: NTIS HC A02/MF A01 CSCL 10B

Signal cancellation techniques are particularly suited to interference from the proposed solar-power satellite which would transmit a coherent, CW, microwave, power signal from a geosynchronous satellite. The analysis concludes that a phase-locked loop and associate AGC circuit could be used to generate a replica of the interfering signal which would then be subtracted from the composite signal. It is also concluded that signal suppression of the order of -30 dB should be possible with current technology. A brief analysis of a second-order, type-one, phase-locked loop is presented. GRA

N81-31676# Institute for Telecommunication Sciences, Boulder, Colo.
ANALYSIS OF INTERFERENCE CAUSED BY THE SOLAR POWER SATELLITE TO SATELLITE EARTH TERMINALS
John R. Juroshek Feb. 1981 44 p refs
(Contract DE-A101-80ER-10160)
(PB81-194268; NTIA-Rept-81-64) HC A03/MF A01 CSCL 10B

The solar power satellite (SPS) is a concept for generating electrical power from solar energy via a geosynchronous orbiting satellite. A facility, such as this, would be able to send approximately 5 to 10 gigawatts of power to Earth on a highly focused 2450 MHz microwave beam. The electromagnetic compatibility problems caused by this amount of microwave power transmission are recognized as a critical factor in the implementation of such a system. The potential for interference between SPS and conventional satellite earth terminals was examined. GRA

N81-31677# Institute for Telecommunication Sciences, Boulder, Colo.
ANALYSIS OF INTERFERENCE FROM THE SOLAR POWER SATELLITE TO GENERAL ELECTRONICS SYSTEMS
John R. Juroshek and Francis K. Steele Feb. 1981 38 p refs
(Contract DE-AI06-79RL-10077)
(PB81-194250; NTIA-Rept-81-65) Avail: NTIS HC A03/MF A01 CSCL 10B

The possibility of interference of conventional consumer electronic devices such as TV receivers, AM/FM stereo receivers, electronic calculators, and FM mobile receivers is considered. Also included are estimates of the field intensities that would be required to produce interference in three different types of integrated circuits. The report also examines the potential for interference to medical electronics devices, with specific emphasis on pacemakers and site security devices such as proximity detectors and security TV cameras. GRA

N81-31678# Commerce Dept., Boulder, Colo.
IMPACT OF SATELLITE POWER SYSTEMS ON THE IONOSPHERE Final Summary Report
1980 103 p refs
(Contract DE-AI02-79CH-10003)
(DOE/CH-10003/1) Avail: NTIS HC A06/MF A01

The material presented is directed toward effects in the ionosphere resulting from heating induced by the passage of the SPS microwave beam. Some topics included are: telecommunication system studies in a simulated SPS environment, and theoretical and experimental studies of the physics of ionospheric heating. DOE

N81-32403# Los Alamos Scientific Lab., N. Mex.
Nb3Ge-BASED 1-m POWER-TRANSMISSION CABLE: MATERIAL DEVELOPMENT, CABLE FABRICATION, AND CABLE-PERFORMANCE TESTS Final Report
M. P. Maley, L. R. Newkirk, J. D. Thompson, and F. A. Valencia Jul. 1981 65 p refs Sponsored by Electric Power Research Inst.
(Contract W-7405-eng-36; EPRI Proj. 7855-1-2)
(DE81-026297; EPRI-EL-1948) Avail: NTIS HC A04/MF A01

The fabrication and testing of a 1 m long coaxial cable constructed from 87 m of our Nb3Ge-clad tape short sample measurements indicated that all of this tape exceeded the specification that J/sub c/ (13.8 K) greater than or equal to 1.8 x 10(6) A/cm(2). The cable was wound in the double helix design of the Brookhaven National Laboratory, BNL, power transmission project. AC current tests were performed at BNL where the cable carried the design current amplitude of 6000 A but exhibited ac losses from 7 to 13 K that were 50 to 100 greater than were expected from short sample measurements.

These losses were attributed to a combination of instrumental problems associated with ac loss measurements on 1-m cables of the double helix design, and effects, and possible tape damage. The results of a materials development program aimed at improving the superconducting performance of our Nb3Ge material is also described. DOE

N81-32455# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
GROUND ENERGY COUPLING
Philip D. Metz 1981 7 p refs Presented at the DOE Heat Pump Contractors Program Integration Meeting, McLean, Va., 2-4 Jun. 1981
(Contract DE-AC02-76CH-00016)
(DE81-024372; BNL-29676; CONF-810672-21) Avail: NTIS HC A02/MF A01

The feasibility of ground coupling for various heat pump systems was investigated. Analytical heat flow models were developed to approximate design ground coupling devices for use in solar heat pump space conditioning systems. A digital computer program called GROCS (GRound Coupled Systems) was written to model 3-dimensional underground heat flow in order to simulate the behavior of ground coupling experiments and to provide performance predictions which have been compared to experimental results. GROCS also has been integrated with TRNSYS. Soil thermal property and ground coupling device experiments are described. Buried tanks, serpentine earth coils in various configurations, lengths and depths, and sealed vertical wells are being investigated. An earth coil used to heat a house without use of resistance heating is described. DOE

N81-32687# Washington Univ., Seattle. Aerospace Lab.
APPLICATIONS OF POWER BEAMING FROM SPACE-BASED NUCLEAR POWER STATIONS
J. R. Powell (Brookhaven National Lab.), T. E. Botts (Brookhaven National Lab.), and Abraham Hertzberg 1981 8 p refs Presented at the IECEC Conf., Atlanta, 9-14 Aug. 1981
(Contract DE-AC02-76CH-00016)
(DE81-025078; BNL-29582; CONF-810812-27) Avail: NTIS HC A02/MF A01

Power beaming was examined using an advanced compact, lightweight Rotating Bed Reactor (RBR). Closed Brayton power conversion efficiencies in the range of 30 to 40% can be achieved with turbines, with reactor exit temperatures on the order of 2000 K and a liquid drop radiator to reject heat at temperatures of approx. 500 K. Higher RBR coolant temperatures are possible, but gains in power conversion efficiency are minimal, due to lower expander efficiency (e.g., a MHD generator). Two power beaming applications were examined - laser beaming to airplanes and microwave beaming to fixed ground receivers. Use of the RBR greatly reduces system weight and cost, as compared to solar power sources. Payback times are a few years at present prices for power and airplane fuel. DOE

N81-33484*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONTINUOUSLY VARIABLE TRANSMISSION: ASSESSMENT OF APPLICABILITY TO ADVANCE ELECTRIC VEHICLES
Stuart H. Loewenthal and Richard J. Parker 1981 32 p refs Presented at the 4th Electric Vehicle Council Symp., Baltimore, 21-23 Oct. 1981
(Contract DE-AI01-77CS-51044)
(NASA-TM-82700; DOE/NASA/51044-23; E-983) Avail: NTIS HC A03/MF A01 CSCL 13F

A brief historical account of the evolution of continuously variable transmissions (CVT) for automotive use is given. The CVT concepts which are potentially suitable for application with electric and hybrid vehicles are discussed. The arrangement and function of several CVT concepts are cited along with their current developmental status. The results of preliminary design studies conducted on four CVT concepts for use in advanced electric vehicles are discussed. R.C.T.

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07
ENERGY STORAGE

Includes flywheels, heat storage, underground air storage, compressed air, storage batteries, and electric hybrid vehicles.

A81-41345 **Energy storage (Energiespeicherung).** U. Kaier (Kraftanlagen AG, Heidelberg, West Germany). *Brennstoff-Wärme-Kraft*, vol. 33, Apr. 1981, p. 161-163. 32 refs. In German.

Developments in the area of energy storage are characterized, with respect to theory and laboratory, by an emergence of novel concepts and technologies for storing electric energy and heat. However, there are no new commercial devices on the market. New storage batteries as basis for a wider introduction of electric cars, and latent heat storage devices, as an aid for solar technology applications, with satisfactory performance standards are not yet commercially available. Devices for the intermediate storage of electric energy for solar electric-energy systems, and for satisfying peak-load current demands in the case of public utility companies are considered. In spite of many promising novel developments, there is yet no practical alternative to the lead-acid storage battery. Attention is given to central heat storage for systems transporting heat energy, small-scale heat storage installations, and large-scale technical energy-storage systems. G.R.

A81-41721 **Systems engineering and analysis.** B. S. Blanchard and W. J. Fabrycky (Virginia Polytechnic Institute and State University, Blacksburg, VA). Englewood Cliffs, NJ, Prentice Hall, Inc., 1981. 715 p. 166 refs. $28.95.

An introduction to systems is provided and tools for systems analysis are considered, taking into account system definitions and concepts, approaches for bringing systems into being, models in systems analysis, economic analysis techniques, mathematical modeling and optimization, probability and statistics, queuing theory and analysis, and control concepts and techniques. The system design process is discussed along with the design for operational feasibility, systems engineering management, and system design case studies. Attention is given to conceptual design, preliminary system design, detail design and development, system test and evaluation, design for reliability, design for maintainability, design for supportability, design for economic feasibility, communication system design, finite population system design, energy storage system design, and procurement-inventory system design. G.R.

A81-41940 **Specific mass energy capacity of disk flywheels produced from composites.** 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.) *Mechanics of Composite Materials*, vol. 16, no. 5, Mar. 1981, p. 605-611. Translation.

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.

A81-42456 **Adding strontium chloride or calcium hydroxide to calcium chloride hexahydrate heat storage material.** G. A. Lane (Dow Chemical Co., Midland, MI). *Solar Energy*, vol. 27, 1981, p. 73-75. 9 refs.

Carlsson, Stymne and Wettermark (1979) reported that the incongruent melting CaCl2-6H20 can be made congruent by adding 2 per cent or more of SrCl2-6H20 or Ca(OH)2. The present paper shows these conclusions to be incorrect because the experimental technique yielded low values for the CaCl2-4H20 liquidus curve, and the chemical analyses of the liquid phases were not reported, prompting the conclusion that SrCl2-6H20 and Ca(OH)2 lower the melting point of CaCl2-4H20, and have little effect on CaCl2-6H20. In addition, although small amounts of CaCl2-4H20 could be obtained on each freezing cycle, in practical use the hexahydrate would freeze before any tetrahydrate is nucleated. D.L.G.

A81-42700 **The mini-prototype solar energy earth storage system.** S. W. Yuan and M. M. Majdi (George Washington University, Washington, DC). *Energy* (UK), vol. 6, July 1981, p. 571-584. 12 refs. Research supported by the RISE, Inc. and Atlantic Research Corp.

A one-tenth scale model of solar energy earth storage (SEES) system was tested under an artificial condition during the first winter season. The earth storage was heated by house hot water heaters and heat was then extracted with a high performance heat exchanger which was exposed to an open air environment under subfreezing temperatures. The results of these preliminary tests show that the thermal performance of the earth storage heat exchanger (polybutylene plastic coils) and the wet soil medium is quite satisfactory. Furthermore, the response rate of the earth storage to a large heat demand over a short-time duration is more than adequate. (Author)

A81-42862 **Durability of high-conductivity solid proton conductors - Dodecamolybdophosphoric acid crystals and dodecatungstophosphoric acid crystals.** O. Nakamura, I. Ogino, and T. Kodama (Osaka, Government Industrial Research Institute, Ikeda, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 119-125.

The effects of humidity on the proton conductivity and dehydration of crystals of dodecamolybdophosphoric acid, H3Mo12PO40.29H2O (12-MPA), and dodecatungstophosporic acid, H3W12PO40.29H2O (12-WPA), to be used as solid electrolytes in H2-O2 fuel cells are investigated, and a simple humidity control device for use with the crystals is presented. The electrical conductivity of polycrystalline pellets was measured by observing the voltage response to a current pulse at room temperature and dehydration was measured according to the weight loss of the pellets under various humidities. Dehydration at humidities less than 70% *relative humidity for 12-MPA and 80% relative humidity for 12-WPA* is observed to lead to corresponding decreases in conductivity as a function of the extent of dehydration. In order to prevent the reduction in conductivity and possible explosion due to contact between H2 and O2 brought on by crystal dehydration, a humidity control device based on a saturated aqueous solution of potassium hydrogen sulfate was used to maintain a humidity of 87% in the box containing the sample. The use of such a device resulted in no decrease in conductivity of dehydration of samples after continuous exposure for 1000 hours. A.L.W.

A81-42908 **A new heat storage system using metal hydrides.** S. Ono, M. Kawamura, Y. Ishido, E. Akiba (National Chemical Laboratory for Industry, Yatabe, Ibaraki, Japan), and S. Higano (Mitsubishi Steel Manufacturing Co., Ltd., Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 937-942.

The development of a prototype chemical heat storage system, designed for the accumulation of fairly high temperature (300 - 400 C) waste heat, and called the Hydriding Heat Storage system is presented. Mg2Ni hydride is used as the high temperature heat storing medium, and LaNi5H6 is used as a reservoir for the hydrogen released from the heat storing medium. The system has been in development since 1976, and a 2000 kcal heat capacity prototype system is to be completed by 1982. Basic investigations, i.e., reaction kinetics of absorption and desorption, and heat transfer characteristics of the hydride and/or the metal powder packed bed, are described. K.S.

A81-42971 **Thermal storage system using metal hydrides.** T. Sakai and N. Honda (Sanyo Electric Co., Ltd., Research Center, Hirakata, Osaka, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2205-2217. 5 refs.

A chemical thermal energy storage system employing CaNi5 and LaNi5 hydrides is described. Experiments were conducted to determine the performance of the hydrides individually and as elements of the system, and energy balances were estimated. It is shown that the methods described are better suited to long-term

storage than the conventional, chemically non-active ones, and that they are well suited to solar energy systems. O.C.

A81-44148 The lithium-sulphur dioxide cell. I - The porous carbon black cathode. V. Manev, A. Nassalevska, and R. Moshtev (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Elektrokhimichni Iztochnitsi na Tok, Sofia, Bulgaria). *Journal of Power Sources*, vol. 6, Oct. 1981, p. 337-345, 347-356. 23 refs.

Specific capacity of porous carbon cathodes in Li/SO2 cells is assessed as a function of binder content, thickness, rate of discharge, and space distributions. Expressions for determining optimum thickness, length of electrodes, and the maximum capacity are also derived. Specific capacity is found to decrease with an increase in binder content, and increase with a decrease of cathode thickness at low current density. Cathodes thicker than 1 mm had an exponential dependency on the current density, while the pre-exponent was determined by pore volume and molar volume of lithium dithionate. Spatial distribution displayed varying states at high discharge rates, including a transient region, a steady state stage, and a stage of secondary redistribution. Cell capacity dependence on the discharge rate is explained in terms of the relationship between the partial capacities of the components and the current, and good agreement is found between experimental values and those calculated by the derived expressions. D.L.G.

A81-46214 Pressure-temperature-composition relationships for heated drawsalt systems. R. W. Mar and C. M. Kramer (Sandia Laboratories, Albuquerque, NM). *Solar Energy Materials*, vol. 5, June-July 1981, p. 71-79. 15 refs.

A molten nitrate salt mixture consisting of 60% NaNO3 and 40% KNO3 by weight is an attractive candidate for a heat transfer and thermal energy storage fluid in large-power solar systems. The relationships between pressure, temperature and composition (nitrate to nitrite ratio) have been determined for this salt mixture under two system configurations: constant volume (sealed containment) and constant pressure (open containment). For the first, families of pressure-temperature and composition-temperature curves were generated for initial salt volume fractions of 0.1 to 0.7. For the constant pressure system, composition-temperature curves were generated for oxygen pressures of 1, 0.2, 0.01 and 0.001 atm. (Author)

A81-46468 Heat transfer characteristics of the latent heat thermal energy storage capsule. K. Katayama, A. Saito, Y. Utaka, A. Saito, H. Matsui, H. Maekawa, and A. Z. Saifullah (Tokyo Institute of Technology, Tokyo, Japan). *Solar Energy*, vol. 27, no. 2, 1981, p. 91-97. 19 refs.

An analytic and experimental investigation is presented of characteristic heat transfer rate variations to and from a latent heat thermal energy storage capsule filled with a phase change material (naphthalene) and subjected to stepwise variations of the surface temperature. Finite difference calculations based on heat conduction were also carried out to compare with the experimental results. Agreement was found between experimental results and calculated heat flux for the case of the heat removal process, but characteristic trends for the case of heat storage differed due to the effects of natural convection. O.C.

A81-47255 Study of energy storage for long time using chemical reactions. N. Yoneda, S. Ito, and S. Hagiwara (Tokyo, Science University, Noda, Japan). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports.
Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 648-657. 12 refs.

A chemical heat pump system for solar heat storage was studied by using the de-ammoniation and ammoniation of the ammoniated salts NiCl2.6NH3 and CaCl2.8NH3. Heat energy was absorbed by the decomposition of NiCl2.6NH3 at a temperature of 200 C, and the dissociated NH3 reacted with CaCl2.4NH3 to form CaCl2.8NH3 at 0 C. The energy was recovered by the reverse process, and the decomposition and ammoniation of the salts were examined. Based on the results, experiments were performed using a prototype system and mini-pilot plant system, which exhibited only a 90% efficiency due to the large heat capacity of the vessel. A table of dissociation temperatures and energies of some ammoniated salts, and schematic arrangements of the prototype and pilot plant systems are also presented, and it is concluded that the chemical heat pump system can work as a heat storage system for a long time, and can increase the heat storage efficiency up to 15% with a reduction of the heat capacity of the vessel. D.L.G.

A81-47256 Experimental characterization of the thermal performance of a heat-of-fusion storage unit. B. Carlsson, A. Schmidt, A. Gyorki, H. Stymne, and G. Wettermark (Tekniska Hogskolan, Stockholm, Sweden). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports.
Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 658-665. 9 refs. Research supported by the Statens Rad for Byggnadsforskning.

Experimentally determined thermal performance data are presented for a heat-of-fusion storage unit based on 200 kg of calcium chloride hexahydrate. Constructed as a tube heat exchanger, the unit has a storage medium encapsulated in vertical tubes. Conditions are chosen for their relevance to the application of short-term storage of solar heat, and the heat-of-fusion storage unit is discussed in relation to sensible heat storage in water. Heat transfer rates are calculated according to experimental results and known empirical relations for the heat-transfer coefficients, and good agreement between a theoretically calculated heat of fusion and thermal characteristics of the unit during charging suggest that the method can also be efficient for dimensioning heat-of-fusion storage units. D.L.G.

A81-47257 Thermal energy storage using heat of solution. P. Kulisic, J. Vuletin, J. Mastelic, M. Bosanac, and B. Prib (Zagreb, Sveuciliste, Zagreb, Yugoslavia). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports.
Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 666-673. 5 refs.

The fact that certain salts dissolve endothermically with the positive coefficient of solubility can be used in storing thermal energy. Thermal energy storage using saturated aqueous solution of KNO3, NaNO3, NH4NO3, and NH2CONH2 is investigated experimentally, and specific heat capacities are determined and compared with calculated values. Heats of solution for saturated solutions are also estimated and are found to be smaller than those for a high degree of dilution. In particular, the saturated solution of KNO3 looks promising, and a mixture of 46% KNO3 and 54% H2O is suggested for a thermal energy storage material. C.R.

A81-47833 Royal Society, Discussion on Prospects for Industrial Electrochemistry, London, England, December 10, 11, 1980. *Royal Society (London), Philosophical Transactions, Series A*, vol. 302, no. 1468, Sept. 2, 1981. 169 p.

Among the topics dicussed are electrode kinetics, organic reactions via electrochemically generated intermediaries, speculations on industrial electrochemistry, classically modified electrodes for electrocatalysis, and bioelectrocatalysis. Also covered are industrially useful electrochemical cell designs and meaningful optimization procedures, the industrialization of electrochemical reations, electrochemistry in the service of engineering, pulse voltametric methods of analysis, and on-line sensors in industrial water analysis. Attention is in addition given to sodium-sulphur batteries, the nickel-zinc battery for electric vehicles, and novel materials for advanced batteries. O.C.

A81-47834 The sodium-sulphur battery. I. W. Jones (Chloride Silent Power, Ltd., Runcorn, Ches., England). *(Royal Society, Discussion on Prospects for Industrial Electrochemistry, London, England, Dec. 10, 11, 1980.) Royal Society (London), Philosophical Transactions, Series A*, vol. 302, no. 1468, Sept. 2, 1981, p. 339-350.

The sodium-sulphur battery is considered as a candidate for electric vehicle and bulk storage applications markets estimated to exceed one billion pounds sterling globally by the turn of the century. The sodium-sulphur device offers five times the energy density of conventional batteries, potential cost reductions due to the use of cheap and readily available construction materials, and operates at the relatively low temperatures of 300-400 C. The cells have a solid electrolyte, made by sintering alumina containing 10% sodium oxide, while the electrodes are liquid at operating temperatures. Ceramic element lives in excess of 1000 cycles have been achieved. Attention is given such design details as the thermal and

physical properties of glass/ceramic seals and current collector materials and structure. O.C.

A81-47835 The nickel-zinc battery for electric vehicles. P. Reasbeck (Lucas Group Services, Ltd., Solihull, West Midlands, England). *(Royal Society, Discussion on Prospects for Industrial Electrochemistry, London, England, Dec. 10, 11, 1980.) Royal Society (London), Philosophical Transactions, Series A,* vol. 302, no. 1468, Sept. 2, 1981, p. 351-358; Discussion, p. 359, 360. 6 refs.

A comparative study is presented on battery systems under consideration for application to electric vehicles. It is shown that: (1) the 70 W h/kg (at the 1 hour rate) gravimetric energy density of the nickel-zinc battery is about 3.5 times better than that of the lead-acid traction battery, and two-thirds that of the sodium-sulfur battery; (2) the nickel-zinc system's sustained power density of 150-200 W/kg is five times better than that of lead-acid traction batteries and twice as good as the sodium-sulfur system; (3) the volumetric energy densities of nickel-zinc and sodium-sulfur batteries is more than twice that of the lead-acid traction device; and (4) the nickel-zinc battery has a flatter discharge profile over its full capacity range than the sodium-sulfur and lithium-sulfur systems. It is concluded that the nickel-zinc device is the most attractive candidate for medium-term electric vehicle applications. O.C.

A81-48989 Increasing the pumping efficiency of a resonant microwave stroage cavity. S. V. Baraev and O. P. Korovin (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). *(Zhurnal Tekhnicheskoi Fiziki,* vol. 50, Nov. 1980, p. 2465-2467.) *Soviet Physics - Technical Physics,* vol. 25, Nov. 1980, p. 1444, 1445. 6 refs. Translation.

A theoretical analysis shows that it is possible to improve the efficiency of pumping of a microwave-energy accumulation system by the use of a resonant accumulator whose coefficient of coupling, beta, with the transmission line significantly exceeds unity. It is found that for beta = 10 the maximum efficiency of pumping is 0.75; for beta = 100, the maximum efficiency attains the limiting value of 0.82. The accumulation time corresponding to the maximum pumping efficiency is of the order of 0.001-0.1 sec, and a pulse power increase of 50-75 dB is attained compared to pumping oscillator power. P.T.H.

A81-49281 Nickel-hydrogen battery technology - Development and status. J. D. Dunlop and J. F. Stockel (COMSAT Laboratories, Clarksburg, MD). *COMSAT Technical Review,* vol. 10, Fall 1980, p. 281-297. 6 refs. Research sponsored by the International Telecommunications Satellite Organization.

The current status of aerospace Ni-H2 battery technology is reviewed. Several different Ni-H2 batteries, including a 50-Ah battery and a high-pressure 50-Ah battery, are compared with respect to energy density, energy per unit volume, structural design, and heat transfer capacity. The maximum energy density achieved is 60-1 Wh/kg for the high-pressure 50-Ah cell. The Ni-H2 batteries planned for use in the next generation of INTELSAT communications satellites should achieve 48-Wh/kg usable energy density as compared with the 39 Wh/kg of INTELSAT V batteries. V.L.

A81-49479 Environmental testing of SPE fuel cell assemblies. O. Adlhart (Englehard Minerals and Chemicals Corp., Edison, NJ). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 1-3. Grant No. DAAK70-77-C-0222.

Solid polymer electrolyte (SPE) fuel cells can be operated at low ambient temperatures. The considered investigation provides an evaluation of SPE fuel cells assemblies over a broad range of ambient conditions. The conducted tests form part of a program which is concerned with the development of SPE devices for power requirements ranging up to a few hundred watts. Attention is given to the test system, the performance objectives, the test results, low temperature tests, and storage characteristics. It was found that at atmospheric pressure, the cell functions at temperatures ranging from slightly above freezing to about 70 C. Above this level, dehydration of currently available membranes has an adverse effect on performance. A critical aspect of SPE cell operation is the need for maintaining conditions at high relative humidity. G.R.

A81-49487 Shelf life degradation study of a reserve zinc-silver oxide battery. J. J. Lander (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) and T. R. Sowder (USAF, Directorate of Material Management, Hill AFB, UT). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 49-51. 7 refs.

The considered battery is hermetically sealed. It is piston-cylinder actuated by means of a gas generator for electrolyte delivery. The cell block contains 20 cells, and each cell contains 19 plates. The new battery delivers about 11 A-hr to 23 V at an average 164 A. Sample batteries were periodically discharged to establish performance degradation rates. The values of various battery parameters were obtained as a function of age. These parameters include the oxygen content of the positive plates, individual plate and whole cell capacities, positive plate active material resistance, and the resistance of positive active material to the grid. It was found that run time of the zinc plate limits capacity. Failure to meet performance requirements is expected to be limited by capacity, not first pulse voltage. If a linear projection of both descriptors can be made, an average of 38 year battery shelf life is anticipated. G.R.

A81-49497 Lithium/iron sulfide cell development for electric-vehicle propulsion. E. C. Gay, W. E. Miller, V. M. Kolba, and H. Shimotake (Argonne National Laboratory, Argonne, IL). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 173-176. Research sponsored by the U.S. Department of Energy.

The status of a program to develop a lithium/iron sulfide battery for electric vehicle propulsion is reviewed. The cells consist of a lithium-aluminum negative electrode, an FeS positive electrode, and molten LiCl-KCl electrolyte. The melting point of the electrolyte (352 C) requires a cell operating temperature in the range 400-500 C. The cells have met the performance goal of 80 W-hr/kg at the 4 hr discharge rate and 60 W/kg at 50% discharge. The most promising cell designs for high specific energy over long cyclic periods have been identified. V.L.

A81-49499 Development of lithium/metal sulfide secondary batteries for electric vehicle applications. K. Gentry and R. Hudson (Eagle-Picher Industries, Inc., Joplin, MO). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 179-181. 5 refs. Research supported by the U.S. Department of Energy.

Lithium aluminum/metal sulfide cells and batteries have been developed for electric vehicle propulsion. Activities included cell design and development, battery concept design, prototype battery fabrication, and design cost studies for production quantities up to 2000 MW-hr per year. Individual cell performance tests indicated that all goals can be met except for the 200 cycle life goal, and due to high operating temperatures of 430-480 C, an insulated container with high thermal efficiency is required to prevent thermal gradients within the battery. Cost and design studies of the Mark II performance indicate that costs may be in the range of $125/kW-hr when produced in a full-scale production plant, and that the LiAl/MS electrochemical system can be considered a candidate for advanced batteries, and may find a commercial market in the near future. D.L.G.

A81-49503 High energy density rechargeable battery for satellite applications. L. Marcoux (Hughes Aircraft Co., Technology Div., El Segundo, CA) and R. Marsh (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 194-196. Contract No. F33615-79-C-2044.

Several advance battery systems were investigated with reference to their suitability for supporting military space missions with 10-100 kW power requirements. The systems evaluated included: lithium-metal sulfide, sodium-beta alumina-sulfur, redox, zinc-chlorine, and zinc-bromine systems. The redox system was shown to be unsuitable based on the inadequacy of the specific energy. The high-temperature systems LiAl/FeS and Na/S exhibited low specific energies when forced to deliver 100 kW peak power. The aqueous

systems, Zn/Br2 in particular, exhibited a marginal specific energy (60-65 W-hr/kg), but met all other requirements for the low earth orbit applications. V.L.

A81-49504 Rechargeable lithium batteries. H. F. Hunger and J. E. Ellison (U.S. Army, Electronics Technology and Devices Laboratory, Fort Monmouth, NJ). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 196-199. 14 refs.

The current status of rechargeable lithium batteries and their potential capabilities are reviewed. Approaches to the optimization of rate capability and cycle life which consider cathode structure, electrolyte characteristics, and electrolyte-electrode chemistry are examined. Technical guidelines are presented for the development of an electrically rechargeable lithium battery for military use with a nominal voltage of 24 V, a nominal capacity of 11 A-hr, and an operating capability over the temperature range from -40 to 71 C. Consideration is also given to molybdenum trioxide electrodes and rechargeable compounds. V.L.

A81-49505 Ambient temperature secondary Li/FeS2 cells. G. H. Newman and L. P. Klemann (Exxon Corporate Research Laboratories, Linden, NJ). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 201-205. 10 refs.

The natural pyrite mineral FeS2 is found to be at least a partially rechargeable cathode material. The study demonstrates 22 deep cycles in cells with 'practical' cathode capacity densities. The long-term rechargeability shown in high-temperature cells is considered to suggest the high cycle life and secondary properties of FeS2. The results establish the technical possibility of applying FeS2 as a high rate cathode material in primary lithium cells which contain lithium organoborate electrolytes. C.R.

A81-49507 Carbon-sulfur compounds as cathodes for lithium high energy secondary cells. C. H. Chang (Exxon Research and Engineering Co., Linden, NJ). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 208-211. 11 refs.

The feasibility of using carbon, a low weight and abundant element, to carry sulfur atoms as a high energy sulfur cathode is demonstrated. The high open-circuit voltages of Li/C(x)S cells suggest that the free energies of formation of the carbon-sulfur compounds are low in comparison with those of other sulfides such that no undue decrease in the cell voltage occurs. The performance of the C(x)S cathode, however, is limited by the discharge current rate in the ambient organic electrolyte system. Preliminary studies suggest that the rate capability of the carbon-sulfur compound is related to the pore structure of the material. C.R.

A81-49510 Evaluation of the pocket plate nickel cadmium cells/battery for military application. J. W. Lear (Martin Marietta Aerospace, Denver, CO). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 222-224.

Test results are presented for a 22-cell 129 A-hr pocket plate nickel cadmium battery designed to power a military communication complex on a twenty-four hour basis (nine hours of discharge followed by fifteen hours of charge). It is shown that, with proper charge control, the battery is capable of operating with minimum overcharges (about 5%) and efficiencies as high as 90-95%; self discharge is approximately 0.1% per day. V.L.

A81-49512 A nickel-hydrogen bipolar secondary battery. R. F. Chireau and A. S. Berchielli (Yardney Electric Corp., Pawcatuck, CT). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 230-236. 26 refs. Research supported by the Yardney Electric Corp.

A study was conducted to test the concept of using bipolar nickel-hydrogen batteries for an energy storage system that would be compatible with both existing and future electrical generation and distribution equipment. The feasibility of a bipolar nickel-hydrogen rechargeable system was investigated with respect to performance characteristics such as charge acceptance, overcharge capability, cell reversal capability, electrolyte management, and cycle life. Peak specific power figures of over 350 W per kilogram were achieved and the specific energy of the bipolar battery was 60 W-hr/kg at the 3 hr rate of discharge. It was concluded that the new energy storage system would be suitable for load-leveling applications. V.L.

A81-49513 High energy density long cycle life nickel-zinc batteries. O. C. Wagner, A. Almerini, and R. L. Smith (U.S. Army, Electronics Technology and Devices Laboratory, Fort Monmouth, NJ). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 237-240.

Results of a nickel-zinc battery research and development program are reported with emphasis on those factors which most influence the battery performance. These factors are: the separator system, the charging mode, additives to the zinc anode, and pressure cutoff controls. It is found that the best separator system consists of two layers of nickel coated Celgard 2500 sandwiched between two layers of uncoated Celgard 3500. The best charging method is an optimized interrupted current mode. The best binary additive tested so far is 1/2% indium hydroxide plus 1% lead oxide. V.L.

A81-49514 Front end nickel-zinc systems for noninterruptible power systems. M. Klein and A. Leo (Energy Research Corp., Danbury, CT). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 244-246. Research supported by the Honeywell Corp. and U.S. Air Force.

Scale-up considerations and performance characteristics of 2000 A-hr Ni-Zn cells are investigated to determine design features for the MX power system. Cell design and construction of the batteries, electrodes, and Co(OH)2, and graphite and Terlon positive plates are discussed. Two 2000 A-hr cells were tested over a thirty week period, charged at 85 A for 48 hr, and discharged at 65 A to 1.30 V. One cell demonstrated excellent capacity retention on float, although the other failed due to dendrite shorting caused by higher current densities obtained as a result of the drying out of the negative plates. Variations in initial performance between the two cells is attributed to variation in the extent of the dryout problem, and limiting factors in the float applications are attributed to separation degradation and electrolyte management. D.L.G.

A81-49515 Status of nickel/zinc and nickel/iron battery technology for electric vehicle applications. N. P. Yao, C. C. Christianson, R. C. Elliott, and J. F. Miller (Argonne National Laboratory, Argonne, IL). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 247-256. 30 refs. Research supported by the U.S. Department of Energy.

Significant progress is reported toward nickel/zinc and nickel/iron battery performance goals necessary for widespread application to electric vehicle systems. Although nickel/zinc module test data have shown a specific energy of nearly 130 W/kg, cycle life improvements beyond the 120-cycle capability demonstrated to date are necessary. Nickel/iron modules have reached a specific energy of nearly 50 W-hr/kg, and a specific power of 100 W/kg, with lives of 300 cycles and energy efficiency improvements from 50 to 65%. The 1984 performance goals are for a nickel/iron cycle life of 2000 cycles, and a nickel/zinc life of 800 cycles, with a price for both systems of $70/kWh, assuming a production level of 100,000 25 kWh units per year. O.C.

A81-49518 Improved lead-acid batteries - The promising candidate for near-term electric vehicles. N. P. Yao, C. C. Christianson, and T. S. Lee (Argonne National Laboratory, Argonne, IL). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 261-265. 18 refs. Research sponsored by the U.S. Department of Energy.

The paper describes the status and progress of the electric vehicle lead-acid battery technology that has been under development since 1978 under the auspices of the DOE/Argonne National Laboratory Near-Term Battery Project. Since the initiation of the program, the energy density of the battery has been increased from

25-30 W-hr/kg to over 40 W-hr/kg and the peak power has increased from 70 W/kg to over 110 W/kg (at 50% state of charge). Currently, the emphasis is on the improvement of cycle life of these batteries from the present level of 120-250 cycles to 800 cycles (at 80% depth of discharge). V.L.

A81-49520 **Thermal energy storage by the chemical reaction - Augmentation of heat transfer and thermal decomposition in the CaO/Ca/OH/2 powder.** A. Kanzawa (Tokyo Institute of Technology, Tokyo, Japan) and Y. Arai. *Solar Energy*, vol. 27, no. 4, 1981, p. 289-294. 11 refs.

Thermal storage using thermal decomposition of Ca(OH)2 has been investigated with the objective of finding an efficient heating technique. It is shown that copper plates placed in Ca(OH)2 powder, whose thermal conductivity is poor, act effectively as heat transfer fins. The best results are obtained with plates 5-10 cm high and 0.02 cm thick spaced 0.5-1.0 cm apart. V.L.

A81-49878 **Electric and hybrid vehicles.** Edited by L. J. Jacovides (General Motors Corp., Detroit, MI), E. P. Cornell (General Electric Co., Fairfield, CT), and R. Kirk (U.S. Department of Energy, Washington, DC). Warrendale, PA, Society of Automotive Engineers (Progress in Technology Series, No. 21), 1981. 355 p. $28.

A study of the energy utilization of gasoline and battery-electric powered special purpose vehicles is discussed along with the impact of electric cars on national energy consumption, the development of electric vehicles in Japan, the applicability of safety standards to electric and hybrid-vehicles, and crashworthiness tests on two electric vehicles. Aspects of energy storage are explored, taking into account a review of battery systems for electrically powered vehicles, the dynamic characterization of lead-acid batteries for vehicle applications, nickel-zinc storage batteries as energy sources for electric vehicles, and a high energy tubular battery for a 1800 kg payload electric delivery van. Subjects considered in connection with drive systems include the drive system of the DOE near-term electric vehicle, a high performance AC electric drive system, an electromechanical transmission for hybrid vehicle power trains, and a hybrid vehicle for fuel economy. Questions of vehicle development are examined, giving attention to the Electrovair electric car, special purpose urban cars, the system design of the electric test vehicle, a project for city center transport, and a digital computer program for simulating electric vehicle performance. G.R.

N81-28560# Argonne National Lab., Ill.
DOE'S NEAR-TERM ELECTRIC VEHICLE BATTERY PROGRAM. STATUS OF IMPROVED LEAD-ACID, NICKEL/IRON, AND NICKEL/ZINC BATTERY DEVELOPMENTS
N. P. Yao, C. C. Christianson, R. C. Elliot, T. S. Lee, and J. F. Miller 1980 48 p refs Presented at the 3d Intern. Elec. Vehicle Exposition and Conf., St. Louis, 20-22 May 1980
(Contract W-31-109-eng-38)
(CONF-800523-4) Avail: NTIS HC A03/MF A01

Significant progress in lead acid, nickel/iron and nickel/zinc battery technology was made towards achieving the technical performance goals necessary for widespread use of these battery systems in electric vehicle applications. The energy density of lead acid eV batteries has advanced from 25 to 30 Wh/kg to over 40 Wh/kg. The prospect for obtaining a lead acid battery having both high energy density and long cycle life in a few years is very promising. Nickel/iron modules demonstrated a specific energy of nearly 50 Wh/kg and a specific power of 100 W/kg, cycle lives of 300 were achieved during early 1980 and testing continues, and the energy efficiency was improved from less than 50 percent to over 65 percent. Nickel/zinc module test data show a specific energy of nearly 70 Wh/kg and a specific power of 130 W/kg. However, cycle life improvements are still needed. Cost reduction continues to receive major emphasis at developers of both nickel/zinc and nickel/iron batteries. DOE

N81-28581# Brookhaven National Lab., Upton, N. Y.
ZIRCONIA FUEL CELLS AND ELECTROLYZERS
H. S. Isaacs 1980 26 p refs Presented at the 1st Intern. Conf. on the Sci. and Technol. of Zirconia, Cleveland, 16 Jun. 1980
(Contract DE-AC02-76CH-00016)
(BNL-29133; CONF-8006157-1) Avail: NTIS HC A03/MF A01

A review of the historical development, operation, and problems of solid oxide electrolyte fuel cells and electrolyzers is given. The thermodynamic principles of operation are reviewed, and the overvoltage losses during operation of fuel cells and steam electrolyzers are discussed including physical factors and electrochemical factors. DOE

N81-28601# Indian Lead Zinc Information Centre, New Delhi.
SYMPOSIUM ON BATTERY SYSTEMS IN THE 1980'S
Nov. 1980 85 p refs Symp. held at New Delhi, 26 Feb. 1979
(PB81-123689) Avail: NTIS HC A05/MF A01 CSCL 10C

The status of the battery industry in the country is discussed. A realistic assessment of the emerging trends in battery technology is presented. While acknowledged experts in the fields of lead acid batteries from India and abroad presented papers covering comprehensively the different aspects of battery systems, the participants were senior executives, technologists and government officials from user and producer interests. Representing the producer interests were the producers of lead and zinc and battery manufacturers. The symposium afforded an opportunity for not only exchange of information but also for cross-fertilization of ideas. GRA

N81-29532*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INITIAL GUIDELINES AND ESTIMATES FOR A POWER SYSTEM WITH INERTIAL (FLYWHEEL) ENERGY STORAGE
Luther W. Slifer, Jr. Dec. 1980 11 p
(NASA-TM-82134) Avail: NTIS HC A02/MF A01 CSCL 10C

The starting point for the assessment of a spacecraft power system utilizing inertial (flywheel) energy storage. Both general and specific guidelines are defined for the assessment of a modular flywheel system, operationally similar to but with significantly greater capability than the multimission modular spacecraft (MMS) power system. Goals for the flywheel system are defined in terms of efficiently train estimates and mass estimates for the system components. The inertial storage power system uses a 5 kw-hr flywheel storage component at 50 percent depth of discharge (DOD). It is capable of supporting an average load of 3 kw, including a peak load of 7.5 kw for 10 percent of the duty cycle, in low earth orbit operation. The specific power goal for the system is 10 w/kg, consisting of a 56w/kg (end of life) solar array, a 21.7 w-hr/kg (at 50 percent DOD) flywheel, and 43 w/kg power processing (conditioning, control and distribution). Author

N81-29571# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
APPLIED BATTERY AND ELECTROCHEMICAL RESEARCH PROGRAM REPORT FOR FISCAL YEAR 1980
E. Cairns, DeJongh Lutgard, James Evans, Frank McLarnon, Rolf Muller, John Newman, Phillip Ross, and Charles Tobias Apr. 1981 135 p
(Contract W-7405-eng-48)
(LBL-12514) Avail: NTIS HC A05/MF A01

The Exploratory Battery R and D area provides for the study of new electrochemical couples, or of new approaches to known battery systems. High temperature systems investigated include Ca/molten salt/FeS2, Li/Li1-Al2O3/TiS2, and Na/beta "-Al2O3/SC14-NaCl-AlCl3. Ambient temperature systems studied were Li/So2/C and Zn/NaCh/Fe(CN)6. New electrode/electrolyte formulations for Zn/KOH/NiOCH and Li/organic electrolyte/TiS2 cells were investigated, and a status study of ambient temperature secondary lithium batteries was conducted. Projects grouped in the Engineering-Science Research area include morphological and optical studies of battery electrodes in Ph/H2SO4/PbO2, Zn/KOH/NiOOH, and metal/air cells; and a thermal management study of the high temperature Li/molten salt/FeS Battery. DOE

N81-29585# Department of Energy, Washington, D. C. Office of Advanced Conservation Technologies.
PHYSICAL AND CHEMICAL ENERGY STORAGE PROGRAM. PROJECT SUMMARY DATA
Mar. 1981 47 p
(DOE/CE-0008) Avail: NTIS HC A03/MF A01

The Department of Energy's Office of Advanced Conservation Technologies is developing cost-effective, efficient, reliable, and environmentally acceptable energy storage systems. The mission of the Energy Storage Program is to develop devices, processes, and subsystems which permit domestic energy resources to be

supplied at the time and locations where they can be used. In this program, energy is stored in thermal, chemical, mechanical, and magnetic forms. Generally, the best storage device for a specific supply system is one which minimizes the need for converting from one energy form to another in the overall system which consists of production, storage, transportation, and end-user equipment. This publication consists principally of summary sheets for each active project in the Chemical/Hydrogen, Thermal, Magnetic, Mechanical, Flywheel and Underground Energy Storage Program for FY 1980. DOE

N81-29587# Midwest Research Inst., Kansas City, Mo. Solar Energy Research Inst.

SURVEY OF SENSIBLE AND LATENT HEAT THERMAL ENERGY STORAGE PROJECTS

F. Baylin and M. Merino May 1981 335 p refs
(Contract DE-AC02-77CH-00178)
(SERI/RR-355-456) Avail: NTIS HC A15/MF A01

Ongoing and completed research projects on sensible and latent heat thermal enegy storage for low, intermediate, and high temperature applications are reviewed. Projects in the United States and abroad are included. Several research efforts are in the index although the project descriptions are absent. Project lists are organized into four sections: short term sensible heat storage; seasonal sensible heat storage; latent heat storage; and models, economic analysis, and support studies. The organization of the Department of Energy programs managing many of these projects is also outlined. Projects are presented in a standard format that includes laboratory; funding level and period; status; project description; technical and economic parameters; and applications. DOE

N81-29619# Oak Ridge Y-12 Plant, Tenn. Fabrication Systems Dept.

OAK RIDGE FLYWHEEL EVALUATION LABORATORY TEST REPORT ON THE GARRETT AIRESEARCH FLYWHEEL

R. S. Steele and E. F. Babelay Feb. 1981 93 p refs
(Contract W-7405-eng-26)
(Y/DX-227) Avail: NTIS HC A05/MF A01

The graphite-epoxy-composite spokes began to splinter in four tip locations after the sixth balance run to 200 Hz (12,000 rpm). Testing was continued until a catastrophic failure was achieved. The spoke splintering did not appear to be a factor in the ultimate capability. Maximum stored energy was 1.16 kWh (4.17 MJ) at 74.6 Wh/kg (269 kJ/kg) at 463 rps (27,780 rpm). Ultimate speed was limited by a dynamic instability at 463 rps. Actual failure occurred in a brakng mode at 390 rps. Other observations of dynamic behavior included the mass eccentricity shifting repeatably with speed at a rate of 0.051 mm in 170 Hz; this action was attributed to nonuniform flexing of the rim. A permanent balance shift of approximately 0.051 mm occurred, possibly indicating a slippage of the rim relative to the hub. Radiography shows that the rims realigned themselves. DOE

N81-29623# California Univ., Livermore. Lawrence Livermore Lab.

APPLICATION ANALYSIS OF ENERGY-STORAGE SYSTEMS FOR TRANSPORTATION

L. G. OConnell and L. R. Spogen 13 Apr. 1981 19 p refs Presented at Tech. and Economic Analysis Contractors' Meeting, Chicago, 21 Apr. 1981
(Contract W-7405-eng-48)
(UCRL-85851; CONF-810459-2) Avail: NTIS HC A02/MF A01

An analysis study of energy storage systems for automotive propulsion was conducted. The most promising energy storage devices and the vehicular missions for which the resultant propulsion systems are best suited were identified. Preliminary findings concerning an assessment of the impact on energy storage device requirements of current transportation developments and trends are discussed. DOE

N81-30051# California Univ., Livermore. Lawrence Livermore Lab.

ENERGY-STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION. VOLUME 2: ENERGY-STORAGE DEVICES Final Report

L. G. OConnell, C. J. Anderson, E. Behrn, W. Cliff (Battelle Northwest Labs., Seattle, Wash.), R. Crisp (Arkansas Univ. Fayetteville), H. C. Forsberg, C. J. Hudson (Interplan Corp.), J. S. Payne, R. Renner (Brookhaven National Lab.), M. D. Schrot et al 15 Dec. 1980 247 p refs 4 Vol.
(Contract W-7405-eng-48)
(UCRL-53053-80-Vol-2) Avail: NTIS HC A11/MF A01

The operating, safety and performance characteristics of specific devices for electrochemical, mechanical, chemical and thermal energy storage are evaluated. The feasibility for use in automobile propulsion systems and the future research required for their use in automobile propulsion systems and the future research required for development of promising devices are addressed. DOE

N81-30052# California Univ., Livermore. Lawrence Livermore Lab.

ENERGY-STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION. VOLUME 3: AUTOMOTIVE PROPULSION SYSTEMS Final Report

L. G. OConnell, C. J. Anderson, E. Behrin, W. Cliff (Battelle Pacific Northwest Labs., Seattle, Wash.), R. Crisp (Arkansas Univ., Fayetteville), H. C. Forsberg, C. L. Hudson (Interplan Corp.), J. S. Payne, R. Renner, M. D. Schrot et al 15 Dec. 1980 372 p refs 4 Vol.
(Contract W-7405-eng-48)
(UCRL-53053-80-Vol-3) Avail: NTIS HC A16/MF A01

Energy storage devices and propulsion systems likely to provide credible alternatives to current and future petroleum-fueled automobiles were examined. Energy storage automobiles, their performance and vehicle characteristics, propulsion, transmission and control equipment, cost estimates, and safety are among the factors addressed. DOE

N81-30054# California Univ., Livermore. Lawrence Livermore Lab.

ALUMINUM-AIR BATTERIES FOR VEHICLES

Ervin Behrin and John F. Cooper 23 Feb. 1981 15 p refs Presented at the 1st Intern. Energy Agency Conf. on New Energy Conservation Technol. and Their Commercialization, Berlin, 6-10 Apr. 1981 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-85605; CONF-810423-1) Avail: NTIS HC A02/MF A01

The aluminum-air battery is an advanced electrochemical energy source in the early stages of development. The battery is potentially capable to providing an electric vehicle with the range, acceleration, and rapid refueling capability of the automobile. Peak cell energy yields above 4 kWh/kg-Al and peak power densities greater than 6 kW/sq m have been demonstrated in single cells. Projected energy density and power density of a complete vehicle battery are greater than 300 Wh/kg and 150 W/kg. The concept, technical status, development strategy, and the results of battery and vehicle analyses are reviewed. DOE

N81-30379# Eaton Corp., Southfield, Mich.

USE OF ELASTOMERS IN REGENERATIVE BRAKING SYSTEMS

1981 28 p refs Presented at the Rubber Div. Meeting of the Am. Chem. Soc., Minneapolis, 1-5 Jun. 1981
(W-7405-eng-48)
(UCRL-15353; CONF-810648-1) Avail: NTIS HC A03/MF A01

The storage of potential energy as strain energy in elastomers was investigated. The evolution of the preferred stressing scheme is described, and test results on full-size elastomeric energy storage units sized for an automotive regenerative braking system application are presented. The need for elastomeric material improvements is also discussed. DOE

N81-30587# Battelle Pacific Northwest Labs., Richland, Wash.

COMPRESSED AIR ENERGY STORAGE TECHNOLOGY PROGRAM Annual Report

L. D. Kannberg Jun. 1981 201 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3804) Avail: NTIS HC A10/MF A01

Major research funded under the Compressed Air Energy Storage Technology Program during the period March, 1980 to March 1981 is reported. The annual report is divided into two segments: (1) reservoir stability studies and (2) second generation concepts studies. The first study represents research performed

to establish stability criteria for CAES reservoirs while the second study reports progress on research performed on second generation CAES concepts. DOE

N81-30597# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 7: SITE INVESTIGATION: DEEP DRILLING Final Report
Apr. 1981 250 p refs Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-7; DOE/ET-5047/7) Avail: NTIS HC A11/MF A01

The results of the deep drilling program performed on the Sunshine Site from January to August 1979 are presented. The work included continuous core drilling and sampling of the Sykesville to a vertical depth of 2556 ft, in hole geophysical logging, determination of rock permeability and stresses, and rock testing. DOE

N81-30598# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 8: DESIGN APPROACHES: UPH. APPENDIX A: UPPER RESERVOIR Final Report
Apr. 1981 91 p Prepared in cooperation with Potomac Electric Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-8-App-A; DOE/ET-5407/8A) Avail: NTIS HC A05/MF A01

Overriding considerations including operating range, volume and lining of reservoir, embankment design, intake/outlet arrangements and filling and make up water provisions were studied within the context of minimizing facility costs and optimizing the plant layout. The study led to the selection of a reservoir formed by embankment of compacted rockfill together with an intake/outlet structure located in the embankment. The reservoir floor and upstream slopes of the embankment will have an asphalt lining to prevent leakage. The material and cost estimates presented are based on the requirements for a 2000 MW plant providing 20,000 MWh of storage with a nominal head of 4600 ft. DOE

N81-30599# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 8: DESIGN APPROACHES: UPH. APPENDIX C: HEAVY HOIST Final Report
Apr. 1981 157 p Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-8-App-C; DOE/ET-5047/8C) Avail: NTIS HC A08/MF A01

Overriding considerations, including type of hoist, capacity limitations, operating speed, haulage ropes, guides, conveyance, and landings were studied within the context both of feasibility and of minimizing equipment costs. The study led to the selection of a twin drum, twin electric drive hoist, and for depths as much as 5000 ft, hoist capacities of up to 300 tons were found to be feasible. A brief reference is made to the requirements for hoisting equipment other than for heavy loads. DOE

N81-30600# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 8: DESIGN APPROACHES. UPH. APPENDIX E: LOWER RESERVOIR Final Report
Apr. 1981 157 p refs Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-8-App-E; DOE/ET-5047/8E) Avail: NTIS HC A08/MF A01

Operational, construction, and geotechnical requirements were examined. Overriding considerations including operating range, volume, construction methods, cavern cross section and reservoir layout were studied within the context of minimizing facility costs and optimizing the plant layout. The study led to a preliminary arrangement of fourteen parallel caverns, each 60 ft wide by 85 ft high in cross section and 3610 ft in length. The requirements for and preliminary design of the intermediate reservoir in the case of a two step UPH facility is also described. The design and the cost estimates presented are based on the requirements for a 2000 MW plant providing 20,000 MWh of storage at a nominal head of 4600 ft. DOE

N81-30601# Acres American, Inc., Columbia, Md.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 9: DESIGN APPROACHES. CAES. APPENDIX B: CHAMPAGNE EFFECT Final Report
Apr. 1981 126 p refs Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-20013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-9-App-B; DOE/ET-5047/9B) Avail: NTIS HC A07/MF A01

The significance of the release of dissolved air from the water in the water shaft during air compression on the design and operation of a hydrolically compensated CAES plant was investigated. This air release phenomena was named the Champagne Effect. Included is a description of the work to investigate the rate of diffusion of air into water, the rate of the subsequent release of air from the water during passage up the water shaft, and an evaluation of the resulting behavior of the air bubbles in the shaft. Also included is a discussion of dynamic modeling. Simulation was based upon a two fluid model of the PEPCO system and includes an analysis of potential modifications to the design that might further mitigate any operation problems. DOE

N81-30602# Acres American, Inc., Columbia, Md.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 9: DESIGN APPROACHES. CAES. APPPENDIX E: ELECTRICAL SYSTEMS Final Report
Apr. 1981 149 p Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-9-App-E; DOE/ET-5047/9E) Avail: NTIS HC A07/MF A01

The design approaches provided the basis for development of the preliminary plant design. The electrical systems described include the plant power system, switchyard and electrical motor starting system. The design approaches presented are based on the design criteria presented in the Project Design criteria - CAES. Selection of the preferred approach reflect the Task 3 study results and conform to the greatest extent possible with PEPCO's standard practices. DOE

N81-30603# Nuclear Utility Services, Inc., Rockville, Md.
PRELIMINARY DESIGN STUDIES OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 10: ENVIRONMENTAL STUDIES Final Report
Apr. 1981 351 p refs Prepared in cooperation with Acres American, Inc., Buffalo, N.Y. Sponsored in part by Electric Power Research Inst. and Potomac Electric Power Co., Washington, D.C.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-10; DOT/ET-5047/10) Avail: NTIS HC A16/MF A01

Results of preliminary environmental assessments for a proposed UPH or CAES demonstration facility are presented. Included are characterizations of the existing environment of the sunshine site in Montgomery County, Maryland, and assessments of environmental impacts and public safety concerns. Elements of the existing environment which are considered sensitive are described. Environmental impacts are identified, rated, and described for both alternative demonstration facilities. Public safety concerns for both alternative demonstration facilities are also identified and discussed. These include, for both UPH and

CAES, underground cavern collapse and surface subsidence, explosives, site security, icing, upper reservoir failure, and mechanical failure of plant equipment. In addition, fuel handling and the champagne effect are addressed for CAES. DOE

N81-30604# Acres American, Inc., Columbia, Md.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 13: CAUPH PRELIMINARY LICENSING DOCUMENTATION Final Report
Apr. 1981 187 p refs Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Corp.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-13; DOE/ET-5047/13) Avail: NTIS HC A09/MF A01

An implementation plan and schedule was developed for the period from project authorization by the sponsor through receipt of all required regulatory authorizations. The documentation is based upon review of all pertinent regulations on the federal, state and local level of government, review of other publications, acquisition of applicable guides and forms, and discussions with responsible agency representatives. The implementation plan is specific to the requirements within the State of Maryland: the plan is based primarily upon the state's siting procedure which provides coordinated state agency approvals. Notwithstanding the site specific nature of the plan, many of the regulatory requirements, as well as the approach to implementation, should be suitable for general reference in developing licensing plans for CAES or UPH facilities. DOE

N81-30611# Lincoln Lab., Mass. Inst. of Tech., Lexington.
OPERATIONAL EXPERIENCES IN LEAD-ACID BATTERIES FOR PHOTOVOLTAIC SYSTEMS
Bronwyn L. Brench 1981 6 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/118; CONF-810526-18) Avail: NTIS HC A02/MF A01

Photovoltaic systems which use different kinds of lead acid batteries, including units normally used for starting, lighting, and ignition (SLI) and for motive power are discussed. Four of these battery subsystems, particularly battery type versus system load, versus performance characteristics, and versus expected lifetime, are compared and analyzed. DOE

N81-30612# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PERFORMANCE CHARACTERISTICS OF SOLAR-PHOTOVOLTAIC FLYWHEEL-STORAGE SYSTEMS
P. O. Jarvinen, Bronwyn L. Brench, and Neil E. Rasmussen 1981 6 p refs Presented at the 15th IEEE Photovoltaic Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/134; CONF-810526-23) Avail: NTIS HC A02/MF A01

A solar photovoltaic energy flywheel storage and conversion system for residential applications was tested. Performance and efficiency measurements were conducted on the system, which utilizes low loss magnetic bearings, maximum power point tracking of the photovoltaic array, integrated permanent magnet motor generator, and output power conditioning sections of either the stand alone cycloconverter or utility interactive inverter type. The overall in/out electrical storage efficiency of the flywheel system was measured along with the power transfer efficiencies of the individual components and the system spin down tare losses. The system compares favorably with systems which use batteries and inverters. DOE

N81-30624# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Labs.
RECENT TECHNOLOGY IMPROVEMENTS IN EXXON'S CIRCULATING ZINC-BROMINE BATTERY SYSTEM
Richard J. Bellows 1981 23 p Presented at the 4th DOE Battery and Electrochem. Contractor's Conf., Washington, D.C., 2 Jun. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-7116C; CONF-810642-1) Avail: NTIS HC A02/MF A01

Electrode and electrolyte performance on 500 wH and 3 kWh units were studied. It was indicated that Exxon's circulating zinc-bromine battery in 20 kWh designs is capable of high energy density and turn around efficiency. The performance, coupled with factory cost projections of $28/kWh, makes zinc-bromine an attractive advanced battery candidate for not only photovoltaic, but also electric vehicle and bulk energy storage applications. DOE

N81-30625# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Labs.
RECENT PROGRESS ON EXXON'S CIRCULATING ZINC-BROMINE BATTERY SYSTEM
Richard J. Bellows 1981 19 p Presented at the 4th DOE Battery and Electrochem. Contractor's Conf., Washington, D.C., 2 Jun. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-7115C; CONF-810642-4) Avail: NTIS HC A02/MF A01

The design, performance, and factory cost of Exxon's circulating zinc bromine batteries are described. The Exxon system has demonstrated stable performance in scaleups to 3 and 10 kWh sub modules. Cost studies based on recently demonstrated extrusion and injection molding techniques, show that this battery, with plastic electrodes, bipolar stacks, Br2 complexation, and circulating electrolytes, can be produced at a factory cost of $28/kWh. DOE

N81-30626# California Univ., Livermore. Lawrence Livermore Lab.
SAFETY OF ISOTROPIC FLYWHEELS
Martin W. Schwartz 30 Apr. 1981 11 p refs Presented to the 5th Intern. Conf. on Fracture ICF5, Cannes, France, 29 Mar. - 30 Apr. 1981 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84347; CONF-810373-1) Avail: NTIS HC A02/MF A01

A probabilistic safety criterion for isotropic flywheel rotors based on the tolerated noncontainment failures rates of commercial aircraft turbojet engine rotors was established. A technique is developed combining reliability with fracture mechanics. A sample calculation is provided to show the energy storage levels that isotropic flywheel rotors could achieve within the constraints of this safety criterion. DOE

N81-30635# Maryland Univ., College Park.
REVIEW OF NATIONAL TECHNO-ECONOMIC ENERGY MODELS WITH PARTICULAR REFERENCE TO THE EVALUATION OF ENERGY STORAGE CONSIDERATIONS
William B. Widhelm and Thomas H. Doyle Dec. 1980 404 p refs
(Contracts DE-FG01-79ET-2685; DE-AS05-77ET-26940)
(DOE/ET-26940/T1; BN-964) Avail: NTIS HC A18/MF A01

Economic considerations used in developing National Techno-Economic (NTEE) models are presented. Methods for comparing NTEE models are discussed; specific NTEE models are described; and possible uses of NTEE models in energy storage studies are examined. DOE

N81-30636# Argonne National Lab., Ill.
HEAT-TRANSFER MODELING AND THERMAL MANAGEMENT OF BATTERIES
N. P. Yao 1980 12 p refs Presented at the 89th Natl. Meeting of the Am. Inst. of Chem. Engr., Portland, Oreg., 17-20 Aug. 1980
(Contract W-31-109-eng-38)
(CONF-800802-27) Avail: NTIS HC A02/MF A01

Thermal behavior of the battery and its thermal management, an important operational problem which would directly affect life cycle, safety, and also the cost of the batter were examined. Two commercial applications for secondary batteries, i.e., electric vehicles and electric utility load leveling, are discussed. Thermal management problems unique to various battery systems are reviewed. An example of engineering modeling which provides methodology for analysis of and engineering solutions to the battery thermal problem is presented. DOE

N81-31294# Avco Systems Div., Wilmington, Mass.
TOWARD OPTIMIZATION OF THE WOVEN FLYWHEEL
Alan D. Sapowith and William E. Handy 1 Jun. 1981 8 p refs
(Contract W-7405-eng-48)
(UCRL-15359) Avail: NTIS, HC A02/MF A01

A constant stress composite flywheel incorporates fibers in the two principal stress directions: radial and circumferential. This design concept, along with two basic fabrication methods, is described. The low cost fabrication approach which incorporates a spiral weave is evaluated for its energy storage capacity. In this evaluation, several extremes of weave design are considered. It is concluded that flywheel performance depends primarily on maximizing the hoop fiber count and determining through expermentation the optimum fiber volume fraction for the composite. DOE

N81-31630*# PRC Systems Sciences Co., Huntsville, Ala.
ELECTROCHEMICAL ENERGY STORAGE SUBSYSTEMS STUDY, VOLUME 1 Final Contractor Report, Oct. 1979 - Sep. 1981
Fred Q. Miller, Peter W. Richardson, C. L. Graff, M. V. Jordan, and V. L. Patterson Sep. 1981 341 p refs 2 Vol.
(Contract NAS3-21962)
(NASA-CR-165420-Vol-1) Avail: NTIS HC A15/MF A01 CSCL 10C

The effects on life cycle costs (LCC) of major design and performance technology parameters for multi kW LEO and GEO energy storage subsystems using NiCd and NiH2 batteries and fuel cell/electrolysis cell devices were examined. Design, performance and LCC dynamic models are developed based on mission and system/subsystem requirements and existing or derived physical and cost data relationships. The models define baseline designs and costs. The major design and performance parameters are each varied to determine their influence on LCC around the baseline values. E.A.K.

N81-31631*# PRC Systems Sciences Co., Huntsville, Ala.
ELECTROCHEMICAL ENERGY STORAGE SUBSYSTEMS STUDY, VOLUME 2 Final Contractor Report, Oct. 1979 - Sep. 1981
Fred Q. Miller, Peter W. Richardson, C. L. Graff, M. V. Jordan, and V. L. Patterson Sep. 1981 259 p refs 2 Vol.
(Contract NAS3-21962)
(NASA-CR-165420-Vol-2) Avail: NTIS HC A12/MF A01 CSCL 10C

The effects on life cycle costs (LCC) of major design and performance technology parameters for multi kW LEO and GEO energy storage subsystems using NiCd and NiH2 batteries and fuel cell/electrolysis cell devices were examined. Design, performance and LCC dynamic models are developed based on mission and system/subsystem requirements and existing or derived physical and cost data relationships. The models are exercised to define baseline designs and costs. Then the major design and performance parameters are each varied to determine their influence on LCC around the baseline values. E.A.K.

N81-31654# Varta Batterie A.G., Hanover (West Germany).
FABRICATION AND TESTING OF A PROTOTYPE GAS-RECOMBINATION DEVICE FOR UTILITY LEAD-ACID CELLS Final Report, 1 Aug. 1979 - 31 Mar 1980
A. Winsel, H. Laig-Hoerstebrock, K. Ledjeff, M. Tochtermann, and R. Schneider Aug. 1980 76 p refs
(Contract W-31-109-eng-38)
(ANL/OEPM-80-8) Avail: NTIS HC A05/MF A01

A prototype hydrogen-oxygen gas recombination device (HORD) was fabricated. The 435-W HORD was tested for performance and gas recombination efficiency using cyclinder H2 and O2 gases at various ratios and at various gas flow rates; high (100%) recombination efficiencies were obtained at all conditions tested. Temperature profiles of the HORD showed an even temperature distribution with no hot spots. The pressure was found to be dependent on the pressure of surplus gases. Higher outside temperatures had a negligible effect on performance. The stibine-arsine removal device was found to be very effective; removal efficiencies may be decreased if water vapor condenses on the activated charcoal. The HORD was also tested with a lead-acid cell over a cycle simulating a typical utility load-leveling application. The system operated gas-tight and maintenance-free. Safety applicances are discussed for cases of high and low explosive gas concentrations inside the HORD. A theoretical model of HORD operation is presented. DOE

N81-31669# CALMAC Mfg. Co., Englewood, N. J.
SALT-HYDRATE THERMAL-ENERGY-STORAGE SYSTEM FOR SPACE HEATING AND AIR CONDITIONING Final Report, 1 Dec. 1977 - 30 Jun. 1980
Calvin D. MacCracken, John M. Armstrong, Mark M. MacCracken, and Brian M. Silvetti 1980 86 p refs
(Contracts DE-AC02-78CS-34698; EM-78-C-02-4698)
(DOE/CS-34698/T1) Avail: NTIS HC A05/MF A01

Latent heat storage equipment using three different salts was developed. The salts are: sodium sulfate pentahydrate which melts at 460 C, magnesium chloride hexahydrate which melts at 1150 C, and a eutectic combination of seven different materials which melts at 70 C. Stirring pumps, tanks, and tubing materials, and field filling of the salts into their tanks are developed. good performance for the tank/heat exchangers with all three salts is reported. Both the 1150 C and 460 C salts are almost equivalent in volume storage to water/ice. The 79.0 C salt, however, begins at about 56% of the BTU's per cubic foot of water/ice and declines due to separation to 40% after repeated cycling. DOE

N81-32608*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REDOX SYSTEM DESIGN FOR SOLAR STORAGE APPLICATIONS
A. W. Nice and Norman H. Hagedorn 1981 9 p refs Presented at the 4th Battery and Electrochem. Contractors' Conf., Washington, D.C., 2-4 Jun. 1981 Sponsored by DOE
(Contract DE-AI04-80AL-12726)
(NASA-TM-82720; DOE/NASA/12726-14; E-1019) Avail: NTIS CSCL 10A

Redox energy storage systems developed for solar power applications and utility load leveling applications are described. The technology readiness of Redox energy storage for transfer of the technology to industry for product development and commercialization by industry is addressed. The design features of Redox systems for application to stand alone or residential storage requirements are described. Redox system designs with 3 to 10 kW power output and storage times of 6 to 250 hours are summarized and performance characteristics presented. J.M.S.

N81-32612*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INITIAL GUIDELINES AND ESTIMATES FOR A POWER SYSTEM WITH INERTIAL (FLYWHEEL) ENERGY STORAGE
Luther W. Slifer, Jr. Dec. 1980 11 p
(NASA-TM-82134) Avail: NTIS HC A02/MF A01 CSCL 10A

Goals for the flywheel system are defined in terms of efficiency train estimates and mass estimates for the system components. The inertial storage power system uses a 5 kw-hr flywheel storage component at 50 percent depth of discharge (DOD). It is capable of supporting an average load of 3 kw, including a peak load of 7.5 kw for 10 percent of the duty cycle, in low Earth orbit operation. The specific power goal for the system is 10 w/kg, consisting of a 56 w/kg (end of life) solar array, a 21.7 w-hr/kg (at 50 percent DOD) flywheel, and 43 w/kg power processing (conditioning control and distribution). T.M

N81-32614# Potomac Electric Power Co., Washington, D.C.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 4: SYSTEM PLANNING STUDIES Final Report
Apr. 1981 94 p Prepared in cooperation with Acres American, Inc., Columbia, Md.
(Contract DE-AC02-77ET-28013)
(DE81-025263; EPRI-EM-1589-Vol-4) Avail: NTIS HC A05/MF A01

Preliminary design and planning studies of water compensated compressed air energy storage (CAES) and underground pumped hydroelectric (UPH) power plants are presented. The costs of the CAES and UPH plant designs, and the results of economic evaluations performed for the PEPCO system are presented. The PEPCO system planning analysis was performed in parallel stages with plant design development. Analyses performed early in the project indicated a requirement for 1000 MW/10,000 MWH of energy storage on a daily operating schedule, with economic installation in two segments of 500 MW in 1990 and 1997. The analysis was updated eighteen months later near the end of the project to reflect the impact of new growth projections and revised plant costs. The revised results indicated economic installations for either UPH or CAES of approximately

675 MW/6750 MWH on a daily cycle, installed in blocks of approximately 225 MW in 1990, 1993 and 1995. Significant savings in revenue requirements and oil fuel over the combustion turbine alternative were identified for both CAES and UPH. DOE

N81-32623# University of Southern Illinois, Carbondale.
LONGTERM SOLAR HEAT STORAGE IN AN UNDERGROUND WATER CISTERN RETROFITTED WITH THERMAL INSULATION Final Technical Report, 15 May 1979 - 31 Mar. 1981
Walter L. Borst 18 Jun. 1981 20 p refs
(Grant DE-FG02-79R5-10106)
(DOE/R5-10106/3) Avail: NTIS HC A02/MF A01

An existing, large underground water cistern was retrofitted with urethane insulation and waterproofing to determine the feasibility of the longterm storage of solar heat and environmental coolness. The thermal characteristics of the storage, heat storage times and interactions between storage and surrounding soil were measured. A 15.3 sq m solar collector was site built to provide the desired heat for storage. The heat was transported in a closed loop to a parallel tube heat exchanger, which was positioned vertically in the cistern. The experimental approach and results for a longterm energy storage system are described. DOE

N81-32625# Department of Energy, Washington, D. C.
ENVIRONMENTAL ASSESSMENT. AQUIFER THERMAL ENERGY STORAGE PROGRAM
Jan. 1981 66 p refs
(DOE/EA-0131) Avail: NTIS HC A04/MF A01

The probable environmental consequences of developing and applying aquifer thermal energy storage were examined. The thermal energy is stored in the aquifer until needed. At recovery, the second well is pumped, and the hot (or chilled) water circulated through the heat exchanger to recapture the stored energy, and the water is returned to the aquifer through the first well. Useable thermal energy is derived from waste heat sources, cogeneration, or from climate derived sources. The thermal energy is stored during periods of low demand and retrieved for various uses. Projects under consideration are located in different regions of the United States, and will store thermal energy as hot water and chilled water. Proposed action, alternatives to the proposed action, the environment affected by the proposed action, and the potential environmental consequences of the proposed action are discussed. DOE

N81-32647# Argonne National Lab., Ill.
ANNUAL SYNOPSIS OF BATTERY SUPPORT RESEARCH, FISCAL YEAR 1980
G. M. Cook May 1981 39 p refs
(Contract W-31-109-eng-38)
(ANL/OEPM-81-3) Avail: NTIS HC A03/MF A01

The improvement of the performance of lead acid, Ni/Zn, and Ni/Fe batteries, especially those for electric vehicles or utility load leveling applications are examined. The following projects are described: lead acid and nickel/zinc battery studies, battery modeling, and analysis and evaluation projects. Summaries of work published or presented during the year are also included. DOE

N81-32654# United Technologies Corp., South Windsor, Conn. Electrical Systems Group.
ADVANCED CONVERTER TECHNOLOGY Technical Progress Report, 23 May 1979 - 22 May 1980
C. V. Banic, S. A. Eckhouse, F. J. Kornbrust, K. Lifman, J. L. Peterson, R. W. Rosati, and D. Young 1980 144 p refs
(Contract DE-AC01-79ET-29079)
(DOE/ET-29079/T1) Avail: NTIS HC A07/MF A01

An advanced converter system for use in electrochemical energy storge was defined. Improved and experimental apparatus are designed to measure these characteristics and to enable better definition of the battery power conditioner interface. Improvement of energy storage system performance through modification of battery converter characteristics is investigated. Power conditioning based on fuel cell use was evaluated. It is concluded that this high switching frequency concept has the potential for significantly reducing the size and cost of battery plant power conditioners. DOE

N81-32674# California Univ., Livermore. Lawrence Livermore Lab.
FLYWHEELS: MOBILE APPLICATIONS
David W. Rabenhorst (APL, Laurel, Md.) 17 Jun. 1981 18 p refs
(Contract W-7405-eng-48)
(DE81-026567; UCRL-15363) Avail: NTIS HC A02/MF A01

The characteristics of modern flywheel energy storage systems uniquely qualify the flywheel for use in a variety of road vehicles, off road vehicles and rail vehicles. About sixty studies and vehicle demonstration programs in a dozen countries indicate that future such flywheel powered vehicles will have improved performance, reduced energy and fuel consumption and reduced life cycle cost. Flywheel capabilities and mobile applications were reviewed. DOE

N81-33620# Argonne National Lab., Ill.
ADVANCED-BATTERY TECHNOLOGIES: WHERE ARE THEY NOW?
Neng-Ping Yao 1980 43 p refs Presented at the Ind. Chem. Session Mod. Eng. and Technol. Seminar, Taipei, Taiwan, 7-25 Jul. 1980
(Contract W-31-109-eng-38)
(CONF-8007103-1) Avail: NTIS HC A03/MF A01

Near term and advanced secondary batteries for application to electric utility load leveling, electric vehicles, and solar photovoltaic power systems are reviewed. Lead acid, iron nickel oxide, and zinc nickel oxide systems are the potential near term candidates for electric vehicle applications. In the near term EV battery program, technological progress was made in the areas of specific energy, specific power, and manufacturing engineering. Cycle life enhancement and reduction of battery cost are emphasized. In parallel to the near term battery program is the research and development of advanced batteries which have potentials of higher performance and lower cost. DOE

N81-33624# Acres American, Inc., Columbia, Md.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 9: DESIGN APPROACHES: CAES Final Report
Apr. 1981 191 p
(Contract DE-AC02-77ET-28013; EPRI Proj. 5047-9)
(DE81-027704; EPRI-EM-1589-Vol-9) Avail: NTIS HC A09/MF A01

Durin - Task 3C of the PEPCO/CAES study detailed design requirements and alternate designs were developed for the major components and systems of the CAES plant. Based upon a preliminary economic and technical evaluation, preferred designs were chosen as the basis for subsequent development in Task 5C. A summary of the project design criteria, a pressure optimization study, and the design approaches for the major plant systems which were developed are presented. The performance, operation and control capabilities of the plant and the results of the preliminary cost estimate are reported. T.M.

N81-33633# Science Applications, Inc., Palo Alto, Calif.
RELIABILITY OF MODULARIZED ENERGY STORAGE SYSTEMS Interim Report
S. L. Basin Electric Power Research Inst. Jun. 1981 209 p refs Sponsored by the Electric Power Research Inst.
(EPRI Proj. 370-17)
(DE81-903725; EPRI-EM-1890) Avail: NTIS HC A10/MF A01

The reliability of modularized electric battery energy storage systems is discussed. The measures of performance include: (1) the time to first failure of the system: (2) the time between successive system failure: (3) available capacity, and (4) the number of module replacements over the planned system lifetime. The effect of module aging, under the assumption of a family of monotone failure rate distribution, is considered. DOE

N81-33653# Department of Energy, Washington, D. C.
PROGRESS AND FORECAST IN ELECTRIC-VEHICLE BATTERIES
W. H. Webster, Jr. and N. P. Yao 1980 9 p refs Presented at Intern. Congr. on Transportation, Dearborn, Mich., 15 Sep. 1980
(Contract W-31-109-eng-38)
(DE81-023833; CONF-800939-2) Avail: NTIS HC A02/MF A01

A battery development program for near term electric vehicles

was undertaken. The program's overall objective is to develop commercially viable batteries for commuter vehicles and for vans and trucks. Three near term battery are discussed: improved lead acid, nickel/iron and nickel/zinc systems. Progress was made in improving the specific energy, specific power, and manufacturing processes of these three battery technologies. Emphasis is on reduction of manufacturing cost and enhancement of battery cycle life and reliability. The zinc chloride battery is the fourth near term battery. DOE

N81-33655# Sandia Labs., Albuquerque, N. Mex. Battery Evaluation Lab.

TESTING BATTERIES FOR PHOTOVOLTAIC POWER SYSTEMS

A. E. Verardo, P. C. Butler, D. M. Bush, and D. W. Miller 1981 10 p refs Presented at the IECEC Conf., Atlanta, 9-21 Aug. 1981

(Contract DE-AC04-76DP-00789)

(SAND-81-0226C; CONF-810812-6) Avail: NTIS HC A02/MF A01

A battery evaluation laboratory was established to investigate the application of various battery technologies for energy storage in a photovoltaic power system. The evaluation laboratory provides a controlled test environment in which batteries can be exposed to any one or all of the following: (1) long term performance testing; (2) accelerated life testing; (3) simulated photovoltaic power system operational testing. Several battery systems are being tested. A description is presented of the laboratory and the tests currently being conducted and a brief description of the battery systems under test. DOE

N81-33664# Accumulation-Fabrik A.G., Soest (West Germany). Zentrallab.

BIPOLAR LEAD ACCUMULATOR CELL WITH HIGH ENERGY DENSITY Final Report

Reiner Kiessling Bonn Bundesministerium fuer Forschung und Technologie Nov. 1980 109 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-80-115; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 22.90

In order to increase the energy density, a cellular design using light weight bipolar electrodes was studied. The reduced water consumption lowers the requirements on maintenance. The negative electrode is made of lead-plated copper. An 80 to 100 micron protecting layer of lead is sufficient because there is no anodic corrosion. Copper itself, in contact with negative active material, remains stable within the range of the usual electrochemical potentials. The alumin positive electrode requires a protecting lead layer of at least 250 microns, without pinholes or other defects, against anodic corrosion. Author (ESA)

N81-34101# California Univ., Livermore. Lawrence Livermore Lab.

FUTURE POSSIBILITIES FOR ENERGY-STORAGE AUTOMOBILES

L. G. OConnell 23 Apr. 1981 20 p refs Presented at 91st Natl. Meeting of the Am. Inst. of Chem. Engr. Detroit, 16 Aug. 1981

(Contract W-7405-eng-48)

(DE81-769416; UCRL-85902; CONF-810814-1) Avail: NTIS HC A02/MF A01

The future of energy storage devices for use in automobile propulsion systems is assessed. Future device characteristics are projected. The propulsion system is analyzed. Future energy storage automobiles were conceptually designed and compared to each other and the baseline internal combustion engine vehicle for several levels of performance. DOE

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08
GENERAL

A81-41594 Improvement of mechanical properties of Cu-Ti alloys by new process. Y. Nishi, H. Aoyagi, T. Suzuki, and E. Yajima (Tokai University, Hiratsuka, Kanagawa, Japan). In: Titanium '80 science and technology; Proceedings of the Fourth International Conference on Titanium, Kyoto, Japan, May 19-22, 1980. Volume 2. Warrendale, PA, Metallurgical Society of AIME, 1980, p. 1419-1425. 6 refs.

A new process is proposed for producing Cu-Ti spring alloys. The new process, which involves quenching from the liquid state, makes it possible to directly obtain supersaturated crystal solid solution without many energy-consuming pretreatments (solution treatment, cold working, and prolonged aging now used in the commercial process. The maximum hardness obtainable with the new process is equal to that of cold-worked (20%) Cu-5 at % Ti alloys. With an additional 10 at % Ti, the maximum hardness equals that of an alloy cold-worked to a 50% reduction. The most important advantage of the new process is shortened aging for maximum hardness. V.L.

A81-41647 From sponge to powder alternatives in titanium processing. R. Ruthardt, H. Stephan, and W. Dietrich (Leybold-Haraeus GmbH, Hanau, West Germany). In: Titanium '80 science and technology; Proceedings of the Fourth International Conference on Titanium, Kyoto, Japan, May 19-22, 1980. Volume 3. Warrendale, PA, Metallurgical Society of AIME, 1980, p. 2289-2299.

Alternative techniques for the production of titanium ingots and powder from raw material ingots, sponge, powder or scrap are examined in light of the material requirements for high-efficiency aircraft gas turbine engines. Attention is given to vacuum arc and electron beam melting methods for the production of titanium ingots, and methods for titanium powder production from the melt which combine melting techniques such as arc, plasma or electron beam melting with means for melt disintegration generally based on centrifugal forces. The environmental cleanliness of the various processes is discussed, and cost considerations in the development of powder production equipment are addressed. A.L.W.

A81-42685 Determination of kinetic parameters of combustion processes using optical detection techniques. J. A. Silver (Aerodyne Research, Inc., Bedford, MA). *Optical Engineering*, vol. 20, July-Aug. 1981, p. 540-545. 28 refs. Contract No. ET-78-C-01-3183.

A high-temperature fast flow reactor has been used in conjunction with resonance lamp and laser-induced fluorescence to obtain reaction rates and identify different product channels for the purpose of elucidating the thermal deNOx chemical mechanisms. Experimental data are then used to develop a comprehensive computer model which describes the features of the NHi/NOx chemical system. V.L.

A81-43701 SOUTHEASTCON '80; Proceedings of the Region 3 Conference and Exhibit, Nashville, TN, April 13-16, 1980. Conference and Exhibit sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 378 p. Members, $18.75; nonmembers, $25.

Topics discussed include microelectronics, radar command and control, system theory, antennas, solar technology, signal processing, millimeter and submillimeter wave techniques, and digital system design. Also considered are communications, network theory, bit-slice processors, simulation and aerospace systems, microwave theory and techniques, biomedical engineering, energy technology, applied physics, and computer design and verification. B.J.

A81-44626 Space - Enhancing technological leadership; Proceedings of the Twenty-seventh Annual Meeting, Boston, MA, October 20-23, 1980. Conference sponsored by AAS, AIAA, Avco Corp., et al. Edited by L. P. Greene (U.S. Department of Transportation, Transportation Systems Center, Cambridge, MA). San Diego, CA, American Astronautical Society (Advances in the Astronautical Sciences. Volume 44); Univelt, Inc., 1981. 627 p. $65.

Papers on systems and technology research are presented, and include such general topics as communication and navigation, solar energy, meteorology, earth resources, materials processing in space, space transportation, and defense applications. Special attention is given to the NAVSTAR Global Positioning System, space manufacturing for the Solar Power Satellites, bridge and spider-web type structures in space, and the Space Shuttle. K.S.

A81-44631 Man's role in space - The far potential. H. L. Mayer (Aerospace Corp., El Segundo, CA). In: Space - Enhancing technological leadership; Proceedings of the Twenty-seventh Annual Meeting, Boston, MA, October 20-23, 1980. San Diego, CA, American Astronautical Society; Univelt, Inc., 1981, p. 263-278. (AAS 80-229)

The optimum role of man in space is discussed in view of future space macro-engineering projects which will necessitate direct human interference in space. Four examples of the macro-projects are presented, and man's potential contributions to them are examined in detail. In the worldwide, multipurpose, microwave-laser communication system, man would be useful in the deployment or assembly of the microwave antennas on orbit, in the initial adjustment of system components, in their maintenance, repair, and periodic replacement. A system for the disposal of the 1-100 year nuclides in low earth orbit is described, and it is shown that the essential role for man in this system stems from the potential danger of radioactive waste disposal. For the space solar power station, man's presence is necessitated by the size of the industrial structure. Man will be needed for monitoring, correcting the mistakes, and repairing and replacing the automata on the Soletta. Man's role in space, based on his economic value to all the projected programs, is discussed. K.S.

A81-44663 * # Synergistic erosion/corrosion of superalloys in PFB coal combustor effluent. S. M. Benford, G. R. Zellars, and C. E. Lowell (NASA, Lewis Research Center, Cleveland, OH). *American Ceramic Society, Annual Meeting, 82nd, Chicago, IL, Apr. 28-30, 1980, Paper.* 25 p. 13 refs.

Two Ni-based superalloys were exposed to the high velocity effluent of a pressurized fluidized bed coal combustor (PFBC). Targets were 15-cm diameter rotors operating at 40,000 rpm and small flat plate specimens. Above an erosion rate threshold (approximately 10 microns/hr), the targets were eroded to bare metal. The presence of accelerated oxidation at lower erosion rates suggests erosion/corrosion synergism. Various mechanisms which may contribute to the observed oxide growth enhancement include erosive removal of protective oxide layers, oxide and subsurface cracking, and chemical interaction with sulfur in the gas and deposits through damaged surface layers. (Author)

A81-44676 SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Conference and Exhibit sponsored by the Institute of Electrical and Electronics Engineers. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981. 934 p. Members, $36.; nonmembers, $48.

The subjects discussed are related to microelectronics, radar systems, power systems, systems theory, bio-engineering, pattern recognition, electromagnetics, Kalman filtering, communications, computer systems, digital signal processing, software engineering, multiprocessor systems, digital filters, computerized speech systems, the automation of power distribution systems, aerospace applications, pattern recognition applications, education, energy systems, antennas, filters applications, electronic devices, power applications, missile image processing applications, devices, instrumentation, new sensor systems, modeling and simulation, environmental aspects, military applications, microprocessor systems design aids, control systems, communication systems, computer aided design, avionics, coding, microprocessor applications, and propagation and scattering. Attention is given to a high-g plastic gyro with wide-angle radiant energy pickoffs, an autonomous, fast-reaction strapdown inertial navigation system, a land navigation system with a precision azimuth and elevation, avionics integrated support facility developments, an

interconnection system for spacecraft distributed control and data collection, an analysis of a new inertial measuring system for aerospace vehicles, and an aircraft landing system employing observers. G.R.

A81-48326 **Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings.** Conference sponsored by AGU, AIAA, AMS, BMES, IMACS, IEEE, ISA, SCS, and S.H.A.R.E. Arlington, VA, AFIPS Press, 1980. 771 p. $40.

Topics examined include computer hardware, software, and systems; modeling methodology; validation and verification; graphics; socioeconomic models; simulation and training; dynamic systems; management sciences; and the application of computer models in energy and resource utilization, transportation, and biological, medical, and ecological systems. Particular consideration is given to an integrated compartment method for the numerical solution of Navier-Stokes equations, an artificial intelligence approach to large-scale simulation, the evolution of real-time digital simulation of aircraft for training applications, time delays in flight simulator visual displays, and the determination of cargo container inventories through logistics simulation. B.J.

A81-48916 **High temperature corrosion in energy systems.** R. A. Rapp (Ohio State University, Columbus, OH), J. H. Devan (Oak Ridge National Laboratory, Oak Ridge, TN), D. L. Douglass (California, University, Los Angeles, CA), P. C. Nordine (Yale University, New Haven, CT), F. S. Pettit (Pittsburgh, University, Pittsburgh, PA), and D. P. Whittle (California, University, Berkeley, CA). *Materials Science and Engineering*, vol. 50, Sept. 1981, p. 1-17. 36 refs. Contract No. DE-AS02-76ER-01198.

High temperature corrosion in energy systems is considered, focusing on specific corrosion problems critical to each group of energy systems, i.e., nuclear, solar, coal combustion and conversion, and oil and gas recovery. Recommendations are made for basic fundamental research in direct support of the known corrosion problems in specific energy systems, and include: (1) a study of the effects of several trace gaseous impurities (particularly chlorine) on the growth and damaging of protective oxide scales, and on the degradation of alloy mechanical properties; (2) high resolution in situ scanning electron microscopy for clarifying uncertain scale growth mechanisms; (3) an examination of the effect of solid deposits, either reactive or relatively inert, on gas-alloy attack; (4) electrochemical studies of alloy corrosion in deep salt melts or slags, where the gaseous environment is remote from the alloy surface; and (5) a study of the influences of temperature gradients and heat fluxes on material compatibility, redistribution of chemical components, and properties of corrosion product layers. K.S.

N81-29027*# California Inst. of Tech., Pasadena.
PUBLICATIONS OF THE JET PROPULSION LABORATORY 1980
15 Jul. 1981 32 p
(NASA-CR-164636; JPL-Bibl-39-22) Avail: NTIS HC A03/MF A01 CSCL 05B

The Bibliography cites 385 externaly distributed technical reports, released during calendar year 1980, that resulted from scientific and engineering work performed, or managed, by the Jet Propulsion Laboratory. Three classes of publications are included: (1) JPL Publications (77-, 78-, 79-series, etc.); (2) articles published in the open literature; and (3) articles from the biomonthly Deep Space Network (DSN) Progress Report (42 series) and its successor, the Telecommunications and Data acquisition (TDA) Progress Report (also 42-series). The citations are listed alphabetically by primary author. A.R.H.

N81-29063*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AEROSPACE IN THE FUTURE
John F. McCarthy, Jr. May 1980 34 p Presented at CECON, Cleveland, 20-21 May 1980
(NASA-TM-82664; E-575) Avail: NTIS HC A03/MF A01 CSCL 05A

National research and technology trends are introduced in the environment of accelerating change. NASA and the federal budget are discussed. The U.S. energy dependence on foreign oil, the increasing oil costs, and the U.S. petroleum use by class are presented. The $10 billion aerospace industry positive contribution to the U.S. balance of trade of 1979 is given as an indicator of the positive contribution of NASA in research to industry. The research work of the NASA Lewis Research Center in the areas of space, aeronautics, and energy is discussed as a team effort of government, the areas of space, aeronautics, and energy is discussed as a team effort of government, industry, universities, and business to maintain U.S. world leadership in advanced technology. A.R.H.

N81-29064# National Bureau of Standards, Washington, D.C.
NBS DIMENSIONS, VOLUME 64, NO. 10 Monthly Report
Dec. 1980 37 p
(PB81-170276; NBS-DIM-64-10) Avail: NTIS HC A03/MF A01 CSCL 14B

Summaries of major technical developments, highlights of work in progress, major speeches and statements by Bureau management, and a listing of NBS publications are presented. Contents for this issue are: An Effective National Program, M. Baum; Southern Exposure (passive solar technology), G. Metz; Arson Sniffers (portable vapor detectors), E. Rudin; Neutron Radiography Used forInspecting Jet Engines, G. Porter; Tracealloy Standard Issued, SRM; Activities in Wood-Heating Safety, R. Peacock, and Fluidic Temperature Sensors, T. Negas. GRA

N81-29582# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY AND TECHNOLOGY REVIEW
May 1981 43 p refs
(Contract W-7405-eng-48)
(UCRL-52000-81-5) Avail: NTIS HC A03/MF A01

Research programs are reviewed. Validation of the pulsed power design for FXR (flash X-ray machine) the NOVA plasma shutter, thermal control of the MFTF (mirror fusion test facility) superconducting magnet, a low energy X-ray spectrometer for pulsed source diagnostis, micromachining, the electronics engineer's design station, and brazing with a laser microtorch is discussed. DOE

N81-31038*# University of Southern California, Los Angeles. NASA Industrial Application Center.
ADVANCED TECHNOLOGY DISPLAY HOUSE. VOLUME 4: BIBLIOGRAPHY
D. H. Maund [1981] 44 p 4 Vol.
(Contract NAS2-10794)
(NASA-CR-166238-Vol-4; DRB-320-Vol-4) Avail: NTIS HC A03/MF A01 CSCL 13B

A bibliography is presented for the Advanced Technology Display House. Information sources used in generating the design concepts studied are included. S.F.

N81-31672# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
[ACTIVITIES REPORT ON AEROSPACE AND ENERGY RESEARCH] Annual Report, 1979 [JAHRESBERICHT 1979]
1980 165 p refs In GERMAN Original contains color illustrations
Avail: NTIS HC A08/MF A01

Research in the following areas is described: (1) transport and communication systems; (2) aircraft; (3) space flight techniques; (4) exploration techniques; (5) energy and drilling technology. Research facilities are described, inculding the German-Dutch wind tunnel, the European transonic cryogenic wind tunnel, and the Spacelab simulator. Author (ESA)

N81-31910# Sheffield Univ. (England). Dept. of Control Engineering.
CASE STUDIES IN COMPUTER CONTROL
J. B. Edwards Mar. 1981 78 p refs
(RR-145) Avail: NTIS HC A05/MF A01

The computer control of three different processes is investigated. These processes are longwall coal cutting, electric vehicle testing, and a pilot distillation column. Analytical process modelling, control theory and computer control strategies are investigated from the systems engineering viewpoint. Test procedures, safety aspects and specifications for hardware and software components are discussed. The benefits to be derived are considerably greater than in ordinary applications of computer control. It is also claimed that those processes cannot operate efficiently without computer control. Author (ESA)

N81-32086*# Denver Research Inst., Colo. Program for Transfer Research and Impact Studies.

SPACE BENEFITS: THE SECONDARY APPLICATION OF AEROSPACE TECHNOLOGY IN OTHER SECTORS OF THE ECONOMY

[1981] 240 p refs

(Contract NASw-3113)

(NASA-CR-164733) Avail: NTIS HC A11/MF A01 CSCL 05A

Some 585 examples of the beneficial use of NASA aerospace technology by public and private organizations are described to demonstrate the effects of mission-oriented programs on technological progress in the United States. General observations regarding technology transfer activity are presented. Benefit cases are listed in 20 categories along with pertinent information such as communication link with NASA; the DRI transfer example file number; and individual case numbers associated with the technology and examples used; and the date of the latest contract with user organizations. Subject, organization, geographic, and field center indexes are included. A.R.H.

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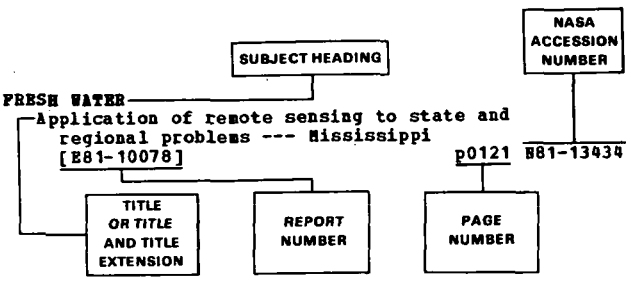

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E

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EFFICIENCY

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SYSTEMS COMPATIBILITY

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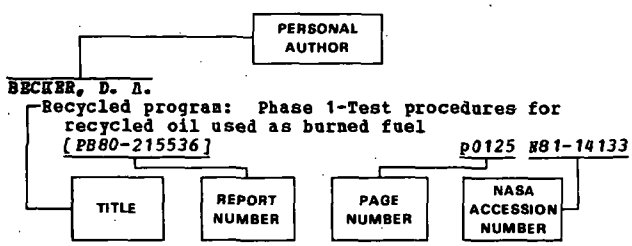

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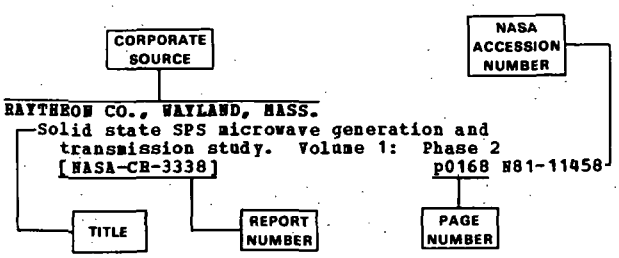

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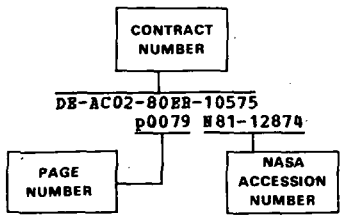
Typical Contract Number Index Listing



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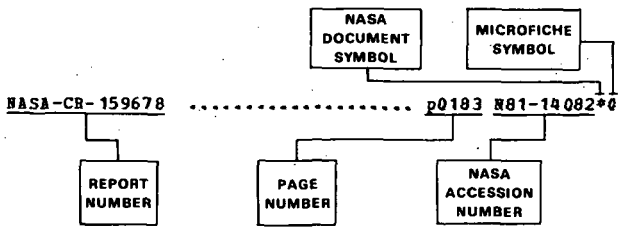

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*U.S. GOVERNMENT PRINTING OFFICE: 1982 539-007/4 1-3

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NASA SP-7043(32)		

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