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ENERGY

A Continuing Bibliography

With Indexes

Issue 19

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 July 1 through September 30, 1978 in

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



Scientific and Technical Information Branch

1978

National Aeronautics and Space Administration

Washington, DC

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(19)) lists 1339 reports, journal articles, and other documents announced between July 1, 1978 and September 30, 1978 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974 and succeeding issues are published quarterly.

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

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

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

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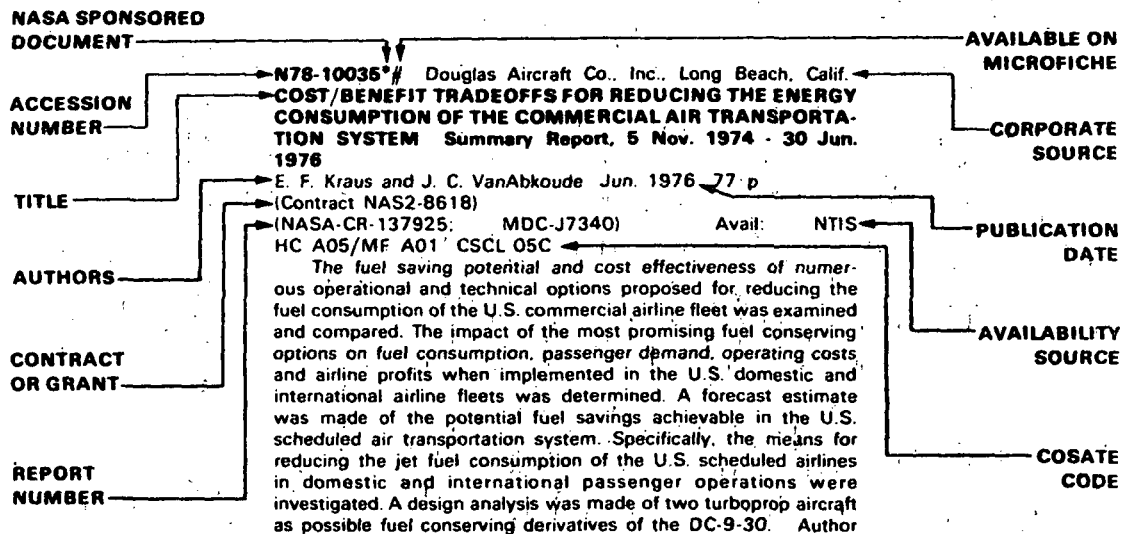
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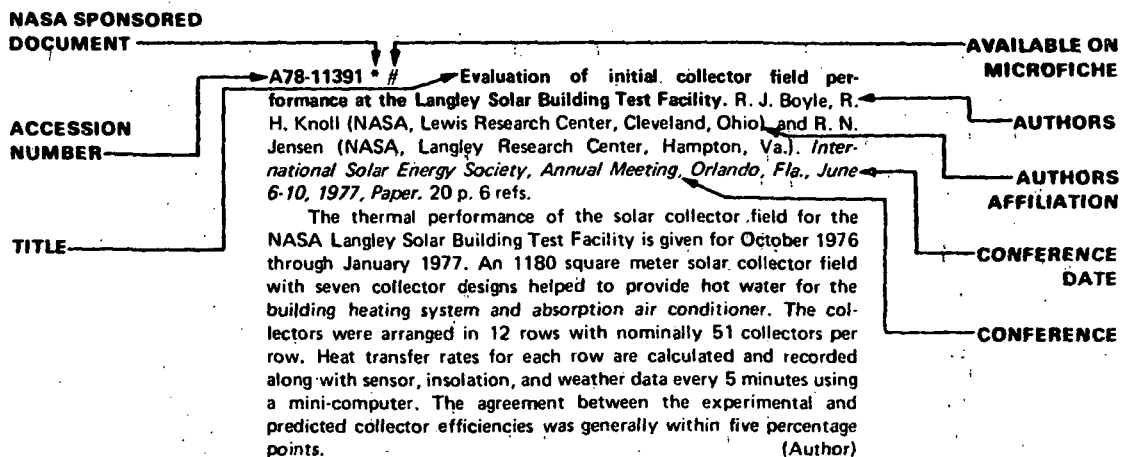
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TYPICAL CITATION AND ABSTRACT FROM IAA



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IAA ENTRIES

A78-32533 # **Energy's challenge to aerospace.** R. C. Seamans, Jr. (MIT, Cambridge, Mass.) and F. I. Ordway (U.S. Department of Energy, Office of the Assistant Secretary for Policy and Evaluation, Washington, D.C.). *Journal of Energy*, vol. 2, Mar.-Apr. 1978, p. 65-70. 16 refs.

The role of the U.S. aerospace industry in contributing to national energy conservation programs and developing alternative energy sources is discussed. Relatively poor returns on investment during the last decade give the aerospace industry an incentive to diversify by entering the field of energy technology, an area in which it possesses much expertise. The size of the energy technology market is attractive, and the economic incentives to developing fuel conservation methodology are also strong. Obstacles to the penetration of the aerospace industry into the energy market are also considered. J.M.B.

A78-32534 # **Some contributions to aerodynamic theory for vertical-axis wind turbines.** H. Ashley (Stanford University, Stanford, Calif.). *Journal of Energy*, vol. 2, Mar.-Apr. 1978, p. 113-119. 27 refs. Grant No. AF-AFOSR-74-2712.

A review and modest extensions are described of quasi-steady aerodynamic theory for performance prediction on Darrieus-type turbines. Results are given for both parallel-axis and curved-blade configurations. Blade stall and variable inflow are neglected; it is hypothesized that unsteady effects support the former approximation down to lower values of tip-speed ratio than hitherto believed. Both profile and induced drag are included, and their influences on power and downwind force are expressed in terms of elliptic integrals. Comparisons are presented with power data from the Sandia 2-m turbine. Three values of profile drag coefficient are employed, and it is argued that numbers in the range of 0.015-0.017 are most appropriate to the example chosen. Finally, a linearized analysis of unsteady flow effects on performance is summarized. Calculations suggest that they may be quite large, considering the low operating reduced frequencies of these machines. (Author)

A78-32535 # **Gulf Stream OTEC resource potential.** W. R. McCluney and L. D. Sivak (Florida Solar Energy Center, Cape Canaveral, Fla.). *Journal of Energy*, vol. 2, Mar.-Apr. 1978, p. 120-122.

Florida Current oceanographic parameters are analyzed in a study of the feasibility of Ocean Thermal Energy Conversion (OTEC) plants located near the coast of Florida. Both the temperature differential and the mean flow required for an OTEC power installation are provided by the Current, which is also conveniently near a large-scale electric power network in the Southeastern U.S. Available heat flux in the Current is analyzed, and calculations for the parasitic power needed to pump sea water and ammonia (the heat transfer fluid for the power plant) are performed. These preliminary computations indicate that the large thermal resource potential of the Current may offer an excellent site for OTEC plants. J.M.B.

A78-32536 # **Aerodynamic characteristics of a cylindrical type of wind turbine with inclined blades.** B. H. L. Gowda and N. V. C. Swamy (Indian Institute of Technology, Madras, India). *Journal of Energy*, vol. 2, Mar.-Apr. 1978, p. 122-124. 11 refs.

An aerodynamic analysis is presented for a Darrieus wind turbine having straight blades provided with inclined portions at their top and bottom ends. The inclined portions are added to the blades in order to make guy-wire support for the windmill feasible. Application of the propeller theory of Glauert to the aerodynamic analysis shows the advantage of the cylindrical wind turbine with inclined blade segments at the ends. Adjustments to blade orientation and curvature are also suggested. J.M.B.

A78-32570 **Heat exchange in an MHD channel with allowance for the ion slippage.** M. L. Mittal and A. N. Bhat (Indian Institute of Technology, Bombay, India). (*Teplofizika Vysokikh Temperatur*, vol. 15, July-Aug. 1977, p. 852-865.) *High Temperature*, vol. 15, no. 4, Jan. 1978, p. 719-729. 13 refs. Translation.

In the present paper, the influence of ion slip on the steady-state heat transfer in an MHD channel with a constant wall temperature is analyzed. Numerical values of the heat transfer coefficient are obtained for various values of some characteristic MHD-generator parameters. It is shown that ion slip leads to changes in the temperature distribution and to a decrease in the mean mass temperature and local Nusselt number. V.P.

A78-32572 **Efficiency of a Faraday MHDG in a scheme with a thermonuclear reactor.** V. V. Breev, V. P. Panchenko, and V. V. Chernukha (Akademii Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). (*Teplofizika Vysokikh Temperatur*, vol. 15, July-Aug. 1977, p. 879-887.) *High Temperature*, vol. 15, no. 4, Jan. 1978, p. 741-748. 12 refs. Translation.

The use of a Faraday MHD generator as a converter of thermonuclear to electric energy is discussed. A quasi-one-dimensional method for calculating such generators is proposed, and supersonic MHD-generators operating with water, argon, and helium (with potassium and lithium additions) are examined. Some aspects of obtaining maximum efficiency in the case of a generator operating with an equilibrium plasma are studied. V.P.

A78-32575 **Stability of nonequilibrium plasma.** R. V. Vasil'eva, A. V. Erofeev, and V. A. Shingarkina (Akademii Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). (*Teplofizika Vysokikh Temperatur*, vol. 15, July-Aug. 1977, p. 901-904.) *High Temperature*, vol. 15, no. 4, Jan. 1978, p. 761-764. 6 refs. Translation.

The quasi-uniform interaction between a magnetic field and a thermally ionized gas flow is a problem requiring attention in the design of MHD generators employing a nonequilibrium plasma with alkali metal additions as the working medium. The shock-tube experiments described in the present paper were carried out to study the interaction between a thermally ionized plasma flow and a magnetic field, with the object of determining the characteristics of the plasma state and the critical conditions for the onset of ionization instability. At the same time, the results obtained verify certain analytical data concerning the conditions for the existence of a stable nonequilibrium weakly ionized plasma. V.P.

A78-32650 **The technology of closed-cycle gas turbines (Technologie des turbines à gaz en circuit fermé).** H. Griepentrog (Gutehoffnungshütte Sterkrade Oberhausen, West Germany). *Entropie*, vol. 14, Jan.-Feb. 1978, p. 18-28. 11 refs. In French. (Translation).

The development of a 50 MWe closed-cycle helium turbine engine, put into operation in 1975, is described. The turbomachinery and heat exchangers adopted for the closed-cycle helium turbine are discussed, and the influence of the type of gas used on the capital investment required for the turbine is assessed. Applications of closed-cycle turbine design to the combustion of pulverized coal or methane are also mentioned, and the possibility of using closed-cycle turbines in solar energy systems is considered. J.M.B.

A78-32652 The electric way ahead for road transport. A. Aldous (Electric Vehicle Development Group Committee, London, England). *Electronics and Power*, vol. 24, Apr. 1978, p. 289-292. 7 refs.

Studies conducted in Britain by the Electric Vehicle Development Group (EVDG) indicate that the widespread use of electric automobiles for personal and commercial use is feasible and even likely by the turn of the century. It is noted that electric vehicles cause far less pollution (via the chimneys of power stations) than do internal combustion engines, and it is further pointed out that by the first decades of the 21st century the only fuels available for vehicular use will be either synthetic fuels derived from coal, or electricity. Small commercial vehicles in operating in London are discussed as an illustration of the requirements of electric vehicles, and of the present state of the art, i.e., a range of approximately 100 km with speeds between 65 and 95 km/h and a weight limit of 16 t.

A78-32653 Technical alternatives for a maglev system. W. Leonhard (Braunschweig, Technische Universität, Braunschweig, West Germany). *Electronics and Power*, vol. 24, Apr. 1978, p. 293-296. Translation.

Two systems for the lift, guidance, and propulsion of magnetically levitated trains are compared: the electromagnetic levitation system (EMS) and the electrodynamic levitation system (EDS). In development, EDS lags approximately two years behind EMS, because of its later start. It is noted that the power requirement of both systems is around 1200 MW, that maximum gradients would be in the neighborhood of 3.5%, and that both systems are capable of speeds in the 400-500 km/h range. The chief advantage of the EMS (both long- and short-stator modes) is that lift and guidance are independent of velocity, i.e., there is virtually no risk of derailment, and that the operating parameters of all system components are already known. Advantages of EDS lie in its large airgap, which decreases the danger from snow and ice formation, and in its weak suspension characteristics, which produce low dynamic loading on the guideway. D.M.W.

A78-32675 Air vs O₂ - Two activated sludge systems compared. M. A. Miller (Union Carbide Corp., Tonawanda, N.Y.). *Water and Wastes Engineering*, vol. 15, Apr. 1978, p. 58-60, 62-65. 17 refs.

Characteristics of pure oxygen activated sludge systems and conventional air activated sludge systems are compared, and advantages of the pure oxygen systems are described. Differences between the two systems are explained. Factors considered include sludge quality, sludge quantity, energy input, dewatering, and the effect of levels of dissolved oxygen on biofloc. A cost comparison of the sludge handling systems is presented. M.L.

A78-32691 On the fill factor of solar cells. D. L. Pulfrey (British Columbia, University, Vancouver, Canada). *Solid-State Electronics*, vol. 21, Mar. 1978, p. 519, 520. 9 refs. Research supported by the National Research Council of Canada.

The calculations presented indicate that, for a given series resistance, the fill factor of a solar cell is principally determined by the saturation dark current rather than the diode factor. The fill factor is a measure of the 'sharpness of the knee' in the output

current-voltage curve and is defined as the ratio of the maximum power that can be delivered by a cell to the product of its short-circuit photocurrent and open-circuit voltage. It is concluded that for satisfactory operation of silicon solar cells at greater than 100 Suns (achieved by sunlight concentrators) series resistance values of a few hundredths of an ohm are required. M.L.

A78-32693 Junction potentials of strongly illuminated $n^{+}/p-p^{+}/n^{+}$ solar cells. A. G. Sabnis (Pittsburgh, University, Pittsburgh, Pa.). *Solid-State Electronics*, vol. 21, Mar. 1978, p. 581-587. 18 refs.

The low-high junction (LHJ) model is applied to an $n^{+}/p-p^{+}/n^{+}$ solar cell having finite dimensions, in order to investigate its performance under intense illumination. Ambipolar transport equations are solved in the three sections of the cell using appropriate boundary conditions. Expressions for junction currents are derived, and the junction potentials under open-circuit conditions are computed by the Newton-Raphson method. The theory presented here includes the effects of high level injection. The generalized current density equations which are derived here for an $n^{+}/p-p^{+}/n^{+}$ device are shown to reduce to the ideal Shockley diode equation with appropriate modifications. The effects of $p-p^{+}$ low-high junction on the open-circuit voltage of the cell are explained. The theoretical results of this paper are consistent with the experimental results of others. (Author)

A78-32695 An integral equation method to calculate the transient behaviour of a photovoltaic solar cell. G. De Mey (Gent, Rijksuniversiteit, Ghent, Belgium). *Solid-State Electronics*, vol. 21, Mar. 1978, p. 595, 596. 9 refs.

The integral equation technique is used to study the time-dependent behavior of the minority carrier concentration in a solar cell irradiated by unit step illumination. By means of the abrupt depletion approximation, a linear equation describing the diffusion and the recombination of the minority carriers is obtained. The equation and the appropriate boundary conditions can easily be transformed into an equivalent Volterra integral equation. When a problem is solved numerically, the replacement of the original two-dimensional equation by an equivalent one-dimensional integral equation reduces computation time and storage requirements. The integral equation method was applied to a p^{+}/n junction solar cell, and the transient short circuit current was compared to the analytical solution. M.L.

A78-32707 # 'Local' breakdown criterion for a highly ionized gas stream (K voprosu o 'lokal'nom' kriterii probnoia v potoke sil'noionizovannogo gaza). Iu. A. Nikuev (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 16, Jan.-Feb. 1978, p. 54-58. 23 refs. In Russian.

Liubimov (1973) has proposed a semiempirical criterion expression for breakdown in an ionized gas flow, the physical meaning of which is that breakdown will occur when the energy imparted to an electron over the mean free path exceeds the ionization energy of a given gas. In the present paper, a modification of Liubimov's criterion, termed the local breakdown criterion, is analyzed and shown to provide better agreement with experimental data on electrical discharges between two cold electrodes in a streaming ionized gas in the presence of an external magnetic field. V.P.

A78-32715 # Investigation of combustion stability in an MHD-generator combustion chamber (Issledovanie ustoiichivosti goreniia v kamere sgoraniia MGD-generatora). A. I. Bystryi, R. V. Ganefel'd, V. G. Davydovskii, Ia. S. Zholubov, and M. M. Nekhamin (Akademiia Nauk Ukrainskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR). *Teplofizika Vysokikh Temperatur*, vol. 16, Jan.-Feb. 1978, p. 143-147. 8 refs. In Russian.

The possibility was studied of obtaining stable combustion in a chamber with a thermal power between 10 and 20 MW under conditions of premixing natural gas with oxygen-enriched air. The working temperature of the combustion products was between 2800 and 2900 K, the chamber efficiency was 97 to 98 percent, the dwell time was 15 msec, and the pressure pulsations were 1 to 3 percent of the total pressure. The influence of the excess air ratio on combustion stability was studied. It is shown that the tendency to instability decreases with increasing percentage of oxygen-enrichment and the associated increase in combustion rate. V.P.

A78-32716 # The U-25B MHD-facility intended for research in strong electric and magnetic fields (MGD-ustanovka U-25B dlia provedeniia issledovaniia v usloviakh sil'nykh elektricheskikh i magnitnykh polei). V. A. Kirillin, A. E. Sheindlin, V. I. Maksimenko, S. A. Pashkov, D. S. Pinkhasik, S. I. Pishchikov, N. P. Privalov, V. D. Semenov, V. S. Sidorov, and Iu. D. Sokirko (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 16, Jan.-Feb. 1978, p. 148-159. 5 refs. In Russian.

The MHD electrical power generating system described in the present paper was developed for use in a Soviet-USA research program to be conducted during 1978 through 1982 to study such aspects of MHD electric power plants as long-term operation of circuit elements at high electric potentials; optimal designing of MHD elements for operation at electric fields as high as 3.5 kV/m, high current densities, and high Hall voltages; the characteristics of superconducting magnetic systems capable of inducing magnetic fields in excess of 5 tesla, etc. The block diagram of the generator and the design of the principal elements and subsystems are discussed. V.P.

A78-32717 # The MHD generator channel No. 1 of the U-25B facility intended for research in strong electric and magnetic fields (Kanal No. 1 MGD-generatora ustanovki U-25B dlia provedeniia issledovaniia v sil'nykh elektricheskikh i magnitnykh poliax). A. V. Karpukhin, V. I. Maksimenko, S. A. Pashkov, V. D. Semenov, and Iu. N. Sokolov (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 16, Jan.-Feb. 1978, p. 160-167. 8 refs. In Russian.

The MHD channel discussed uses the combustion products of natural gas and 60-wt% oxygen-enriched air as the working medium; with additional injection of cold air in front of the combustion chamber, and alkali metal additions in the form of aqueous solutions of potassium or cesium salts in amounts of up to 1.5 mol%. The maximum stagnation pressure at the channel inlet is 3.5 atm abs; the stagnation temperature at the inlet is 2750 K at 40% O₂-enrichment, and 3000 K at 60% O₂-enrichment; the stagnation pressure at the outlet is 0.8 to 1.0 atm abs, depending on the mode of exhaust-fan operation and the amount of air inflow behind the diffuser. The design of the MHD channel is illustrated, and its characteristic features are discussed. V.P.

A78-32718 # Study of a collisional plasma rotating between two cylinders (Issledovanie stolknovitel'noi plazmy, vrashchaisheisia mezhdu dvumia tsilindrami). V. Thiagarajan and V. K. Rohatgi (Bhabha Atomic Research Centre, Bombay, India). *Teplofizika Vysokikh Temperatur*, vol. 16, Jan.-Feb. 1978, p. 168-177. 9 refs. In Russian.

In the present paper, the two-fluid MHD equations are applied to the analysis of an argon plasma which rotates between two coaxial cylindrical electrodes in crossed electric and magnetic fields. The plasma is generated by a diffuse discharge; i.e., under conditions where charge transfer occurs over the entire gap. The steady velocity and density distributions at a pressure of 33 mm Hg are obtained from a numerical solution of the dimensionless equations. It is shown that the centrifugal force is negligible, whereas the Coriolis force and the electron pressure gradient should be taken into consideration. In the case of an inward directed radial current, gas motion may reverse in the gap. V.P.

A78-32761 # Solar-powered global aerospace transportation. L. N. Myrabo (W. J. Schafer Associates, Inc., Wakefield, Mass.). *American Institute of Aeronautics and Astronautics and Deutsche Gesellschaft für Luft- und Raumfahrt, International Electric Propulsion Conference, 13th, San Diego, Calif., Apr. 25-27, 1978, AIAA Paper 78-689*. 30 p. 76 refs.

Basic foundations are suggested for a laser-powered aircraft/shuttle technology designed for compatibility with future orbital energy-common-carriers: e.g., geostationary satellite solar power stations, space colonies and other space-based industries which will have large centralized electric (and/or laser) power plants. A systems methodology for integrating the various engine/optics/airframe requirements is introduced. Several variable-cycle engine configurations are described including External and Internal Laser-Heated (ELH and ILH, respectively) pulsejets, rotary ILH pulsejets and MHD-augmented pulsejets. System tradeoff requirements between efficient engine coupling, minimum propagation losses and maximum overall mission performance are analytically addressed. (Author)

A78-32762 # A scheme of low powered thermal energy conversion for satellite manoeuvres. R. Holdaway (Science Research Council, Appleton Laboratory, Slough, Bucks, England). *American Institute of Aeronautics and Astronautics and Deutsche Gesellschaft für Luft- und Raumfahrt, International Electric Propulsion Conference, 13th, San Diego, Calif., Apr. 25-27, 1978, AIAA Paper 78-690*. 9 p. 8 refs.

The low powered thermal energy converter operates on a closed Brayton Cycle and consists of a high efficiency cavity solar boiler heated directly from a concentrator, a compressor and two stage turbine, and a radiator. A generator driven by the turbine provides electrical power for the main propulsion system. The design concept is investigated and suitable thrusters, system efficiencies and parameters are defined and quantified. The system proposed is ideally suited to the emplacement of large geosynchronous satellites, and the advantages of a solar tug incorporating the thermal energy converter are outlined. (Author)

A78-32765 * # Self-powered electric propulsion of satellite power systems. J. B. Weddell, W. V. McRae, and S. T. Cerri (Rockwell International Corp., Space Div., Downey, Calif.). *American Institute of Aeronautics and Astronautics and Deutsche Gesellschaft für Luft- und Raumfahrt, International Electric Propulsion Conference, 13th, San Diego, Calif., Apr. 25-27, 1978, AIAA Paper 78-694*. 10 p. 9 refs. Research supported by the Rockwell International Corp.; Contract No. NAS8-42375.

Electric propulsion using argon ion bombardment thrusters is described as a means of transferring solar power satellites from low earth orbit (LEO) to geosynchronous equatorial orbit (GEO). A portion of the satellite GaAs solar array is constructed in LEO and provides power for ascent propulsion; the remainder of the array is constructed in GEO. The electric propulsion system is returned to LEO by detaching a section of the solar array. Alternatively, an autonomous electric propulsion vehicle is assembled in LEO and transports power satellite materials to a GEO construction site. Maximum thrust per thruster and minimum argon consumption are achieved at specific impulse (Isp) 13,000 s. The thrust/power relationship leads to minimum transportation vehicle mass, including the solar array, at Isp 9,000 s. Thruster screen, accel, and discharge supplies are obtained directly from the solar array. (Author)

A78-32833 Two-dimensional analysis of diagonal MHD generator via equivalent circuit. M. Yoshida and J. Umoto (Kyoto University, Kyoto, Japan). *Electrical Engineering in Japan*, vol. 97, Mar.-Apr. 1977, p. 1-7. 18 refs. Translation.

A technique involving two types of equivalent circuits is proposed for the two-dimensional analysis of diagonal MHD generators; the technique may be applied to both Faraday and Hall generators if electrode tilt angles, electrode connection and load connection are appropriately modified. The two-dimensional analysis includes consideration of the wall leakage current, ion slip and the

electrode finite segmentation effect. The effect of boundary layer thickness on the generation characteristics is also assessed. J.M.B.

A78-32883 # Advanced lightweight solar array technology. L. G. Chidester (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). In: Communications Satellite Systems Conference, 7th, San Diego, Calif., April 24-27, 1978, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 55-60. 5 refs. (AIAA 78-533)

The paper discusses large-area, lightweight, flexible-substrate solar-array technologies applicable to future communication satellites and considers advances expected in the field. Intelsat V will introduce a new generation of communication satellites that incorporate three-axis body stabilization and sun-oriented solar arrays. The new technology would increase solar array specific power from 20 W/kg to 50-60 W/kg. When applied to the Space Transportation System, the large-area, lightweight arrays promise improvements in stowage volume, weight, cost, and resistance to environmental degradation during the satellite lifetime. B.J.

A78-32885 # NTS-2 nickel hydrogen battery performance. J. F. Stockel, J. D. Dunlop (COMSAT Laboratories, Clarksburg, Md.), and F. Betz (U.S. Navy, Naval Research Laboratory, Washington, D.C.). In: Communications Satellite Systems Conference, 7th, San Diego, Calif., April 24-27, 1978, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 66-71. Research sponsored by the Communications Satellite Corp. (AIAA 78-536)

The nickel-hydrogen battery was first used for satellite energy storage aboard NTS-2. Ground testing demonstrated the battery's ability to endure the conditions encountered during spacecraft integration and environmental testing. No detrimental effects were observed from the dynamic forces during launch, the steady load accompanying spinning or the zero-g environment. One eclipse season was completed with the battery supplying spacecraft power during the shadow periods. The automatic charge control system adequately recharges the battery while minimizing overcharge and internal heating. The strain gages provide a reliable, operationally usable state-of-charge indicator to aid in performance evaluation. B.J.

A78-32912 # Development of satellite flywheels utilizing magnetic bearings with passive radial centering - Concepts and results. P. C. Poubeau (Société Nationale Industrielle Aérospatiale, Les Mureaux, Yvelines, France). In: Communications Satellite Systems Conference, 7th, San Diego, Calif., April 24-27, 1978, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 285-296. 7 refs. Research sponsored by the International Telecommunications Satellite Organization, European Space Agency, and Centre National d'Etudes Spatiales. (AIAA 78-571)

The paper describes the basic design features and overall performance characteristics of satellite reaction and momentum flywheels with magnetic suspension of the rotor. The magnetic bearings provide passive radial centering of the rotor and employ a single servoloop for axial position control of the rotor. The concept does not limit rotational speed at the level of the bearings and composite rotors have been developed to maximize the benefits of high rotational speed. The possibility of using the concept for kinetic energy storage is also discussed. B.J.

A78-33026 Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. Meeting sponsored by the American Society of Mechanical Engineers. Edited by J. R. Howell (Houston, University, Houston, Tex.) and T. Min (Michigan Technological University, Houghton, Mich.). New York, American Society of Mechanical Engineers, 1977. 139 p. \$20.

Three broad fields are discussed: collector and storage design,

experimental system evaluation, and analysis and simulation of systems. Particular papers are presented on the natural-convection characteristics of flat-plate collectors, preliminary performance evaluation of the New Mexico State University solar house, a study of solar water heating for existing homes in Southern New England, modeling and performance prediction of a solar-powered Rankine cycle/vapor compression cycle, and heat transfer analysis of the University of Virginia system for the annual collection and storage of solar energy. B.J.

A78-33027 Performance characteristics of air-cooled solar collectors as determined by computer simulation. J. T. Lapointe (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.) and F. L. Test (Rhode Island, University, Kingston, R. I.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 1-7. 7 refs.

A numerical model that is both dynamic and deterministic has been developed for an air-cooled flat plate solar collector. Utilizing a computer simulation, various parameters were studied over the course of a year. A ten year average of insolation and weather data from Eppley Laboratory and the Weather Bureau were curve fit and programmed into the simulation. The performance of the air-cooled collector as a function of climate conditions, collector geometry; and operating conditions were compared. A comparison was made with a water-cooled collector under similar operating conditions in order to determine the relative merits of each. It was found that the particular air-cooled collector considered was slightly less efficient than its counterpart but has a definite advantage in climates where freezing is a problem. It can be concluded that air-cooled collectors are a viable alternative component that should be investigated further in terms of an integrated heating system. (Author)

A78-33028 Natural convection characteristics of flat plate collectors. K. R. Randall, J. W. Mitchell, and M. M. El-Wakil (Wisconsin, University, Madison, Wis.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 9-16. 12 refs.

Local and average heat transfer coefficients for natural convection between parallel plates inclined between 45 and 90 degrees from the horizontal have been experimentally studied using interferometric techniques. The experimental conditions were similar to those existing in flat plate solar collectors. Correlations have been developed for the local and average heat transfer Nusselt numbers as functions of tilt angle and Grashof number. The results are useful in determining the top loss coefficient for flat plate collectors and, eventually, for finding means of minimizing these losses. (Author)

A78-33029 Techniques for reducing thermal conduction and natural convection heat losses in annular receiver geometries. A. C. Ratzel, C. E. Hickox, and D. K. Gartling (Sandia Laboratories, Albuquerque, N. Mex.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 17-24. 8 refs. ERDA-supported research.

Techniques studied for reducing conduction heat losses in annular receiver geometries for solar collectors include evacuation of the annulus gas, oversizing of the annular space while maintaining slight vacuum levels and utilization of gases other than air in the annular space. For the geometry considered, total heat reductions of 10-50% may be obtained depending on the means by which conduction heat loss is limited. In addition, numerical analysis indicates that highly nonuniform temperature distributions are required to affect significantly natural convection between concentric cylinders and that rather large eccentricities cause only a slight increase in natural convection heat transfer. B.J.

A78-33030 * **Experimental evaluation of a fixed collector employing vee-trough concentrator and vacuum tube receivers.** M. K. Selcuk (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 33-37. 6 refs. ERDA-sponsored research; Contract No. NAS7-100.

A test bed for experimental evaluation of a fixed solar collector which combines an evacuated glass tube solar receiver with a flat plate/black chrome plated copper absorber and an asymmetric vee-trough concentrator was designed and constructed. Earlier predictions of thermal performance were compared with test data acquired for a bare vacuum tube receiver; and receiver tubes with Alzak aluminum, aluminized FEP Teflon film laminated sheet metal and second surface ordinary mirror reflectors. Test results and system economics as well as objectives of an ongoing program to obtain long-term performance data are discussed. (Author)

A78-33032 **Preliminary performance evaluation of the New Mexico State University solar house.** T. R. Mancini, J. L. Peterson (New Mexico State University, Las Cruces, N. Mex.), and P. R. Smith. In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 45-58. 7 refs. Research supported by the New Mexico Energy Resources Board.

The performance of the New Mexico University solar heated and cooled house, the Collins Casa del Sol, during eight days in February of 1977 is presented and discussed. The 181 square meter Casa del Sol was designed in an energy efficient manner through the use of elements of passive solar system design, such as massive walls, exterior insulation, and shaded windows. The solar system design is a liquid type in which a solution of water and propylene glycol is circulated through 69.7 square meters of double glazed, flat plate solar collectors. The energy collected is transferred through a tube-in-shell heat exchanger and stored in the form of sensible heat in 7570 liters of water in an insulated, buried storage tank. This energy is removed as required to heat, cool and provide domestic hot water for the house. The data presented include insolation, weather data, heating loads, collector array performance, storage temperature and the electrical power consumption of the solar equipment during the eight days studied. In addition, the effect of varying the flow rate of coolant through the solar collectors is discussed. (Author)

A78-33033 **A solar energy system for space heating and space cooling.** T. J. McNamara (V. A. Scavo and Associates, Chicago, Ill.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 59-70.

The paper surveys design, cost and energy-conservation considerations related to the development of a solar heating and cooling system for the Chicago Museum of Science and Industry. A series of tables is presented summarizing the following data for the 12 months of the year: design heating loads, solar collector shading, solar energy collected, and energy saving and consumption. Diagrams are presented of the solar collector and related systems. B.J.

A78-33034 **A study of solar water heating for existing homes in Southern New England.** T. P. Mastrorade (Combustion Engineering, Inc., Windsor, Conn.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 71-80. 13 refs. Research supported by the University of Connecticut.

This paper examines the technical and economic feasibility of retrofitting existing residences in the Southern New England climate with solar water heaters. As part of the study, a solar water heater, using the Bliss self-draining concept for freeze protection, was

installed on a representative single family home. Performance records for the first two years of operation are presented, along with the annual savings in energy costs. A detailed computer simulation, using hourly values of radiation, ambient temperature, and hot-water demand, permits the evaluation of a wide range of parameters which affect system performance and cost. These include: collector tilt, collector azimuth, storage capacity, collector area, hot water demand, daily hot water demand variations, and collector construction. An economic analysis of the benefits or liabilities incurred with the retrofit of an existing residence is presented from the point of view of an individual homeowner. With long payback times and consistent energy cost escalation, solar water heating can be demonstrated to be only marginally competitive when supplementing an electric water heater. (Author)

A78-33035 **Economic feasibility of solar heating systems in the northeastern United States.** M. F. Modest, D. F. Fitzgerald, and A. Pfister (Rensselaer Polytechnic Institute, Troy, N.Y.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. (A78-33026 13-44) New York, American Society of Mechanical Engineers, 1977, p. 81-91. 16 refs. Research sponsored by the New York State Energy Research and Development Authority.

A heat transfer analysis was performed together with an economic analysis in order to investigate the economic feasibility of solar-augmented residential home heating systems in the northeastern United States. Three types of systems were studied: (1) direct solar systems; (2) solar-augmented air-to-air heat pumps, and (3) solar-augmented water-to-air heat pumps. The heat transfer analysis included heat load calculations as well as solar energy calculations, using actual 'Design Year' temperature and insolation data for four locations within New York State. Detailed economic analyses of the three systems were made covering a broad range of pertinent parameters such as mortgage rates, local real estate tax exclusions, income tax deductions, interest rates, fuel oil and electrical costs and inflation rates. Results show that economic feasibility depends most strongly on system cost and energy inflation rates. It is seen that, without Government incentives, solar heating systems are unlikely to be profitable before the turn of the century in the region considered. (Author)

A78-33036 **Solar powered Rankine cycle/vapor compression cycle modeling and performance prediction.** A. N. Egrican, R. W. Allen, and D. K. Anand (Maryland, University, College Park, Md.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 93-102. 29 refs. Contract No. E(40-1)-4976.

A Rankine cycle/vapor compression cycle (RC/VCC) for solar cooling is simulated in the form of a water-cooled chiller with turbine expander and reciprocating compressor using R-114 and R-22, respectively. The free parameters are the inlet water temperatures, inlet water flow rates, heat transfer conductances of the exchangers, and rotating component efficiencies. A variable off-design turbine efficiency model is included. Sample simulations are performed in the area of RC/VCC subsystem design and again in the area of RC/VCC subsystem off-design performance. Characteristic performance curves are shown and a temperature zone of design and a temperature zone of off-design operation are portrayed in order to relate performance limits to the solar application. (Author)

A78-33037 **Operational dynamics of coupled flat plate solar collector and adsorption cycle heat pump system with energy storage.** A. W. Harris (General Electric Co., Schenectady, N.Y.) and C. N. Shen (Rensselaer Polytechnic Institute, Troy, N.Y.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 103-111. 9 refs.

A78-33038 Heat transfer analysis of a system for annual collection and storage of solar energy. J. T. Beard, J. W. Dickey, F. A. Iachetta, L. U. Lilleht, M. D. Duvall, L. A. Dirhan, and M. F. Coyle (Virginia, University, Charlottesville, Va.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 113-119. 15 refs. Contract No. E(40-1)-5136.

The paper presents details of engineering design and performance of a system for the annual collection and storage of solar-heated water for the heating of buildings at the University of Virginia. The system consists of an energy storage subsystem which stores hot water in an underground pool and of a solar-collector subsystem which acts not only to collect solar energy throughout the year but also to limit the evaporative and convective heat losses from the storage subsystem. Data are presented illustrating the transient heat transfer which occurs during the start-up phase of operation. Thermal performance results are presented illustrating the efficiency of the solar collector and the variation of solar energy input to storage during a typical day's operation in May. An analog model has been developed to analyze the transient energy phenomena within the soil surrounding the pool. B.J.

A78-33039 Shading effect for uniformly spaced solar collector arrays on plane surfaces. C. W. Chiang and D. C. Hopkins (South Dakota School of Mines and Technology, Rapid City, S. Dak.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 121-126. Contract No. E(49-19)-2399.

The paper considers the use of relative spacing (ratio of the distance between rows of collectors to the collector length) to avoid excessive shading and maximize collector area for a flat-plate collector array for a solar house. The relative spacing of long rows of collectors which will give 10% shading of the integrated beam radiation for a clear day is calculated. Calculations are applicable to arrays laid out on any plane as the base, but the results presented here are for horizontal and vertical arrays such as would be encountered on a flat roof or vertical wall. It is found that the percent shading is linear with relative spacing for most of the year from the 10% level of shading to complete shading. B.J.

A78-33040 On the study of applications of solar thermal energy for mobile home park and community. J. P. Chiou (Detroit, University, Detroit, Mich.). In: Heat transfer in solar energy systems; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 127-135. 34 refs.

A78-33102 Steam bottoming plants for combined cycles. R. W. Foster-Pegg (Westinghouse Electric Corp., Generation Systems Div., Lester, Pa.). In: Turbomachinery developments in steam and gas turbines; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 1-10.

A combined cycle is a synergistic combination of cycles operating at different temperatures, each of which could operate independently. For most bottoming cycles, steam is the dominant fluid and the Rankine mode has been the most prevalent. The overall efficiency of the cycle is given by the equation $E_b = E_{bc} \times E_{be}$, where E_b is the bottoming plant efficiency, E_{bc} is combined cycle efficiency, and E_{be} is the fraction of heat flowing from the topping plant which is captured by the bottoming plant. The major components of the Rankine bottoming plant are listed, including heat recovery boiler, turbine, condenser, feed-pump, feedwater heaters, and circulating water system. Comparisons are made between the bottoming mode and conventional steam engines, noting the multiple pressures and high heat input realized by the former. The Rankine bottoming plant is found to have applications in both reheat and non-reheat cycles. D.M.W.

A78-33108 Gas turbine combustion and fuels technology; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. Meeting sponsored by the American Society of Mechanical Engineers. Edited by E. K. Bastress (U.S. Department of Energy, Washington, D.C.) New York, American Society of Mechanical Engineers, 1977. 78 p. \$14.

Gas turbine combustion and fuels technology are discussed with reference to three basic categories: combustion diagnostic methods, gas turbine fuel injection, and gas turbine combustion. Attention is given to laser instruments for measuring fluid properties, in combustion processes, comparisons between conventional fuel injectors and prevaporizing-premixing injection systems, and fuel hydrogen content as an indicator of aircraft combustor performance. D.M.W.

A78-33114 Fuel hydrogen content as an indicator of radiative heat transfer in an aircraft gas turbine combustor. T. A. Jackson (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) and W. S. Blazowski (Exxon Research and Engineering Co., Linden, N.J.). In: Gas turbine combustion and fuels technology; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. New York, American Society of Mechanical Engineers, 1977, p. 59-65. 8 refs.

Eleven fuels representing a wide range of hydrogen content were studied using a T56 single can combustor rig. Test fuels included single and double ring aromatic types as well as paraffins blended with each other and with JP-4. Fuel mixtures with hydrogen contents ranging from 9.9 to 15.9 percent by weight were examined. The combustor inlet conditions simulated the discharge from both low and high pressure ratio gas turbine compressors operating at the cruise condition. Thermocouple data from the T56 liner are correlated with fuel hydrogen content using a new, non-dimensional combustor liner temperature parameter. Least-squares mathematical treatment of the data resulted in an excellent second order correlation between the non-dimensional temperature parameter and fuel hydrogen content and a simplified radiation analysis is presented which also explains the resulting empirical trends. (Author)

A78-33119 Molten salt energy storage system - A feasibility study. B. G. Jones, R. P. Roy, and R. W. Bohl (Illinois, University, Urbana, Ill.). In: Heat transfer in energy conservation; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. Meeting sponsored by the American Society of Mechanical Engineers. New York, American Society of Mechanical Engineers, 1977, p. 39-45. 13 refs.

A molten-salt energy-storage system for central power plant use in meeting system load demand fluctuations has been studied. A conceptual design of the energy-storage system is presented. Included are basic system design, thermodynamic cycles, results of pertinent heat transfer studies, overall performance estimates, and economic considerations. The results, from both technical and economic viewpoints, are encouraging. (Author)

A78-33120 Heat transfer effects in compressed air energy storage. K. G. Vosburgh (General Electric Co., Schenectady, N.Y.) and P. G. Kosky (Lehigh University, Bethlehem, Pa.). In: Heat transfer in energy conservation; Proceedings of the Winter Annual Meeting, Atlanta, Ga., November 27-December 2, 1977. Meeting sponsored by the American Society of Mechanical Engineers. New York, American Society of Mechanical Engineers, 1977, p. 83-90. 20 refs. Research supported by the Electric Power Research Institute.

Compressed-air energy-storage (CAES) systems are being developed for peak-load-leveling applications by electric utilities. Energy is stored by compressing air in an underground cavern; when power is required, the air is heated and expanded through a turbine-generator system. This work is part of a conceptual design of an 800-MW CAES system which uses a set of storage cavities mined in salt. Each storage cavern forms a constant-volume reservoir; thus, the storage pressure and temperature vary over the weekly cycle. The thermal properties of the air and the salt region surrounding the cavern were simulated using a finite-difference approach. The cavern surface temperature shows a wide variation over the weekly cycle,

although this is damped out several meters from the wall. The walls act to cool the air at high temperature, but to heat at low temperature. Detailed examples of this effect are presented along with an analysis of optimal air-injection conditions to maximize storage of energy while avoiding excessive thermal stress. (Author)

A78-33123 * Aerospace technology can be applied to exploration 'back on earth'. L. D. Jaffe (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Oil and Gas Journal*, Aug. 15, 1977, p. 92-97. Contract No. NAS7-100.

Applications of aerospace technology to petroleum exploration are described. Attention is given to seismic reflection techniques, sea-floor mapping, remote geochemical sensing, improved drilling methods and down-hole acoustic concepts, such as down-hole seismic tomography. The seismic reflection techniques include monitoring of swept-frequency explosive or solid-propellant seismic sources, as well as aerial seismic surveys. Telemetry and processing of seismic data may also be performed through use of aerospace technology. Sea-floor sonar imaging and a computer-aided system of geologic analogies for petroleum exploration are also considered. J.M.B.

A78-33126 # Evaluation of two industrial boilers with combustion modifications for reduced pollutant emissions. S. C. Hunter, J. G. Sotter (KVB, Inc., Tustin, Calif.), R. E. Hall (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Research Triangle Park, N.C.), and W. Nazimowitz (KVB, Inc., Scarsdale, N.Y.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/APC-1*. 13 p. Members, \$1.50; nonmembers, \$3.00. U.S. Environmental Protection Agency Contract No. 68-02-2144.

A78-33127 # Fume formation in ammonia scrubbers. N. D. Moore (Tennessee Valley Authority, Chattanooga, Tenn.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/APC-2*. 11 p. 8 refs. Members, \$1.50; nonmembers, \$3.00.

Ammonia scrubbing has been employed for many years to remove sulfur dioxide from waste gases. As a result of the use of ammonia scrubbing, a problem of ammonia salt formation (fuming) has been identified. Techniques for the control of the fuming associated with ammonia scrubbing have been the subject of patents and pilot plant investigations. The thermodynamic equations published by several authors are reviewed and revised in light of available literature and small-scale test results. Methods for preventing the formation of ammonia salts are presented and the efficacy of the application of these methods is discussed. The four ammonia salts identified as possible fuming agents are ammonium sulfite, $(\text{NH}_4)_2\text{SO}_3$, ammonium bisulfite, NH_4HSO_3 , ammonium pyrosulfite $(\text{NH}_4)_2\text{S}_2\text{O}_5$ and ammonium sulfite-monohydrate, $(\text{NH}_4)_2\text{SO}_3\text{H}_2\text{O}$. For typical scrubbing applications treating flue gas from coal fired power plants, the most likely fuming salt is identified as ammonium sulfite-monohydrate, $(\text{NH}_4)_2\text{SO}_3\text{H}_2\text{O}$. (Author)

A78-33129 # Effect of carbon monoxide on the reaction of hydrogen sulfide and calcium oxide. C. H. Schreiber (Sverdrup and Parcel and Associates, Inc., St. Louis, Mo.) and T. W. Petrie (Southern Illinois University, Carbondale, Ill.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/APC-6*. 7 p. 10 refs. Members, \$1.50; nonmembers, \$3.00. NSF Grant No. ENG-74-11654.

Experiments were conducted with simulated low-Btu coal gas to focus on the effect of carbon monoxide on the rate of reaction of calcium oxide and hydrogen sulfide. No significant effect of carbon monoxide concentrations up to 35 percent by volume is noted. Other parameters of interest for high-temperature desulfurization process development were varied. Within the predicted precision error of ± 40 percent and the observed scatter due to sample variation, hydrogen concentrations from 10 to 40 percent by volume have no effect. The observed reaction rate is not affected by progressive conversion of part of the solid samples from calcium oxide to calcium sulfide. Data at 700 C are compared to data in the literature and agree well. The data at 700 C plus others at 600 C and

800 C show a temperature variation consistent with a constant activation energy. At 700 C, the reaction rate for 0.389-mm geometric mean particle diameters over a broad range of simulated coal gas compositions is $K(\text{per sec}) = 0.000166$ times the H_2S volume fraction to the 0.85 power for calcined dolomite and $K(\text{per sec}) = 0.000150$ times the H_2S volume fraction to the 1.00 power for calcined calcium carbonate. The H_2S volume fraction is in percent by volume and ranges from 0.1 to 5.0 percent. (Author)

A78-33130 # Factors detrimental to electrostatic precipitator performance. W. R. Lane (Bechtel Power Corp., San Francisco, Calif.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/APC-7*. 8 p. 7 refs. Members, \$1.50; nonmembers, \$3.00.

This paper provides information concerning problems that can occur with the specification, selection, design, and operation of an electrostatic precipitator applied to coal-fired boilers. The areas covered have been observed to have detrimental effects on precipitator performance. Areas of concern include inadequacy of coal field data, coal chemistry, calculation of gas flow rate and inlet grain loading, temperature variations, oil burning quality during startup or stabilization of coal firing, flue gas velocity distribution, opacity/grain loading correlations, precipitator erection tolerances, and precipitator electrical performance. (Author)

A78-33143 # Design and calculated performance and cost of the ECAS Phase II open cycle MHD power generation system. L. P. Harris (General Electric Co., Schenectady, N.Y.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Ener-5*. 12 p. Members, \$1.50; nonmembers, \$3.00. ERDA-NSF-sponsored research; Contract No. NAS3-19406.

A 2000 MWe MHD/steam plant for central station applications has been designed and costed as part of the Energy Conversion Alternatives Study (ECAS). This plant is fueled by Illinois No. 6 coal, rejects heat through mechanical draft wet cooling towers, and includes coal processing equipment, seed reprocessing, electrical inversion of the MHD generator output and emission controls to current EPA standards. It yields an estimated overall efficiency of 0.483 (7066 Btu/kWe-hr), a capital cost of \$718 per kWe (1975 dollars), and a cost of electricity at 65% capacity factor of 32 mills per kWe-hr. If the assumed life and reliability could be achieved with these performance parameters, the MHD system should prove attractive. (Author)

A78-33144 # Thermionic energy conversion topping system. F. N. Huffman and G. Miskolczy (Thermo Electron Corp., Waltham, Mass.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Ener-6*. 8 p. 17 refs. Members, \$1.50; nonmembers, \$3.00.

Thermionic energy converters (TEC) are an attractive means of topping steam cycles in order to utilize the thermodynamic availability between the combustion temperature and the conventional utilization temperature. The thermodynamics and cost of a reference design of a coal-fired, TEC-topped steam system have been analyzed. For the unoptimized system parameters selected, the combined cycle thermodynamic efficiency is 48.4 percent and the powerplant efficiency (as well as the overall energy efficiency) is 44.02 percent. Cost factors are competitive. The study identified several avenues to improved performance; namely, higher-temperature air preheater, increased heat flux density into the TEC's and elimination of the air as an intermediate heat transfer fluid. With such modification, station efficiencies up to 50 percent appear possible. The performance and cost projections indicate that TEC is a viable candidate for topping steam powerplants. (Author)

A78-33145 # Performance and cost evaluation for a thermionic topping power plant. G. Carnasciali (Foster Wheeler Development Corp., Livingston, N.J.), G. O. Fitzpatrick, and E. J. Britt (Rasor Associates, Inc., Sunnyvale, Calif.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Ener-7*. 8 p. 12 refs. Members, \$1.50;

nonmembers, \$3.00. Contract No. EY-76-C-02-2263.

Thermionic topping of a coal-fired steam power plant, which involves rejecting part of the heat output into the steam cycle, has been found to increase overall system efficiency to 46.8%, as compared to an efficiency of 37% for a standard plant. The thermionic heat exchanger power modules used in the topping design are described, and costs of the system are analyzed. A capital cost of \$902 per kilowatt and an electricity cost of 47.4 mills per kilowatt hour are projected for a current thermionic topping power plant design. J.M.B.

A78-33146 # Coal fired non-equilibrium, Closed Cycle MHD/steam power generation. B. Zauderer, C. H. Marston, L. K. Davis, D. A. Rogers (GE Space Sciences Laboratory, King of Prussia, Pa.), J. Bazan (Foster Wheeler Development Corp., John Blizard Research Center, Livingston, N.J.), and J. Parsons (General Electric Co., Schenectady, N.Y.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Ener-8.* 14 p. 22 refs. Members, \$1.50; nonmembers, \$3.00. ERDA-supported research.

A 1000 MWe Closed Cycle MHD/steam bottoming power plant which incorporates an integrated, two-stage, pressurized fluidized bed combustor meeting all emission control requirements has been studied. The coal pile to bus bar efficiency for this plant is calculated to be 46 percent. A dc-dc conversion system is proposed for matching the output of the Faraday MHD Channel to the inverters. The effect on efficiency of perturbations in nominal performance of key components is shown, along with regenerative heat exchanger performance and plant layout. (Author)

A78-33147 * # Open-Cycle Gas Turbine/Steam Turbine Combined Cycles with synthetic fuels from coal. R. P. Shah and J. C. Corman (General Electric Co., Schenectady, N.Y.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Ener-9.* 12 p. Members, \$1.50; nonmembers, \$3.00. ERDA-NSF-sponsored research; Contract No. NAS3-19406.

The Open-Cycle Gas Turbine/Steam Turbine Combined Cycle can be an effective energy conversion system for converting coal to electricity. The intermediate step in this energy conversion process is to convert the coal into a fuel acceptable to a gas turbine. This can be accomplished by producing a synthetic gas or liquid, and by removing, in the fuel conversion step, the elements in the fuel that would be harmful to the environment if combusted. In this paper, two open-cycle gas turbine combined systems are evaluated: one employing an integrated low-Btu gasifier, and one utilizing a semi-clean liquid fuel. A consistent technical/economic information base is developed for these two systems, and is compared with a reference steam plant burning coal directly in a conventional furnace. (Author)

A78-33148 # A low-risk approach to the high-temperature turbine. N. G. Carlson, F. L. Robson (United Technologies Research Center, East Hartford, Conn.), and J. S. Westmoreland (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Ener-10.* 9 p. Members, \$1.50; nonmembers, \$3.00.

An ERDA-sponsored program to develop high-temperature turbines for electrical power generation contemplates a nominal 100-MW frame size operating at 1425 C in a combined steam and gas turbine cycle. Water-cooled and air-cooled designs are considered; internal cooling of the high- and low-pressure vane by subcooled boiling water is described. Emission control measures and combustor durability at high firing temperatures also receives attention. J.M.B.

A78-33149 # Conceptual design of a coal-fueled, fluid bed combined cycle power plant. R. M. Costello (Burns and Roe Industrial Services Corp., Paramus, N.J.), A. J. Giamonti (United Technologies Research Center, East Hartford, Conn.), and J. W. Smith (Babcock and Wilcox Co., Power Generation Group, Barberton, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper*

77-WA/Ener-11. 8 p. 11 refs. Members, \$1.50; nonmembers, \$3.00. Contract No. E(49-18)-2371.

The use of an air-cooled pressurized fluid bed (PFB) reactor to top a conventional coal-fired steam plant is discussed. The PFB combustion concept involves a process pressure of several atmospheres, such as would be found in the exhaust of the compressor of a gas turbine. Although the PFB system requires highly efficient hot particulate removal devices, the economic and environmental advantages of PFB combustors suggest commercial application of the PFB concept may be feasible. J.M.B.

A78-33150 # The utilization of high temperature gas turbines in integrated coal-derived fuel combined cycles. R. C. Sheldon and W. H. Day (General Electric Co., Gas Turbine Div., Schenectady, N.Y.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Ener-12.* 18 p. Members, \$1.50; nonmembers, \$3.00.

The plant design and economics are discussed for several high-temperature gas turbine systems used in combined cycles with low-Btu coal gasification systems or with coal-derived liquid fuels. Water-cooled turbine designs with no external cooling holes in the airfoils may operate satisfactorily on coal-derived liquids with high contaminant levels; operation on low-Btu gas with alkali-bearing particulates may also be possible. Integrated low-Btu combined cycle plants involving fixed-bed coal gasification or an entrained-bed design are also described. J.M.B.

A78-33151 * # Analytical investigation of thermal barrier coatings for advanced power generation combustion turbines. D. J. Amos (Westinghouse Electric Corp., Generation Systems Div., Lester, Pa.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Ener-13.* 27 p. 10 refs. Members, \$1.50; nonmembers, \$3.00. Contract No. NAS3-19407.

An analytical evaluation was conducted to determine quantitatively the improvement potential in cycle efficiency and cost of electricity made possible by the introduction of thermal barrier coatings to power generation combustion turbine systems. The thermal barrier system, a metallic bond coat and yttria stabilized zirconia outer layer applied by plasma spray techniques, acts as a heat insulator to provide substantial metal temperature reductions below that of the exposed thermal barrier surface. The study results show the thermal barrier to be a potentially attractive means for improving performance and reducing cost of electricity for the simple, recuperated, and combined cycles evaluated. (Author)

A78-33152 # Combined cycles for operation on coal derived fuels with high temperature combustion turbines. R. E. Strong (Westinghouse Electric Corp., Generation Systems Div., Lester, Pa.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Ener-14.* 11 p. 5 refs. Members, \$1.50; nonmembers, \$3.00.

During Phase I of the High Temperature Turbine Technology Program, combined cycles were studied using a selected low Btu gasification system and a coal derived liquid fuel. Cycle analysis work was done to investigate pressure ratio and operating temperature for combustion turbines operating above 2600 F (1700 K) utilizing advanced air cooling configurations. The effects of both hot and cold gas cleanup on power plant heat rate were determined for coal gasification systems. Plant arrangements were made for low Btu gasification combined cycle and a combined cycle utilizing a coal liquid. Environmental factors were estimated for both power plants. (Author)

A78-33171 # Cost-effectiveness study of heat pipe heat exchangers. D. C. Lu and K. T. Feldman, Jr. (New Mexico, University, Albuquerque, N. Mex.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/HT-5.* 7 p. 12 refs. Members, \$1.50; nonmembers, \$3.00. NSF Grant No. ENG-74-018062.

The initial costs of three types of heat pipe heat exchangers are presented: aluminum-Freon 11 for the temperature range from -23 C

to 121 C, copper-water for 38 C to 232 C, and carbon steel-Dowtherm A for 120 C to 400 C. An optimization computer program for the cost-effectiveness analysis is developed, which takes into consideration the costs for equipment, installation, operation, and maintenance. An optimization example is given for a carbon steel-Dowtherm A heat pipe heat exchanger designed to recover heat from the 8534 cu m/min of 316 C flue gas exhausting from the University heating plant boilers. (Author)

A78-33175 # Transient conduction in the space surrounding a ring of holes. M. Crawford (Alabama, University, Birmingham, Ala.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/HT-12.9* p. 5 refs. Members, \$1.50; nonmembers, \$3.00.

The problem of transient conduction around a ring of symmetrically spaced holes in an infinite medium is analyzed. The analysis is used to assess the feasibility of developing underground thermal storage facilities for solar energy systems. The basic problem of the transient temperature field around a single hole is solved; consideration is then given to arrays involving rings of holes with or without a center hole. Total heat storage and thermal storage cycles for the arrays are studied. The results of the investigation indicate that a ring array could provide adequate thermal storage for solar energy from a focusing collector. J.M.B.

A78-33185 # Fusion energy. R. A. Gross (Columbia University, New York, N.Y.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/NE-1.5* p. 10 refs. Members, \$1.50; nonmembers, \$3.00. Contract No. EY-76-S-02-2456.

Fundamentals of controlled thermonuclear fusion power are summarized. Methods of heating plasma to ignition conditions and some plasma confinement techniques are discussed. Principles of the tokamak magnetic trap are described, and some of the major engineering developments that lie ahead are enumerated. (Author)

A78-33186 # Structural and mechanical design of tokamaks. W. C. Young and I. N. Sviatoslavsky (Wisconsin, University, Madison, Wis.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/NE-2.8* p. 14 refs. Members, \$1.50; nonmembers, \$3.00. Research supported by the Wisconsin Electric Utilities Research Foundation, Electric Power Research Institute, and ERDA.

The UWMMAK series of reactor studies have assessed the technological problems associated with the design and construction of a working power reactor. A procedure has been developed to evaluate the quality of magnet design by a comparison to a minimum mass system established by the virial theorem. Failure and fault analyses and material selection for the many diverse environments are critical for long term reliability. Overall structural compatibility and multipurpose use of structural components are also emphasized. (Author)

A78-33187 # Tokamak reactors. R. G. Mills (Princeton University, Princeton, N.J.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/NE-3.5* p. 20 refs. Members, \$1.50; nonmembers, \$3.00. Contract No. EY-76-C-02-3073.

The physical properties of nuclear fusion reactions govern the fuel choice and the selection of the operating plasma temperature. Scientific feasibility, or energy break-even, is one objective of the current research program. Engineering and economic feasibilities will depend on achievable plasma densities at thermonuclear temperatures and on technological questions of achievable magnetic field, effects of radiation damage, and mechanical design problems. A pure fusion reactor will have stringent requirements on its performance parameters. If achieved, it should provide clean, safe, abundant economic power, but from rather large central stations. Hybrid fission/fusion systems put far less stringent requirements on the plasma performance. They simplify the fission lattice design. They may provide a superior method for burning the vast reserves of uranium-238. (Author)

A78-33189 # Evaluation of portable optical property measurement equipment for solar selective surfaces. R. B. Pettit (Sandia Laboratories, Albuquerque, N. Mex.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/SOL-1.8* p. 13 refs. Members, \$1.50; nonmembers, \$3.00. ERDA-supported research.

A78-33190 # Design and operational influences on thermal performance of 'Solaris' solar collector. J. T. Beard, F. A. Iachetta, L. U. Lilleleht, F. L. Huckstep, and W. B. May, Jr. (Virginia, University, Charlottesville, Va.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Sol-2.6* p. 8 refs. Members, \$1.50; nonmembers, \$3.00. Contract No. E(40-1)-4927.

Thermal performance characteristics of the 'Solaris' water-trickle collector have been experimentally determined using the University of Virginia Solar Energy Research Facility. A theoretical model of the collector has also been used to examine the thermal performance of the collector. The model and experimental measurements were used to determine the sensitivity of the collector's performance to such variables as ambient temperature, mass flow rate, insolation rate, wind, and glazing cleanliness. It was found that ambient temperature and wind are the two major variables which influence collector performance. Experimental measurements and the model also were used to demonstrate how design changes, such as glazing spacing, glazing material, double glazing, and condensate suppression influence the performance of the water-trickle collector. (Author)

A78-33191 # The effect of certain major parameters on the annual effectiveness of solar systems for residential dwellings. E. B. Kear, Jr. (Clarkson College of Technology, Potsdam, N.Y.) and E. B. Kear, III. *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Sol-3.6* p. 10 refs. Members, \$1.50; nonmembers, \$3.00.

The effectiveness of an individual solar system depends not only upon the design of the system, but also upon the characteristics of the micro-climate at the specific site and the pattern of energy usage within the structure. This paper utilizes hourly weather data for temperature, wind velocity, total and diffuse insolation for a period of one year, together with a detailed simulation of the energy usage for both space heating and potable hot water to investigate the effects of changing certain major parameters on the overall annual effectiveness of the solar system. The results of this study are presented in such a way as to be of a general interest to all those considering the application of solar systems to residential dwellings. (Author)

A78-33192 # Low cost test procedure for solar collectors. F. W. Hottenroth (ZZ Corp., Los Alamitos, Calif.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Sol-4.5* p. 5. Members, \$1.50; nonmembers, \$3.00.

This paper describes a test procedure which is suitable for small as well as large organizations, uses low cost equipment, can be performed at low cost and gives accurate results. Efficiency is calculated from the temperature rise of a closed circuit, recirculating system. The procedure can be used for in-house tests and can also be used for testing solar collectors in the field to check their efficiency under operating conditions. A recommendation is made that the efficiency of solar collectors be specified as two numbers, namely: the efficiency when the ambient temperature and the collector temperatures are 20 C and the 'stall' temperature when the isolation is 1000 W/sq m. (Author)

A78-33193 # A 'no-flow' method for measuring solar collector performance. J. H. Morehouse (Texas A & M University, College Station, Tex.) and R. I. Vachon (Auburn University, Auburn, Ala.). *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga., Nov. 27-Dec. 2, 1977, Paper 77-WA/Sol-5.8* p. 8 refs. Members, \$1.50; nonmembers, \$3.00.

An alternative method is presented to experimentally determine the efficiency of flat-plate collectors. The 'no-flow' testing method is based on the equilibrium (stagnation) temperature the collector will attain when in the no fluid flow (zero efficiency) condition. The 'no-flow' method described requires little time and minimal equipment, and yet collector performance curves are produced which are in close agreement with those obtained by current testing procedures. (Author)

A78-33212 Combustion and incineration processes. W. R. Niessen (Camp Dresser and McKee, Inc., Boston, Mass.). New York, Marcel Dekker, Inc. (Pollution Engineering and Technology Series. Volume 7), 1978. 378 p. 179 refs. \$35.

Aspects of stoichiometry are considered, taking into account units and fundamental relationships, analyses, balances based on fuel analysis, balances based on flue gas analysis, cross-checking between fuel and flue gas analysis, energy balances, equilibrium, an introduction to kinetics, the kinetics of carbon monoxide oxidation, and the kinetics of soot oxidation. Selected topics on combustion processes are related to gaseous combustion, liquid combustion, solid combustion, and air pollutant generation in combustion processes. Combustion systems and incineration applications of the combustion process are also discussed, giving attention to refractory enclosure systems, water cooled enclosure systems, conduction, convection, radiation, heat transfer implications in design, driven flow, induced flow, solid waste composition, solid waste properties, the municipal incinerator, incineration economics, and incineration systems for solids, sludges, liquids, and gases. A description is presented of approaches to incinerator design. G.R.

A78-33221 * # Effluent characterization from a conical pressurized fluid bed. R. J. Priem, R. J. Rollbuhler, and R. W. Patch (NASA, Lewis Research Center, Cleveland, Ohio). *International Conference on Fluidized-Bed Combustion, 5th, Washington, D.C., Dec. 12-14, 1977, Paper. 14 p.* 10 refs.

An important factor regarding the use of a pressurized coal burning fluidized bed (PFB) providing gases for driving a gas turbine is the turbine blade lifetime. However, very little data are currently available to predict erosion and corrosion rates produced by the effluent from a PFB. To assess the potential of alloys developed for aeronautical applications to resist this environment it was decided to build a coal burning fluidized bed that could be employed to measure erosion and corrosion rates. Tests were conducted with a conical fluidized bed to obtain some degree of filtration through the top of the bed. A description is presented of the data obtained in the first 138 hours of testing to characterize the effluent from the bed under different test conditions. The considered tests had been made to determine the best operating conditions prior to using the bed for a determination of the erosion and corrosion rates of typical turbine blade materials. G.R.

A78-33271 AlGaAs-GaAs graded-heterostructure photocells with expanded sensitivity spectrum. Zh. I. Alferov, V. M. Andreev, M. B. Kagan, V. I. Korol'kov, T. S. Tabarov, and F. M. Tadzhibaev (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). (*Pis'ma v Zhurnal Tekhnicheskoi Fiziki*, vol. 3, Aug. 12, 1977, p. 725-729.) *Soviet Technical Physics Letters*, vol. 3, Aug. 1977, p. 294-296. 10 refs. Translation.

The photocells investigated were prepared with smooth nGaAs-pGaAs-pAl(x)Ga(1-x)As heterojunctions, increasing the x-parameter from zero to x = 0.3 or 0.4 toward the surface. The aim was to extend the spectral response into the 0.3 to 0.5 micron region of the solar spectrum to meet the requirements for solar energy conversion. This extension proved possible by lowering the rate of surface recombination with the aid of a 0.3 to 1.5 micron thick AlAs film, protected by its own oxide, (at a pulling field of 1 kWt/cm) deposited on the heterojunction. V.P.

A78-33301 Annual Conference on Ocean Thermal Energy Conversion, 4th, University of New Orleans, New Orleans, La., March 22-24, 1977, Proceedings. Conference supported by the Energy Research and Development Administration; Contract No. EG-77-G-05-5363. Edited by G. E. Ioup (New Orleans, University, New Orleans, La.). New Orleans, University of New Orleans, 1977. 630 p. \$20.

The OTEC conference is divided into the following sections: total systems, mission analysis, environmental and siting considerations, ocean engineering, heat exchangers, biofouling and corrosion, and alternative power cycles. Particular papers are presented on economic incentives for the commercialization of OTEC, the potential mariculture yield of OTEC plants, an estimate of the impact of OTEC operation on the vertical distribution of heat in the Gulf of Mexico, resource assessment of a high potential OTEC site near Puerto Rico, and some factors affecting the selection of OTEC plant platform/cold water pipe designs. Also considered are enhanced single-phase heat transfer for OTEC systems, primary biofouling films and OTEC heat exchangers, and the effects of sea water leakage on the performance of the ammonia cycle for OTEC plants. B.J.

A78-33302 # An Early Ocean Test Platform Conversion. L. K. Donovan and C. R. Odden (U.S. Naval Facilities Engineering Command, Alexandria, Va.). In: *Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings.* New Orleans, University of New Orleans, 1977, p. II-3 to II-5.

The Hughes Mining Barge will be converted to OTEC-1, the first major test vehicle to perform operational testing of power cycle components; sea trials are scheduled for 1979. The barge is 324 feet long with a 106-foot beam having a displacement of about 6000 light tons. OTEC-1 will be designed to test components which will produce about 1 MWe (gross): heat exchangers, pumps, cold water pipe and ammonia system. The three phases of barge conversion are discussed. B.J.

A78-33303 # An Early Ocean Test Platform for testing cycle components. R. W. Falconer, F. A. Cohan, and M. J. Smith (Mechanics Research, Inc., Santa Monica, Calif.). In: *Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings.* New Orleans, University of New Orleans, 1977, p. II-6 to II-10.

A five-month study has shown that the Hughes Mining Barge (HMB) is ideally suited for use as the OTEC Early Ocean Test Platform (EOTP) using a 1 MWe power plant. The general arrangement evolved from systematic tradeoff analyses which considered the EOTP system requirements, operational suitability, technical feasibility/risk and cost effectiveness. These analyses identified the necessary HMB physical modifications to accommodate the planned OTEC plant, crew accommodations, and support equipment. It was established that the only EOTP system having unique design requirements was the pipe handling system (i.e., all other systems can be composed of off-the-shelf items). B.J.

A78-33304 # A comparison of two generic OTEC systems and missions. G. H. Lavi and C. Zener (Carnegie-Mellon University, Pittsburgh, Pa.). In: *Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings.* New Orleans, University of New Orleans, 1977, p. II-11 to II-21; Comments, p. II-21 to II-24; Authors' Reply, p. II-24, II-25. 17 refs.

Comparisons are made between electrical (20-30 mills/kwh transmitted to shore) vs chemical (10 mills/kwh produced at sea for the production of ammonia and other chemicals) OTEC utilization, near shore vs open sea installation, and shell and tube vs plate type heat exchangers. It is argued that the electric power mission involving direct delivery to the United States mainland and possessions is economically the best. If the busbar cost of OTEC power can be reduced, the first demonstration plant can more profitably employ an over-designed vessel (semisubmersible type) located near the United States than a simpler vessel (barge type) located in the open

seas. It is noted, however, that because of the potentially lower cost of the plate-type variety, the continued development of the plate-type design and other shell-less heat exchangers is justified. B.J.

A78-33305 # Cost comparison of selected OTEC power plant designs. R. Roberts (Mitre Corp., Metrek Div., McLean, Va.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. 11-26 to 11-37; Comments, p. 11-37; Author's Reply, p. 11-37, 11-38. 14 refs. Contract No. E(49-18)-2322.

The OTEC design of the Applied Physics Laboratory (APL) has the objective of generating electric power to carry out the on-site production of selected energy intensive materials such as ammonia, aluminum and hydrogen; the OTEC design of the Lockheed Missiles and Space Co. (LMSC) has the objective of delivering power ashore where it can be used in the electric distribution system or for onshore industry. The present paper reviews the cost differential of the APL and LMSC designs, indicating that the differences in design cost estimates arise from the mission and temperature differential selected. The less benign locations for the LMSC system lead to a heavier platform and additional costs for mooring. B.J.

A78-33306 # Influence of design factors on the economy of sea thermal power plants. J. H. Anderson and J. H. Anderson, Jr. (Sea Solar Power, Inc., York, Pa.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. 11-39 to 11-56.

An attempt is made, using simple examples, to show how efficiency losses can drastically affect the cost of an OTEC plant. Consideration is given to the relationship between heat rejected per unit of power and the thermal efficiency of an OTEC plant and to the following potential losses in OTEC plants: temperature losses, internal friction losses, machinery losses, buoyancy losses, external friction losses, and pipe load losses. Some design solutions for reducing OTEC losses are discussed. B.J.

A78-33307 # Economic incentives for the commercialization of OTEC. J. M. Nilles and B. J. Washom (Southern California, University, Los Angeles, Calif.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. III-3 to III-16. NSF Grant No. APR-75-18279.

The needs and alternative means for federal intervention in the OTEC marketing process through regulatory influence and provision of various incentives in order to change the supply and demand portions of the market process are discussed. Consideration is given to reasons for preferential (or other) governmental support of OTEC and with the policy options open to government agencies in this connection. B.J.

A78-33308 # Legal, political, and environmental aspects of Ocean Thermal Energy Conversion - A report on an ASIL/ERDA study. H. G. Knight (Louisiana State University, Baton Rouge, La.), R. E. Stein (International Institute for Environment and Development, Washington, D.C.), and J. D. Nyhart (MIT, Cambridge, Mass.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. III-17 to III-20.

A survey is presented of papers presented at the ASIL (American Society of International Law) workshop (held in Washington, D.C., January 15-16, 1976) on legal, political, and environmental aspects of OTEC. International aspects include jurisdiction to deploy and operate OTEC devices, political implications of such deployment, regulation of operations, and protection of the marine environment. Domestic aspects include multiple use of ocean space, State and Federal regulation, responsibility and liability for damage to and by OTEC devices, protection of the marine environment, financing, and general economic issues. B.J.

A78-33309 # Potential mariculture yield of sea thermal power plants. II - Food chain efficiency. S. Laurence and O. A. Roels (Texas, University, Port Aransas, Tex.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. III-21 to III-25. 9 refs. Grant No. NOAA-04-6-158-44117.

The results of a series of experiments designed to determine the potential organic productivity of an OTEC/mariculture system in tropical or subtropical oceans are presented. It has been shown at the St. Croix Artificial Upwelling Laboratory that plant nutrients (such as nitrate and phosphate) brought to the surface from deep-sea water and exposed to sunlight can be used for phytoplankton production in a continuous system; this phytoplankton is then fed to shellfish whereby animal protein is produced. The conversion efficiency of available nutrients and the protein production per unit area of this mariculture system were superior to conventional agricultural systems. It is concluded that a combined energy- and food-producing OTEC system appears much more desirable than an energy-producing plant alone. B.J.

A78-33310 # Electrical energy transmission for OTEC power plants. B. M. Winer and J. Nicol (Arthur D. Little, Inc., Cambridge, Mass.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. III-26 to III-33.

The technical problems involved in transmitting OTEC energy to shore via electric power cables have been investigated and the associated costs have been estimated. There appear to be no insuperable technical problems associated with transmitting electrical energy from an OTEC plant located in relatively shallow water (a depth less than 6000 ft). A parametric analysis of the cost effect of various plant and cable design options was performed. The criterion used to determine the number of redundant cables required to provide reliable energy transmission was minimization of the total cost of energy delivered to shore. B.J.

A78-33311 # Ocean energy industrial complexes. B. Lindal, C. D. Hornburg, and N. El-Ramly (DSS Engineers, Inc., Fort Lauderdale, Fla.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. III-34 to III-46. ERDA-supported research.

A feasibility study was conducted with the purpose of examining the economic, technological and environmental aspects of the recovery of marketable chemicals from sea water and the production of other energy intensive products in conjunction with floating OTEC plants. Analysis of production methods and other data on 62 major products led to the selection of 23 of these for further study. Production was grouped into five separate potential complexes. Further market and transportation studies showed that production in a sea-chemicals complex and an organic chemicals and plastics complex has the highest economic potential. B.J.

A78-33312 # Alternative forms of energy transmission from OTEC plants. A. Konopka, N. Biederman, A. Talib, and B. Yudow (Institute of Gas Technology, Chicago, Ill.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. III-47 to III-57. 22 refs. NSF Grants No. C-1008; No. AER-75-00033; Contract No. E(49-18)-2426.

The paper provides a concise technical assessment and economic analysis of components associated with the conversion, storage, transportation and shore-based receiving facilities for the conversion of OTEC mechanical energy to chemical energy, and compares this in a like manner to the conversion into and transmission of electrical power. The following chemical energy-carriers are considered: gaseous and liquid ammonia; methanol; gasoline; hydrazine hydrate; anhydrous hydrazine; unsymmetrical dimethylhydrazine; 1,7-Octadiyne; tetrahydrodicyclopentadiene. B.J.

A78-33313 # Market definition, commercial development plan, and OTEC financing - A summary of 1976 APL work for the U.S. Maritime Administration. E. J. Francis (Johns Hopkins University, Laurel, Md.) and J. Seelinger (Maritime Administration, Washington, D.C.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. III-58 to III-66.

A concept for Ocean Thermal Energy Conversion (OTEC) plant-ships for the onboard production of ammonia or other products at tropical sites has been developed. Liquid ammonia could be shipped to the U.S. to supply fertilizer and chemical markets or as a carrier of hydrogen for use in fuel cells to produce electricity. A cost estimate for a 100-MWe, 313-short-ton/day, demonstration-size OTEC/ammonia plant-ship provided the basis for cost estimates for commercial-size ships producing 1000 tons per day or more of ammonia. Economic and marketing analyses have been conducted to provide forecasts bearing on the commercialization potential for the 1983-2000 period, including ammonia production costs and prices, U.S. and world market penetration, and benefits to the U.S. and the world from a successful program. Less extensive analyses have been conducted for OTEC aluminum production and for the case of direct transmission of OTEC electric power to U.S. and foreign shores.

(Author)

A78-33315 # OTEC implementation problems for specific missions. E. Tschupp, B. Berkowitz, and W. Hausz (GE Center for Advanced Studies, Washington, D.C.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. III-76 to III-82. Contract No. E(49-18)-2421.

The feasibility of four specific OTEC missions as commercial ventures is considered: (1) near-shore production of electric power delivered to shore via submarine cable, (2) off-shore production of sea chemicals, (3) off-shore production of aluminum, and (4) off-shore production of fertilizers based on fixed nitrogen in the form of ammonia. The competitiveness of OTEC products in the marketplace is considered along the impacts of the technology and the political, institutional and environmental factors associated with OTEC operations.

B.J.

A78-33316 # Stratified turbulence modeling for the near field external flow. G. O. Roberts (Science Applications, Inc., McLean, Va.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. IV-7 to IV-25. 16 refs. Contracts No. E(49-26)-1005; No. N00014-77-C-0033.

A simplified two-dimensional model, employing the NRFLO2 computer code, is used to calculate the turbulent flow near the two outflows and the warm inflow associated with one power module of the Lockheed baseline Ocean Thermal Power Plant (OTPP) design. It is found possible to design an OTTP so that recirculation problems are negligible and the warm inflow temperature is very close to the surface temperature, even in the absence of an ambient current. To achieve this, the warm inflow and outflow speeds should be smaller than about 3 ft/sec and the depth of separation should be at least 30 ft. The far-field environmental impact is determined by the details of the near-field flow.

B.J.

A78-33317 # An estimate of the impact of OTEC operation on the vertical distribution of heat in the Gulf of Mexico. P. J. Martin and G. O. Roberts (Science Applications, Inc., Fluid Mechanics Div., McLean, Va.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. IV-26 to IV-34. 17 refs. Contracts No. E(49-26)-1005; No. N00014-77-C-0033.

The effect of OTEC operation on the vertical thermal structure of the Gulf of Mexico is estimated on the basis of a one-dimensional z-t heat conservation equation to predict the horizontal mean temperature. It is indicated that the effect of the operation of 100 200-MW OTEC plants on the mean vertical thermal structure of the Gulf would be fairly slight. With complete recirculation of plant intake and discharge flows within the Gulf, the predicted drop of the mean sea surface temperature is about 0.05 C and the rate of warming of the deep water between the cold water intake and discharge levels is about 0.03 C/yr. Even with 1000 plants, the drop in the mean sea surface temperature is less than 0.5 C. Recirculation between the cold water intake and discharge flows with such a large number of plants has the potential to decrease significantly the available thermal resource due to warming of the deep water. B.J.

A78-33319 # The external flow induced by an Ocean Thermal Energy Conversion /OTEC/ power plant. T. R. Sundaram, E. Sambuco, A. M. Sinnarwalla, and S. K. Kapur (Hydronautics, Inc., Laurel, Md.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. IV-42 to IV-49. 10 refs. Contract No. E(49-18)-2348.

In connection with the operation of an OTEC power plant (OTECPP) about 60,000 gal/min of water per MW of capacity are withdrawn from both the surface and deeper layers of the ocean and discharged at intermediate levels. The processes involved and the effects produced by them change the stratification characteristics of the ocean water upon which the operation of an OTECPP is based. An investigation is, therefore, conducted concerning the external flow of an OTECPP. The results are presented of two classes of experiments, one involving the absence of ambient currents, and the other the absence of ambient stratification. It is found that recirculation will occur in spite of impeding factors when certain critical values of the governing similitude parameters are exceeded. The appropriate similitude parameters, as well as their critical values, are being delineated.

G.R.

A78-33320 # Development of a numerical ocean model of the Gulf of Mexico for OTEC environmental impact and resource availability studies. J. D. Thompson, H. E. Hurlburt, and L. B. Lin (JAYCOR, Alexandria, Va.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. IV-50 to IV-56. 10 refs. Contract No. E(49-26)-1005.

A78-33322 # Operational sea state and design wave criteria - State-of-the-art of available data for U.S.A. coasts and the equatorial latitudes. C. L. Bretschneider (Hawaii, University, Honolulu, Hawaii). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. IV-61 to IV-73. 56 refs. ERDA-supported research.

In designing Ocean Thermal Energy Conversion (OTEC) platforms, it is critical to accurately evaluate the conditions of the ocean environment. Project OPES-DEWAC (Operational Sea State and Design Wave Criteria) is an effort to parameterize conditions in the waters off the U.S. coastline, including Hawaii, and in the equatorial regions between 20 deg N and 20 S. Tables are presented listing wind, wave, and current measurements for a given area. Attention is given to the history of hurricanes and typhoons in tropical regions.

D.M.W.

A78-33323 # Resource assessment of a high potential OTEC site near Puerto Rico. D. K. Atwood (NOAA, Miami, Fla.), C. P. Duncan (Universidad de Puerto Rico, Mayaguez, P.R.), M. C. Stalcup (Woods Hole Oceanographic Institution, Woods Hole, Mass.), and M. J. Barcelona (California Institute of Technology, Pasadena, Calif.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings.

New Orleans, University of New Orleans, 1977, p. IV-74 to IV-78.

Environmental assessment of potential OTEC sites near Puerto Rico indicates that a high-potential site exists off the southeast coast. The temperature gradient to 1000 meters can be as high as 24 C (43 F) and is never less than 20 C (36 F). The insular slope at the site is steep, and water depths of 1000 meters exist within 1.5 miles off shore. Geostrophic conditions guarantee a warm thick mixed layer with surface currents of the order of 1/3 of a knot. The supply of cold water can be considered limitless. The site is protected from north and northeast swell, and a mild sea state exists all year round (except during hurricanes). The salinity, temperature, and nutrient distributions at the site are typical of open tropical seas, making the site ideal for a prototype OTEC plant. (Author)

A78-33324 # A further evaluation of the oceanographic conditions found off Keahole Point, Hawaii, and the environmental impact of nearshore ocean thermal energy conversion plants on subtropical Hawaiian waters. K. H. Bathen (Hawaii, University, Honolulu, Hawaii). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. IV-79 to IV-99. 18 refs.

A78-33325 # Some factors affecting the selection of OTEC plant platform/cold water pipe designs. R. A. Barr and P. Y. Chang (Hydronautics, Inc., Laurel, Md.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. V-11 to V-22. 15 refs. Contracts No. E(11-1)-2681; No. EX-76-C-01-2424.

A78-33326 # Hydrodynamic loads on the cold water pipe. D. T. Hove and W. C. L. Shih (Science Applications, Inc., El Segundo, Calif.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. V-23 to V-39. 16 refs. Contract No. E(49-18)-2331.

A long cylindrical cold water pipe is part of every proposed OTEC design. Pressure variations on the pipe have been analyzed in terms of lift, drag, and Strouhal shedding frequency for Reynolds numbers in the one to 10 million range. An analytical technique is evaluated, which extends lower Reynolds number data to higher Reynolds values by modeling the influence of roughness on cylinder boundary layer flows. D.M.W.

A78-33327 # Cold water transport, cold water pipe, and deep water mooring line analysis - A parametric approach. T. E. Little (Westinghouse Electric Corp., Annapolis, Md.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. V-40 to V-48. 16 refs.

The successful implementation of the ocean thermal power plant is dependent upon the technical and economic feasibility of transporting large volumes of cold water from sea depths of 500 meters or more, through suitable ducting to the power plant condensers. In addition, plant/platform station keeping must be provided by a mooring arrangement and/or by use of dynamic positioning. Highlights of the analysis and evaluation of the cold water transport, cold water pipe, and deep water mooring lines are provided with a view toward judging the impact of these subsystems on the overall OTEC plant/platform concept and to provide an estimate of material and construction cost. Selected parameters, issues, and evaluation criteria are used to assess the merits of candidate subsystems over a range of plant size from 100 MWe to 1000 MWe net output power. (Author)

A78-33328 # Anchor systems. P. J. Valent and J. M. Atturio (U.S. Navy, Naval Construction Battalion Center, Port Hueneme, Calif.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings.

New Orleans, University of New Orleans, 1977, p. V-49 to V-55. 7 refs.

The Ocean Thermal Energy Conversion (OTEC) power plant will impose lateral loads from 5 to 100 MN (1 to 23 million lb) on its anchor systems, depending on the particular site environment. This report compares anchor systems in order to identify those best suited to scaling up to the sizes required by OTEC. Deadweight anchors with base shear keys are identified as the best choice for the deep ocean environment. Pile anchors attached to a common frame (template) are identified as a possible better anchor choice on hard (rock) seafloors and in high-energy shallow water areas typified by the Gulf Stream. Concepts for transporting and lowering the required deadweight and pile anchor systems to the seafloor site are described, and their limitations noted. The attractiveness and technical feasibility of using a free-fall-emplaced deadweight anchor installation is highlighted. (Author)

A78-33329 # Screens for the OTEC plants. J. H. Nath, J. W. Ambler, and R. M. Hansen (Oregon State University, Corvallis, Ore.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. V-56 to V-69. 16 refs.

The reported investigation had the objective to determine the kinds and quantities of biological materials which must be excluded from an Ocean Thermal Energy Conversion (OTEC) Rankine plant, taking into account also the development of suitable methods for implementing such an exclusion. The existing biological information is obtained from the results of sampling fish with mid-water trawls. It is pointed out that this sampling condition is considerably different from that of an OTEC plant which will be sucking in large quantities of warm and cold water. An important part of the investigation is, therefore, concerned with the development of a suitable sampling method which reproduces the conditions prevailing in an OTEC plant. The investigation takes into account the eastern and southern coasts of the U.S., the tropical seas to plus or minus 20 deg latitude, and the region around the Hawaiian Islands. G.R.

A78-33330 # Compact heat exchangers for sea thermal power plants. J. H. Anderson and J. H. Anderson, Jr. (Sea Solar Power, Inc., York, Pa.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VI-3 to VI-14; Discussion, p. VI-14.

The cost of converting ocean thermal energy to electric power appears to depend primarily on the design and development of effective, low-cost heat exchangers for both boiling the working fluid into vapor and condensing the vapor back to liquid. An investigation is in this connection conducted concerning the problem of designing boilers for sea thermal power plants which seems to present greater difficulties than the problem of designing suitable condensers. The difficulties are partly related to a lack of effective wetting of the heat transfer surface and the tendency for the liquid and the gas to segregate. The approaches used to overcome these difficulties in the evaporators employed in refrigeration processes are considered. Sample heat exchanger types and present-day costs are discussed, taking into account a boiler for a geothermal plant. It is recommended to design plate-fin exchangers which do have the potential of reducing the cost of exchangers, as well as improving their efficiency, and reducing their physical size. G.R.

A78-33331 # Analytical and experimental studies of OTEC heat transfer problems at Oak Ridge National Laboratory. J. W. Michel (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VI-15 to VI-26; Discussion, p. VI-26. ERDA-sponsored research.

During the past year, Oak Ridge National Laboratory has been involved in assisting ERDA in the analysis, planning, and imple-

mentation of a program to develop advanced heat exchangers for ocean thermal energy conversion (OTEC) application. An analysis of the NH_3 binary cycle and the current state of commercial heat exchanger technology indicated that the goals of this program should be to improve the seawater heat transfer coefficients by a factor of 2, the ammonia heat transfer coefficients by a factor of 2 to 4, and to be able to control fouling factors at a value of 0.0003 or below. These improvements coupled with qualifying aluminum for this seawater/ammonia service would go far toward assuring the economic viability of the OTEC concept. A single tube ammonia heat transfer loop has been built and operated to evaluate the heat transfer characteristics of fluted tubes. Preliminary ammonia condensation results are presented. (Author)

A78-33333 # An outline for optimizing and evaluating proposed OTEC systems. R. N. Lyon (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VI-34 to VI-38. ERDA-sponsored research.

The development of a suitable approach for an optimization of an Ocean Thermal Energy Conversion (OTEC) system is considered. It appears to be advisable to develop at an early stage a generalized computer model and optimization program, which could be tested with respect to its correctness and be accordingly modified. The model could then provide a suitable basis for selecting the lines of OTEC system development and for avoiding decisions leading to less than optimum paths. A truly general model should fit all possible OTEC concepts. To date these concepts include vapor-turbine (or 'Rankine Cycle') systems and hydraulic turbine systems. A description is presented of a logical order of computation for a given set of values for the parameters and independent variables. The final part of an optimization program, which may in fact dominate the modeling, is the determination of the optimum set of values for the independent variables. G.R.

A78-33335 # The OTEC program at Carnegie-Mellon University - Heat transfer research and power cycle transient modeling. R. R. Rothfus and C. P. Neuman (Carnegie-Mellon University, Pittsburgh, Pa.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VI-55 to VI-70. 12 refs.

Results of experiments on falling film, fluted, vertical tube heat transfer surfaces are reported. It is found that flutes enhance the heat transfer coefficient far in excess of what might be expected from increased surface. Data for refrigerant 11 and ammonia are presented. Fine axial flutes on the water side seem to increase the heat transfer coefficient and the pressure drop in proportion to the increase of surface brought about by the flutes. It is concluded therefore that enhancement on the water side can result in a substantial reduction in heat transfer surface requirements and so also a reduction in volume for OTEC heat exchangers. Finally, analytical models for the transient behavior of OTEC power cycle components are exhibited. These models form the basis for control system design and operational strategies for OTEC. (Author)

A78-33336 # Enhanced performance heat exchangers. A. M. Czikk, H. D. Fricke, and E. N. Ganic (Union Carbide Corp., Linde Div., Tonawanda, N.Y.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VI-71 to VI-92. 8 refs. NSF Grant No. 43441; Contract No. E(49-18)-2448.

This program involves development of enhanced performance shell and tube evaporators and condensers for the OTEC application, using proprietary heat transfer enhancement devices. The work includes: analytical development of thermal and fluid flow models for sprayed bundle and flooded bundle evaporators; experimental determination of the heat transfer and fluid flow factors necessary

for the evaporator models; designing, building and testing three pilot scale heat exchangers, comprising a sprayed bundle evaporator, a flooded bundle evaporator, and a horizontal tube condenser.

(Author)

A78-33337 # Heat transfer enhancement for evaporators. C. M. Sabin and H. F. Poppendiek (Geoscience, Ltd., Solana Beach, Calif.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VI-93 to VI-104. 7 refs.

Investigations are made of the enhancement of heat transfer conductants in evaporators, noting water flowing through round tubes, ammonia boiling over horizontal submerged tubes, and ammonia film evaporators. Water heat transfer enhancement is studied for both large-scale motions and modifications of wall layers. Research in the boiling heat-transfer enhancement of ammonia nucleate is directed at increased conductance, a decreased temperature difference required to initiate nucleation, and decreased sensitivity to contamination. The basic heat-exchanger design consists of a heat transfer enhancement surface on the boiling ammonia side with the water side unmodified. Both ammonia boiling enhancement mechanisms and water forced-convection heat-transfer mechanisms are discussed. S.C.S.

A78-33338 # Comments on sea water side enhancement for OTEC heat exchangers. W. L. Owens (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VI-105 to VI-109; Reply, p. VI-110. 6 refs.

A78-33339 # Experiments on and design of low-cost aluminum heat exchangers for OTEC plant ships. G. L. Dugger, H. L. Olsen, P. P. Pandolfini, and W. H. Avery (Johns Hopkins University, Laurel, Md.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VI-111 to VI-123. 28 refs.

In order for OTEC stations to be adopted into the overall scheme of energy production, they must be economically competitive with land-based power stations. The most expensive elements of OTEC stations are the evaporators and the condensers. Aluminum has traditionally been used in the construction of these elements, largely because of its low cost. A description of the structural characteristics of aluminum heat exchangers is presented, i.e., a two-phase-heat flow construction (ammonia inside/sea water outside) is integrated with a barge-type reinforced concrete hull. Each 2.5 MW evaporator or condenser module has 259, 76 mm O.D. tubes approximately 730 ft long, folded to 27 horizontal passes each; 7 of which are nested in a vertical plane in each of 37 elements. An evaluation of the costs involved in such an assembly is presented, together with a description of the assembly techniques. Inlet quality (mass percent vapor) for a single tube was varied from 0 to 20% with a digitally modularized, steam jacketed preheater. Some flow stratification occurred at low values, but heat transfer coefficients were in general agreement with the Chaddock-Brunemann correlation. D.M.W.

A78-33340 # A design and producibility study of heat exchangers for Ocean Thermal Energy Conversion systems. A. F. Manikowski and A. R. Pfluger (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VI-124 to VI-134; Comments, p. VI-134, VI-135; Authors' Reply, p. VI-135 to VI-137. 5 refs. ERDA-supported research.

Potential shell-and-tube heat exchanger design concepts that are economical and within the reach of current technology for Ocean Thermal Energy Conversion (OTEC) systems are examined. Although

the Lockheed concept is used as a basis, the design and manufacturing approaches identified are generally applicable to any large shell and tube heat exchanger. The discussion concerns both titanium-tubed and aluminum-tubed designs. The pressure vessels assessed include monocoque cylinders and spheres, and ring-stiffened cylinders produced with aluminum, steel, and concrete. The aluminum baseline design is employed as a basis for developing manufacturing plans and estimating costs of the heat exchangers. A computer optimization program is used to define the power-cycle parameters for a 25-MW(e) power module. Achievement of the economies indicated for aluminum requires an engineering and manufacturing development program to develop tube-to-tubesheet joining techniques for a reliable joint from a mechanical and leakage standpoint. S.D.

A78-33341 # Ultra clean heat exchangers - A critical OTEC requirement. A. F. Conn, M. S. Rice, and D. Hagel (Hydronautics, Inc.; Laurel, Md.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VII-11 to VII-14. 7 refs. Research supported by Battelle Memorial Institute.

Cleanliness of the heat exchanger tube, so as to maintain large heat transfer coefficients, has been identified as one of the critical requirements for successful operation of an OTEC power plant due to the already very low thermal efficiency which is projected for this concept. It has been estimated that it may be necessary to keep the microfouling layer (slime and other deposits) on the seawater side of the tubes down to a thickness of only 0.001 in. (25 microns). The objective of this study is to provide a catalog of methods now used to maintain the cleanliness of conventional heat exchangers, either by preventing or removing fouling, and to assess critically the applicability of each method for OTEC. Preliminary results and conclusions from this on-going study are presented. (Author)

A78-33342 # Studies of biofouling in Ocean Thermal Energy Conversion plants. J. G. Fetkovich, G. N. Grannemann, L. M. Mahalingam, D. L. Meier (Carnegie-Mellon University, Pittsburgh, Pa.), and F. C. Munchmeyer (Hawaii, University, Honolulu, Hawaii). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VII-15 to VII-23. 5 refs. NSF-ERDA-supported research.

The techniques and methods used in biofouling studies in Ocean Thermal Energy Conversion plants are discussed. A pipe is used to carry seawater to a flow meter. The heat transfer coefficient from the pipe wall to the water is measured by heating the outer surface of a Cu block above water temperature, and observing the time constant of thermal decay. The technique yields precise values because it employs a thermopile and quartz clocks. The method is not affected by calibrations except those of the flowmeter. The system is protected from changes in ambient conditions, and may be operated at depths to 100 feet. Tests have been made from a submerged buoy at Keahole Point, Hawaii and the results are presented. It is noted that biofouling rates are slow at early times and increase rapidly after several weeks, as influenced by pumping velocity. The surface roughness of a tube and the depth may significantly influence biofouling ranges. Even in relatively constant-condition waters there may be great seasonal variations in biofouling rates. S.C.S.

A78-33343 # Corrosion and biofouling on an Ocean Thermal Energy Conversion power plant: What are the questions. V. J. Castelli (U.S. Naval Material Command, David W. Taylor Naval Ship Research and Development Center, Annapolis, Md.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VII-34 to VII-36. 11 refs.

Efforts to control biofouling on Ocean Thermal Energy Conversion (OTEC) platforms have focused on two approaches: chemicals and structural materials. Included in the chemical ap-

proach are organic toxins, copper salts, and organometallics. The structural approach has led to experiments with carbon and low alloy steels, Organotin rubber sheeting, carbon composites, bronze, and to some extent, aluminum. At present, fouling control is effective for a maximum of three years in temperate waters; less in the tropics. D.M.W.

A78-33344 # Corrosion fatigue of 5086-H34 aluminum in sea water. S. P. Flodder and W. H. Hartt (Florida Atlantic University, Boca Raton, Fla.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VII-41 to VII-45. 16 refs.

Results are presented for an experimental investigation of corrosion fatigue crack growth in 0.500-in.-thick symmetrical center-cracked plate specimens of 5086-H34 aluminum in air and in sea water. A procedure involving precracked specimens is selected as it permits obtaining substantial information from relatively few tests. Of particular interest is the range of low stress intensities where little data are presently available. Limited experiments with cathodic protection are also performed. Plots of crack growth rate versus stress intensity show ranges of stress intensity where corrosion is most detrimental and where cathodic protection is most advantageous. Significance of the experimental results for ocean thermal energy conversion systems is discussed. S.D.

A78-33345 # Compatibility studies for the ammonia-titanium-seawater system as related to Ocean Thermal Energy Conversion. E. W. Saaski and P. C. Owzarski (Sigma Research, Inc., Richland, Wash.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VII-46 to VII-53. 6 refs.

The objective of this project is to determine if titanium is susceptible to stress corrosion cracking (SCC) in ammonia-seawater environments. The scope involves slow tensile strain experiments until failure of titanium rods in pure liquid ammonia, ammonia-water (0.025-1.0%) and ammonia-seawater (0.025-1%) mixtures. Results will be quantified by percent elongation and area reduction at failure, galvanic voltage versus elongation and by microscopic analysis of SCC crack growth. Preliminary rapid strain experiments showed that the Ti specimens became highly anodic before failure and that repassivation occurred slowly, but at a somewhat faster rate in liquid ammonia-1-1/2% seawater than in anhydrous ammonia. Small amounts of gas appeared on the Ti specimen under strain in anhydrous ammonia. White precipitate appeared in liquid ammonia (0.27-5%) seawater mixtures, and in seawater (1-5%) ammonia mixtures. The nature and possible role in fouling and corrosion of these precipitates is addressed. (Author)

A78-33346 # Hydrodynamic control of biofouling in OTEC heat exchangers. J. S. Tennant and M. A. Wood (Florida Atlantic University, Boca Raton, Fla.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VII-56 to VII-60. 6 refs.

A78-33347 # Potential of open cycle OTEC - A general survey. A. D. Watt, F. S. Mathews, and R. E. Hathaway (Colorado School of Mines, Golden, Colo.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VIII-3 to VIII-11; Discussion, p. VIII-11.

In an open cycle Ocean Thermal Energy Conversion (OTEC) system warm surface water is introduced into a low pressure chamber where it flashes to steam, passes through a turbine, and condenses in a low pressure chamber where the spent steam comes in direct contact with cold water from deep in the ocean. The noncondensable gases from the ocean water which accumulate in the condenser must be removed. Structure sizes and material requirements for the

evaporator, turbine generator system, and condenser are examined and the cost factor is determined. A computer program was developed in which the cost versus performance characteristics of each of the components are related in a system model. A comparison of major subsystem characteristics and costs is developed as the various input and operating parameters are varied. On the basis of preliminary results, it appears that major efforts at cost reduction should be centered on the turbine/generator, the evaporator-condenser, and the cold water pipe.

G.R.

A78-33348 # Sea thermal power cycles. L. Van Hemelryck (Texas, University, Port Aransas, Tex.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VIII-12 to VIII-17; Discussion, p. VIII-17. Grant No. NOAA-04-6-158-44117.

In power plants based on the utilization of the temperature difference between surface and subsurface waters in tropical and subtropical oceans, the unit costs associated with the deep-sea water flow, are, in the case of plants located at or near the surface, bound to be more significant than those related to surface water flow. Efficient use of the deep-sea water flow is indicated by the specific gross power generated, per unit of flow. An investigation utilizing this criterion is conducted regarding the determination of the optimum operating point. It is pointed out that the selection of operating points has to maximize the product of the amount of heat processed by the thermodynamic efficiency of the process and not the efficiency itself. It is shown that the operation of a plant in accordance with the developed principles would result in the release of deep-sea water at a temperature significantly closer to the surface-water temperatures.

G.R.

A78-33350 # The foam OTEC system - A proposed alternative to the closed cycle OTEC system. C. Zener (Carnegie-Mellon University, Pittsburgh, Pa.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VIII-27 to VIII-29; Discussion, p. VIII-30.

Traditionally, Ocean Thermal Energy Conversion (OTEC) plants have operated either on the D'Arsonval closed cycle or the Claude open cycle, both of which use a single-phase working fluid. This paper presents a new concept for OTEC, whereby a two-phase foam system is used to move the input warm water downward into the two-phase region, where the liquid and vapor phases are closely coupled. Advantages of the system include the absence of heat exchangers (thereby reducing the possibility of fouling), no warm water exhaust, and greater (by a factor of 5 to 10) power output per unit of warm water input. Attention is given to the structural parameters of the foam itself.

D.M.W.

A78-33351 # Preliminary analysis of the effects of sea water leakage on the performance of the ammonia cycle. H. Hafezzadah, D. W. Johnson, and K. E. Starling (Oklahoma, University, Norman, Okla.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VIII-31 to VIII-35; Discussion, p. VIII-35, VIII-36. Contract No. E(40-1)-4918.

The effects of water contamination on an OTEC power plant utilizing ammonia as the working fluid were investigated with reference to power cycles with and without recycle around the evaporator. The thermodynamic effects of increasing the water concentration in an optimized ammonia cycle plant were analyzed by means of the Han-Starling generalized correlation with appro-

prate parameters for ammonia-water mixtures. In the analysis and in a study using an OTEC simulator it was assumed that an actual OTEC-ammonia plant was operating at an offshore location. The results indicate that a small amount of water could be tolerated without serious degradation in cycle performance, and that the amount of water which could be tolerated increased as the recycle ratio around the evaporator increased.

M.L.

A78-33352 # The Mist Flow OTEC Plant. S. L. Ridgway (R & D Associates, Marina del Rey, Calif.). In: Annual Conference on Ocean Thermal Energy Conversion, 4th, New Orleans, La., March 22-24, 1977, Proceedings. New Orleans, University of New Orleans, 1977, p. VIII-37 to VIII-41.

The Mist Flow OTEC Plant uses the steam evaporated from a spray of very fine warm water droplets to lift these droplets to substantial heights. The used steam is condensed at the end of the lift by a cold water spray. Gravitational potential energy is removed from the warm water in a conventional hydraulic turbine to provide the desired power output. The large evacuated duct in which the upward mist flow takes place is the major (\$360/kw) cost element of the system.

(Author)

A78-33359 * Making aerospace technology work for the automotive industry - Introduction. W. T. Olson (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper. 10 p.*

In many cases it has been found that advances made in one technical field can contribute to other fields. An investigation is in this connection conducted concerning subjects from contemporary NASA programs and projects which might have relevance and potential usefulness to the automotive industry. Examples regarding aerospace developments which have been utilized by the automotive industry are related to electronic design, computer systems, quality control experience, a NASA combustion scanner and television display, exhaust gas analyzers, and a device for suppressing noise propagated through ducts. Projects undertaken by NASA's center for propulsion and power research are examined with respect to their value for the automotive industry. As a result of some of these projects, a gas turbine engine and a Stirling engine might each become a possible alternative to the conventional spark ignition engine.

G.R.

A78-33364 * An overview of aerospace gas turbine technology of relevance to the development of the automotive gas turbine engine. D. G. Evans and T. J. Miller (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780075, 23 p. 65 refs.*

The NASA-Lewis Research Center (LeRC) has conducted, and has sponsored with industry and universities, extensive research into many of the technology areas related to gas turbine propulsion systems. This aerospace-related technology has been developed at both the component and systems level, and may have significant potential for application to the automotive gas turbine engine. This paper summarizes this technology and lists the associated references. The technology areas are system steady-state and transient performance prediction techniques, compressor and turbine design and

performance prediction programs and effects of geometry, combustor technology and advanced concepts, and ceramic coatings and materials technology. (Author)

A78-33368 Electric vehicles in Germany - Present and future. C. Bader and W. Stephan (Deutsche Automobilgesellschaft, Forschungslaboratorium, West Germany). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780087*. 14 p. 13 refs.

As long as economic considerations keep electric transport vehicles in the limelight of interest, the arguments raised in favor of the electric vehicle in general will prove unconvincing. In the drive system the separately excited shunt-wound D.C. motor is becoming widely acknowledged as traction motor; current developments deal with the replacement of electric power control units by mechanical components. Hybrid drive units are mainly employed in buses; so far no uniform solution has evolved. List prices of electric transport vehicles reveal the financial burden caused by energy storage units and their maintenance. (Author)

A78-33376 General safety considerations of the Ohio DOT electric vehicle. W. C. Harhay. *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780160*. 23 p.

Two conventional gasoline-powered four passenger coupes were converted to electric drive for use in the Ohio Department of Transportation motor pool. Compliance to applicable Federal Motor Vehicle Safety and anticipated Department of Energy Standards were design goals. The implications for fire and shock hazards as well as dynamics compliance were considerations in the scope of effort. Techniques used and results of preliminary tests are reported. It was concluded that conversion of conventional vehicles to electric drive can be undertaken to achieve safety parity. (Author)

A78-33377 A digital computer program for simulating electric vehicle performance. K. E. White (Exxon Enterprises, Inc., New York, N.Y.). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780216*. 16 p. 24 refs.

A digital computer program has been developed that simulates dc and ac electric vehicle operation. Included in the program are battery, controller and motor models which are designed to be easily modified as new drive systems are developed. The simulation technique used accurately models the time response of the vehicle and has proven useful in the design and stability analysis of vehicle control systems. (Author)

A78-33378 Computer simulation of an advanced hybrid electric-powered vehicle. M.-C. Chang (AiResearch Manufacturing Company of California, Torrance, Calif.). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780217*. 17 p.

The advanced hybrid electric-powered vehicle features a regenerative power system that uses a flywheel that supplements lead-acid battery power during peak power demands for current leveling, and that converts vehicle kinetic energy to retrievable flywheel energy by means of regenerative braking. The process of energy storage and conversion to propulsion power is accomplished by a unique arrangement of the flywheel, generator, motor, and final power drive shaft connected by a differential planetary gear set. (Author)

A78-33379 On the relationship between gross vehicle weight, payload, effective range, and cost of electric vehicles. J. P. Altendorf, A. Kalberlah, and N. Saridakis (Volkswagen AG, Wolfsburg, West Germany). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780220*. 11 p. 6 refs.

A78-33380 Mathematical model for the design of grids for electric vehicle batteries. L. E. Vaaler and E. W. Brooman (Battelle

Columbus Laboratories, Columbus, Ohio). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780221*. 10 p.

The potential and current distribution over the grid of a lead-acid battery can be calculated by applying Kirchhoff's Law to a three-dimensional resistance network analog. Such a model was used to simulate the high-rate discharge of a typical grid having a conventional, uniform pattern of grid members. The potential and current density were found to vary widely over the grid surface. Modifications to the design of the grid make the potential and current density distribution more uniform, which would lead to more efficient utilization of the battery active materials, and an improved battery performance. (Author)

A78-33381 Further studies with a hydrogen engine. J. Levi and D. B. Kittelson (Minnesota, University, Minneapolis, Minn.). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780233*. 10 p. 14 refs.

This paper describes the performance and emissions of a hydrogen-fueled, spark-ignited engine. An electronic control device, designed to provide the engine with a timed injection of the fuel; is shown to give high mean effective pressures and high efficiencies. The oxides of nitrogen from the exhaust gases have been analyzed and the mechanism for their formation is reviewed. The paper further describes an experiment with traces of hydrocarbons added to the hydrogen in an attempt to explain any additional phenomena that may be taking place during the combustion, such as 'prompt NO' which is known to occur in hydrocarbon flames only. As it turns out, such additions have a negligible effect on the NO_x formation in the region investigated. (Author)

A78-33382 * Test and evaluation of 23 electric vehicles for state-of-the-art assessment. M. O. Dustin and R. J. Denington (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780290*. 12 p. 18 refs.

Data developed by ERDA used to evaluate the performance parameters of modern electric vehicles is presented with reference to range, acceleration, coast-down, and braking. Eight of the tested vehicles had some type of regenerative braking system, which provided range increases from 1 to 31 percent. In comparison with conventional vehicles, performance was found to be lower, and reliability poorer. Energy consumption was the same, but electric power is less damaging to the environment than hydrocarbon fuels, and does not use up an increasingly scarce resource. D.M.W.

A78-33383 The efficiency improvement of electric vehicles by regenerative braking. R. Kasama, S. Naito, H. Katada (Hitachi, Ltd., Sawa Works, Sawa, Japan), and T. Shibata (Hitachi, Ltd., Tokyo, Japan). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780291*. 12 p.

Generally in electric vehicles regenerative braking is incorporated to increase urban driving range on a single charge and to get the same brake torque as engine brake. In this paper analysis of the regenerative operation by thyristor chopper control is described. Firstly, to clarify regenerative efficiency, the calculation of various losses, such as commutation loss and thyristor loss, which arise at braking mode is discussed, and it is shown that the regenerative efficiency calculated from above losses agrees closely with test results. Secondly, the A.F.C. (Automatic Field Control) regenerative braking system is introduced. As in this A.F.C. regenerative control system, using shunt motor, field current is controlled inversely proportional to motor speed and regenerative operation is obtainable by low motor speed, this system is very suitable for electric vehicles. Thirdly, it is noted that by utilizing this A.F.C. regenerative brake control, actual urban driving range can be increased by approximately 16%. (Author)

A78-33385 Large buses and the Townobile electric city transit system. L. R. Leembruggen (Elroy Engineering Pty., Ltd., Australia). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780293*. 11 p.

Mass transit vehicles are considered in regard to their operational efficiency, i.e., speed, cost, fuel economy, stage of development, and their usefulness in a given urban/suburban situation. Attention is given to the dual-mode Townobile Battery-Trolley coach, which recharges its batteries automatically when riding connected to overhead wires in urban areas, but can operate independently on the stored power when away from the wires in a suburban setting.

D.M.W.

A78-33386 Decreasing on-board fuel consumption in heat engine/battery electric hybrids by battery depletion. V. Wouk. *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780295*. 15 p. 20 refs.

Test results on three different configurations of low-emission hybrid vehicles (heat engine/battery-electric hybrids) are presented. Hybrid I is characterized by a quasi-constant manifold vacuum operation; Hybrid II is a parallel hybrid designed as a taxi capable of having the engine operate in an off-on mode with an all-electric operation for low noise and zero emissions in residential communities; Hybrid III is an all-electric series hybrid. The effect of battery depletion on the use of onboard petroleum is assessed. Attention is given to a discussion of the data obtained when measuring the electrical energy required to charge the batteries to the state of energization existing prior to the test during which the batteries discharged. It is shown that fuel consumption is reduced as much as 35% on the FDP (Federal Driving Procedure) for testing emissions and measuring fuel economy, and that more than 50 mpg is obtained on SAE J227a, the standard for measuring range of an electric vehicle on a repetitive test cycle.

S.D.

A78-33387 Electric-flywheel vehicle for postal service applications. T. A. Norman (U.S. Postal Service, Washington, D.C.). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780297*. 4 p.

The U.S. Postal Service and the Department of Energy have jointly developed and installed a flywheel system in a 1/4 ton electric postal delivery vehicle. The completed vehicle is undergoing test and evaluation. Electric vehicles have the advantage over existing internal combustion engine vehicles of producing minimum pollution and requiring no oil based fuels. Preliminary test results show that adding a flywheel can significantly improve performance and increase the potential application of the electric vehicle for postal delivery service without an increase in energy consumption.

(Author)

A78-33388 Experimental and theoretical analysis of Wankel engine performance. G. A. Danieli (Calabria, Università, Arcavacata di Rende, Italy), J. C. Keck, and J. B. Heywood (MIT, Cambridge, Mass.). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780416*. 23 p. 24 refs.

A model for predicting the performance and emissions characteristics of Wankel engines has been developed and tested. Each chamber is treated as an open thermodynamic system and the effects of turbulent flame propagation, quench layer formation, gas motion, heat transfer and seal leakage are included. The experimental tests were carried out on a Toyo Kogyo 12B engine under both motoring and firing conditions and values for the effective seal leakage area and turbulent heat transfer coefficient were deduced. The agreement between the predicted and measured performances was reasonable. Parametric studies of the effects of reductions in seal leakage and heat transfer were carried out and the results are presented. (Author)

A78-33389 Development on exhaust emissions and fuel economy of the rotary engine at Toyo Kogyo. K. Yamamoto and T. Muroki (Toyo Kogyo Co., Ltd., Japan). *Society of Automotive*

Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780417. 22 p.

A78-33390 An update of the development on the new Audi NSU rotary engine generation. R. van Basshuysen and G. Wilmers (Audi NSU Auto Union AG, West Germany). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780418*. 22 p. 7 refs.

A78-33395 Gas laser with solar excitation. B. F. Gordiets, L. I. Gudzenko, and V. Ia. Panchenko (Akademiia Nauk SSSR, Fizicheskii Institut, Moscow, USSR). (*ZHETF Pis'ma v Redaktsiiu*, vol. 26, Aug. 5, 1977, p. 163-165.) *JETP Letters*, vol. 26, Aug. 5, 1977, p. 152-154. 6 refs. Translation.

Gas lasers are found suitable for use with solar energy as a pump source because they provide a high volume of the active medium, coupled with low values for the pump threshold. The dynamics of solar pumped gas lasers are analyzed using CO₂, Br₂, and He. It is noted that the larger part of solar radiation lies in the visible spectrum, which is not especially suitable for pumping, but reactions within the gases are found to render long visible wavelengths somewhat more energetic.

D.M.W.

A78-33573 Investigation of the effective thermal conductivity of metal-fiber wicks in low-temperature heat pipes. M. G. Semena and V. K. Zaripov (Kievskii Politekhnikheskii Institut, Kiev, Ukrainian SSR). (*Inzhenerno-Fizicheskii Zhurnal*, vol. 33, Aug. 1977, p. 255-262.) *Journal of Engineering Physics*, vol. 33, no. 2, Mar. 10, 1978, p. 911-916. 16 refs. Translation.

The experiments described were carried out to study the effective heat conductivity of wicks prepared from sintered copper, nickel, Nichrome, and stainless-steel fibers impregnated with methyl and ethyl alcohol, acetone, and distilled water. The monodisperse discrete fibers measured 20, 30, 40, 50, and 70 microns in diameter. The porosity of the wicks ranged from 10 to 96%. Test temperatures were between 16 and 35 C. The influence of such factors as porosity, fiber diameter, contact thermal resistance, and the heat conductivity of the liquids and fiber materials on the effective heat conductivity of the wicks was investigated. The heat transfer coefficients in the condensation zones of several low-temperature heat pipes employing metal-fiber wicks are calculated.

V.P.

A78-33589 # The extraterrestrial imperative. K. A. Ehrlicke (Space Global, La Jolla, Calif.). *Air University Review*, vol. 29, Jan.-Feb. 1978, p. 2-20.

The exploitation of the space environment for economic gain in the short run, and for the evolution of the human species (in terms of expanded consciousness), is dealt with in three phases: exo-industrialization, exourbanization, and neocosms. The first phase, currently at its beginnings, includes the Space Shuttle and the macrostructures which it will fabricate in orbit, e.g., large reflectors for beaming sunlight to selected areas on the night side of earth for urban illumination, the generation of solar power, and horticulture; as well as facilities for the transmission of solar energy in the form of microwaves (SSPS), and direct beam communications, effecting a quantum leap in the amount of data which can be exchanged among the different regions of earth. The second and third phases, space habitats and Androcells, respectively, envision all of human activity taking place in a space environment, with applications ranging from manned interplanetary expeditions to the production of goods and services for terrestrial use.

D.M.W.

A78-33801 Solar heating - Solar collectors for heating purposes (Le chauffage solaire - Les insolateurs à fonction thermique). M. Touchais (Coopération Méditerranéenne pour l'Energie Solaire, Marseille, France). Villeneuve-Loubet, Alpes-Maritimes, France, Estrel, 1977. 119 p. 10 refs. In French. \$19.85.

Solar collectors for heating systems are discussed, with attention given to heat losses, the optimal collector orientation for Northern

Hemisphere applications, energy output calculations, and design problems encountered when installing solar collectors in an urban environment. Types of collectors described include anticonvective designs, reinforced designs for year-round use, and selective-collection cellular designs. Solar collectors relying on air or water as the heat transfer fluid receive consideration; solar heating systems employing a heat pump to recycle heat losses are also mentioned.

J.M.B.

A78-33803 Fluidized bed combustion of coal and waste materials. L. Yaverbaum, Park Ridge, N.J., Noyes Data Corp. (Pollution Technology Review, No. 35; Energy Technology Review, No. 15), 1977. 278 p. 60 refs. \$39.

In a discussion of coal-fired fluidized beds attention is given to the development of coal-fired fluidized bed boilers, general studies of combustion processes, combustion configurations and cycle designs, studies of alternative concepts and modifications, sorbents for sulfur removal systems, questions of spent stone disposal, regeneration systems for spent stone, particulate control systems, and trace element studies. Problems of waste handling in fluidized beds are also investigated, taking into account residual oil gasification/desulfurization, proprietary disposal systems and special designs, and sewage, industrial, and other waste treatment processes. Aspects of sewage sludge incineration are discussed along with systems for municipal sewage, the combustion of anthracite wastes, char combustion to drive a power plant, radioactive waste incineration, fluidized bed solidification of nuclear wastes, and combustion disposal of manure wastes.

G.R.

A78-34008 The influence of interface states and energy barriers on the efficiency of heterojunction solar cells. H. J. Pauwels and G. Vanhoutte (Gent, Rijksuniversiteit, Ghent, Belgium). *Journal of Physics D - Applied Physics*, vol. 11, Apr. 1, 1978, p. 649-667. 28 refs.

The optimum structure of heterojunction solar cells is studied with reference to the influence of interface states and energy barriers. Diagrams which make it possible to determine the optimum number of band gaps for an energy barrier at the interface and the corresponding optimum efficiency are given. Three types of optimum structures are found. The first, which acts like a Schottky diode solar cell, consists of a weakly doped semiconductor with an optimum band gap which is inverted at the interface, and a strongly doped semiconductor with a larger band gap. The second type consists of a strongly doped semiconductor with an optimum band gap and an energy barrier at the interface which approaches zero from the positive side. The third type consists of a cell similar to the first type but with the strongly doped semiconductor having a smaller band gap.

S.C.S.

A78-34009 Cu/xS/CdS thin-film solar cells using chemically sprayed CdS films. W. C. Siu and H. L. Kwok (Chinese University of Hong Kong, Shatin, Hong Kong). *Journal of Physics D - Applied Physics*, vol. 11, Apr. 1, 1978, p. 669-680. 9 refs.

A study is made of Cu(x)S/CdS thin-film solar cells formed on chemically sprayed CdS films. Particular consideration is given to cell photovoltaic response when the physical properties (such as film deposition parameters, film thickness, grain size and structure, and spectral response) of the chemically sprayed CdS films are changed. It is found that the photovoltaic output is limited by the series resistance and a junction effect when the crystallite size becomes too large. This inhomogeneous structure lowers the shunting resistance and increases recombination losses. It is suggested that a brief annealing at 300 C improves cell performance. The maximum short-circuit current and open-circuit voltage at 1 AMO for an iodine doped cell are 6.2 mA/sq cm and 0.30 V, respectively. A fill factor of 0.5-0.6 at 50% sunlight intensity is obtained.

S.C.S.

A78-34021 # Photovoltaic conversion of solar energy for terrestrial use - The present situation and the developmental trends (Conversione fotovoltaica dell'energia solare per impiego terrestre - Situazione attuale e linee di sviluppo). E. Fanetti, G. Fiorito, C. Flores, and G. Gasparrini (Centro Informazioni Studi ed Esperienze

S.p.A., Milan, Italy). *Alta Frequenza*, vol. 47, Mar. 1978, p. 104-113. 78 refs. In Italian.

The prospects for solar cell development are reviewed, with special attention given to silicon cell manufacturing techniques, cadmium sulfide cells, and the use of thin-film cells for solar concentrators. Silicon cell manufacturing techniques include polycrystalline processes, the Czochralski method, and chemical vapor deposition; costs of these preparation techniques are also assessed. In addition, mass production of solar cells through deposition of thin films of Si, GaAs, CdS or InP on inexpensive substrates receives consideration. The economics of low-cost silicon cell conversion processes and silicon cell concentrating schemes are discussed on the basis of ERDA data.

J.M.B.

A78-34048 The influence of tunneling effects on the efficiency of heterojunction solar cells. P. De Visschere and H. J. Pauwels (Gent, Rijksuniversiteit, Ghent, Belgium). *Applied Physics*, vol. 15, Apr. 1978, p. 413-422. 8 refs. Research supported by the Commission of European Communities and Belgian Ministry of Science.

A theoretical model is developed which presents the transport properties through the space charge region of a p-n heterojunction solar cell, whereby not only recombination through interface states but also tunneling through potential barriers is taken into account. The question of whether tunneling can give rise to optimum heterojunction structures which have better efficiencies than without tunneling is investigated. It is found that tunneling can make the structure optimum only if the strongly doped semiconductor has an optimum bandgap and the weakly doped semiconductor a larger bandgap. In all other cases of optimum structures tunneling lessens the efficiency.

(Author)

A78-34076 # A parametric study of hot water storage for peak power generation. K. W. Li (North Dakota State University, Fargo, N. Dak.). *ASME, Transactions, Journal of Engineering for Power*, vol. 100, Apr. 1978, p. 229-234. 10 refs.

A parametric study of a steam turbine power plant with hot-water storage is presented based on the concept of thermodynamic availability. Parameters affecting the plant performance and its economic acceptance are identified, and fuel cost and storage size are estimated for peak power generation. Expressions relating to the storage power plant performance include the overall peak power conversion efficiency, the storage availability (energy), and the ratio of peaking operation time to off-peak operation time. The basic principle used is an availability balance with allowance for all availability losses. Results of numerical calculations indicate that feedwater storage attached to a conventional power plant can generate additional power, which may be used for peak power production in utility companies.

S.D.

A78-34078 * # Performance and economics of advanced energy conversion systems for coal and coal-derived fuels. J. C. Corman and G. R. Fox (General Electric Co., Schenectady, N.Y.). *ASME, Transactions, Journal of Engineering for Power*, vol. 100, Apr. 1978, p. 252-259. Contract No. NAS3-19406.

The desire to establish an efficient Energy Conversion System to utilize the fossil fuel of the future - coal - has produced many candidate systems. A comparative technical/economic evaluation was performed on the seven most attractive advanced energy conversion systems. The evaluation maintains a cycle-to-cycle consistency in both performance and economic projections. The technical information base can be employed to make program decisions regarding the most attractive concept. A reference steam power plant was analyzed to the same detail and, under the same ground rules, was used as a comparison base. The power plants were all designed to utilize coal or coal-derived fuels and were targeted to meet an environmental standard. The systems evaluated were two advanced steam systems, a potassium topping cycle, a closed cycle helium system, two open cycle gas turbine combined cycles, and an open cycle MHD system.

(Author)

A78-34080 # Power system economics - On selection of engineering alternatives. P. Leung (Bechtel Power Corp., Los Angeles, Calif.) and R. F. Durning. (*American Society of Mechanical Engineers, Joint Power Generation Conference, Long Beach, Calif., Sept. 18-21, 1977, Paper 77-JPGC-Pwr-7.*) *ASME, Transactions, Journal of Engineering for Power*, vol. 100, Apr. 1978, p. 333-343; Discussion, p. 343-346; Authors' Closure, p. 346. 18 refs.

The paper outlines the computation technique of the 'present worth of revenue requirements' method for selection of engineering alternatives primarily for thermal electric power systems. This method of comparison is best suited for selection of competing engineering alternatives, particularly when they have different capital costs, different annual expenses, or expenses may occur intermittently throughout the economic life of the alternatives. The method is discussed in terms of components of revenue requirements, fuel expense, and operating and maintenance expenses. Illustrative examples are presented which stress applications in the electrical, mechanical, and thermodynamic areas of electric power generation. The method is suitable for converting intangible items into tangible dollars in terms of revenue receipts and disbursements enabling the comparison of engineering alternatives on a compatible basis. S.D.

A78-34186 # Emissions from FBC boilers. D. B. Henschel (U.S. Environmental Protection Agency, Research Triangle Park, N.C.). *Environmental Science and Technology*, vol. 12, May 1978, p. 534-538. 5 refs.

Emissions from coal-fired fluidized-bed combustion plants are discussed. The emissions include wastes arising from storage and handling of coal and limestone, the steam cycle effluents, stack gas outputs and solid residues. These emissions may be subject to control by a number of federal regulations, such as source performance standards, ambient air quality standards and hazardous air pollutant emission standards. Control methods for sulfur dioxide, oxides of nitrogen and particulates emitted by fluidized-bed combustors are considered, with special attention given to the sorbent requirements needed to meet sulfur dioxide emissions standards for atmospheric fluidized-bed combustors. J.M.B.

A78-34223 Coal gasification - Better late than never. D. F. Hogsett and B. W. Primeaux (Cities Service Gas Co., Oklahoma City, Okla.). *Energy Communications*, vol. 4, no. 2, 1978, p. 107-127.

This paper justifies the development of coal gasification in the U.S. to supplement dwindling supplies of natural gas. First, the need for development of domestic coal resources is outlined. Then, by means of a comparison with coal fired electric power generation, coal gasification is shown to be economically attractive, particularly to existing gas customers. The status of announced coal gasification projects and the problems encountered are outlined with emphasis on regulatory, financing and timing problems. Possible government support for such projects is discussed. This paper shows that coal gasification will be a part of the future energy picture in the United States. (Author)

A78-34224 SO₂ control technologies - Commercial availabilities and economics. W. H. Ponder, R. D. Stern (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Research Triangle Park, N.C.), and G. G. McGlamery (Tennessee Valley Authority, Muscle Shoals, Ala.). *Energy Communications*, vol. 4, no. 2, 1978, p. 175-212. 28 refs.

The technology, commercial availability, and costs of six SO₂ control technologies are discussed. The technologies are the use of coal with an acceptably low sulfur content, physical and chemical coal cleaning, flue gas desulfurization (FGD) processes, coal gasification, coal liquefaction, and fluidized bed combustion of coal. Availability/cost estimates data for SO₂ control alternatives are provided. It is suggested that essentially all coal-fired electric power plants could achieve compliance operation between now and 1985 through the application of currently available continuous SO₂ emission control technologies, singly or in combination. Combined approaches involving either FGD/coal cleaning or FGD/low-sulfur coal might be more economical than any single approach during the period up to 1985. M.L.

A78-34225 Political and economic justification for immediate realization of a syn fuels industry. J. T. Gallagher (American Lurgi Corp., Hasbrouck Heights, N.J.). *Energy Communications*, vol. 4, no. 2, 1978, p. 213-231. 6 refs.

Patterns of energy use and shortages are considered, and reasons for immediately launching a syn fuels industry (based on synthesized natural gas from coal) are presented. The costs of first generation plants are examined with reference to the contributions that first generation plants would provide to the design of second generation plants. Political, economic, and employment benefits that would result from a large-scale program are indicated. It is suggested that, with government cooperation, four large SNG plants could be built and in operation in less than four years. M.L.

A78-34237 Intense relativistic electron-beam trajectories and their effect on beam heating of toroidally confined plasma. T. R. Lockner and B. R. Kusse (Cornell University, Ithaca, N.Y.). *Journal of Applied Physics*, vol. 49, Apr. 1978, p. 2357-2364. 27 refs. NSF Grant No. 75-22556.

The trajectories of an intense relativistic electron beam propagating between a toroidal plasma column and a conducting vacuum wall are calculated theoretically and verified experimentally. Three classes of trajectories are observed, including a set of banana-type orbits. The significance of these trajectories on the ability of the beam to transfer energy to the plasma is discussed. (Author)

A78-34256 High conductivity ZnSe films. J. Aranovich, A. L. Fahrenbruch, and R. H. Bube (Stanford University, Stanford, Calif.). *Journal of Applied Physics*, vol. 49, Apr. 1978, p. 2584, 2585. 11 refs. Research supported by the U.S. Department of Energy.

The large band gap (2.7 eV) of ZnSe makes it suitable for photovoltaic heterojunctions in solar energy conversion devices. The material must therefore be available in thin films with moderate resistivity (10-100 Ohm cm). A method for obtaining thin ZnSe films is outlined, whereby vacuum evaporation is effected using three Knudsen cells for simultaneous and independent coevaporation of ZnSe, In or Ga, and Zn. The remaining ZnSe, with all but trace impurities removed, was observed, to offer electrical conductivity comparable to degenerate n-type material with electron densities in the 10 to the 19th per cu cm range. D.M.W.

A78-34273 * Some studies on a solid-state sulfur probe for coal gasification systems. K. T. Jacob (California, University, Berkeley, Calif.; Toronto, University, Toronto, Canada), D. B. Rao (NASA, Ames Research Center, Moffett Field; California, University, Lawrence Berkeley Laboratory, Berkeley, Calif.), and H. G. Nelson (NASA, Ames Research Center, Moffett Field, Calif.). *Electrochemical Society, Journal*, vol. 125, May 1978, p. 758-762. 16 refs.

As a part of a program for the development of a sulfur probe for monitoring the sulfur potential in coal gasification reactors, an investigation was conducted regarding the efficiency of the solid electrolyte cell Ar+H₂+H₂S/CaS+CaF₂+(Pt)/CaF₂/(Pt)+CaF₂+CaS/H₂S+H₂+Ar. A demonstration is provided of the theory, design, and operation of a solid-state sulfur probe based on CaF₂ electrolyte. It was found that the cell responds to changes in sulfur potential in a manner predicted by the Nernst equation. The response time of the cell at 1225 K, after a small change in temperature or gas composition, was 2.5 Hr, while at a lower temperature of 990 K the response time was approximately 9 hr. The cell emf was insensitive to a moderate increase in the flow rate of the test gas and/or the reference gas. The exact factors affecting the slow response time of galvanic cells based on a CaF₂ electrolyte have not yet been determined. The rate-limiting steps may be either the kinetics of electrode reactions or the rate of transport through the electrolyte. G.R.

A78-34274 CuInS₂ liquid junction solar cells. M. Robbins, K. J. Bachmann, V. G. Lambrecht, F. A. Thiel, J. Thomson, Jr., R. G. Vadimsky, S. Menezes, A. Heller, and B. Miller (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). *Electrochemical Society*,

Journal, vol. 125, May 1978, p. 831, 832. 6 refs.

Samples of single crystal CuInS₂ were converted into n-type material of low resistivity. Polycrystalline CuInS₂ powder was pressure sintered to obtain pellets with 99.5 to 99.9% of single crystal density. In both cases the material was annealed in Cd vapor. Current-voltage curves for n-CuInS₂ crystal electrodes exposed to constant tungsten-halogen illumination as a function of temperature were obtained. At 60-75 mW/sq cm insolation levels, cells with different n-CuInS₂ specimens delivered, at ambient temperatures, maximum power outputs corresponding to power conversion efficiencies of 3.5 - 4.3%. The possibilities for practical applications in the case of the n-CuInS₂ based cell depend probably to a large degree on the enhancement of the fill factor to take advantage of the good limiting open circuit and short circuit parameters. G.R.

A78-34331 # Investigation of the energy capacity of wound composite flywheels. (Issledovanie energoemkosti makhovikov iz kompozitov, izgotovlennykh namotkoi). G. G. Portnov and V. L. Kulakov (Akademiia Nauk Latvinskoi SSR, Institut Mekhaniki Polimerov, Riga, Latvian SSR). *Mekhanika Polimerov*, Jan.-Feb. 1978, p. 73-81. 13 refs. In Russian.

The paper analyzes the energy capacity of flywheels fabricated with windings of composite materials with given relations between the deformation and strength characteristics. Maximum-stress criteria are used to determine the greatest energy capacity of the flywheels. The regions of strength and stiffness parameters corresponding to various means of calculating the energy capacity are identified. S.D.

A78-34380 Energy conservation and thermal comfort in a New York City high rise office building. J. T. H. Lammers (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands), L. G. Berglund, and J. A. J. Stolwijk (Yale University, New Haven, Conn.). *Environmental Management*, vol. 2, Mar. 1978, p. 113-117.

Detailed analysis of an energy conservation program implemented on a 46 story government building is presented. Conservation was achieved by reduced lighting, changes in building operating hours, thermostat settings of 20 C in the winter and 27 C in the summer, and the elimination of air conditioning reheat. As a result, energy consumption in the summer was reduced by 54 percent. A survey of the occupants' thermal comfort and the insulating value of their clothing was taken. In the summer 68 percent were comfortable compared with 80 percent in the winter. The insulating value of the clothing worn by the women was consistently less than that of the men; the difference was largest in the summer. Though the temperatures in the occupied spaces were not as cold or as warm as the thermostat settings, the survey indicates that comfort could be improved if occupants dressed more appropriately for the expected thermal environment of the work place. Additional large savings may be achieved in this and similar buildings through a reduction in the energy cost of transporting air and chilled and hot water around the building for the environmental control systems. (Author)

A78-34398 Magma - A potential source of fuels. C. J. M. Northrup, Jr., T. M. Gerlach, P. J. Modreski, and J. K. Galt (Sandia Laboratories, Albuquerque, N. Mex.). *International Journal of Hydrogen Energy*, vol. 3, Mar. 31, 1978, p. 1-10. 29 refs. Contract No. AT(29-1)-789.

Recent calculations and measurements indicate that basaltic magma is a new, extensive source for fuels (hydrogen, carbon monoxide, and methane). The fuel production processes have been found to occur in nature as well as the laboratory and as a result, our work indicates that current concepts of geothermal energy can be broadened beyond producing only steam and heat. When magma is considered as a geothermal resource, its use for the direct production of fuels should be included. It is possible to generate several mole percent hydrogen when water-rich fluid is equilibrated with the ferrous and ferric iron in magma. This paper describes the basis of the fuel production processes, the fuel yields for injected water and water plus natural organic matter (biomass), and the increased

geothermal resources that would be made available by these processes. (Author)

A78-34399 The role of nuclear energy in the more efficient exploitation of fossil fuel resources. W. Seifritz (Eidgenössische Technische Hochschule, Würenlingen, Switzerland). (Symposium Course on Hydrogen Energy and Applications, Puerto Ordaz, Venezuela, Mar. 7-11, 1977.) *International Journal of Hydrogen Energy*, vol. 3, Mar. 31, 1978, p. 11-20. 7 refs.

Energy input/output relations for nuclear and solar systems which interact with fossil fuel use are examined in terms of the energy theory of value. According to this theory, the value of a resource is defined more or less completely by the energy that that resource can produce. An analysis of potential energy production suggests that nuclear power generation offers an efficient way of extending the use of limited fossil fuel resources and of facilitating the transition to a fossil fuel alternative. It is thought that nuclear power would be particularly useful during the transition period when the use of the new alternative energy source would be expected to increase at an exponential rate. The role of nuclear energy in conjunction with energy production from hydrogen is discussed. M.L.

A78-34400 High efficiency water electrolysis in alkaline solution. A. J. Appleby, G. Crepy, and J. Jacquelin (Compagnie Générale d'Electricité, Marcoussis, Essonne, France). *International Journal of Hydrogen Energy*, vol. 3, Mar. 31, 1978, p. 21-37. 30 refs.

The paper examines procedures for increasing the efficiency and lowering the capital cost of state-of-the-art pressure-type electrolyzers which utilize alkaline solutions. The desired improvements, including a doubling of current density accompanied by a halving of the internal resistance, are discussed. Improved electrode activity can be obtained by catalysis and by increasing the effective surface area and temperature. As long as asbestos separators are not used, a temperature increase to 120-130 C, considered feasible, would probably not cause materials problems. It is shown that advanced electrodes are capable of operating at conditions which correspond to isothermal operation. M.L.

A78-34468 * High temperature thermal energy storage, including a discussion of TES integrated into power plants. R. H. Turner (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). Philadelphia, Pa., Franklin Institute Press, 1978. 101 p. 48 refs. \$6.50.

Storage temperatures of 260 C and above are considered. Basic considerations concerning energy thermal storage are discussed, taking into account general aspects of thermal energy storage, thermal energy storage integrated into power plants, thermal storage techniques and technical considerations, and economic considerations. A description of system concepts is provided, giving attention to a survey of proposed concepts, storage in unpressurized fluids, water storage in pressurized containers, the use of an underground lined cavern for water storage, a submerged thin insulated steel shell under the ocean containing pressurized water, gas passage through solid blocks, a rock bed with liquid heat transport fluid, hollow steel ingots, heat storage in concrete or sand, sand in a fluidized bed, sand poured over pipes, a thermal energy storage heat exchanger, pipes or spheres filled with phase change materials (PCM), macroencapsulated PCM with heat pipe concept for transport fluid, solid PCM removed from heat transfer pipes by moving scrapers, and the direct contact between PCM and transport fluid. G.R.

A78-34486 Vehicular gas turbine with ceramic recuperative heat exchanger. (Fahrzeuggasturbine mit keramischem rekuperativen Wärmeübertrager). S. Förster, G. Hewing, and M. Kleemann. *Motortechnische Zeitschrift*, vol. 39, Apr. 1978, p. 141-144, 147-149. In German.

A utilization of gas temperatures of about 1300 C at the turbine inlet for an improvement of the operational efficiency of vehicular gas turbines requires a use of ceramic materials for the construction of certain gas turbine components. A description is presented of a ceramic recuperator which is particularly suited for vehicular

propulsion systems of all types with shaft powers of 30 kW and above. The first ceramic recuperator elements which have been developed are to be tested in a comprehensive experimental program with regard to their thermal and operational characteristics. Three manufacturing techniques appear suitable for an inexpensive and reliable production of the recuperator elements from silicon nitride or cordierite. Gas turbines for one-flow and two-flow recuperators for shaft powers of 70 and 140 kW are discussed, taking into account three design examples. G.R.

A78-34511 Testing of solar collectors. H. Tabor (Scientific Research Foundation, Jerusalem, Israel). *Solar Energy*, vol. 20, no. 4, 1978, p. 293-303. 6 refs.

The paper describes the theory and the experimental procedure for connecting a small number of similar collectors in series and then measuring the temperature rise across each collector. Since, at any instant of time, the flow rates and the solar intensity are identical for the collectors, a number of points on the efficiency-temperature curve are obtained from which the characteristic equation of the collectors can be determined. The limitation of temperature rise, the use of a 'standard' day, and the effects of atmospheric conditions are considered. M.L.

A78-34512 Diffuser augmentation of wind turbines. K. M. Foreman, B. Gilbert, and R. A. Oman (Grumman Fluid Dynamics Laboratory, Bethpage, N.Y.). *Solar Energy*, vol. 20, no. 4, 1978, p. 305-311. 10 refs. Contract No. E(11-1)-2616.

The theory of diffuser augmentation is described, and the wind tunnel investigation of models of two diffuser design concepts is considered in an economic analysis of diffuser-augmented turbines (DAWT). One design concept involves the use of the energetic external wind to prevent separation of the diffuser's internal boundary layer, while the other method uses high-lift airfoil contours for the diffuser wall shape. Diffuser model tests indicate almost a doubling of wind power extraction capability for DAWT in comparison with conventional turbines. Economic studies (1975 cost projections) suggest that the specific power costs for a realistic DAWT configuration are lower than the costs for conventional wind turbines for rotors with diameters over 50 m or less than 20 m. M.L.

A78-34513 Optical properties of solar-absorbing oxide particles suspended in a molten salt heat transfer fluid. W. D. Drotning (Sandia Laboratories, Albuquerque, N. Mex.). *Solar Energy*, vol. 20, no. 4, 1978, p. 313-319. 12 refs. ERDA-supported research.

The optical absorption properties of a high-temperature molten-salt heat-transfer fluid were measured from 0.35 to 2.5 microns using both hemispherical transmission and reflection techniques. This fluid has application as a direct-absorbing working fluid in a high-temperature central-receiver solar-energy facility. To enhance its solar absorption, particulate metallic oxides of Co or Cu were introduced into the fluid. Absorption spectra of these oxide-particle suspensions in the molten salt were determined as a function of dopant concentration ranging from 0 to 0.1 wt% metal nitrate added to the molten salt. The solar-averaged absorption in a fixed layer thickness was calculated for various concentrations of the fluid-particle mixtures. The fluid without oxide particles absorbs approximately 8 per cent of the solar spectrum per cm of path length. Addition of 0.1 wt% of $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ increases this absorption to approximately 90 per cent per cm. (Author)

A78-34514 On the fluctuating power generation of large wind energy converters, with and without storage facilities. B. Sørensen (Copenhagen University, Copenhagen, Denmark). *Solar Energy*, vol. 20, no. 4, 1978, p. 321-331. 19 refs.

Meteorological data for Denmark are used to analyze the power fluctuations and time duration patterns of large hypothetical wind energy generators. When the annual pattern of load variation is taken as the standard, it is found that the power fluctuations from wind energy generators are no greater than the fluctuations in the relation between power used and constant load. The addition of a hypothetical short-term storage capable of delivering the average

power for 10-20 hr would make the wind energy system as dependable as one large nuclear power plant. The requirements for a long-term storage system that would permit full coverage by a wind energy system are discussed. M.L.

A78-34515 Thermochemical energy transport costs for a distributed solar power plant. O. M. Williams (Australian National University, Canberra, Australia). *Solar Energy*, vol. 20, no. 4, 1978, p. 333-342. 19 refs.

Thermochemical energy transport costs are calculated for a solar thermal power plant based on a distributed network of paraboloidal collectors, and the procedure for determining the optimum pipe size distribution is explained. Thermochemical energy transport costs for systems based on ammonia, methanol, water-methane, and sulfur trioxide are dominated by the pipe installation cost, and large collectors tend to have lower installation costs per unit energy than do smaller collectors. The development of pipelaying technology tailored to the requirements of solar thermal power plants is recommended as a means of reducing transport costs. A suggested improvement would involve thermochemical energy transfer systems based on small diameter pipes and hence high system pressures. M.L.

A78-34516 Steering a field of mirrors using a shared computer-based controller. P. O. Carden (Australian National University, Canberra, Australia). *Solar Energy*, vol. 20, no. 4, 1978, p. 343-355. 12 refs.

The paper describes a system for steering a multiplicity of two-axis mirrors by means of a shared computer-based controller. There is no local feedback at the mirrors. The system is applicable to power towers as well as to multifocus paraboloidal mirror systems. Topics discussed include anticipation of the sun's position, mirror coordinate systems, nontracking maneuvers, time sharing, pointing accuracy, rotary actuator, method of communication, and implication for mirror cost and drive mechanism. System operation is explained, economic costs in comparison with other systems are considered, and results from operation are presented. M.L.

A78-34517 * Calibration standards and field instruments for the precision measurement of insolation. M. S. Reid, C. M. Berdahl, and J. M. Kendall, Sr. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Solar Energy*, vol. 20, no. 4, 1978, p. 357, 358. 6 refs. Contract No. NAS7-100.

The design of a fieldworthy survey instrument based on a developed radiation calibration standard is discussed. The radiometer system, a fieldworthy modification of Pacrad, is an all-weather solar radiometer, and a field test is described which demonstrates the instrument's stability in severe environments over an extended period of time. It is suggested that the instrument may be considered a transfer standard as well as a radiometer. It is hoped that future modifications might reduce the 15-deg view angle and improve the tracking system to eliminate weekly manual declination adjustments. M.L.

A78-34520 Energy: Global prospects, 1985-2000. Edited by C. L. Wilson (MIT, Cambridge, Mass.). New York, McGraw-Hill Book Co., 1977. 313 p. \$6.95.

Global energy futures are examined, taking into account critical problems related to the gaps between supply and demand, the decline of the oil era, data concerning the energy demand, aspects of conservation, coal, natural gas, nuclear energy, hydroelectricity, heavy oil, oil sands, oils from shale, a use of solar heat and solar electric energy, the utilization of wind and tidal energy sources, geothermal energy, questions of energy pricing, environment and climate, uncertainties, and national and international issues. An approach for solving the energy problems of the future is discussed. Attention is given to the challenges of forecasting, the overall framework of the considered approach, the world energy price, the world economic growth, the national policy response, oil discoveries and production limits, the principal replacement fuel, and energy and economic growth prospects for the developing countries for the time from 1960 to 2000. G.R.

A78-34603 Variational irreversible thermodynamics of heat and mass transfer in porous solids - New concepts and methods. M. A. Biot (Royal Academy of Belgium, Brussels, Belgium). *Quarterly of Applied Mathematics*, vol. 36, Apr. 1978, p. 19-38. 15 refs.

A recently developed variational principle of virtual dissipation along with a new approach to the thermodynamics of open systems is applied to coupled mass and heat transfer in a porous solid containing a fluid. General differential field equations are derived directly from the variational principle. A general energy flux theorem is formulated. Vapor-liquid phase transition and capillary condensation are discussed. Field equations for nonequilibrium adsorption are also obtained. Lagrangian equations with generalized coordinates are derived directly from the variational principle without use of the field equations. They provide the foundation of finite-element methods as well as of many other techniques particularly suitable in geothermal systems analysis. (Author)

A78-34631 * Preliminary results on the conversion of laser energy into electricity. R. W. Thompson, E. J. Manista, and D. L. Alger (NASA, Lewis Research Center, Cleveland, Ohio). *Applied Physics Letters*, vol. 32, May 15, 1978, p. 610, 611. 11 refs.

A preliminary experiment was performed to investigate conversion of 10.6 micron laser energy to electrical energy via a laser-sustained argon plasma. Short-circuit currents of 0.7 A were measured between a thoriated-tungsten emitter and collector electrodes immersed in the laser-sustained argon plasma. Open-circuit voltages of about 1.5 V were inferred from the current-voltage load characteristics. The dominant mechanism of laser energy conversion is uncertain at this time. Much higher output powers appear possible. (Author)

A78-34677 How do alternative powerplant costs compare. G. Mauri, G. P. Fetterman, Jr., and R. L. Ricci (Exxon Enterprises, Inc., New York, N.Y.). *Automotive Engineering*, vol. 86, May 1978, p. 39-41.

Initial and operating costs are compared for four advanced automotive powerplants: an advanced spark ignition engine, a battery-powered electric motor, a diesel engine, and a diesel-electric hybrid. These systems are studied through computer simulations of vehicle operation over a specific driving cycle which yielded energy consumption estimates. Two types of vehicles are considered: a subcompact passenger car designed primarily for urban/suburban use but capable of cruising at 100 km/hr and mixing safely with suburban traffic; and a full-size car designed for comfortable interstate-highway operation as well as local driving. Power requirements, energy consumption, and cost comparison data are tabulated and discussed for both types of vehicles equipped with the four power systems. It is shown that for subcompacts the all-electric propulsion system can provide an attractive vehicle for local transportation, and that for full-size cars the fuel savings of the diesel and diesel-electric hybrid make them economically attractive. S.D.

A78-34847 New TiO_x-MIS and SiO₂-MIS silicon solar cells. P. Van Halen, R. P. Mertens, R. J. Van Overstraeten, J. Van Meerbergen (Leuven, Katholieke Universiteit, Heverlee, Belgium), and R. E. Thomas (Carleton University, Ottawa, Canada). *IEEE Transactions on Electron Devices*, vol. ED-25, May 1978, p. 507-511. 11 refs. Research supported by the Nationaal Fonds voor Wetenschappelijk Onderzoek.

Two new types of solar cells are described in which either a TiO_x or a SiO₂ layer is deposited onto p silicon; contacts are obtained by means of a MIS tunnel diode grid. It is shown that the TiO_x-MIS cells can be realized by single-mask completely low-temperature processing by employing spin-on of titanium-oxide antireflective coating. Conversion efficiencies of 8% at AM1 have been achieved with these cells; they perform even more efficiently at higher illumination levels. With the SiO₂-MIS cells efficiencies of 12% have been reached, at the expense of a slightly more complicated process. A detailed comparison between the two cells is given. (Author)

A78-34850 A computer analysis of Ga(1-x)Al(x)As-GaAs solar cells with multilayered window structure. A. Usami, Y. Hamamoto, and M. Sonobe (Nagoya Institute of Technology, Nagoya, Japan). *IEEE Transactions on Electron Devices*, vol. ED-25, May 1978, p. 546, 547. 7 refs.

Numerical calculations have been made of the spectral response and conversion efficiency of Ga(1-x)Al(x)As-GaAs solar cells with multilayered window structures. Maximum conversion efficiencies of about 20% are predicted, equaling those achieved with graded band-gap solar cells, for the case of three-layered window structures. (Author)

A78-34877 Significance of the space imagery for studies of the petroleum platform areas. P. V. Florenskii (Akademii Nauk SSSR, Geologicheskii Institut, Moscow, USSR) and A. S. Petrenko (Moskovskii Institut Neftekhimicheskoi i Gazovoi Promyshlennosti, Moscow, USSR). In: Remote sensing of earth resources. Volume 6 - Annual Remote Sensing of Earth Resources Conference, 6th, Tullahoma, Tenn., March 29-31, 1977, Technical Papers. Tullahoma, Tenn., University of Tennessee, 1977, p. 441-464. 13 refs.

Scanner imagery from Landsat-1 and from the Soviet Meteor series satellites was used as an aid in clarifying the plutonic structure of the Lower Volga region of the Soviet Union. The space imagery provided useful information on the geological lineaments of the area and served to define boundaries of deep-seated Precambrian blocks and to locate anticlines containing petroleum and natural gas. The relationship between the space imagery and the internal structure of the region was elucidated by reference to neotectonic formations, gravimetric geodesy and magnetic field measurements. J.M.B.

A78-34905 * # Remote monitoring of the Gravelly Run thermal plume at Hopewell and the thermal plume at the Surry nuclear power plant on the James River. T. A. Talay (NASA, Langley Research Center, Hampton, Va.), K. W. Sykes, III, and C. Y. Kuo (Old Dominion University, Norfolk, Va.). *Virginia Academy of Science, Annual Meeting, 56th, Virginia Polytechnic Institute and State University, Blacksburg, Va., May 9-12, 1978, Paper. 18 p.*

A78-34932 The effects of air leaks on solar air collector behaviour. D. J. Close and M. B. Yusoff (North Queensland, James Cook University, Townsville, Australia). *Solar Energy*, vol. 20, no. 6, 1978, p. 459-463.

The construction of conventional solar air collectors and the fact that they will operate with a significant pressure difference between the heated air stream and ambient, suggests that significant quantities of air may leak into or out of them. A search of the literature reveals no consideration of the effects these air leaks may have on the validity of collector efficiency measurements, on the efficiency itself, or indeed what the meaning of efficiency is under such operating conditions. This paper discusses the meaning of collector efficiency when leaks into the collector occur, analyses the effects on efficiency measurements, and solves the collector efficiency for the simple case of a constant leakage rate along the collector. Assuming that air leaking in from ambient can replace deliberate fresh air supply to the load as in building heating, then significant measurement errors are made if air leaks in to the collector are not accounted for. Further, the collector efficiency is increased over the no leak case, so that complex construction methods to make the collector air tight are probably not warranted. (Author)

A78-34933 Sunstations. E. Berman (Boston University, Boston, Mass.), A. Braunstein (Tel Aviv University, Tel Aviv, Israel), and D. Biran. *Solar Energy*, vol. 20, no. 6, 1978, p. 465-467.

A method of obtaining insolation data is described which provides information directly usable in the sizing of solar equipment. The method is particularly valuable for the collection of data at a large number of sites where equipment cost and availability of technically trained personnel are critical. The device consists of a calibrated solar cell, and electrochemical accumulator and associated electronic equipment having the following characteristics: capacity 3600 kWh/sq m; temperature range -55 to +71 C; low cost; no field maintenance; reproducibility + or -5%. (Author)

A78-34934 Optimization models for the economic design of wind power systems. H. M. Bae (Consolidated Papers, Inc., Wisconsin Rapids, Wis.) and M. D. Devine (Oklahoma University, Norman, Okla.). *Solar Energy*, vol. 20, no. 6, 1978, p. 469-481. 12 refs.

Optimization models are presented for the economic design of large-scale wind power systems. Two basic models are introduced: (1) systems without storage - all power generated is fed directly into the existing network, and (2) systems with storage - the systems are operated as part of base load or peak load capacity. The objective of the models is to maximize the total net value of power generated under assumed operating rules and general conditions regarding wind speed and demand variations. The model for wind power systems without storage is developed to determine the total capacity of wind turbines that vary in the values of design parameters such as rotor diameter, tower height, and rated power. The model for systems with storage uses an analytical storage model as a basis of representing storage requirements. The model is designed for the case of little serial correlation in successively measured wind speeds. It is then modified for the case of a low degree of correlation. Separable programming is used as a solution technique in both models and limited computational results, based on available cost estimates and Oklahoma wind and demand data, are presented to illustrate the use of the models. (Author)

A78-34935 Probability models of wind velocity magnitude and persistence. R. B. Corotis, A. B. Sigl, and J. Klein (Northwestern University, Evanston, Ill.). *Solar Energy*, vol. 20, no. 6, 1978, p. 483-493. 5 refs. NSF Grant No. AER-75-00357; Contract No. EY-76-S-06-2342.

Hourly wind data from the National Climatic Center are used to study probability density functions of wind velocity and wind power and run duration persistence. Observed histograms of velocity are compared with the chi-2 and Weibull distributions using goodness-of-fit statistics, and wind power histograms are compared with distributions derived from these. From an engineering standpoint, the observed histograms compare well with the models, although discrepancies exist. Over the power ranges of interest for wind energy conversion, taking into account the effects of wind generator response characteristics (cut-in, feathering, etc.), the models appear promising. Velocity run duration histograms above and below fixed levels are constructed and compared with both an exponential and power law persistence model. Calibrating the exponential model from the observed mean duration leads to reasonable estimates for the longer runs. A simplified technique of scaling the power law model from the mean seasonal velocity at a site gives good run duration estimates, except for the longer runs. (Author)

A78-34936 Thermic diode solar panels for space heating. S. Buckley (MIT, Cambridge, Mass.). *Solar Energy*, vol. 20, no. 6, 1978, p. 495-503. 14 refs. Research supported by the Cabot Solar Energy Fund, NSF, and ERDA.

The paper describes the design and operation of thermic diode panels. A single 2 x 8 ft panel contains all the elements of a complete solar energy system: collectors, controls, storage, heat exchangers, and ducting. Heat is transferred from the collector to the storage layer by natural flow of heated water, the flow being controlled by a

check valve that permits flow from the collector to the storage layer when the sun is shining, but as the collector cools, prevents return flow from the storage layer. Results of simulations of thermic diode panel performance are presented, and their predicted performance is at least as good as that of conventional solar space heating systems. They promise cost savings due to their modularity and integral cool collector/storage design. P.T.H.

A78-34937 A cellwise method for the optimization of large central receiver systems. F. W. Lipps and L. L. Vant-Hull (Houston, University, Houston, Tex.). *Solar Energy*, vol. 20, no. 6, 1978, p. 505-516. Contracts No. E(04-3)-1188; No. EG-76-G-05-5178.

The collector field of a central receiver type solar power system is modeled as a number of rearrangeable cells, each of which consists of several hundred heliostats. The paper describes an optimization procedure carried out in order to determine the best of four possible arrangements of the heliostats in a cell: (1) radially oriented cornfields, (2) radially oriented staggers, (3) north-south oriented cornfields, and (4) north-south oriented staggers. P.T.H.

A78-34953 Laser fusion. C. M. Stickley (U.S. Department of Energy Office of Laser Fusion, Washington, D.C.). *Physics Today*, vol. 31, May 1978, p. 50-56, 58.

The principles of laser fusion are reviewed with attention to the Lawrence Livermore Shiva Nova facility. The ultimate object of laser fusion is to produce heat to drive turbines to produce electricity. The energy is obtained through high energy neutrons, produced when multiple shell (Nd:glass) targets are imploded by (CO₂) laser pulses. New technologies are designed for yields in the 300 kJ range. Four categories of interaction physics leading to the thermonuclear burn are mentioned: absorption in the less dense plasma corona, transport of energy from the absorption region to the pellet core, compression, and fusion burn at the core. Particle-beam development is discussed with reference to high current pinch and beam focusing. Also discussed is the possibility of using ions for driving targets. It is noted that ions lose their energy near the end of their path through a target shell, so that energy deposition occurs deep within the target, and that ions produce virtually no bremsstrahlung or backscatter. Another option in the realm of nuclear power is a fission-fusion hybrid reactor, i.e., a subcritical fission reactor driven by an internal source of high energy neutrons from a fusion burner. D.M.W.

A78-34972 Energy storage (Energiespeicherung). G. P. Merker (München, Technische Universität, Munich, West Germany). *Brennstoff-Wärme-Kraft*, vol. 30, Apr. 1978, p. 162-164. 88 refs. In German.

A survey is provided of investigations, published during the year 1977, which are concerned with the storage of energy. Attention is given to the storage of primary energy in salt caverns, the subterranean storage of oil and liquid gas, questions of coal storage, the storage of compressed air in caverns, the use of the energy in the underground of cities for the heating of buildings with the aid of heat pumps, the economy of long-term and short-term hot water storage, a preliminary comparison of energy storage costs for energy storage systems of different types, artificial lakes for the storage of solar energy, hydrates and eutectics for the storage of low-temperature heat, the possibilities for a long-term storage of solar energy, thermally stratified hot water storage tanks, the production and seasonal storage of hot water to heat a city, reversible chemical reactions for thermal energy storage, thermal energy storage using sodium sulfate decahydrate and water, the use of transition metal compounds to sensitize a photochemical energy storage reaction, and a thermal energy storage concept for solar Brayton power plants. G.R.

A78-34973 Thermal refuse treatment (Thermische Müllbehandlung). R. Rasch. *Brennstoff-Wärme-Kraft*, vol. 30, Apr. 1978; p. 164-170. 136 refs. In German.

The various approaches and procedures involved in the disposal of municipal refuse are examined. Refuse incineration is an important part of a suitable waste management program. Appropriate deposition procedures are required for the disposal of pyrolysis residue products. Attention is given to waste management developments in the U.S., refuse disposal in Japan, aspects of refuse pretreatment, degassing and gasification of refuse, refuse incineration, high temperature corrosion problems, flue gas purification, pyrolysis in the case of refuse with special characteristics, and aspects of sludge disposal. An extension of refuse-incineration methods involving a utilization of the thermal energy appears to represent the best solution for refuse disposal problems in densely populated areas on the basis of expediency and environmental and economic considerations. G.R.

A78-34974 Refuse-derived fuel wins out over oil and coal at new industrial power plant. B. Schwiager. *Power*, vol. 122, May 1978, p. 33-38.

The paper describes the planning and components of a semi-suspension-firing/waterwall-furnace system which will use municipal and commercial garbage to generate steam and electricity for industrial use. The advantages of this technology in comparison with other technologies are considered. Several aspects of plant design, including refuse-pit unloaders, air classifiers, back-up coal and fuel-oil handling systems, environmental control, and fire protection, are discussed. Problems associated with contracting for garbage are examined. M.L.

A78-35052 # Calculation of porous-particle combustion (K raschetu goreniiia poristoi chastitsy). A. M. Golovin and V. R. Pesochin. *Fizika Goreniia i Vzryva*, vol. 14, Jan.-Feb. 1978, p. 11-18. 20 refs. In Russian.

A theoretical investigation in the quasi-steady approximation of the combustion of carbon particles at high temperature (up to 2500 K) and high pressure is performed. Consideration is given to changes in pore size, degree of porosity and the character of the reaction surface; the effects of convective transfer in the pores on burning rate are also examined. It is found that surface reactivity is negligibly small compared to reactivity inside the pores. B.J.

A78-35091 # Selection of the thermal modes of operation for the reactor/condenser system of electrochemical current generators (K vyboru teplovyykh rezhimov raboty sistemy reaktor-kondensator elektrokhimicheskikh generatorov toka). E. N. Bukreev, A. B. Guliaenko, A. I. Kalinchak, and Iu. L. Tonkonogii (Odesskii Tekhnologicheskii Institut Pishchevoi i Kholodil'noi Promyshlennosti, Odessa, Ukrainian SSR). *Inzhenerno-Fizicheskii Zhurnal*, vol. 34, Apr. 1978, p. 642-647. In Russian.

The paper deals with an investigation of the influence of the thermal mode of the reactor/condenser system on the efficiency of an electrochemical current generator. The mass transfer characteristics of the system are examined, and the permissible range of variation of the fluid temperature at the reactor and condenser inputs is determined. A system of equations describing the system parameter interaction is derived and solved. Analysis of the solution reveals the existence of an optimal fluid temperature, at the condenser input, which depends on the temperature selected for the reactor, and also the existence of an optimal transverse water-vapor mass flow. This makes it possible to determine the optimal condenser area. V.P.

A78-35171 Nitric acid cycle process for extracting thermal energy from low-level heat sources. N. Wakao and K. Nojo (Yokohama National University, Yokohama, Japan). *Nature*, vol. 273, May 4, 1978, p. 25-27.

Attention is given to a nitric acid cycle process for recovering thermal energy from a low-level heat source. The process is based on the heat generated when nitric acid and water are mixed. Nitric acid forms a maximum boiling point azeotrope with water. The azeotrope at 9 mm Hg is approximately 65% nitric acid and boils at 25 C. At this pressure water boils at 9.7 C. The mixture of nitric acid and water is separated into 65% nitric acid and water in distillation columns. Warm (28 C) surface seawater is used as the heating medium and cold seawater (5-7 C) as the cooling medium. Instead of a single distillation tower, two or more columns are operated at different low pressures. In calculating heat recovery, heat losses are not assumed in the transfer lines or mixing tanks. A 4% overall useful heat gain is estimated. S.C.S.

A78-35179 Hydrogen as an energy carrier: Production, storage, transport. (Wasserstoff als Energieträger: Herstellung, Lagerung, Transport). N. Getoff (Wien, Universität, Vienna, Austria). Research supported by the Bundesministerium für Wissenschaft und Forschung of Austria. Vienna, Springer-Verlag, 1977. 433 p. 475 refs. In German. \$45.10.

The basic techniques involved in producing hydrogen by electrolytic and thermochemical methods are discussed with attention to the use of solar and nuclear energy to provide the necessary power for hydrogen extraction. Thermodynamic principles are reviewed, together with various proposals for the design of electrolytic materials. Hydrogen-yielding chemical reactions are described, especially those which are by-products of coal and petroleum technology, e.g., coking, catalytic cracking, desulfurization, etc. Suggestions for the storage of hydrogen are presented, including one- and two-wall tanks, liquification, and metal hydrides. Also considered are problems arising from the transport of both liquid and gaseous hydrogen, especially safety and security. D.M.W.

A78-35280 Alternative energy sources in the USSR. R. Grünbaum (Swedish Embassy, Moscow, USSR). *Ambio*, vol. 7, no. 2, 1978, p. 49-55. 22 refs.

A broad survey of alternative energy sources in the USSR is presented. Soviet estimates suggest that within the next 10-15 years wind and solar energy for electricity production may reach 7 TWh per year. Research and development in wind energy is concentrated in the elevation and desalination of ground and seawater, the powering of irrigation equipment, the protection of pipelines against corrosion, and the powering of household equipment. Solar energy research is associated with the pumping and desalination of water for livestock, solar heating and cooling, the powering of household appliances, the powering of communications equipment, and the use of pulsed solar irradiation for plant breeding. Tidal power plants are in operation along the European coast of the USSR, and the conversion from geothermal to electrical energy is being practiced in the southern portion of the Kamchatka Peninsula on the Pazhetsk River. S.C.S.

A78-35281 Solar Sweden. T. B. Johansson (Secretariat for Future Studies, Stockholm; Lund, Universitet, Lund, Sweden) and P. Steen (Secretariat for Future Studies, Stockholm, Sweden). *Ambio*, vol. 7, no. 2, 1978, p. 70-74.

An energy system for Sweden based on renewable energy sources is outlined with attention to technical, economic, and organizational factors of the project. Assumptions are made regarding energy use in 2015, including estimates of population, the production of goods and services, and specific energy use. The solar energy influx per year in Sweden is calculated. Renewable energy sources such as hydropower, windpower, solar cells, aquatic energy, biomass, and solar heating are discussed with reference to industrial combustion and cogeneration, fuel cells, methanol production, and district heating cogeneration. S.C.S.

A78-35282 Electrical and photovoltaic characteristics of indium-tin oxide/silicon heterojunctions. W. G. Thompson and R. L. Anderson (Syracuse University, Syracuse, N.Y.). *Solid-State Elec-*

tronics, vol. 21, Apr. 1978, p. 603-608. 13 refs. NSF-supported research.

Measurements on indium-tin-oxide/Si (ITO/Si) heterojunctions indicate that the conduction band discontinuity at the interface is of the order of 0.45 eV for ITO with 9 mole-% SnO₂. This value is inappropriate for use of ITO/Si heterojunction cells for photovoltaic energy conversion. It is too large for ITO/p-Si cells and too small for ITO/n-Si devices. For either type of device the resultant built-in voltage is inadequate for high-efficiency solar cells. The maximum solar conversion efficiencies obtained are of the order of 0.3%. These results are in disagreement with previous work on ITO/Si heterojunctions. (Author)

A78-35287 Influence of an insulating layer on the efficiency of a semiconductor-insulator-semiconductor (SIS) heterojunction solar cell. H. J. Pauwels and P. de Visschere (Gent, Rijksuniversiteit, Ghent, Belgium). *Solid-State Electronics*, vol. 21, Apr. 1978, p. 693-698. 9 refs.

A78-35297 Refuse without imperfection - Refuse combustion with combined sediment processing (Müll ohne Makel - Müllverbrennung mit kombinierter Klärschlamm-Mitverarbeitung). H. Koch (Widmer und Ernst GmbH and Co., Bad Hersfeld, West Germany) and W. Trebing (Abfalltechnik GmbH, Essen, West Germany). *Energie*, vol. 30, Mar. 1978, p. 94-97. In German.

The sludge deposits obtained in the sedimentation process are subjected to a preliminary drying procedure. The resulting product is mixed with dried sludge and dried in a hammer mill. In the hammer mill the material is dispersed and brought into contact with flue gas. The heat content of the flue gas is utilized to vaporize the main part of the water which is still in the sludge. A part of the dried sludge is mixed with the product of the preliminary drying procedure. The remainder can be used as soil improvement material in agriculture or horticulture. It can also be introduced into the combustion chamber and be burnt. Organic odorants are eliminated by burning in the combustion chamber. Attention is also given to details concerning the utilization of the energy contained in the sludge, the experience obtained with the described system in the refuse disposal plant of a German city, and the flue gas washer. G.R.

A78-35300 Giant laser system readied for tests. B. M. Elson. *Aviation Week and Space Technology*, vol. 108, May 15, 1978, p. 71, 73, 74.

The 10,000 J neodymium:glass laser fusion system, Shiva, is described in terms of its design and operating characteristics. The system is intended to produce 30 terawatt optical power bursts in nanosecond pulses as part of a research effort to develop an inertially confined fusion pellet power generator. The principle of laser fusion, i.e., fuel compression to 1000-10,000 times its liquid density, resulting in plasma temperatures of 100 million K, is compared with the more traditional magnetic confinement schemes. A successor to Shiva, Nova, is also discussed. Nova is designed to use the data obtained from Shiva to provide the basis for a program which stresses the practical aspects of laser fusion. D.M.W.

A78-35361 A comparison of some alternative domestic energy systems. A. Brown (University of Wales Institute of Science and Technology, Cardiff, Wales). *Applied Energy*, vol. 4, Apr. 1978, p. 127-144. 12 refs.

Solar energy, a heat pump system employing air as the working fluid, and a conventional space and water heating system are compared in terms of their efficiency and economic benefits in residential applications. The heat pump is assumed to use air down to two deg C as a heat source; solar energy systems with heat pump upgrading of a conventional radiator-pipe hot water system, with blown-air space heating and heat pump upgrading for hot water, and with blown-air space heating and boiler upgrading for hot water are also studied. An analysis of capital and running costs for the systems indicates the solar energy blown-air space heating design is the most effective. J.M.B.

A78-35362 Radiation heat losses in solar collectors with plastic covers. M. Sikkens (Groningen, Rijksuniversiteit, Groningen, Netherlands). *Applied Energy*, vol. 4, Apr. 1978, p. 145-151. 6 refs.

A78-35411 Optical performance of absorber-reflector combinations for photothermal solar energy conversion. A. Donnadieu and B. O. Seraphin (Arizona, University, Tucson, Ariz.). *Optical Society of America, Journal*, vol. 68, Mar. 1978, p. 292-297. 14 refs. Contract No. E(29-2)-3709.

For a number of absorber-reflector combinations the reflectance spectrum and the figure of merit a/e have been computed numerically in order to find an optimum set of parameters. Values of a/e in excess of 20 result for an absorber consisting of 0.5 micron Ge on a silver reflector, overlaid by 2.0 microns Si carrying a four-layer antireflection sequence in which the refractive index varies from 2.79 to 1.43. To maximize the optical acceptance angle the antireflection coatings must vary the refractive index in a graded profile from the value of index silicon to the one of air. (Author)

A78-35420 Energy modeling and forecasting at the U.S. Energy Research and Development Administration. R. H. Williamson and E. J. Hanrahan (U.S. Department of Energy, Washington, D.C.). *Nuclear Technology*, vol. 39, June 1978, p. 10-17. 9 refs.

The application of a combined set of energy and economic models describing the complex interactions of the nation's energy system improved the planning processes at the U.S. Energy Research and Development Administration for new technology development. The models include econometric techniques for macroeconomic projections, input-output techniques for sector detail, linear programming approaches for resource allocation, and accounting tools for other physical constraints. Comparison studies on the use of energy prices alone versus a combination of energy prices and new technology show that new technology permits higher gross national product growth rate, more jobs, lower delivered energy prices, and improved energy-economic efficiency. (Author)

A78-35423 # Problems and progress in developing the automotive gas turbine. F. Hirschfeld. *Mechanical Engineering*, vol. 100, May 1978, p. 40-49.

An employment of automotive gas turbines has been considered for some 25 years. However, such a gas turbine has still not come into production. A key factor appears to be the necessity to reduce fuel consumption. The next step would involve the construction of an efficient turbine which would demonstrate a clear competitive advantage. Increments in fuel economy could be achieved by means of increases in turbine inlet temperatures. Other advances considered are related to the development of a single-shaft machine, the design of a ceramic radial turbine, improved emissions control, and a suitable catalytic combustor. Attention is also given to developments concerning high-temperature ceramic components, approaches for obtaining a high efficiency, centrifugal compressor performance, and the step-wise introduction of ceramics into an all-metal engine. G.R.

A78-35444 MHD's target - Payoff by 2000. E. Levi (New York, Polytechnic Institute, Brooklyn, N.Y.). *IEEE Spectrum*, vol. 15, May 1978, p. 46-51.

The magnetohydrodynamic (MHD) technique for generating electricity involves the interaction between a magnetic field and a conducting medium that is fluid rather than solid, as in conventional generators. In connection with the desirability to improve the efficiency of fuel utilization, programs are being conducted in a number of countries to translate the MHD concept into a viable, commercially acceptable energy-conversion technology. In the U.S. it is planned to have an operational pilot plant as early as 1985, and a base/load commercial demonstration plant before 1995. The MHD program in the U.S. emphasizes the use of coal in a combined MHD/steam energy-conversion system. All the rigid structures in MHD generators are stationary. This makes an operation at elevated

temperatures approaching 3000 K feasible. Consequently, higher efficiencies are possible with MHD systems than with conventional plants. Attention is given to physical constraints, the status of key components in the U.S., approaches towards commercial demonstration, and aspects of international cooperation between the U.S. and the U.S.S.R. G.R.

A78-35560 Evacuated-tube solar collector - Effect of control on efficiency at high operating temperatures. W. C. Louie and D. C. Miller (Smith, Hinchman and Grylls Associates, Inc., Detroit, Mich.). *ASHRAE Journal*, vol. 20, May 1978, p. 39-42.

A78-35574 Offshore and underground power plants. Edited by R. Noyes. Park Ridge, N.J., Noyes Data Corp. (Energy Technology Review, No. 19; Ocean Technology Review, No. 6), 1977. 319 p. \$42.

The underground pumped storage concept is examined, taking into account site selection, site investigation, access to underground facilities, material and equipment handling, shaft construction, rates of construction, upper-reservoir facilities, the function of the lower reservoir, power plant facilities, and aspects of schedule, costs, and operation. Underground nuclear power plants are discussed along with floating shallow water nuclear plants, floating deepwater nuclear plants, seabed and island nuclear plants, offshore coal-fired power plants, wave power, tidal power, the possibility to obtain electric power from oceanic currents, a utilization of salinity gradients, and sea thermal power plants based on thermal gradients. Products and services considered in connection with an evaluation of offshore windpower systems are related to the heating and cooling of buildings, firm-power-on-demand electricity, peak power electricity, hydrogen for the fueling of aircraft and other transportation systems, and nitrogenous fertilizer. G.R.

A78-35576 International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, Inc., 1978. 444 p. Members, \$45.; nonmembers, \$50.

The development of an axially grooved heat pipe with non-constant groove width is considered along with a variable conductance heat pipe for terrestrial applications, experiments with gravity assisted heat pipes with and without circumferential grooves, the supersonic flow of vapor in the condensation zone of high temperature heat pipes, numerical calculations on the vapor flow in a flat-plate heat pipe with asymmetrical boundary conditions, entrainment limits in heat pipes, the dry-out limits of gravity assist heat pipes with capillary flow, the performance evaluation of gravity-assisted copper-water heat pipes with liquid overfill, and emerging heat pipe applications. Attention is also given to heat pipe mirrors for high power lasers, a sodium vapor heat pipe laser cell, technical applications of heat pipes in the low and high temperature range, compatibility tests of various heat pipe working fluids and structural materials at different temperatures, a gas-controlled thermostat, the investigation of a cryogenic thermal diode, the reliability of low-cost liquid metal heat pipes, and a thermal canister experiment for the Space Shuttle. G.R.

A78-35578 # A variable conductance heat pipe for terrestrial applications. W. Molt (Dornier System GmbH, Friedrichshafen, West Germany). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 10-14, 5 refs. (AIAA 78-377)

A new type of variable conductance heat pipe, the Liquid Controlled Heat Pipe (LCHP), has been developed. While the gas controlled heat pipe is able to stabilize the temperature of the heating zone, the LCHP limits the temperature of the cooling zone to a certain adjustable value. The physical principle is to regulate the heat transfer capability by regulating the amount of liquid inside the

heat pipe. The liquid is partly stored in a reservoir with a variable volume, as for example, a bellows. The temperature of the cooling zone, corresponding to the vapor pressure inside the heat pipe, can be adjusted by the outer pressure (gas or spring) on the bellows. The LCHP is applicable where heat is needed at a constant temperature or where the vapor pressure inside a heat pipe has to be limited.

(Author)

A78-35585 # Emerging heat pipe applications. A. Basuili and D. J. Formiller (Hughes Aircraft Co., Torrance, Calif.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 59-62. 9 refs. (AIAA 78-390)

The article discusses the application of heat pipes in various industrial, military, and space projects. Several types of heat pipes are described, including simple cylindrical heat pipes, switching heat pipes, thermal diodes, variable conductance heat pipes, and vapor chambers. Potential future applications of heat pipes are identified in the fields of electronics, spacecraft thermal control, heat pipe recovery systems, and missile applications. S.C.S.

A78-35586 # Heat pipe mirrors for high power lasers. R. R. Barthelemy, D. Rabe (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio), and D. Jacobson (Arizona State University, Tempe, Ariz.; USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 63-70. 11 refs. (AIAA 78-391)

The test and evaluation of cylindrical copper-water heat pipe mirrors for application in high power lasers were conducted. Testing of the heat pipe mirror determined its ability to reduce thermal distortions in comparisons with water cooled and uncooled mirrors. The experiments were conducted on a 10 kilowatt carbon dioxide laser. The test mirror was placed in an interferometer and simultaneously irradiated with a laser beam of approximately 2.1, 5.7 and 7.6 KW/sq cm over an area of 3.8, 1.4 and 1.0 sq cm respectively. Changes of the mirror surface figure were recorded in high speed motion pictures. The results from these tests indicate that heat pipe mirrors are practical mirrors for high power applications. (Author)

A78-35587 # Sodium vapor heat pipe laser cell. J. E. Deverall and G. W. York (California, University, Los Alamos, N. Mex.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 71-75. Research sponsored by the U.S. Department of Energy. (AIAA 78-392)

A sodium heat pipe cell containing high-voltage discharge plates was constructed to study the band absorption of light by the sodium dimer and to determine the feasibility of creating a metal vapor laser. Spectrographic measurements indicated that the increase in sodium dimer population with temperature resulted in 90% light absorption at 970 K. High-voltage discharges in the sodium vapor dissociated the dimers and restored transparency to the medium. No lasing action of the sodium vapor with high-voltage discharges was observed either because of insufficient ionization or nonuniformity of the ionization over the plate area. (Author)

A78-35588 # A large scale heat exchanger with polygonally configured heat pipe units. T. Koizumi, S. Furuya, K. Matsumoto, and K. Karawawa (Furukawa Electric Co., Ltd., Tokyo, Japan). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 76-79. (AIAA 78-393)

* A large scale heat exchanger with polygonally configured heat pipe units is proposed, for heat recovery system with large gas flow rate. The length of a heat pipe is restricted by the maximum heat transfer limit and the limit of fabrication, and therefore the height/width ratio of the face area becomes unbalanced if the heat pipes are arranged in traditional rectangular prism configuration. This makes the installation space unfavorably large and unsymmetrical, and then ducting work also becomes much more difficult. The problem can be resolved by introducing a novel arrangement of heat pipe elements in polygonal configuration. This paper describes outline of the large heat exchanger, some design examples and experimental results of a model heat exchanger with hexagonally configured heat pipe units. (Author)

A78-35589 # Technical applications of heat pipes. O. Brost, M. Groll, and W. D. Münzel (Stuttgart, Universität, Stuttgart, West Germany). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 80-87. 11 refs. (AIAA 78-396)

Heat pipes have been developed to prototype and series-production level for various commercial applications. The low temperature applications comprise: high-performance fixed conductance and variable conductance heat pipes, and heat pipe diodes for spacecraft thermal control; gravity-assisted heat pipes for plastic fiber processing; heat pipes for cooling of electric motors and high-power semiconductor devices; axial groove heat pipes for waste heat recovery units. The high temperature applications comprise: annular alkali-metal heat pipes as isothermal inserts for tubular furnaces, as black-body radiators, and as pyrolysis-cleaning furnaces; heat pipe heat transport system for Stirling engines. (Author)

A78-35592 # A non-tracking moderately focusing heat pipe solar collector. C. C. Roberts, Jr. (Packer Engineering Associates, Naperville, Ill.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 114-122. 6 refs. (AIAA 78-402)

A design for a moderately focusing heat pipe solar collector is presented that incorporates advantages of both flat plate and concentrating collectors. This collector is utilized primarily for heating, has a heat pipe absorber and uses the thermal diode effect of the heat pipe to prevent nocturnal heat loss. A prototype collector was constructed and tested using four gravity assisted heat pipes. The concentration ratio was 3.31 to 1. Test data demonstrated collector efficiencies near 60% at low loss factor. Absorber temperatures ranged from 40 to 55 deg C. (Author)

A78-35597 # Augmenting the condenser heat transfer performance of rotating heat pipes. P. J. Marto and L. L. Wagenseil (U.S. Naval Postgraduate School, Monterey, Calif.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 147-154. 19 refs. (AIAA 78-409)

A rotating heat pipe assembly was tested at rotational speeds of 700, 1400, and 2800 RPM using distilled water as the working fluid. Tests were made during film condensation on several copper condensers; including smooth-walled cylinders, an internally finned cylinder, and a truncated cone. The truncated cone surface was also promoted for dropwise condensation using n-octadecyl mercaptan in octanoic acid. Heat transfer performance improved with increasing rotational speed. The internally finned cylinder and the truncated-

cone showed a 100 percent improvement over the equivalent smooth-walled cylinder. Dropwise condensation showed substantial improvement over film condensation, primarily at low rotational speeds. (Author)

A78-35614 # Study of liquid-metal heat pipes characteristics at start-up and operation under gravitation. V. I. Tolubinskii, E. N. Shevchuk, and V. D. Stambrovskii (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 274-282. 12 refs. (AIAA 78-434)

Temperature changes in liquid metal heat pumps (LMHP) are evaluated under conditions of both start-up and continuous operation. An analysis of dynamic characteristics is presented in three stages: (1) heat supply to start-up temperature, (2) establishment of sonic flow at the evaporator exit to the point at which the vapor flow along the entire LMHP length can be considered as a continuum, and (3) the point at which start-up temperature along the whole length becomes a stationary operating temperature. Attention is given to the effects of superheating and temperature pulsations throughout the system. D.M.W.

A78-35615 # High temperature heat pipes for terrestrial applications. W. A. Ranken and L. B. Lundberg (California, University, Los Alamos, N. Mex.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 283-291. 19 refs. ERDA-sponsored research. (AIAA 78-435)

A high temperature heat pipe design is described in which ceramic tubing is used to provide the basic structure and containment. The interior wall of this tubing is lined with a chemically vapor deposited metallic layer to protect the ceramic from the alkali metal working fluid and furnish a distributive wicking surface. High temperature brazes and ceramic bonding agents are used to seal the assembly. The results of a program to develop such a unit for application to high temperature recuperators are discussed and potential applications to coal conversion and coal utilization systems are reviewed. (Author)

A78-35619 * # Heat pipes in space and on earth. S. Ollendorf (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 312-315. 10 refs. (AIAA 78-439)

The performance of heat pipes used in the thermal control system of spacecraft such as OAO-III and ATS-6 is discussed, and applications of heat pipes to permafrost stabilization on the Alaska Pipeline and to heat recovery systems are described. Particular attention is given to the ATS-6, launched in 1974, which employs 55 heat pipes to carry solar and internal power loads to radiator surfaces. In addition, experiments involving radiative cooling based on cryogenic heat pipes have been planned for the Long Duration Exposure Facility spacecraft and for Spacelab. The role of heat pipes in Space Shuttle heat rejection services is also mentioned. J.M.B.

A78-35620 # A reactive-heat-pipe for combined heat generation and transport. G. M. Faeth, E. G. Groff, H.-Z. You, R. Altstadt (Pennsylvania State University, University Park, Pa.), and D. Icenhauer (U.S. Naval Material Command, David W. Taylor Naval Ship Research and Development Center, Annapolis, Md.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 316-326. 16 refs. (AIAA 78-440)

The operation of a reactive-heat-pipe for generating thermal energy from the reaction between molten alkali metals and halo-

generated gases, and transporting the energy to a load by heat pipe action is described. The present study was limited to the lithium-sulfurhexafluoride reactant combination. Experiments were conducted which demonstrated the operation of a reactive-heat-pipe at 1200 K, sustained heat fluxes in the range 0-300 kW/sq-m, good fuel utilization for the reaction, and refueling procedures. Theoretical results are also described to illustrate aspects of system operation and limitations due to wick pumping capabilities; liquid displacement across the wick; and thermal resistances in the wick, the vapor transport system, and the condenser. (Author)

A78-35623 # 'T-System' - Proposal of a new concept heat transport system. P. Tamburini (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 346-353. (AIAA 78-444)

A heat transport system which relies on pressure changes generated by evaporation and condensation of the working fluid to drive circulation is described. The heat transport system, which requires no conventional pump, can work against gravity and consequently may be tested on the ground before launch in a spacecraft. In addition, the system offers a high degree of flexibility in design, accommodating bends, elbows and flex hoses with no major limitations. A bench model of the heat transport system has been tested; applications of the concept to thermal control in Spacelab payloads and to solar energy collection are mentioned.

J.M.B.

A78-35625 # Application of heat pipes in electronic modules. L. A. Nelson, K. S. Sekhon, and L. E. Ruttner (Hughes Aircraft Co., Fullerton, Calif.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 367-372. 10 refs. (AIAA 78-449)

The design of heat pipes for circuit cards is discussed, with special attention given to heat pipes developed for the thermal control systems of the U.S. Navy's Standard Electronics Module (SEM). The heat pipes discussed here are fabricated of beryllium copper and employ methanol as the working fluid. Testing of one heat pipe system for the SEM indicates that the cooled module may be operated at up to 20 watts total power dissipation without exceeding the critical component temperature of 100 C. Heat pipe card guides capable of interfacing with existing hardware and providing a heat transfer rate in the range of 500 to 600 watts have also been developed.

J.M.B.

A78-35626 # Direct heat pipe cooling of semiconductor devices. L. A. Nelson, K. S. Sekhon, and J. E. Fritz (Hughes Aircraft Co., Fullerton, Calif.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 373-376. 10 refs. (AIAA 78-450)

A heat pipe system has been used to reduce by as much as 33% the thermal resistance from junction to case in a semiconductor. Difficulties in utilizing heat pipes to cool transistor junctions include the physical problem of applying a wick to bring the working fluid in contact with the junction, the chemical problem of fluid-transistor material interactions, and the electrical interference that may be caused by the heat pipe. Development of fiber wicks and high-performance powder wicks for RF power transistors is given particular consideration.

J.M.B.

A78-35629 # Heat pipe nuclear reactors for space applications. D. R. Koenig and W. A. Ranken (California, University, Los Alamos, N. Mex.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 391-397. 18 refs. Research sponsored by the U.S. Department of Energy. (AIAA 78-454)

A heat pipe nuclear reactor design concept is being investigated for space power applications. The reactor can be coupled to a variety of high-temperature (1200-1700 K) electrical conversion systems such as thermoelectric, thermionic, and Brayton cycle converters. It is designed to operate in the power range 0.1-3 MW sub t for lifetimes of about 10 years. The reactor is a fast spectrum, compact assembly of hexagonal fuel elements, each cooled by an axial molybdenum heat pipe and loaded with fully enriched UC-ZrC or Mo-UO₂. Reactor control is provided in the radial reflector. A comparison of several power plants employing the heat pipe reactor concept is presented for an output power level of 50 kWe. (Author)

A78-35631 * # A thermal canister experiment for the Space Shuttle. R. McIntosh and S. Ollendorf (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 402-407. (AIAA 78-456)

An experiment will be described which, if successful, will demonstrate the feasibility of using a heat pipe thermal canister to control the temperature of a wide variety of instruments operating in the bay of the NASA Space Shuttle. The experiment will be launched in December 1979 as part of the fourth orbital flight test of the Shuttle. Predictions indicate that the canister can provide an environment controlled to + or - 1 C over the range of 0 C to 30 C for conductively and radiatively coupled instruments with internal power dissipations of approximately 100 to 400 watts. This is the most ambitious thermal control program yet attempted which uses heat pipes as the primary control element. The outcome of this experiment will have far reaching implications for instruments which are operated in the Shuttle bay. (Author)

A78-35632 # Heat pipes for sun energy conversion. Z. Murgu, D. Murgu, L. Cojocaru, M. Huzum (Centrul de Cercetari Tehnice si Fizice, Iasi, Rumania), and E. Tvardochlieb (Centrul de Cercetari Tehnice si Fizice, Polyester Fibers Plant, Iasi, Rumania). In: International Heat Pipe Conference, 3rd, Palo Alto, Calif., May 22-24, 1978, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 408-413. 6 refs. (AIAA 78-457)

Heat pipes fabricated from copper and employing organic fluids or water as the working fluid have been developed for use with solar collectors. The gravity pipes were tested for operation at angles of inclination from 0 to 90 deg. A porous structure (glass wool) was adopted to assure efficient circulation of the fluid. Data for heat pipes tested with acetone, ethyl alcohol, freon or water are reported.

J.M.B.

A78-35646 # Temperature operating conditions of the energy storage device of a solar heating system (Temperaturnyi rezhim akkumuliatora solnechnoi otopitel'noi sistemy). M. Biashimov and Sh. A. Nazarov (Akademiiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Akademiiia Nauk Turkmenskoi SSR, Izvestiia, Seriya Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 1, 1978, p. 44-48. In Russian.

An analytical solution is presented for the problem of determining the temperature operating conditions for space heating and energy storage as a function of various parameters of the solar heating system, the level of solar radiation, and the air temperature. Simplifying assumptions are described, and two cases are examined: no change in external temperature and direct radiation during a given time interval, and change in external temperature with no change in efficiency. An example of the use of the procedure to determine optimum values of system parameters is provided.

M.L.

A78-35676 Dispersion and control of atmospheric emissions: New-energy-source pollution potential. Edited by R. L. Byers (Exxon Research and Engineering Co., Florham Park, N.J.), B. B. Crocker (Monsanto Chemical Co., St. Louis, Mo.), and D. W. Cooper (Harvard University, Boston, Mass.). *AIChE Symposium Series*, vol. 73, no. 165, 1977. 365 p. (For individual items see A78-35677 to A78-35705)

Atmospheric dispersion modeling, atmospheric chemistry, particulate collection and removal techniques for hydrocarbons, nitrogen oxides and sulfur oxides are considered; advanced energy conversion processes and methanol-fuel power source operations are studied as potential contributors to air pollution. The topics of the papers include an atmospheric dispersion model for an industrial city, a two-dimensional pollutant transport model for an urban basin, reactive plume simulation through numerical modeling, the effect of the energy shortage on ambient air quality, a three-year study of air-borne particulate matter variations, particle growth laws for photochemical smog, turbulent diffusion in electrostatic precipitators, the use of oxygen/water for coal desulfurization, a process for sulfur dioxide removal from stack gases, and the exhaust emissions of spark-ignition engines burning methanol or a methanol/gasoline mixture. J.M.B.

A78-35683 A modeling analysis of the impact of the energy shortage on ambient air quality. R. D. Siegel, K. W. Wiltsee, Jr., P. H. Guldberg (Abcor, Inc., Wilmington, Mass.), and G. L. Gipson (U.S. Environmental Protection Agency, Research Triangle Park, N.C.). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 71-83. 14 refs.

The Air Quality Implementation Planning Program model, which incorporates the Air Quality Display Model, was used to predict ground-level sulfur dioxide and total suspended particulates concentrations from the emissions inventory for quarterly time periods in 1973 and 1974 in the Metropolitan Boston Air Quality Control Region. A comparison of the seasonal modeling results for 1973 with corresponding predicted values for 1974 reflects the combined effect of meteorology, growth, conservation, and variance implementation on source emissions. In order to obtain a clearer understanding of the impact and potential impact of the energy shortage, a procedure was developed to isolate the relative effects of these factors on predicted concentration levels. (Author)

A78-35693 Chemical desulfurization of coal. R. A. Meyers (TRW Systems and Energy, Redondo Beach, Calif.). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 179-182. 9 refs.

The Meyers process for desulfurizing coal is discussed. The process uses aqueous ferric sulfate for the selective oxidation and leaching of pyritic sulfur from coal. Either fine (pulverized) coal or coal with top-sizes up to 1/4 in. can be treated, and the process satisfies criteria for mild conditions and selectivity of the desulfurization reaction. Process chemistry, engineering, and operating conditions are examined, and experimental results for a test plant are reported. M.L.

A78-35694 The use of oxygen/water for removal of sulfur from coals. S. S. Sareen (TRW, Inc., McLean, Va.), R. A. Giberti, L. J. Petrovic (Kennecott Copper Corp., Lexington, Mass.), and P. F. Irmingier (Peabody Coal Co., St. Louis, Mo.). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 183-189. 12 refs.

Experimental results have demonstrated the versatility of the Ledgemont Oxygen Leaching (LOL) process in removing pyritic sulfur from coals of different ranks. The effect of temperature on pyrite oxidation and coal oxidation to form CO₂ has been studied, and activation energies equal to 14 kcal/mole and 17.64 kcal/mole, respectively, have been measured. The effect of oxygen partial pressure on pyrite removal and coal oxidation has also been studied, and total oxygen requirements for the process computed. (Author)

A78-35697 Consol stack gas process for SO₂ removal. R. T. Struck, E. Gorin, and W. E. Clark (Conoco Coal Development Co., Library, Pa.). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 229-240. 7 refs. Research supported by the Allegheny Power, Consumers Power, Detroit Edison, Niagara-Mohawk, Ontario-Hydro, Philadelphia Electric, and C. Itoh and Co.

A new regenerative process for the removal of 95% or more of SO₂ from power plant stack gases is described. Scrubbing is achieved by circulating a concentrated aqueous solution of potassium thiosulfate through a pump-around loop containing a packed bed scrubber for SO₂ removal as well as an external reaction drum. A solution containing a mixture of hydrosulfides, polysulfides, carbonates, and bicarbonates is injected into the circulating salt solution just ahead of the reaction drum. Sulfite is formed by the reaction of SO₂ with carbonates, and the hydrosulfides and polysulfides are quantitatively removed from the circulating salt solution by reacting with sulfites to form potassium thiosulfate, so that the hydrosulfides and polysulfides do not enter the scrubber. The byproduct yield of sulfate represents about 1% of the SO₂ absorbed. M.L.

A78-35698 Methods and costs of controlling sulfur emissions from a petroleum refinery. G. E. Benson, J. Plater-Zyberk, and A. A. Metry (Roy F. Weston, Inc., West Chester, Pa.). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 241-248. 5 refs.

Topics relevant to the control of sulfur emission are surveyed. Topics include emission regulations, sulfur emission sources, emission controls, and environmental impact. Processes that will provide Claus unit tail-gas cleanup are considered, and costs of control for a new refinery of a certain type are estimated. The refinery, to satisfy environmental requirements, burns naphtha instead of low-sulfur fuel oil in the boilers and uses dual sulfur-recovery plants, each with full capacity (Claus-Beavon process). (Author)

A78-35699 A systematic approach to the problem of characterizing the emission potential of energy conversion processes. K. J. Bombaugh, E. C. Cavanaugh (Radian Corp., Austin, Tex.), and A. Jefcoat (U.S. Environmental Protection Agency, Research Triangle Park, N.C.). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 267-279. 7 refs.

The reported investigation is concerned with the development of a cost-effective program for characterizing the pollution potential of a new process as a basis for establishing uniform emission standards and control regulations. The advantages of the considered approach are related to the timely definition of emission standards and controls, more reliable judgments based on existing knowhow, a comprehensive strategy for sampling and analysis, and a task analysis reflecting job costs. The strategic use of existing process and analytical knowledge makes it possible to avoid delays in the implementation of a realistic control program. The described procedure consists of three phases, including an engineering phase, an analytical phase, and an extrapolation phase. G.R.

A78-35700 Prediction of air quality impacts for a commercial shale oil complex. G. E. Fosdick (Shell Oil Co., Denver, Colo.) and M. W. Legatski (Atlantic Richfield Hanford Co., Richland, Wash.). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 281-290. 13 refs.

A78-35701 Electricity generation by utilities - 1974 nationwide emissions estimates. S. M. Slater (Tufts University, Medford, Mass.) and R. R. Hall (GCA Corp., Bedford, Mass.). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 291-311. 37 refs. U.S. Environmental Protection Agency Contract No. 68-02-1316.

A78-35702 Methanol-gasoline blends - Performance and emissions. R. R. Adt, Jr., K. A. Chester (Miami, University, Miami, Fla.), J. Pappas, and M. R. Swain (Hawthorne Research and Testing, Inc., Coral Gables, Fla.). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 319-327. 9 refs. U.S. Environmental Protection Agency Grant No. R-803401-01-0.

Some steady state performance and emissions characteristics of a multicylinder, carbureted engine fueled with Indolene and 10, 20, and 30% methanol-Indolene blends over a limited range of operation (about 2000 r.p.m. and about 10-in. Hg or about 16-in. Hg manifold vacuum with lean fuel-air ratios) are presented. The blend-leaving effect is found to be in agreement with elementary carburetor theory. With no engine adjustments, the torque is found to decrease with increasing blend levels, the rate of decrease becoming greater at higher blend levels. At torque and engine speed equal to those of gasoline-fueled operation: (1) brake thermal efficiency for the blends is greater than that for gasoline up to about a 30% methanol blend level; (2) NO(x) mass emissions are less for the blends, about 60% less for the 30% blend; (3) CO mass emissions increase with increasing blend levels; and (4) intake manifold mixture temperatures are decreased by about 5.6 C for each 10% increase in methanol blend level. (Author)

A78-35703 Engine performance and exhaust emission characteristics of spark-ignition engines burning methanol and methanol-gasoline mixtures. W. Lee and W. Geffers (Volkswagenwerk AG, Wolfsburg, West Germany). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 328-337. 7 refs. Research supported by the Bundesministerium für Forschung und Technologie.

Engine dynamometer tests and road tests using pure methanol, methanol-gasoline blend (15 vol. % methanol plus 85 vol. % gasoline) called M 15 blend and commercial gasoline were made. The results showed that, in principle, from technological aspects it is possible to use methanol as a gasoline extender or in methanol/gasoline blends for automobiles. With regard to energy consumption, methanol and methanol/gasoline blend (M 15) lead to interesting results. But the fuel economy benefits of using M 15 was found to be just in the part-throttle operation of a 1975 car. The emission characteristics except aldehyde emission and unburnt methanol are improved by using pure methanol, a considerable reduction in NO(x) by using pure methanol, in CO by using M 15, and in PNA by using both found in this paper. The potential problems are, on the one hand, cold start and unacceptable driveability in warm-up phase when using pure methanol and, on the other hand, vapor lock in summer and phase separation in winter when using a methanol/gasoline blend (M 15). (Author)

A78-35704 Methanol - A boiler fuel alternative. R. W. Duhl (Vulcan Cincinnati, Inc., Cincinnati, Ohio). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 338-348. 9 refs.

Current energy shortages and the increasing demands for improved air quality led to the adaptation of proven chemical grade methanol technology for production of a new liquid fuel having all the environmental advantages of natural gas and low sulfur fuel oil. A potential use is for power generation in stationary boilers. Potential sources are the large reserves of associated gas not being utilized in the major oil producing countries overseas and also the domestic coal reserves. The application of this fuel to power generation has been demonstrated by full-scale operation in a utility boiler. (Author)

A78-35705 Evaluation of NO(x) emission characteristics of alcohol fuels for use in stationary combustion systems. G. B. Martin (U.S. Environmental Protection Agency, Research Triangle Park, N.C.) and M. P. Heap (Ultrasystems, Inc., Irvine, Calif.). *AIChE Symposium Series*, vol. 73, no. 165, 1977, p. 349-365. 13 refs.

After extensive study for automotive use, alcohol fuels have recently been considered for use in stationary combustion equipment. This study presents results of combustion of methanol and/or isopropanol in both hot and cold wall experimental systems. Results of tests in a package boiler are presented. An explanation of low NO(x) emissions is proposed. (Author)

A78-35751 The solar transition. B. Commoner (Washington University, St. Louis, Mo.). *Environment*, vol. 20, Apr. 1978, p. 6-10, 13-15.

It is suggested that the transition to the wide-spread use of solar energy is economical and that this transition should be subsidized. It is thought that without subsidies, there is a tendency for fuel costs to rise until the development of alternate energy technologies is stimulated; with subsidies, solar energy systems could be introduced on the basis of social need rather than on a basis of cost effectiveness. Subsidies would enable the poor, who can not afford the initial costs of a solar energy system, to participate in the benefits. The economics of solar energy is examined and the value of compatible energy systems is explained. The creation of a solar energy market by federal government purchases is recommended. M.L.

A78-35752 An economic comparison of three technologies - Photovoltaics, nuclear power, co-generating engines. R. Scott (Washington University, St. Louis, Mo.). *Environment*, vol. 20, Apr. 1978, p. 11, 12.

It is calculated that, if the government stimulates interest by purchasing \$98 million of photovoltaic cells (all figures are 1975 dollars), an investment between 1983 and 1987 of \$1 billion for photovoltaic cells and another \$1 billion for batteries and installation would result in the production in 1987 of electricity that costs \$0.051 to 0.188/kwh delivered, assuming that the cells are located at the place of energy use. On the basis of certain assumptions, it is estimated that the investment of \$1 billion in cogenerating engines (modified automobile engines) would result in 1987 in electricity that costs \$0.029/kwh. The cost of electricity generated by nuclear power plants in 1987 is estimated to be \$0.091; a substantial part of this cost is due to amortization and electricity distribution. M.L.

A78-35753 Power plant performance. J. M. Fowler (National Science Teachers Association, Washington, D.C.), C. Hohenemser (Clark University, Worcester, Mass.), and R. L. Goble. *Environment*, vol. 20, Apr. 1978, p. 25-32. 14 refs.

Nuclear and coal-fired power plants are compared in terms of their capacity performance with attention to the effects of age, size, and future improvements. Similarities and differences with Komanoff's (1976) conclusions, based on regression analysis and the projection of capacity factor trends, are described. (The capacity performance, a measure of reliability and a modification of the capacity factor, takes 'load following', the deliberate reduction of power output at times of low demand, into account.) Both studies agree that the performance of both types of plants which produce 400 MW or more is approximately the same, and that the reliability of both types of plants decreases with an increase in size. The studies disagree on maturation and vintage effects; the present study presents evidence that the maturation patterns will be size dependent while the Komanoff study assumes that all reactors of a specified type mature in the same way regardless of size. Among nuclear plants, pressurized water reactors of 450-800 MW generating capacity are found to have the best performance record. M.L.

A78-35763 The electric automobile. K. V. Kordesch (Union Carbide Technology Laboratory, Parma, Ohio). In: Batteries. Volume 2 - Lead-acid batteries and electric vehicles. New York, Marcel Dekker, Inc., 1977, p. 201-413. 186 refs.

Arguments in favor of electric vehicles are partly related to the fact that in 1966 the exhausts of 90 million motor vehicles constituted 61% of the nation's air pollution. However, in recent years considerable progress has been made in reducing emission levels. Other arguments refer to energy considerations. Lead batteries as they exist are marginal in capacity and life expectancy, and better systems must be developed. Such a development will take decades. In the meantime, lead-acid cells will have to be used. Attention is given to the social and economic aspects of electric vehicles, the history of electric vehicles during the time from 1837 to 1960, and the design and the operational characteristics of modern electric vehicles. It is

found that a small electric car could fulfill most of the requirements of personal transportation. A short description is presented of the lead-acid battery system from the viewpoint of the person interested in electric vehicles. New battery systems currently under development include nickel-zinc batteries, zinc-air-batteries, iron-air or iron-oxygen systems, aluminum-air systems, sodium-air systems, zinc-halogen systems, and fuel cell systems. G.R.

A78-35764 Lead-acid battery-operated electric street vehicles - New constructions from Germany. K. Salamon (Varta Batterie AG, Kelkheim, West Germany). In: Batteries. Volume 2 - Lead-acid batteries and electric vehicles. New York, Marcel Dekker, Inc., 1977, p. 443-462. 20 refs.

In an evaluation of the technological development possibilities for lead-acid batteries it had been found that a lightweight cell made with positive grid plates may have an ultimate energy density of about 45 Wh/kg and a life of 700 cycles. A more robust type of cells with positive tubular plates is characterized by an energy density of about 36 Wh/kg at the 5-hr rate and a life of at least 1500 cycles. At the present time such cycle life is reached with the standard industrial cell at 24 to 28 Wh/kg. Improvements will be based on the development of new cell constructions, the utilization of new materials, and new technologies in manufacturing batteries. Cell constructions from the viewpoint of the electric vehicle designer are considered, taking into account plates and post straps, cell assemblies, intercell connections, and the reduction of maintenance requirements. Electric road vehicle projects started in Germany in the 1970s were mainly concerned with improving the driving characteristics of the vehicles. Attention is given to the loss-free regulation of the current flow to the motor, the usefulness of regenerative braking, electrobus developments, and electrically powered transport vehicles. G.R.

A78-35768 Geothermal energy in the Western United States: Innovation versus monopoly. S. L. Bierman, D. F. Stover (Postal Rate Commission, Washington, D.C.), P. A. Nelson (Michigan Technological University, Houghton, Mich.), and W. J. Lamont. Research supported by the National Science Foundation; NSF Grant No. APR-75-18321-A02. New York, Praeger Publishers, 1978. 486 p. 570 refs. \$25.

The roles of raw fuel companies, electric utilities and government agencies in developing geothermal energy in the Western United States are studied. The investigation, conducted along the lines of an antitrust inquiry, attempts to identify the market factors which may lessen competition and inhibit progress in the geothermal energy industry. Factors tending to slow geothermal development include difficulties in locating a reserve of adequate size to make electrical generation economically viable, the frequent necessity of leasing lands from the federal government, and the limited output (50 to 150 megawatts) of geothermal power plants. The partnership of small firms and large corporations (sometimes utilities) in developing geothermal resources is discussed, and the special benefits of geothermal development for smaller utility systems are assessed. J.M.B.

A78-35778 Production of synthetic methanol from air and water using controlled thermonuclear reactor power. II - Capital investment and production costs. V. D. Dang and M. Steinberg (Brookhaven National Laboratory, Upton, N.Y.). *Energy Conversion*, vol. 17, no. 4, 1977, p. 133-140. 17 refs.

A preliminary evaluation of various processes for the production of synthetic methanol was conducted to determine economic feasibility, taking into account nine different methods of carbon dioxide extraction. Projections of demand of methanol in the year 2020 are also considered. It is found that as a consequence of an absence of requirements for absorption towers separation of carbon dioxide from sea water provides an approach involving the lowest unit capital investment of about \$1146/bbl/day methanol at a plant capacity of 21,700 bbl/day. The production cost of methanol synthesis lies between 10.5 and 17.2 cents/gal. The extraction of carbon dioxide from the atmosphere allows a greater degree of freedom for siting the synthetic fuel plant. Production costs range

from 11 to 82 cents/gal among the eight methods of extraction of carbon dioxide from the atmosphere. G.R.

A78-35781 On the relation between insolation and climatological variables. III - The relation between normal incidence solar intensity, total insolation, and weather at Fort Hood, Texas. IV - Construction of a model year of solar intensity and climate. D. Rapp (Texas University, Richardson, Tex.) and A. A. J. Hoffman (Texas Christian University, Fort Worth, Tex.). *Energy Conversion*, vol. 17, no. 4, 1977, p. 163-181. 9 refs. Research supported by the University of Texas and Texas Christian University; Contract No. E(40-1)-4924.

The described investigation was carried out to extend earlier studies conducted by Rapp and Hoffman (1976, 1977) on correlations of insolation with climate to a new correlation of normal incidence solar intensity (NISI) with climate. A digest of NISI data taken at Fort Hood during the time from September 1974 to November 1975 is presented and a correlation which provides the NISI at any hour of any day of the year for clear weather is developed. A correlation is developed between the fraction of clear day NISI received on cloudy days and cloud cover and visibility. A correlation between the fraction of clear day NISI and the fraction of clear day insolation on cloudy days is also obtained. The presented equations provide a unique prediction of NISI for any hour of any day under any weather conditions. The relations should make it possible to convert long-term data on cloud cover and visibility to long-term NISI patterns. A model year of hourly solar intensity and climatological variables is constructed by choosing a set of 12 months which approximate average behavior for solar intensity and climate. G.R.

A78-35782 Maximisation of operating efficiency of solar cells. D. M. Divan (Calgary University, Calgary, Alberta, Canada) and M. M. Hasan (Indian Institute of Technology, Kanpur, India). *Energy Conversion*, vol. 17, no. 4, 1977, p. 183-188. 5 refs.

The operating efficiency of a solar cell depends to a large degree on the incident intensity of solar radiation and on the load. Variations of radiation intensity on a normal day are so great that there is a considerable difference between the maximum efficiency of a solar cell and its average operating efficiency even under constant load conditions. This difference is at least 17%. The difference between maximum efficiency and average operating efficiency is further enlarged in connection with load fluctuations. A description is presented of two control mechanisms which will optimize the operating efficiency of a solar cell for arbitrary conditions of illumination and load. One method is based on the principle of peak detection. In the second method, which requires less hardware for its implementation, the monitored variable is the rate of change of the instantaneous power output of the solar cell. G.R.

A78-35783 Coming - In situ gasification. M. K. Buder (Bechtel National, Inc., San Francisco, Calif.). *Coal Mining and Processing*, vol. 15, May 1978, p. 54-59. 16 refs.

It is suggested that of the coal contained in steeply dipping beds (approximately 100 billion tons in the United States), 25% is recoverable by underground coal gasification (UCG). The basic principles of UCG are reviewed, noting that to date it has only been attempted in the Soviet Union. Holes are drilled either underneath or through the coalbed to serve as air injection or gas production wells, respectively. The holes are then linked by pneumatic or hydraulic fracturing, reverse combustion, or (most promising) directional drilling. In the gasification phase, air is injected into the wells entering the footwall of the coalbed, and the produced gas exits via the wells drilled through the steep coalbed itself. The locations of such beds in the U.S. (mostly in the western states) are described, and it is pointed out that the subbituminous coal indigenous to the region can provide a cheap and sure solution to the area's growing energy needs for decades (or centuries) to come (as low as \$1 per million Btu). D.M.W.

A78-35795 Experimental evaluation of natural convection solar air heaters. I. C. Macedo and C. A. C. Altemani (Campinas, Universidade Estadual, Campinas, São Paulo, Brazil). *Solar Energy*, vol. 20, no. 5, 1978, p. 367-369.

Four basic types of natural convection solar air heaters, in many geometries, were tested in a wide range of input solar energy values. Measured values of air flow rate, temperature increase and efficiency are reported. It is expected that the results and conclusions will be valuable in the design of equipment for drying, space heating and other purposes. (Author)

A78-35796 Optimum design of wideband selective absorbers with provision for specified included layers. B. S. Thornton and Q. M. Tran (New South Wales Institute of Technology, New South Wales, Australia). *Solar Energy*, vol. 20, no. 5, 1978, p. 371-377. 21 refs. Research supported by the Foundation for Australian Resources.

The theoretical design of multilayer solar absorbers is modelled on the concept of impedance matching in electrical transmission line and microwave transmission studies using the analogy between a dielectric multilayer optical filter and a multisection impedance transformer. A multilayer composite is to be designed for a substrate with a surface impedance which can be specified and obtained by the use of surface corrugations. The design is optimized in order to achieve the minimum of reflection loss and the related reflection response over a wide band in the solar radiation spectrum. The optimization problem involves the minimization of a quadratic objective function representing the impedance mismatch between the multilayer composite and free space, subject to constraints arising from inclusion of prespecified layers and from the selected configuration for the impedance path. G.R.

A78-35797 Collection times for trough-type concentrators having arbitrary orientation. C. W. Miller (Chamberlain Manufacturing Corp., Waterloo, Iowa). *Solar Energy*, vol. 20, no. 5, 1978, p. 399-404.

A mathematical condition is derived which determines the times at which acceptance of the sun's beam radiation begins and ceases for a trough-type concentrator having arbitrary orientation. The concentrator considered is a two-dimensional, ideal concentrator which has a definite range of acceptance angles. Sample calculations are performed which investigate the period of acceptance of a 1.8X concentrator. For year-round optimal collection a south-facing 1.8X concentrator should be oriented with axis horizontal and with slope equal to the latitude. If the concentrator faces slightly away from south, however, a horizontal axis and a slope equal to latitude will result in severely reduced collection times near a solstice. (Author)

A78-35798 The efficiency of solar flat-plate collectors. E. Marschall and G. Adams (California, University, Santa Barbara, Calif.). *Solar Energy*, vol. 20, no. 5, 1978, p. 413, 414. 10 refs.

A78-35799 Time integrated calculation of the insolation collected by a reflector-collector system. S. Baker, D. K. McDaniels, H. D. Kaehn, and D. H. Lowndes (Oregon, University, Eugene, Ore.). *Solar Energy*, vol. 20, no. 5, 1978, p. 415-417. 6 refs. Research supported by the Pacific Northwest Regional Commission.

The problem of collecting solar energy in cloudy climates is considered, taking into account a study concerning the feasibility of using inexpensive reflectors to enhance the light collection of a simple flat-plate collector. An investigation is conducted concerning the performance of the reflector-collector system when solar energy collection over the entire day is included. The optimum geometrical arrangement is obtained by weighting the system performance away from solar noon by the available direct solar intensity and averaging over the entire day. The optimum reflector orientation, the effect of finite reflector length, and the loss due to a finite reflector width are evaluated on this time-integrated basis. The advantages of a curved reflector are also briefly evaluated. G.R.

A78-35800 A simulated comparison of the useful energy gain in a fixed and a fully tracking flat plate collector. P. Drago (U.S.

Merchant Marine Academy, Kings Point, N.Y.). *Solar Energy*, vol. 20, no. 5, 1978, p. 419-423. 6 refs.

A78-35876 Ocean thermal energy - Status and prospects. W. H. Avery (Johns Hopkins University, Laurel, Md.). (*Marine Technology Society and American Institute of Mining, Metallurgical and Petroleum Engineers, Special Symposium, Rosslyn, Va., Sept. 15, 1977.*) *Marine Technology Society Journal*, vol. 12, Apr.-May 1978, p. 9-16. 6 refs.

The term OTEC describes a method for generating power by using the warm water at the surface of the tropical oceans, in combination with the cold water available at a depth of half a mile, to operate a heat engine. A description is given of an optimized OTEC-ammonia-fuel cell system which could deliver base-load electric power to the user at a cost averaging about 30 mills/kWh (in 1975 dollars). The system can deliver not only base-load power but, if adequate fuel cell capacity is provided, can also deliver intermediate-load power at approximately 33 mills/kWh and peak power at 50 to 60 mills/kWh on demand. It is found that OTEC-ammonia-electric power promises to compete favorably in cost with other options and can provide a future basis beginning by 1990 for an energy economy primarily based on OTEC ammonia that will be stable in price and available on an equal basis to the whole world. G.R.

A78-35893 Supersonic transport in terms of energy savings (Le transport supersonique face aux économies d'énergie). G. Cormery (Société Nationale Industrielle Aérospatiale, Toulouse, France). (*Congrès International, Aéronautique, 13th, Paris, France, June 2, 3, 1977.*) *L'Aéronautique et l'Astronautique*, no. 69, 1978, p. 3-14. In French.

The utilization of petroleum-based fuel for civil aviation is considered within the framework of total energy consumption. Attention is given to developments in the United States and France, both currently and over the near-term future (through the 1980s). Various improvements in engine and aerodynamic design are discussed, including use of composite materials, supercritical wings, high bypass engines, and improved engine geometries. The Concorde aircraft is presented as a model upon which the design of a second, more fuel efficient supersonic transport can be based. Also considered are schemes for noise reduction using reduced ejection velocities. D.M.W.

A78-35897 Research in a pre-vaporization combustion chamber on natural gas in liquid and gaseous states (Recherches sur une chambre à pré-vaporisation alimentée en gaz naturel en phase gazeuse ou liquide). G. Matton (Valenciennes, Centre Universitaire, Valenciennes, Nord, France) and J.-P. Muller (Ecole Nationale Polytechnique, Algiers, Algeria). *L'Aéronautique et l'Astronautique*, no. 69, 1978, p. 57-77. 44 refs. In French.

Phase diagrams derived from pre-vaporization combustion chamber observations are presented to support the contention that LNG or liquid methane could be employed as reliably as LH2 in aircraft fuel. It is noted that LNG can be burned as effectively as natural gas in gaseous form, and can also be used to start gas jet turbines and increase overall power by bypassing the heat exchanger. The cryogenic circuitry involved in aircraft applications is reviewed. It is also pointed out that LNG can be used more safely than LH2. D.M.W.

A78-36016 # Natural convection in groove-like geometries - The overall heat transfer coefficient. H. Nabavi and R. B. Bannerot (Houston, University, Houston, Tex.). *American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Thermophysics and Heat Transfer Conference, 2nd, Palo Alto, Calif., May 24-26, 1978, AIAA Paper 78-896.* 6 p. 13 refs. Contract No. EY-76-S-05-5100.

Groove-like geometries are being used to form non-tracking concentrating solar energy collectors. Experimental determinations of the overall heat loss coefficients from a trapezoidal groove, heated from the short side and insulated on the sloping sides are reported. The effects of tilt and internal baffling are investigated. The relative importance of the various modes of heat transfer is analyzed.

(Author)

A78-36018 # Experimental performance of flat plate solar collectors with various cover materials with and without transparent plastic honeycomb. R. K. Wedel, R. E. Dammann, and S. A. Greenberg (Lockheed Research Laboratories, Palo Alto, Calif.). *American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Thermophysics and Heat Transfer Conference, 2nd, Palo Alto, Calif., May 24-26, 1978, AIAA Paper 78-899*. 5 p. 6 refs. Contract No. E(04-3)-1256.

An experimental program was performed in which the efficiency of a flat plate collector was measured as a function of various collector cover materials. The materials chosen as candidate covers were FEP Teflon, Tedlar, and high transmittance glass. Efficiency data was also measured for the collector with a Lexan honeycomb between the cover and the absorber plate. The results showed that the optimum cover material was dependent upon the operating temperature.

(Author)

A78-36019 # Solar and infrared radiation properties of parallel-plate honeycomb. J. R. Felland and D. K. Edwards (California, University, Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Thermophysics and Heat Transfer Conference, 2nd, Palo Alto, Calif., May 24-26, 1978, AIAA Paper 78-901*. 13 p. 26 refs. ERDA-sponsored research.

Three radiative transfer problems are identified and solved for describing the thermal performance of parallel-plate honeycomb arrays, which may be used to construct solar-transparent insulated walls. First, the relatively straightforward problem of calculating solar transmittance is treated. Complicating factors of scattering, polarization, and mild spectral selectivity are included. Second, the problem of calculating effective emittance (or passage transmittance) is analyzed. The primary factor is the significant spectral selectivity of thin glass and plastic wall materials, because of partially transmitting spectral regions and resonance reflection (reststrahlen) bands. Third, there is determined the influence upon the effective emittance of the reradiated energy contributed by the absorbed solar radiation. Results are calculated for both thin-walled glass and mylar honeycombs based upon spectral measurements in the 0.33 to 24 microns region, which were used to derive working values of optical constants. With these results the engineer or architect can evaluate the merit of applying honeycombs to solar collectors, greenhouses, residences, and commercial buildings.

(Author)

A78-36020 # A simple test for determining a best flow rate through solar collectors. H. C. Hewitt, Jr., B. K. Parekh, and G. L. Askew (Tennessee Technological University, Cookeville, Tenn.). *American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Thermophysics and Heat Transfer Conference, 2nd, Palo Alto, Calif., May 24-26, 1978, AIAA Paper 78-900*. 6 p. 7 refs.

It is pointed out that in the studies which have been conducted to improve the performance of flat-plate solar collectors the flow distribution system design has not received the amount of notice it deserves. After a particular collector has been selected for an installation, a test is needed to be certain that the total solar energy-collection system will be operated in optimal performance condition. The results of the reported investigation indicate that such a test is possible. The particular pumping system should be checked for its overall efficiency. The basic equation for the considered mathematical model was obtained on the basis of an improvement of an analytical model first developed by Hottel and Woertz (1942).

The validity of the mathematical model was verified in an experimental investigation.

G.R.

A78-36021 * # Thermal optical surface properties and high-temperature solar energy conversion. L. Wen (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Thermophysics and Heat Transfer Conference, 2nd, Palo Alto, Calif., May 24-26, 1978, AIAA Paper 78-903*. 11 p. 15 refs. Research sponsored by the U.S. Department of Energy; Contract No. NAS7-100.

The effects of thermal surface properties on the performance of representative point focusing solar power plants are assessed in this paper. The tradeoff relationships are presented in terms of normalized system performance as a function of thermal optical design parameters. Crucial surface properties include solar reflectance, specular spreading due to microscopic roughness, surface error due to manufacturing slope tolerance or waviness and concentrator pointing accuracy. Two representative power conversion systems, a Rankine steam cycle and an open air Brayton cycle, are considered.

(Author)

A78-36022 # Optical design of solar concentrators. J. H. McDermitt (McDonnell Douglas Astronautics Co., Huntsville, Ala.) and T. E. Horton (Mississippi, University, University, Miss.). *American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Thermophysics and Heat Transfer Conference, 2nd, Palo Alto, Calif., May 24-26, 1978, AIAA Paper 78-904*. 9 p. 18 refs.

A generalized technique for the optical design of solar concentrators has been developed. The design technique considers limb darkening effects, collector placement errors, concentrator optical errors and concentrator pointing errors. In addition to giving the designer the ability to explore the sensitivity of a design to the above parameters, the technique also allows the designer to prescribe the heating distribution on the collector surface. A detailed derivation of the design technique and illustrative results are presented.

(Author)

A78-36030 American Vacuum Society, National Symposium, 24th, and Conference on Microbalance Techniques, 15th, Boston, Mass., November 8-11, 1977, Proceedings. Edited by M. G. Lagally. *Journal of Vacuum Science and Technology*, vol. 15, Mar.-Apr. 1978. 721 p.

The properties of thin films, ion beams for thin-film production, surface structure studies using such techniques as low-energy electron diffraction or Auger electron spectroscopy, chemisorption processes, and ion-textured materials are discussed. Topics of the papers include chemisorption of CO on Pd/mica, an evaluation of Mo and Mo-base alloys for beam dump material in tokamaks, ion scattering as a means to study the sorption of CO on Ni and W, sputter-deposition of WC + Co films, an ion source for micromachining, and the optical properties of metal/insulator composite films for selective solar energy absorption.

J.M.B.

A78-36032 Optical properties of selectively absorbing metal/insulator composite films. H. G. Craighead and R. A. Buhrman (Cornell University, Ithaca, N.Y.). *American Vacuum Society, National Symposium, 24th, and Conference on Microbalance Techniques, 15th, Boston, Mass., Nov. 8-11, 1977, Journal of Vacuum Science and Technology*, vol. 15, Mar.-Apr. 1978, p. 269-271. 6 refs.

The optical properties of Ni/Al₂O₃ and several other metal/insulator composite films have been studied with consideration given to their applicability as selective solar energy absorbers. Thin films were produced by coevaporation and the microstructure examined by electron microscopy. The optical properties of Ni/Al₂O₃ composites, measured over the range of the solar spectrum, are in good accord with the predictions of Maxwell-Garnett theory provided the Ni volume fraction is less than about

0.2. The Ni/Al₂O₃ films have excellent spectral selectivity for the absorption of solar radiation with a solar absorptivity of 0.94 obtained for a film produced with a graded composition. Low-temperature emissivities of about 0.1 have been obtained for Ni/Al₂O₃ on a highly reflecting metal backing. (Author)

A78-36035 Thickness dependence of structural and electrical properties of CdS films for solar cells. A. Amith (Princeton University, Princeton, N.J.). (*American Vacuum Society, National Symposium, 24th, and Conference on Microbalance Techniques, 15th, Boston, Mass., Nov. 8-11, 1977.*) *Journal of Vacuum Science and Technology*, vol. 15, Mar.-Apr. 1978, p. 353-358. 18 refs. Research sponsored by SES, Inc.

Polycrystalline films of CdS were evaporated on zinc-plated foils of copper so that different thicknesses were obtained in the same evaporation. The different thicknesses were compared with respect to their surface morphologies, acid etching, grain sizes, grain structure, and orientation as well as crystallographic orientation. Concomitant measurements of the electrical properties as functions of thickness were taken. It was established that grain size, the preferential grain orientation and the surface roughness all increased as the film thickness increased. Furthermore, it was found that the concentration of free carriers increased with film thickness, the quality of the diode behavior improved in the same manner, and the existence of voltage-dependent shunting paths diminished as the film thickness increased. An explanation is proposed which relates the observed electrical behavior as a function of thickness to the structural parameters. (Author)

A78-36036 Structure and morphology of chemical-sprayed CdS films. R. S. Berg, R. D. Nasby (Sandia Laboratories, Albuquerque, N. Mex.), and C. Lampkin (Photon Power, Inc., El Paso, Tex.). (*American Vacuum Society, National Symposium, 24th, and Conference on Microbalance Techniques, 15th, Boston, Mass., Nov. 8-11, 1977.*) *Journal of Vacuum Science and Technology*, vol. 15, Mar.-Apr. 1978, p. 359-362. 17 refs. ERDA-supported research.

The preparation of CdS films by chemical spray pyrolysis is described; the film-growth technique has potential for large-scale inexpensive production of semiconductor materials for photoconductors and photovoltaic applications. Study of the structures and morphologies of the pyrolytic chemical-sprayed CdS films indicates that their surface contains many nodular and serpentine features, and that the crystallite size is generally a few hundred nanometers. Contamination effects, device junction area and the very large optical scattering of the films are also discussed. J.M.B.

A78-36046 TFTR vacuum system. B. D. Abel (Grumman Aerospace Corp., Bethpage, N.Y.). (*American Vacuum Society, National Symposium, 24th, and Conference on Microbalance Techniques, 15th, Boston, Mass., Nov. 8-11, 1977.*) *Journal of Vacuum Science and Technology*, vol. 15, Mar.-Apr. 1978, p. 726-733. 17 refs. Contract No. EY-76-C-02-3073.

The Tokamak Fusion Test Reactor (TFTR) will be the first magnetic plasma device in the United States capable of producing energy in any significant quantity by the fusion of deuterium and tritium nuclei. The function of the vacuum pumping system is to provide the high-vacuum environment for plasma initiation, to remove spent plasma constituents at the conclusion of each plasma pulse, and to provide initial high vacuum and regeneration of the neutral beam cryopanels. Radiation produced by the fusion reaction and the requirement to pump tritium have presented significant design problems not ordinarily encountered in the design of ultrahigh vacuum systems. The configuration and piping schematic of the preliminary design vacuum pumping system capable of fulfilling the requirements is discussed. The selection process for the high-vacuum pumps is reviewed and the rationale for the use of turbomolecular pumps, based on projected overall vacuum pumping system reliability, is presented. A computer was used to predict vacuum system performance. Preliminary computer-generated pumpdown curves are presented for plasma-pulsing operations and pumpdowns from atmospheric pressure. (Author)

A78-36126 # Methods of energy conversion /Some results of the International Electrotechnology Congress - Moscow, 1977/ (Sposoby preobrazovaniia energii /Nekotorye itogi Vsemirnogo Elektrotekhnicheskogo Kongressa - Moskva, 1977 g./). N. S. Lidorenko. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Mar.-Apr. 1978, p. 9-17. 9 refs. In Russian.

Several papers dealing with direct energy conversion are reviewed. The review, divided into two sections, focuses on such physical methods of conversion as photoelectric, thermoelectric and thermionic power generation and also considers methods of electrochemical power generation. Attention is also given to the technology of thyristors and semiconductor diodes, to methods of data conversion, and to new current generators. B.J.

A78-36127 # Problems of electrical energy generation /Some results of the International Electrotechnology Congress - Moscow, 1977/ (Problemy generirovaniia elektricheskoi energii /Nekotorye itogi Vsemirnogo Elektrotekhnicheskogo Kongressa - Moskva, 1977 g./). I. A. Glebov. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Mar.-Apr. 1978, p. 18-27. In Russian.

A review is presented of reports and discussions on electrical energy generation at the Electrotechnology Congress. Emphasis is placed on the development of more efficient turbogenerators and hydrogenators of maximum power along with excitation and control systems as well as on the utilization of superconductors in electric generators. MHD and thermonuclear methods of power generation are discussed briefly. B.J.

A78-36128 # Automated complex electromechanical systems in industry and new types of electric equipment /Some results of the International Electrotechnology Congress - Moscow, 1977/ (Avtomatizirovannye promyshlennye elektromekhanicheskie komplekсы i novye vidy elektrooborudovaniia /Nekotorye itogi Vsemirnogo Elektrotekhnicheskogo Kongressa - Moskva, 1977 g./). M. G. Iun'kov and B. I. Motsokhein. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Mar.-Apr. 1978, p. 28-40. 22 refs. In Russian.

A review of reports and discussions on complex electromechanical systems in industry and transportation is presented. Emphasis is placed on the following aspects of automation of electromechanical systems: (1) utilization of local microprocessors in complex automatic controls of electric-drive mechanisms, (2) utilization of direct digital controls of force converters, (3) utilization of linear ac motors in transportation systems, and (4) utilization of high-power frequency-controlled ac drives, including those based on thyristor frequency-converters with autonomous inverters. B.J.

A78-36129 # Specialized complex electromechanical systems - Computer and microelectronics technology in control systems /Some results of the International Electrotechnology Congress - Moscow, 1977/ (Spetsializirovannye elektromekhanicheskie komplekсы, vychislitel'naia i mikroelektronnaia tekhnika v sistemakh upravleniia /Nekotorye itogi Vsemirnogo Elektrotekhnicheskogo Kongressa - Moskva, 1977 g./). N. N. Sheremet'evskii. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Mar.-Apr. 1978, p. 41-54. 23 refs. In Russian.

Consideration is given to specialized complex electromechanical systems for nuclear power plants and other types of power plants. The architecture and circuit technology of control computers for electromechanical systems are discussed and attention is given to the prospects of applying large scale integration and microprocessors in such control systems. Complex microminiaturization of electronic equipment, complex systems based on machines that employ the superconductivity effect and electromechanical systems for magnetic-levitation vehicles are all reviewed. Special emphasis is placed on specialized electromechanical systems for spacecraft and orbital stations. B.J.

A78-36130 # Technoeconomic estimates of a possible thermonuclear power plant with a tokamak reactor (Tekhniko-ekonomicheskie otsenki vozmozhnoi termoiadernoi elektrostansii s reaktorom tipa tokamak). N. N. Vasil'ev, D. K. Kurbatov, G. B. Levental', V. I. Miroshnichenko, A. V. Nedospasov, G. E. Shatalov, and V. S. Shvetsov. *Akademiia Nauk SSSR, Izvestia, Energetika i Transport*, Mar.-Apr. 1978, p. 65-73. 6 refs. In Russian.

The limiting capital investment, assuring cost-effective power generation, in a fusion power plant is estimated and compared with that of other types of power plants. It is found that under certain conditions the capital costs of a commercial fusion plant can be less than the maximally permissible cost. The technoeconomic analysis is applied to a hypothetical plant with a tokamak reactor and an MHD power generation system. B.J.

A78-36134 # Spectral characteristics of photoconverters with nonuniform distribution of defects in the base (Spektral'nye kharakteristiki fotopreobrazovatelei s neravnomernym raspredeleniem defektov v baze). E. B. Vinogradova, T. M. Golovner, S. M. Gorodetskii, G. M. Grigor'eva, E. V. Zhidkova, A. K. Zaitseva, and L. B. Kreinin (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotekhnika*, no. 1, 1978, p. 13-17. 9 refs. In Russian.

The described procedure for analyzing the spectral distribution of the silicon photoconverter collection coefficients permits a qualitative estimation of the clumping of defects in the base region of the specimen. The long wave portion of the silicon photoconverter spectrum indicates the distribution of the recombined centers in the base regions adjacent to p-n junctions. The derivation of an expression for the effective values of diffusion lengths is explained, and the analytic procedure can indicate operating conditions which do not cause the appearance of defect layers. Experimental results are presented. M.L.

A78-36135 # Study of diffusion processes in low-temperature thermal elements (Issledovanie diffuzionnykh protsessov v nizkotemperaturnykh termoelementakh). V. M. Sokolova, L. D. Dudkin, L. I. Petrova, and N. Kh. Abrikosov (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotekhnika*, no. 1, 1978, p. 18-21. In Russian.

The paper describes the kinetics of formation as well as the qualitative and quantitative chemical analysis of the composition of the reactive diffusion layer in a (Bi,Sb)2Te3-Co contact with respect to the hot junction of a low-temperature thermal battery. An expression is presented for the relation between the diffusion coefficient and the temperature. The results of the quantitative analysis of the diffusion layer are found to correspond to the phase equilibrium of the Ca-Sb-Te system. M.L.

A78-36136 # General principles of calculating multielement concentrating systems (Obshchie printsipy rascheta mnogoelementnykh kontsentriruiushchikh sistem). R. A. Zakhidov (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priroostroeniia, Uzbek SSR). *Geliotekhnika*, no. 1, 1978, p. 22-29. 13 refs. In Russian.

Some aspects of a procedure for calculating characteristics of any arbitrary multielement solar energy concentration system are discussed. Topics include the ray vector field, the statistical brightness, the ray path, and reflection. The organization of the calculation model and the computer algorithm is indicated. M.L.

A78-36137 # A device with a sectioned photodetector and a laser transmitter for determining the precision characteristics of solar energy concentrators (Ustanovka s sektiionirovannym fotopriemnikom i lazernym izluchatelem dlia opredeleniia tochnostnykh kharakteristik kontsentratorov solnechnogo izlucheniia). V. I. Krasilovskii, B. V. Tarnizhevskii, and E. V. Tver'ianovich (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotekhnika*, no. 1, 1978, p. 30-35. 7 refs. In Russian.

A78-36138 # Selection of a method for calculating parameters of storage devices used at wind and solar installations (Vybor metoda rascheta parametrov akkumuliruiushchikh ustroistv pri vetro- i gelioustanovkakh). R. B. Salieva (Tashkentskii Elektrotekhnicheskii Institut Sviazi, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 1, 1978, p. 67-71. 5 refs. In Russian.

The paper describes the kind of data required for application of the calendar method to determine reliable parameters for energy storage devices used at wind and solar installations. Results based on periodic observations are compared with results based on hourly observations. It is found that 20 years of periodic observations are sufficient for establishing reliable winter, spring, and fall patterns, while 10 years of periodic observations are sufficient for the summer pattern. M.L.

A78-36272 Wind-wave power available to a wave energy converter array. M. E. McCormick (Swarthmore College, Swarthmore, Pa.; U.S. Naval Academy, Annapolis, Md.). *Ocean Engineering*, vol. 5, Apr. 1978, p. 67-74. 19 refs.

A theoretical analysis of the wave power available to a line array of wave energy conversion devices is presented. The Pierson-Neumann-James directional spectrum for deep water is used to model the random sea. The present theory predicts 3/4 of the maximum power predicted by the former theory that neglected the directionality of the power. The maximum power occurs when the wind direction is normal to the line array. When the wind direction is parallel to the array the present theory predicts a power transmission of 1/4 the maximum value, while the former theory predicted no power. P.T.H.

A78-36274 Artificial upwelling induced by ocean currents - Theory and experiment. N. K. Liang, C. T. Hsieh, P. A. Huang, D. J. Li, L. L. Chu, C. L. Wu (National Taiwan University, Taipei, Nationalist China), and N. T. Liang (Academia Sinica, Institute of Physics, Taipei, Nationalist China). *Ocean Engineering*, vol. 5, Apr. 1978, p. 83-89, 91-94. Research sponsored by the Joint Commission on Rural Reconstruction.

A submerged apparatus, which consists of a buoy, several horizontal contraction and expansion tubes (Venturi-type tubes) and a long pipe, is expected to be used to pump the subsurface sea-water (200-300 meter depth) containing abundant nutrients to surface layer (50-100 m) by the dynamics of ocean currents, i.e. an artificial upwelling without energy cost. A preliminary experiment and analysis are undertaken and shows that the capacity of pumping the nutrient-rich sea-water is sufficient to justify building pilot prototype model. (Author)

A78-36279 Aircraft propulsion from the back room /Sixty-sixth Wilbur and Orville Wright Memorial Lecture/. W. Hawthorne (Cambridge University, Cambridge, England). *Aeronautical Journal*, vol. 82, Mar. 1978, p. 93-108. 25 refs.

A brief review is presented of the early history of jet engines and gas turbines along with a historical review of work done at the RAE Turbine Division. Particular attention is given to gas dynamics, axial compressor research and fuel economy. B.J.

A78-36301 # The geostationary orbit, focal point of space telecommunication law. A. A. Cocca (United Nations Committee on the Peaceful Uses of Outer Space, New York, N.Y.). *ITU Telecommunication Journal*, vol. 45, Apr. 1978, p. 171-173. 7 refs. Translation.

As a limited natural resource, the geostationary satellite orbit has been subjected to various definitions by the Space Treaty of 1967 and the International Telecommunications Convention of 1973. Priority rights to an orbital path, as well as limitations on the radio emissions of a spacecraft, are considered as principles relevant to the legal interpretation of the geostationary orbit. In addition, the concept of the geostationary orbit may create a need to resolve conflicting interests in the use of solar energy by satellites. J.M.B.

A78-36319 # A small tokamak 'Nova II'. M. Fukao, Y. Fujiwara, H. Zushi, H. Suemitsu, Y. Terumichi, and H. Nishihara (Kyoto University, Kyoto, Japan). *Kyoto University, Faculty of Engineering, Memoirs*, vol. 39, Oct. 1977, p. 431-445. 8 refs.

Design and operating parameters of a small tokamak (major radius 30 cm, minor radius 6 cm) are described. The maximum toroidal field is 15 kG, with electron temperatures (measured by diamagnetism and conductivity) of over 100 eV. Stable discharge is maintained for 15 msec or longer, and an electron density of 10-20 trillion/cu cm has been measured by a 6 mm microwave interferometer. Applications include the study of positional plasma stabilization, especially in terms of the effects of conductive and resistive shells, control of plasma current profile by a high frequency field, near the lower hybrid resistance, and effects of initial discharge dynamics on the final plasma equilibrium. D.M.W.

A78-36320 # Analysis of end effects in diagonal type MHD generator by means of equivalent circuit. M. Yoshida and J. Umoto (Kyoto University, Kyoto, Japan). *Kyoto University, Faculty of Engineering, Memoirs*, vol. 39, Oct. 1977, p. 504-522. 9 refs.

Numerical results of a study of the end region of a large scale combustion gas diagonal MHD generator using the equivalent circuit method are compared to a similar analysis by the conventional finite difference method. It is noted that the nozzle or the diffuser, connected to the generator duct or inlet, respectively, must be taken to at least the extent of the duct height. Attention is given to the effects of applied magnetic flux distribution, load current, and output electrode number on the current concentration at the ends of the output electrodes. Good agreement is found between the two methods of analysis. D.M.W.

A78-36321 # Electrical dissipation effects on propagation of magneto-hydrodynamic waves in anisotropic media. M. Numano (Kyoto University, Kyoto, Japan). *Kyoto University, Faculty of Engineering, Memoirs*, vol. 39, Oct. 1977, p. 523-534. 8 refs.

The Hall effect is considered in relation to the modification of MHD wave propagation by electrical dissipation. A generalized system using Maxwell's equations and Ohm's law is developed to obtain a dispersion relation with emphasis on ion cyclotron motion. As in cases of electrical dissipation or the Hall effect, three waves are observed, the slowest of which is found to evanesce in a perfectly conducting medium in the direction determined by the frequency due to ion cyclotron resonance. All three waves propagate in random directions, however, when the conductivity of the medium is finite. As the electrical conductivity decreases, one of the waves is reduced to an ordinary acoustic wave, while the other two waves are reduced to electromagnetic waves. D.M.W.

A78-36371 Application of gas turbines for peak and base load operation (Anwendung von Gasturbinen für Spitzen- und Grundlastbetrieb). M. Gard (AEG-KANIS Turbinenfabrik GmbH, Berlin, West Germany). *AEG-Telefunken, Technische Mitteilungen*, vol. 68, no. 1-2, 1978, p. 41-47. In German.

Characteristic data on the several types of gas turbines under different operating arrangements for peak and base load are presented. Startup and stopping characteristics of the PG 5341 gas turbine, a 25 MW machine without exhaust utilization, are plotted. The useful heat and heat losses for natural-gas fired gas turbines are compared with the useful heat and losses for the same machines but using an additional boiler feeding a condensation steam turbine. Large gas turbines in conjunction with condensation steam turbines have a terminal efficiency of 41-44.3%. The driving gas temperature is also higher. Heat performance data are also given for natural-gas fired gas turbines with remote heating. The block diagram of a three-stage fuel preparation system is discussed. P.T.H.

A78-36372 Use of gas turbines in natural gas transport systems /pipelines/ (Die Anwendung von Gasturbinen in Erdgas-Transportsystemen /pipelines/). J. Günther and W. Moldenhauer (AEG-KANIS Turbinenfabrik GmbH, Berlin, West Germany). *AEG-Telefunken, Technische Mitteilungen*, vol. 68, no. 1-2, 1978, p. 48-53. In German.

The paper describes some of the materials and equipment requirements for a natural gas pipeline station. The effect of environmental demands on design is discussed in the light of the Orenburg-Chust pipeline in the USSR. Requirements on an attendance-free station are examined. P.T.H.

A78-36443 Enzymes show promise for biomass conversion. E. K. Pye (Pennsylvania University, Philadelphia, Pa.). *Energy*, vol. 3, Spring 1978, p. 23, 24.

Enzymatic procedures for converting cellulose into glucose which can be fermented to ethanol are considered. Current research projects involve the use of *Thermoactinomyces* cellulase and hemicellulase to convert beef cattle wastes into sugars, the use of *Trichoderma reesei* cellulase to convert a variety of cellulosic materials, the use of amylglucosidase to transform plant starch, and the use of *Trichoderma viride* enzymes to break down cellulose from paper mill pulp, corn cobs, and cotton gin trash. An advantage of enzymatic processes is that they proceed under moderate conditions (30-50 C, neutral pH) and do not require the high temperature and pressure and low pH that are necessary for acid decomposition of cellulose. The cost of obtaining ethanol from cellulose is discussed and is shown to be competitive with alternative fuel costs in some parts of the world. M.L.

A78-36444 Photovoltaic electricity - On the way. I - An optimistic view. II - Solar cell arrays too expensive . . . but interesting. B. L. Welch (Environmental Biomedicine Research Institute; Johns Hopkins University, Baltimore, Md.) and E. M. Cohn. *Energy*, vol. 3, Spring 1978, p. 25-27.

Two views of the potential use and cost of photovoltaics are presented. One view holds that costs will continue to decline and that the proportion of U.S. energy produced by photovoltaics will increase. The other view holds that costs associated with installation of solar cell arrays makes their use prohibitively expensive except in areas outside the U.S. where resources to maintain traditional electricity-generating systems are lacking. Costs, marketing, funding, and manufacturing procedures are discussed. M.L.

A78-36445 Hydrogen fuel and its application to vehicular systems. R. E. Billings (Billings Energy Corp., Provo, Utah). *Energy*, vol. 3, Spring 1978, p. 28-30. 14 refs.

Some hydrogen storage systems for hydrogen-fuel automobiles are surveyed, and the engine efficiency of gasoline and hydrogen fuel automobiles is compared. Advantages and disadvantages of iron-titanium hydride and cryogenic hydrogen storage systems are examined, safety tests of a metal hydride tank are reported, and the lack of air pollution caused by hydrogen combustion is noted. The operational economics of hydrogen fuel use is considered with attention to the efficiencies of generating synthetic hydrogen, methanol, gasoline, and electricity from coal. It is suggested that a taxi fleet could be used to test the application of hydrogen as a vehicular fuel sometime during the 1980-1985 period. M.L.

A78-36497 Energy and the atmosphere: A physical-chemical approach. I. M. Campbell (Leeds University, Leeds, England). London and New York, John Wiley and Sons, 1977. 406 p. 32 refs. \$35.95.

The earth as a planet is examined and a description is presented of the natural energy balance of the earth. The gross structure of the earth's atmosphere is considered along with the photosynthetic origin of fuels, combustion and fuels, the realization of energy, the major cycles of the atmosphere, and the ionic species in the mesosphere and lower thermosphere. The photochemistry of the polluted troposphere is discussed, taking into account the need for photochemical activation, basic photochemical considerations, the rates of photodissociation processes in the troposphere, the overall chemistry of photochemical smog, the photooxidation of sulfur dioxide, and tropospheric aerosols. The neutral chemistry of the upper atmosphere is also investigated, giving attention to the upper atmosphere as a chemical reactor, primary photochemistry of the

upper atmosphere; secondary chemistry of the stratosphere, potential anthropogenic perturbations of stratospheric chemistry, biological effects of ultraviolet radiation, and the chemistry of the atmosphere above the stratopause. G.R.

A78-36551 High-temperature materials for MHD generators (Vysokotemperaturnye materialy dlia MGD-ustanovok). Edited by A. I. Rekov and A. I. Romanov. Moscow, Izdatel'stvo Nauka, 1977. 184 p. In Russian.

The papers deal with the physicochemical aspects of the production technology of refractory materials suitable for use as MHD-channel and combustion chamber components. Data on the composition and structure of such materials are presented, along with data on the thermomechanical stability, heat and corrosion resistance, electrical conductivity, thermionic emission, heat conductivity, chemical stability, and on the behavior of these properties under the operating conditions of MHD channels. Techniques developed for testing such refractory materials are described. V.P.

A78-36556 # Oxide ceramics for electrodes on open-cycle MHD generators (Okisnaia keramika dlia elektrodov MGDG otkrytogo tsikla). A. I. Rekov, G. P. Chernyshev, F. A. Akopov, B. V. Lukin, and R. Ia. Drozdov. In: High-temperature materials for MHD generators. Moscow, Izdatel'stvo Nauka, 1977, p. 35-41. 7 refs. In Russian.

The paper deals with the production technology and the thermomechanical, electrophysical, and chemical properties of ceramics of the following compositions: 85 mol% ZrO₂, 12 mol% CeO₂, 3 mol% Y₂O₃, and 91 mol% ZrO₂, 5 mol% Nd₂O₃, 4 mol% Y₂O₃. The grain size was less than 3 microns in all cases. Photographs of the microstructure of these electrode materials are presented, along with their thermal expansion curves and electrical conductivity vs temperature curves. Preliminary experimental data obtained with these electrodes are discussed. V.P.

A78-36563 # Investigation of the thermionic emission of some advanced cathode materials (Issledovanie termoelektronnoi emissii nekotorykh katodnykh materialov dlia novoi tekhniki). V. G. Gordon, B. S. Kul'varskaia, B. M. Levinov, A. I. Rekov, and E. G. Spiridonov. In: High-temperature materials for MHD generators. Moscow, Izdatel'stvo Nauka, 1977, p. 72-76. In Russian.

In the study described, the thermionic characteristics of a number of refractory materials intended for operation in oxidizing and nonoxidizing media were investigated. A Cr-LaCrO₃ cermet (57.52% La, 20.89% Cr) devoid of free lanthanum and chromium oxides was found to be best suited as matrix material for emitters intended for operation in oxidizing media. For nonoxidizing media, preference is given to graphite materials containing BaO, SrO, and Y₂O₃ additions. V.P.

A78-36566 # Refractory periclase materials and means of using them in high-temperature power plants (Periklazovye ognepurnye materialy i puti ikh ispol'zovaniia na vysokotemperaturnykh energeticheskikh ustanovkakh). S. G. Tresviatskii, B. I. Terekhovskii, I. D. Barabanova, Ia. I. Zholidov, and A. A. Miroshnichenko. In: High-temperature materials for MHD generators. Moscow, Izdatel'stvo Nauka, 1977, p. 91-97. In Russian.

A78-36578 # Study of the behavior of periclase materials in gas flows containing alkali additions (Issledovanie povedeniia periklazovykh materialov v gazovom potoke so shchelochnoi prisadkoi). T. S. Ignatova, L. V. Uzberg, L. F. Gruz'd', and G. K. Malikov. In: High-temperature materials for MHD generators. Moscow, Izdatel'stvo Nauka, 1977, p. 167-176. 13 refs. In Russian.

In the experiments described, electrically smelted periclase specimens differing in magnesia content were used to study the penetrability of alkali additions at temperatures ranging from 800 to 1800 C. The corrosion and the characteristics of precipitation of alkali compounds in the bulk of the specimens were studied as a function of the heat flux to the wall. The influence of potassium compounds on the electrical insulation properties of periclase materials was also investigated. Guidelines for using pure periclase materials as MHD-channel linings are proposed. V.P.

A78-36616 Cold flow mixing rate data for pulverized coal reactors. V. J. Memmott and L. D. Smoot (Brigham Young University, Provo, Utah). *AIChE Journal*, vol. 24, May 1978, p. 466-473. 14 refs. Research supported by the Electric Power Research Institute and U.S. Department of Energy.

Mixing rates of particles and gases in confined, coaxial jets are reported for tests with conditions simulating those of pulverized coal gasification and combustion processes. Gas velocity, particle mass flux, and gas composition were measured at various radial and axial locations downstream of the primary jet exit plane. Effects of inlet velocity, density, injection angle, particle loading level, and particle size on the rates of mixing were determined. Increasing injection angle and secondary velocity significantly increased gas and particle mixing rates, while effects of other variables were much less significant. Dispersion of particles lagged that of the gas in all cases investigated. (Author)

A78-36623 Marine thermic energy and the combination of solar, radiative and aeolian energies (L'énergie thermique marine et la combinaison des énergies solaire, radiative et éolienne). A. Dauvillier. *Revue de l'Energie*, vol. 29, Mar. 1978, p. 142-145. In French.

A thermodynamic process for the generation of energy is presented which uses meteorological elements through the creation of a heat source due to day-time rays and a cold source due to night-time rays plus a minor addition of aeolian energy obtained by a heat pump. Marine thermic energy, the radiation process, aeolian energy and the problem of sites and construction are all successively studied in this article. (Author)

A78-36650 Solar thermal heating systems: Technical aspects and economic limits /2nd revised edition/ (Solarthermische Heizungssysteme: Technische Aspekte und wirtschaftliche Grenzen /2nd revised edition/). H. Grallert. Munich, R. Oldenbourg Verlag GmbH, 1978. 216 p. 24 refs. In German. \$23.06.

The book attempts to show the technical possibilities for a utilization of solar energy. Its main objective is to provide information for engineers, technicians, and architects, concerned with the design and the employment of solar heating installations. The general principles of solar heating are examined, taking into account functional aspects, weather conditions, questions related to the solar spectrum and the radiation exchange with the environment, the theoretical solar energy irradiation, effects due to the presence of clouds, environmental temperature and pressure effects, and the general requirements which a solar heating system has to satisfy. In an investigation of the technical possibilities, attention is given to system concepts, the collector cycle, control problems, the connection between the collector cycle and the consumption cycle, solar energy collectors, the collector concept for solar house heating, thermal and optical material characteristics, geometrical dimensions in the direction of the normal of the plane, special construction types and design relations for flat-plate collectors, and heat pumps. A study of the economy of solar heating is also conducted. G.R.

A78-36679 Pollution control with SO₂ recovery. K. S. Gaur (Davy Powergas, Inc., Lakeland, Fla.). *Pollution Engineering*, vol. 10, May 1978, p. 51-55.

The Wellman-Lord sulfur dioxide recovery system is described. The method is based on the reaction between the absorbent sodium sulfite solution and sulfur dioxide. This produces sodium bisulfite.

Three primary operating procedures are identified: gas pretreatment/ SO_2 absorption, chemical regeneration, and purge treatment. Based on the performance of the first-generation plant, it is found that SO_2 removal efficiency exceeds 90%, particulate emissions do not exceed 0.1 lb/million Btu heat input, and Na_2CO_3 averages 94% of the maximum allowable. Capital and operating costs are discussed along with energy requirements. Future development is centered on reducing capital requirements in sulfate purge treatment, reducing steam consumption for chemical regeneration, and reducing pressure drop across the absorption system. S.C.S.

A78-36697 The role of advanced transit in the implementation of the polycentric city concept. J. Schneider (Washington, University, Seattle, Wash.) and T. Noguchi. (Advanced Transit Association, International Conference, Indianapolis, Ind., Apr. 25-28, 1978.) *High Speed Ground Transportation Journal*, vol. 12, Spring 1978, p. 1-22. 7 refs. Research supported by the U.S. Department of Transportation.

The paper reviews the activity centers concept and examines its relationship to the public transit part of the regional development plan. The polycentric city concept is discussed, and the planned development of regional centers in four metropolitan areas - Toronto, Vancouver, Minneapolis-St. Paul, and Denver - is indicated. Policy decisions that would foster the development of major diversified centers are considered, with attention to the question of whether rapid transit linkage of a regional center to downtown aids or hinders regional center growth. The implementation of the polycentric city concept is favored because it is thought that an urban area of this type is more able to support a viable public transportation system than would a monocentric city. M.L.

A78-36700 The German research and technology program concerning advanced tracked ground-transportation systems. H. Schulz (Bundesministerium für Forschung und Technologie, Bonn, West Germany). *High Speed Ground Transportation Journal*, vol. 12, Spring 1978, p. 101-111. 8 refs.

The paper discusses the rationale, program, and goals of tracked ground transportation systems research which is sponsored by the Federal Republic of Germany's Federal Minister for Research and Technology. The state-of-the-art of the magnetic levitation technique is reviewed, and a comparison of transport modes is presented. Data are provided for the primary energy consumption of different modes, investment costs versus topographic conditions, and noise emission versus speed. M.L.

A78-36701 The industrialization of space; Proceedings of the Twenty-third Annual Meeting, San Francisco, Calif., October 18-20, 1977. Parts 1 & 2. Meeting sponsored by AAS, AIAA, American Society for Quality Control, et al. Edited by R. A. Van Patten (Stanford University, Stanford, Calif.), P. Siegler, and E. V. B. Stearns (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). San Diego, Calif., American Astronautical Society (Advances in the Astronautical Sciences. Volume 36, pts. 1 & 2); Univelt, Inc., 1978. Pt. 1, 608 p.; pt. 2, 541 p. Price of two parts, \$85.

The technical aspects of large space structures are discussed, taking into account freedoms from constraints in solar power satellite design, the automated space fabrication of structural elements, a near-term space demonstration program for large structures, solar power satellite construction concepts, and structural and assembly concepts for large erectable space systems. Advanced transportation systems are considered along with the technical aspects of systems implementation, the key steps in the development program to space industrialization, communications and navigation, the technical aspects of space habitation, historical precursors and analogs, the economic realities of space operations, psycho-social and biological considerations, and problems of space law. Questions of space community planning are also investigated, giving attention to space community planning in a down-to-earth context, design

principles and cultures, a preliminary investigation of space habitat atmospheres, alternative social structures in a vacuum, and space industrialization as a challenge to private enterprise capitalism. G.R.

A78-36702 Freedoms and constraints in solar power satellite design. R. Sperber and H. Zipursky. In: The industrialization of space; Proceedings of the Twenty-third Annual Meeting, San Francisco, Calif., October 18-20, 1977. Part 1. San Diego, Calif., American Astronautical Society; Univelt, Inc., 1978, p. 7-26. 31 refs. (AAS 77-200)

The term 'freedom' is used to denote the ability to choose between several options, each of which is compatible with the constraints. A description is presented of geometric, structural, electrical, optical assembly, and implementation freedoms and constraints as they affect satellite power design. Geometric design is the positioning and orientation of system components. Primary constraints in geometric design for a power satellite as a whole are basic orientation, moments of inertia as they affect attitude control, thermal radiative requirements, and meteoroid flux direction. The main structural constraint on a power satellite is the large distance the main structure will have to span, up to tens of kilometers. Electrical design considerations for power satellites as compared to similar earthbound systems seem to be mainly a series of thermal constraints. G.R.

A78-36705 Solar power satellite construction concepts. K. H. Miller (Boeing Aerospace Co., Seattle, Wash.). In: The industrialization of space; Proceedings of the Twenty-third Annual Meeting, San Francisco, Calif., October 18-20, 1977. Part 1.

San Diego, Calif., American Astronautical Society; Univelt, Inc., 1978, p. 79-99. Contract No. NAS9-15196. (AAS 77-203)

In-space construction of a photovoltaic solar power satellite that is 5 1/2 by 25 km in size and weighs 81,000 tons is discussed. One of the construction approaches being considered requires 1/8-size power collection satellite modules to be constructed in low earth orbit (LEO) and transported to geosynchronous orbit (GEO) using self-powered electric thrusters. At GEO, these 1/8-size modules are connected and the antenna is constructed and attached. This construction approach will require about 300 people at LEO and 380 people at GEO working 10 hour shifts for 90 day staytimes. This paper describes the construction operations and construction equipment. Also discussed are some of the human factors considerations. (Author)

A78-36712 A baseline of logistic and power requirements for full-scale manufacturing of metallic materials in earth orbit. H. Bloom (General Electric Co., Space Div., Valley Forge, Pa.). In: The industrialization of space; Proceedings of the Twenty-third Annual Meeting, San Francisco, Calif., October 18-20, 1977. Part 1. San Diego, Calif., American Astronautical Society; Univelt, Inc., 1978, p. 277-295. 11 refs. (AAS 77-237)

Typical space-processed materials and their potential uses are considered, taking into account tungsten for X-ray targets, high-temperature tungsten-nickel eutectics for aircraft gas turbine blades, beryllia dispersion in beryllium for nuclear reactor reflectors, refractory metals (Mo) for aircraft gas turbine blades, tantalum or niobium-based alloys for electronic component substrates, monotectic alloys (W-Cu) for electric power contacts, superalloys with dispersed rare earth oxides for gas turbine components and high-temperature structures, superconducting monotectics (Nb Sn-Sn) for electrical components, and metal foams (Al/Ar). Attention is given to the functional requirements for logistics, the functional requirements of power, a set of metallic materials for establishing logistics and power requirements, and logistics and power requirements. G.R.

A78-36716 A road map to space products. R. L. Hammel and D. M. Waltz (TRW Defense and Space Systems Group, Redondo

Beach, Calif.). In: The industrialization of space; Proceedings of the Twenty-third Annual Meeting, San Francisco, Calif., October 18-20, 1977. Part 1. San Diego, Calif., American Astronautical Society; Univelt, Inc., 1978, p. 363-390. 6 refs. (AAS 77-239)

The advantages of a processing of materials in space are related to the presence of the low-gravity environment, the vacuum conditions, and the readily available solar energy. Five basic types of processes envisioned are related to crystal growth, purification/separation, mixing, solidifications, and processes in fluids. Potential space products are listed in a table. Electronic products considered include semiconductors, integrated circuit chips, magnetic switches, relays, magnetic detectors, ultrasonic and optical frequency filters, superconductors, and X-ray targets. Optical and biological products envisaged are related to large diameter crystals, uniformly doped crystals, high index of refraction glasses, IR-transmitting glasses, improved fiber optics, holographic storage devices, high-purity biologicals for use in making vaccines, human cell purification, enzyme isolation, and protein purification and production. Materials for structural uses comprise better turbine blade materials, high strength composites, and high purity materials. A description is presented of the development of space manufacturing during the flight research phase (1965-1984), the product and process development phase (1982-1990), and the industrial utilization phase (1990-2000). G.R.

A78-36717 * Satellite mirror systems for providing terrestrial power - System concept. K. W. Billman, W. P. Gilbreath (NASA, Ames Research Center, Moffett Field, Calif.), and S. W. Bowen. In: The industrialization of space; Proceedings of the Twenty-third Annual Meeting, San Francisco, Calif., October 18-20, 1977. Part 1. San Diego, Calif., American Astronautical Society; Univelt, Inc., 1978, p. 391-414. 11 refs. (AAS 77-240)

A system of orbiting reflectors, SOLARES, has been studied as a possible means of providing terrestrial power with a space system of minimum mass and complexity. The key impact that such a system, providing continuous and slightly concentrated insolation, makes on the economic viability of solar farming is demonstrated. New developments in solar sailing are incorporated to reduce mirror mass and transportation cost. The system is compatible with incremental implementation and continual expansion to produce the world's power needs. Key technology, environmental, and economic issues and payoffs are identified. SOLARES appears to be economically superior to other advanced, and even conventional, energy systems and could be scaled to completely abate our fossil fuel usage for power generation. (Author)

A78-36718 * In orbit manufacture of solar reflector satellites. R. M. Muller (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: The industrialization of space; Proceedings of the Twenty-third Annual Meeting, San Francisco, Calif., October 18-20, 1977. Part 1. San Diego, Calif., American Astronautical Society; Univelt, Inc., 1978, p. 415-428. (AAS 77-241)

The implementation of an idea reported by Oberth (1929) is discussed. This idea is concerned with the reflection of sunlight to the ground by means of orbiting metal mirrors. The approach used for implementing Oberth's idea makes use of aluminized Mylar as a reflecting material which is supported with the aid of a structure which includes six booms and a peripheral mirror cable. Four low resistance one turn coils are formed by the structure. Magnetic forces for attitude maneuvers are obtained by energizing the coils. A bipropellant propulsion system is to be used to raise the initial 330 km circular parking orbit to a 330 by 1000 km elliptical orbit. Two thrusters are employed. They are oriented parallel to each other and the mirror surface. The mirror satellite can be completely folded so as to maximize the launch capability of the Shuttle. G.R.

A78-36729 Space industrialization - The long-range view and the near and intermediate steps. C. L. Gould (Rockwell International Corp., Space Div., Downey, Calif.). In: The industrialization of space; Proceedings of the Twenty-third Annual Meeting, San Francisco, Calif., October 18-20, 1977. Part 2. San Diego, Calif., American Astronautical Society; Univelt, Inc., 1978, p. 697-728. (AAS 77-230)

A summary is provided of the results of a study on space industrialization. It is found that the industrial utilization of space is important to the nation, and facilitates the advancement of developing countries. It is both technologically feasible and economically rewarding on a need/market oriented basis. The most immediate rewards and the most favorable investment conditions in the 1980's are indicated in the service area both for information transmission and acquisition. The Shuttle/Spacelab combination provides an early step toward a general-purpose manufacturing R and D facility. The prospects for meaningful production levels of a number of biochemical and directional solidification products by the mid-1980's are promising. Attention is also given to energy-related developments in space for the near-term (1984-1990) and the intermediate term (1995-2010), plasma research in orbit to achieve controlled fusion, and the use of lunar materials, including an employment of lunar oxygen for spacecraft propulsion applications. G.R.

A78-36825 Broadlands - A gas-dominated geothermal field. M. A. Grant (Department of Scientific and Industrial Research, Wellington, New Zealand). *Geothermics*, vol. 6, no. 1-2, 1978, p. 9-29. 15 refs.

Characteristics of the Ohaki region in the Broadlands geothermal field in New Zealand are analyzed and are shown to be a consequence of the presence of a few percent of CO₂ in a two-phase system. At the 260 C level, the rock is 80% saturated with liquid and 20% saturated with vapor. The large overpressures of CO₂ indicate that the field is boiling to 2 km, and all the producing bores exploit two-phase aquifers. The two phases in the rock impede each other's flow, and the field would be unusable for energy purposes if the aquifer were less permeable. Topics investigated in the analysis include equations of flow, linearized perturbation equations - permeability in the Ohaki aquifer, mathematical modeling of field behavior, and results of model simulation. The differences between the Ohaki bores and the rest of Broadlands are described, gas contents of the field and initial state are reported, and characteristics of Broadlands and Wairakei geothermal fields are compared. M.L.

A78-36854 Output power and lifetime of high-voltage, low-temperature thermoelectric batteries. L. D. Dudkin, A. N. Moskalev, A. E. Nadzhip, O. B. Sokolov, and A. Ia. Terekov (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istoknikov Toka, Moscow, USSR). (*Geliotekhnika*, no. 3, 1977, p. 3-7.) *Applied Solar Energy*, vol. 13, no. 3, 1977, p. 1-4. Translation.

The article discusses the design of low-temperature high-voltage thermopiles featuring a high ratio of output voltage to unit power drain U/W (ratio roughly ten) capable of operating at temperatures from 50 to 300 C over a 200 C temperature drop. Extruded rods of low-temperature thermoelectric materials with such a ratio are used in fabricating the thermopiles. 4000-h lifetime tests run on specimens with hot-junction temperatures near 270 C revealed no degradation of thermopile energy output or performance. R.D.V.

A78-36855 Photoelectric and electric properties of nSiC-nCdS heterojunctions. Sh. A. Mirsagatov, M. Duisenbaev, and D. T. Rasulov (Akademiiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). (*Geliotekhnika*, no. 3, 1977, p. 8-11.) *Applied Solar Energy*, vol. 13, no. 3, 1977, p. 5-8. 5 refs. Translation.

Dark voltage-current and voltage-capacitance characteristics of n-type (SiC + CdS) heterojunctions were investigated, in order to ascertain the mechanism of current transport through the structure. The heterojunctions were fabricated by thermal vaporization of CdS

A78-36856 Determination of the thermodynamic parameters of a thermal compressor. A. G. Popov and V. S. Trukhov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). (*Geliotekhnika*, no. 3, 1977, p. 12-19.) *Applied Solar Energy*, vol. 13, no. 3, 1977, p. 9-14. 7 refs. Translation.

A procedure for calculating the thermodynamical performance characteristics of a thermocompressor operating on a modified Stirling cycle is worked out. An ideal thermocompressor model is developed, with constant temperatures in hot and cold zones, identical masses of working fluid taken in and exhausted over a cycle at constant pressures, no leaks, no friction, no drag, and with an ideal regenerator. Design with rod diameter taken into account and left out of account are considered. The thermal efficiency of the ideal thermocompressor is found to increase with compression ratio and to decline when monatomic working fluid is replaced by diatomic.

R.D.V.

A78-36858 Truncated 'focones' and 'foclines'. M. V. Braslavskia and V. K. Baranov. (*Geliotekhnika*, no. 3, 1977, p. 25-30.) *Applied Solar Energy*, vol. 13, no. 3, 1977, p. 19-22. Translation.

Graphs and tabular data are presented on the parameters of parabolic torus solar energy concentrators and parabolic cylinder focusing wedges. Straightforward determination of the performance parameters of shortened focusing concentrators and focusing wedges as functions of specified element depth or allowable degradation of concentration ratio is addressed. Spatial selectivity and aperture dimensions of the solar array elements are defined and formulated. Shortening a concentrator by a third, and a wedge by a half, is found to result in only 10% degradation in concentration.

R.D.V.

A78-36859 Technique of testing silazane coatings. R. A. Zakhidov, A. I. Ismanzhanov, and L. A. Dubrovskii (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). (*Geliotekhnika*, no. 3, 1977, p. 31-35.) *Applied Solar Energy*, vol. 13, no. 3, 1977, p. 23-26. 6 refs. Translation.

Procedures for accelerated ageing tests on Silazan resin protective coatings and statistical processing of test data are outlined. Resin coatings on solar concentrators are tested under various intensified solar UV radiation patterns simulating five-fold or forty-fold UV intensities. Mercury lamps are employed in the accelerated exposures. Parameters for the accelerated ageing tests, functions linking the lifetime and operating conditions of the coated object, and conversion of test results are discussed.

R.D.V.

A78-36860 Radiative heat transfer in axially symmetric hollow collectors of high-temperature solar installations. R. A. Zakhidov and Sh. I. Klychev (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). (*Geliotekhnika*, no. 3, 1977, p. 39-44.) *Applied Solar Energy*, vol. 13, no. 3, 1977, p. 29-33. 7 refs. Translation.

Radiative heat transfer in cavity type solar collectors was investigated with the object of arriving at useful simplifications in early-design selection of cavity parameters. A computer program is developed and the effect of optical-geometrical cavity parameters on heat flux is investigated, with attention given to the concentration field. Relationships between influx distribution and redistributions of outward-going flux are explored.

R.D.V.

A78-36862 Development of a solar-power cadaster. R. B. Salieva (Tashkentskii Elektrotekhnicheskii Institut Svizi, Tashkent, Uzbek SSR). (*Geliotekhnika*, no. 3, 1977, p. 56-64.) *Applied Solar Energy*, vol. 13, no. 3, 1977, p. 43-48. 18 refs. Translation.

Basic purposes of a solar energy cadastral survey incorporating objective numerical data based on an adequate stochastic model are outlined. The survey is intended to provide a data base for exploitation and storage of solar energy and for forecasting of favorable insolation conditions, with benefits in electric power, communications, refrigeration and heating, irrigation, and water resources management. The microstructure of solar radiation exposure is broken down from a continuous series to phase-homogeneous periods lasting one calendar month. Histograms, tables, and graphs are compiled as aids in determining repeatability of solar radiation patterns.

R.D.V.

A78-36863 Analysis and classification of concentrating-system design methods. R. A. Zakhidov (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). (*Geliotekhnika*, no. 4, 1977, p. 3-13.) *Applied Solar Energy*, vol. 13, no. 4, 1977, p. 1-9. 47 refs. Translation.

A review and classification is presented of the methods for calculating the radiation field and the design parameters of concentrating systems in solar energy equipment having single-mirror, multi-mirror, and facet type configurations. The method of elementary conical beams, the Gaussian-beam method, and the method of Gaussian deflection of the normal are described. Attention is given to the accuracy and limits of the various techniques.

S.C.S.

A78-36864 Focone and focline concentration of radiation scattered by circumsolar parts of the sky. V. K. Baranov. (*Geliotekhnika*, no. 4, 1977, p. 14-21.) *Applied Solar Energy*, vol. 13, no. 4, 1977, p. 10-16. 9 refs. Translation.

Previously derived formulas defining the ability of conical and cylindrical concentrators to concentrate the energy of extended radiation sources are combined with a model of solar-radiation scattering (in a clear sky, a lightly-clouded sky, and a densely-clouded sky) for the purpose of estimating the contribution of scattered radiation to the overall energy concentrated by such solar collectors. The analysis shows that in a densely-clouded sky the contribution of scattered radiation is negligible. In a clear or lightly-clouded sky the total radiation concentrated by the two types of collectors exceeds concentrated direct radiation by 5-10%, and even (for the cylindrical concentrators) up to 15%. When a silicon element is used as a receiver, the difference in the spectral composition of direct and scattered radiation does not significantly influence the system's effectiveness.

S.C.S.

A78-36865 Prospect for using Fresnel lenses for the concentrating systems of solar installations. N. S. Lidorenko, K. V. Zhukov, F. Kh. Nabiullin, and E. V. Tver'ianovich (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). (*Geliotekhnika*, no. 4, 1977, p. 22-25.) *Applied Solar Energy*, vol. 13, no. 4, 1977, p. 17-19. 11 refs. Translation.

A78-36868 Some results of an experimental investigation of a Stirling engine. G. Ia. Umarov, V. S. Trukhov, Iu. E. Kliuchevskii, I. A. Tursunbaev, E. P. Orda, and N. P. Vogulkin (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). (*Geliotekhnika*, no. 4, 1977, p. 34-37.) *Applied Solar Energy*, vol. 13, no. 4, 1977, p. 26-28. Translation.

This model Stirling engine, developed for solar energy systems, incorporates a displacer and a piston in a single cylinder. The volume measured by the displacer is found to be 60 cu cm. The engine's thermodynamic characteristics are studied in various operating modes. The engine rotations fluctuate within a range of up to 100 atm. The results obtained are compared with the theory.

S.C.S.

- A78-36869** Thermal optimization of solar power plants - Radiation concentration and working-fluid temperature. D. I. Teplyakov and R. R. Aparisi (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). (*Geliotekhnika*, no. 4, 1977, p. 38-47.) *Applied Solar Energy*, vol. 13, no. 4, 1977, p. 29-36. 10 refs. Translation.

The thermal interface of the concentrator and steam generator of a solar power plant is studied with emphasis on the concentrator efficiency and the temperature of the working medium in the steam generator. The dependence of the thermodynamic efficiency of conversion of radiation into mechanical work on the coordination between the concentrator and the steam generator is demonstrated. It is shown that in each particular case optimal coordination can be achieved between the concentrating power and the temperature of the heat transfer agent to provide maximum thermodynamic efficiency of a plant operating in the Carnot cycle. S.C.S.

- A78-36870** Comparative analysis of geometric characteristics of solar power plant boilers. L. N. Vladimirova and B. A. Garf (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). (*Geliotekhnika*, no. 4, 1977, p. 48-53.) *Applied Solar Energy*, vol. 13, no. 4, 1977, p. 37-41. Translation.

- A78-36871** Experience in operating a solar absorption cooling plant with open solution regenerator. A. A. Kakabaev, O. Klyshchaeva, A. Khandurdyev, and N. Kurbanov (Akademiia Nauk Turkmensoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). (*Geliotekhnika*, no. 4, 1977, p. 73-76.) *Applied Solar Energy*, vol. 13, no. 4, 1977, p. 57-59. Translation.

Results are reported of a four-year study of a nine-room three-floor model home utilizing absorption-cooling solar equipment with a cooling power of 50,000 kcal/hour. Some improvements in design and use of such equipment are suggested. It is seen that absorption-cooling equipment has potential for use in buildings located in southern regions. S.C.S.

- A78-36945** The significance of domestic refuse recycling for raw material requirements and energy consumption of the nonferrous metals industry (Bedeutung des Hausmüllrecyclings für Rohstoffbedarf und Energieverbrauch der NE-Metallindustrie). R. Turowski (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Metall*, vol. 32, May 1978, p. 498-500. In German.

The reported investigation has the objective to evaluate the economic feasibility of domestic refuse cycling in West Germany, taking into account the competitive position of refuse cycling in comparison to other refuse disposal methods. The investigation makes use of the methods of energy analysis to determine the energy required for obtaining the various products. Fractions of special interest for recycling include paper, glass, iron, nonferrous metals, and plastics. Textiles are separated together with paper and cardboard. They are used as fiber material in the manufacture of paper. Recycling installations are found to be economically feasible in areas in which a high population density assures the minimum material quantities required for an economic operation. Attention is given to the reduction of raw material requirements as a consequence of recycling operations, the recycling potential and the use of the secondary metal, the relief provided for the energy balance, energy consumption in the case of aluminum, and possibilities for a saving of energy on a global basis. G.R.

- A78-36964** Thermoelectric power and ac conductivity of A-type Nd₂O₃. V. Pratap and B. K. Verma (Gorakhpur, University, Gorakhpur, India). *Pramana*, vol. 10, Feb. 1978, p. 173-177. 10 refs.

- A78-37114** Aero engines climb towards better fuel efficiency. M. Hewish. *New Scientist*, vol. 78, May 11, 1978, p. 380, 381.

The low-by-pass-ratio turbofans of the early 1960s had specific fuel consumptions about 15 percent lower than the previous straight turbojets. The introduction of high-bypass turbofans in the early 1970s led to a further 20 percent reduction. Studies financed by NASA have the objective to reduce fuel consumption by another 12 percent. Gains to be made are related to improved components performance, revised maintenance procedures to reduce deterioration in use, reduced sensitivity to factors which cause performance to fall while the engine is in service, and a modified operating cycle, mainly involving changes in bypass ratio, overall pressure ratio, and turbine inlet temperatures. The integrated fan duct, which provides structural strength and damps out fan noise, contributes to performance gains by more efficient mixing of the fan flow and hot gas stream from the engine core. G.R.

- A78-37139** Intensity dependence of inverse bremsstrahlung absorption in an inhomogeneous standing wave. R. J. Faehl and N. F. Roderick (California, University, Los Alamos, N. Mex.). *Physics of Fluids*, vol. 21, May 1978, p. 793-797. 13 refs. ERDA-sponsored research.

Using both a simple analytic model and exact one-dimensional calculations, the intensity dependence of inverse bremsstrahlung absorption in a nonuniform standing wave in a plasma is investigated. The heuristic model for intensity corrections to the absorption coefficient is extrapolated to Airy-like field distributions. The numerical calculations simultaneously solve Maxwell's equations with the ion and electron fluid equations on the electromagnetic time scale. Values are found for the fractional reduction in inverse bremsstrahlung absorption. Good agreement is found between calculated and model results. It is noted that the study has applications in laser fusion. S.C.S.

- A78-37143** Wall stabilization of axisymmetric modes in noncircular tokamak plasmas. M.-S. Chu and R. L. Miller (General Atomic Co., San Diego, Calif.). *Physics of Fluids*, vol. 21, May 1978, p. 817-826. 20 refs. Contract No. EY-76-C-03-0167-PA-38.

The axisymmetric stability of tokamak equilibria with arbitrary cross section is studied numerically using the energy principle. The contribution to delta W from the plasma region is minimized analytically with respect to displacements in the toroidal and poloidal directions. The formulation of Lüst and Martensen is used for the vacuum contribution. Bessel-Fourier and other sets of trial functions are then employed to cast the minimization of delta W into a matrix eigenvalue problem. A computer code named AXISYM evaluates these matrix elements and solves for the eigenvalues. The code is fully toroidal and compressible mode trial functions are included. Wall stabilization is studied by placing a conducting wall around the vacuum region. (Author)

- A78-37147** Mode mixing of large scale fluctuations in JFT-2 tokamak. K. Odajima, M. Wakatani, M. Maeno, and N. Fujisawa (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan). *Physics of Fluids*, vol. 21, May 1978, p. 846-851. 14 refs.

Low frequency fluctuations in the JFT-2 tokamak are investigated. The fluctuations propagate in the direction of the electron diamagnetic drift velocity and have a toroidal mode number $n = 1$. Density fluctuations reveal that the $m = 2$ mode is dominant; on the other hand, magnetic field fluctuations show a poloidal mode number $m = 3$. The apparent discrepancy is explained by a sum of $m = 2$, $m = 3$, and/or $m = 4$ modes. Theoretical analysis based on the magnetohydrodynamic theory of kink and tearing modes agrees well with experimental observations. (Author)

A78-37172 Waste pyrolysis - Alternative fuel source. L. M. Puce. *Power*, vol. 122, June 1978, p. 101-103.

Four means for producing alternative fuel sources via waste pyrolysis are considered. In the first, low-Btu gas is produced by waste pyrolysis in a refractory-lined rotary kiln. The second is based on solid waste passing through a gasifier, and then through stages of drying, pyrolysis, and combustion. This also yields a low-Btu gas. The third method produces a medium-Btu gas by using oxygen reacting with char residue to produce hot gases which pyrolyze incoming waste. In the fourth technique, a flash-pyrolysis process produces a high-Btu liquid fuel. S.C.S.

A78-37174 Photo-galvano-voltaic cell - A new approach to the use of solar energy. H. T. Tien and J. M. Mountz (Michigan State University, East Lansing, Mich.). *International Journal of Energy Research*, vol. 2, Apr.-June 1978, p. 197-200. 9 refs. Research supported by Michigan State University.

A novel photo-electrochemical cell based on a combined principle of photogalvanic and photovoltaic effects is proposed and tested. The principal element of the cell consists of a pigmented membrane separating two aqueous solutions; one of which contains thionine dye and ferrous ions. The photo-emf generated across the cell is equal to the sum of the voltages derived from the photogalvanic and photovoltaic processes. The feasibility of such a photo-galvano-voltaic device for light transduction has been demonstrated. (Author)

A78-37177 Ideal flux concentrators with reflector gaps. R. Winston (Chicago, University, Chicago, Ill.). *Applied Optics*, vol. 17, June 1, 1978, p. 1668, 1669. 7 refs. Contract No. ER-78-5-02-4657.

Although it has been argued that solar concentrators with the maximum theoretical concentration ratio must have reflecting surfaces connecting the absorbers to the entrance apertures, this feature may not always be possible in practical devices. Accordingly, a design strategy is developed to preserve ideal flux concentration on the absorber while slightly oversizing the reflector. The design strategy is applicable to arbitrary convex receiver shapes and quite general illumination of the entrance aperture; the design is also adaptable to case involving refractive elements. J.M.B.

A78-37189 Modeling solar cells for use as optical detectors - Background illumination effects. L. A. Mallette and R. L. Phillips (Florida Technological University, Orlando, Fla.). *Applied Optics*, vol. 17, June 1, 1978, p. 1786-1788. 12 refs.

Solar cells have traditionally been used for direct sunlight to energy conversion, but there has been relatively little investigation into their use as a low data rate optical detector. This paper presents an experimental procedure used to determine the ac model of a specific solar cell. A lumped circuit model and governing equations are developed. Open circuit responses to pulses are used to determine values for the internal capacitances as a function of background illumination. Possible problems encountered with noise generation are also reviewed. (Author)

A78-37260 # Thin film CdS-CuI heterojunction photocells. V. E. Stoianov, M. S. Lakova, D. I. Dimova, and I. K. Baltov (B'lgarska Akademiia na Naukite, Institut po Fizika na Tv'rdoto Tialo, Sofia, Bulgaria). *Bolgarskaia Akademiia Nauk, Doklady*, vol. 30, no. 12, 1977, p. 1697-1700. 11 refs.

The development of a new type of CdS heterojunction referred to as CdS-CuI is described. The factors justifying the use of CuI as a junction to CdS are that CuI is a stable p-type material, is a wide-bandgap material, is easily processed, and can serve as an antireflective coating. The samples are prepared by consecutive deposition of CdS and CuI on glass or Kapton substrates cleaned previously by standard technology. The vacuum-deposited CdS film has a thickness of 4-5 microns, while the CuI film has a thickness of 0.05-0.1 micron. Different metals such as Au, Al, and Ni are vacuum deposited as ohmic contacts to CdS and Au to CuI. CdS-CuI

photocells with stable parameters up to 80 C are obtained. The best samples exhibit at 80 mW/sq cm an open-circuit voltage of 450-500 V, a short-circuit current of 3-4 mA/sq cm, and an efficiency of 1-2% for a fill factor of about 0.5. The photovoltaic effect observed shows a very good stability at elevated temperatures up to 80 C for several thousands of hours. Better parameter values can be obtained after optimization of the technological processes involved. S.D.

A78-37261 # Photoelectric properties of CdS thin films obtained by vacuum evaporation from the heterogeneous CdS.Cr2O3 system. M. S. Lakova, D. I. Dimova, S. K. Kunev, and I. K. Baltov (B'lgarska Akademiia na Naukite, Institut po Fizika na Tv'rdoto Tialo, Sofia, Bulgaria). *Bolgarskaia Akademiia Nauk, Doklady*, vol. 30, no. 12, 1977, p. 1701-1704. 9 refs.

A78-37297 Analysis of spray combustion in a research gas turbine combustor. P. B. Patil, M. Sichel, and J. A. Nicholls (Michigan, University, Ann Arbor, Mich.). *Combustion Science and Technology*, vol. 18, no. 1-2, 1978, p. 21-31. 9 refs. U.S. Environmental Protection Agency Grant No. R-802925-02-2.

This paper deals with the analysis of liquid fuel spray combustion in an idealized gas turbine combustor. The flow, which is assumed to be one dimensional, is divided into two regions: (1) the heat up region and (2) the combustion region. Appropriate non-dimensional equations have been solved for each region and the solutions matched at the common boundary. Analytical expressions have been developed for the burning velocity eigenvalue as well as for the solution in the combustion region. The effects of the properties of the fuel and the air as well as effects of the conditions prevalent within the combustor on the solution are discussed. Typical results for JP-4 fuel are presented. The research gas turbine combustor designed and built at The University of Michigan comes very close to satisfying the assumptions made in this analysis. (Author)

A78-37299 Performance and NO_x emissions of spark ignited combustion engines using alternative fuels - Quasi one-dimensional modeling. I - Hydrogen fueled engines. J. J. Fagelson, W. J. McLean, and P. C. T. de Boer (Cornell University, Ithaca, N.Y.). *Combustion Science and Technology*, vol. 18, no. 1-2, 1978, p. 47-57. 35 refs. U.S. Department of Transportation Contract No. OS-30113.

A computer simulation of the performance and NO_x emissions of hydrogen fueled spark ignition engines is described. The engine combustion process is modeled by employing a semiempirical turbulent flame speed expression, and the NO_x emissions are determined by integrating the chemical rate equations resulting from the extended Zeldovich mechanism over the boundary conditions determined by the cycle analysis. Maximum NO_x emissions are predicted and experimentally found for lean mixtures whose equivalence ratio is in the vicinity of 0.8, while for richer mixtures the rapid decomposition of NO during the expansion stroke lowers exhaust emissions. Lean hydrogen-air mixtures are attractive from an efficiency standpoint, but the near stoichiometric mixtures required for full power operation lead to excessively high pressure rise rates. Exhaust gas recirculation moderates the burning rate and reduces the power output at little or no loss in efficiency. M.L.

A78-37421 # Operational experience with a 5m Darrieus wind turbine. V. A. L. Chasteau (Auckland, University, Auckland, New Zealand). *Institution of Engineers, Australian Hydraulics and Fluid Mechanics Conference, 6th, Adelaide, Australia, Dec. 5-9, 1977, Paper. 4 p.* 11 refs.

A demonstration Darrieus wind turbine with a rotor diameter of 4.72 m was found to provide a power output much different from the output predicted by theory. Whereas a peak power of about 6

kW in a 14 m/sec wind was expected, the turbine in fact developed ever-increasing power with wind speed increments, registering a maximum output of 23 kW in a 22 m/sec wind. The relationship between power coefficient and tip speed ratio was studied on the basis of line current and windspeed records; the blade Reynolds numbers appeared to have a significant influence on the shape of the power coefficient curve. J.M.B.

A78-37462 Silicon solar cell designs based on physical behavior in concentrated sunlight. J. G. Fossum, E. L. Burgess (Sandia Laboratories, Albuquerque, N. Mex.), and F. A. Lindholm (Florida University, Gainesville, Fla.). *Solid-State Electronics*, vol. 21, May 1978, p. 729-737. 17 refs. ERDA-supported research.

A theoretical and experimental analysis is presented for the performance of silicon solar cells in concentrated sunlight. An understanding of the fundamental device physics is used to work out three distinct cell designs of the n-on-p type with much higher efficiencies than achieved before. The three types of n-on-p cells are (1) n(+)-p with base resistivity = 0.3 ohm-cm; (2) n(+)-p with base resistivity = 10 ohm-cm; and (3) n(+)-p-p(+) back-surface-field cell with base resistivity = 10 ohm-cm. None of the designs involves significant departures from basically conventional silicon solar cell structures. Theoretical performance projections for these designs - based on relevant device physics, numerical analysis, and experiment - predict conversion efficiencies of about 20% at illumination levels in the range 25-100 suns under AM1 conditions. S.D.

A78-37464 Influence of bandgap narrowing on the performance of silicon n-p solar cells. P. Lauwers, J. Van Meerbergen, P. Bulteel, R. Mertens, and R. Van Overstraeten (Leuven, Katholieke Universiteit, Heverlee, Belgium). *Solid-State Electronics*, vol. 21, May 1978, p. 747-752. 18 refs. Research sponsored by the Instituut tot Aanmoediging van het Wetenschappelijk Onderzoek in Nijverheid en Landbouw and Nationale Fonds voor Wetenschappelijk Onderzoek.

The effectiveness of incorporating an experimentally determined bandgap narrowing in the modeling of n(+)-p silicon solar cells was examined. Within every batch of solar cells fabricated, the substrate resistivity of the different cells was variable to ensure that all cells, with variable substrate concentration, were treated in an identical way. The discussion covers the physical model on which the computations are based, the technology used to fabricate the solar cells, the measurement of the minority carrier lifetime in the substrate, a comparison between the measured and computed values for the short-circuit current and open-circuit voltage and maximum output current, a theoretical case with only Auger recombination, and computed results for solar cells with different surface concentrations. It is shown that incorporation of bandgap narrowing is necessary for obtaining a good agreement between computed and measured results, without using lifetime values inconsistent with experimental data. An experimentally determined lifetime versus substrate doping relation is also required. S.D.

A78-37466 Analysis of generation in space charge regions of solar cells. H. J. Pauwels, P. de Visschere, and P. Reussens (Gent, Rijksuniversiteit, Ghent, Belgium). *Solid-State Electronics*, vol. 21, May 1978, p. 775-779. 8 refs.

A mathematical formulation of carrier transport in space charge regions in the presence of photoexcitation is presented. The analysis is only useful if bulk recombination can be neglected or is an a priori known function of position. The physical insight offered by this formulation is illustrated for the case of carrier transport in the space charge region of a heterojunction, and in a surface field region.

(Author)

A78-37467 Polycrystalline silicon p-n junctions. T. L. Chu, S. S. Chu, G. A. van der Leeden, C. J. Lin, and J. R. Boyd (Southern Methodist University, Dallas, Tex.). *Solid-State Electronics*, vol. 21, May 1978, p. 781-783, 785, 786. 5 refs. Contract No. EY-76-C-03-1285.

Silicon films deposited on recrystallized metallurgical silicon substrates have been used for the fabrication of low cost solar cells. The substrate is polycrystalline, and the active region of the solar cell is epitaxial with respect to the substrate. Since the dark current-voltage characteristics of a solar cell are important factors affecting its conversion efficiency, the characteristics of a number of epitaxial mesa diodes of the configuration n(+)-silicon/p-silicon/p(+)-metallurgical silicon/graphite have been measured over a wide temperature range to study the effects of grain boundaries. The results were analyzed on the basis of the two-exponential model of Stirn (1972). (Author)

A78-37468 Frequency limitations of transferred electron devices related to quality of contacts. L. F. Eastman (Cornell University, Ithaca, N.Y.) and M. S. Shur (Wayne State University, Detroit, Mich.). *Solid-State Electronics*, vol. 21, May 1978, p. 787-791. 8 refs.

Output power, efficiency and negative resistance of transferred electron generators are estimated in the frame of a simple model. The results are used to analyze how the finite contact resistance and the skin-effect set up a limit for the upper frequency of the generation. (Author)

A78-37469 Solar cell behaviour under variable surface recombination velocity and proposal of a novel structure. A. Luque, A. Cuevas, and J. Eguren (Madrid, Universidad Politécnica, Madrid, Spain). *Solid-State Electronics*, vol. 21, May 1978, p. 793, 794. 7 refs.

An experimental method is described which permits measurement of the open-circuit voltage (Voc) and the short-circuit current (Isc) of a solar cell having a variable surface recombination velocity (SRV) at the face opposite to the junction. Therefore, the Isc and Voc for very high SRV such as that of conventional cells, or for very low SRV such as that of a cell using back surface field (BSF), can be experimentally compared using the same cell, thus avoiding sample-to-sample variations. In particular, the double-side illuminated (DSI) cell can be compared to the cited structures and experimental studies can be performed for interdigitated back contact cells. The experimental results for a symmetrical n(plus)-p-n(plus) cell structure suggest a novel low-cost DSI structure consisting of n(plus)-p-p(plus) cell structure in which a metal grid is deposited on both sides for contact. When this cell is illuminated on the face where the n(plus)-p junction is formed, its Voc x Isc product is the same as that of a BSF cell. S.D.

A78-37860 Investigating the efficiency of gas turbines in off-design operation. G. G. Ol'khovskii and N. I. Ol'khovskaia (Vsesoiuznyi Nauchno-Issledovatel'skii Teploekhnicheskii Institut, Moscow, USSR). (*Teploenergetika*, vol. 24, no. 9, 1977, p. 25-29.) *Thermal Engineering*, vol. 24, no. 9, 1978, p. 16-19. 8 refs. Translation.

Parameters useful in characterizing the efficiency of gas turbines have been studied on the basis of information accumulated while refining the starting and operating performance of multistage gas turbines. Among the parameters discussed are the expansion ratio, the characteristic ratio (on which individual turbine-stage efficiency is strongly dependent), available heat drop, and internal efficiency. In addition, the internal capacity of the turbines is obtained from the capacity balance (allowance being made for the capacity of the starting motor). A number of the parameters are monitored for multistage gas turbines from cold start to operational gas temperature. J.M.B.

A78-37861 The effect of burner design and operational factors on the emission of nitrogen oxides when burning an anthracite/slurry mixture. E. Kh. Verbovetskii, V. I. Babii, I. T. Zhukov, and M. P. Kutlunin (Vsesoiuznyi Nauchno-Issledovatel'skii Teploekhnicheskii Institut, Moscow, USSR). (*Teploenergetika*, vol. 24, no. 9, 1977, p. 37-40.) *Thermal Engineering*, vol. 24, no. 9, 1978, p. 23-25. Translation.

A78-37862 Reducing nitrogen oxides in the flue gases from gas/oil-fired boilers at high-capacity power stations. A. D. Gorbatenko, L. A. Fanas'eva, E. V. Bozhevol'nova, V. A. Krutiev, and S. G. Shtal'man (Vsesoiuznyi Nauchno-Issledovatel'skii Teploekhnicheskii Institut, Moscow, USSR). (*Teploenergetika*, vol. 24, no. 9, 1977, p. 74-77.) *Thermal Engineering*, vol. 24, no. 9, 1978, p. 51-54. 8 refs. Translation.

A78-37901 Korea Atomic Energy Research Institute, Collected Reprints. Volume 4. Seoul, Korea Atomic Energy Research Institute, 1977. 363 p. In Korean and English.

Construction of an economical superradiant N2 laser with high peak power, the minority carrier lifetimes of three different silicon solar cells, and the development of a single-side drift-field silicon solar cell are among the topics discussed. Attention is also given to a statistical approach to comparing alternative fuel cycles for a 1125-MWe power plant, a technique for grafting acrylic acid onto polyvinyl chloride fibers, and countermeasures for Xe-135 poisoning in nuclear reactors. J.M.B.

A78-37903 # Minority carrier lifetime measurement of silicon solar cell. H. Y. Lee and Y. S. Kim (Korea Atomic Energy Research Institute, Seoul, South Korea). (*New Physics*, vol. 16, Dec. 1976, p. 203-206.) In: Korea Atomic Energy Research Institute, Collected Reprints. Volume 4. Seoul, Korea Atomic Energy Research Institute, 1977, p. 83-86. 5 refs. In Korean, with abstract in English.

A78-37904 # Ion-implanted drift field silicon solar cell. H. Y. Lee, J. K. Kim, and Y. S. Kim (Korea Atomic Energy Research Institute, Seoul, South Korea). (*Korean Nuclear Society, Journal*, vol. 8, Mar. 1976, p. 29-40.) In: Korea Atomic Energy Research Institute, Collected Reprints. Volume 4. Seoul, Korea Atomic Energy Research Institute, 1977, p. 112-123. 22 refs.

Development of a single-side drift-field silicon solar cell with the structure p(+)-p-n is discussed. The p-n junction is obtained by use of a gas discharge and heating implanter, which deposits dopant atoms onto the substrate by the processes of radiation-enhanced diffusion and, secondarily, hot implantation. The open-circuit voltage of the experimental solar cells is 0.44 V and the conversion efficiency is 5%. The simplicity of the p-n junction formation is the chief advantage of this solar cell fabrication technique. J.M.B.

A78-37912 # Heat transfer in a dense layer at large Biot numbers (Teploobmen v plotnom sloe pri bol'shikh znacheniiakh chisla Bio). E. I. Merzliakov, I. A. Ryzhenko, and A. S. Tsyur'nikov (Akademiiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Teplofizika i Teploekhnika*, no. 34, 1978, p. 44-48. 5 refs. In Russian.

A method of solving systems of thermoconvection equations for two-dimensional filtration of a liquid in a dense layer (Biot number much greater than unity), is proposed, in which the blocks of the matrices are modeled by real physical bodies. The assumption of linear interphase heat transfer even under conditions of a thermally homogeneous medium is made. The limits of applicability of the laws of quasi-steady regime in the determination of the temperature fields in the layer are established. P.T.H.

A78-37944 # Calculation of photocurrent and limit efficiency of p-CdTe - n-CdS film-type photocells (K raschetu fototoka i predel'nogo K.p.d. plenochnykh p-CdTe - n-CdS-fotoelementov). N. Lunusov, Sh. A. Mirsagatov, and D. T. Rasulov (Akademiiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotehnika*, no. 2, 1978, p. 6-13. In Russian.

A78-37945 # Thermal deformations of solar concentrators (Temperaturnye deformatsii kontsentratorov solnechnoi energii). V. M. Korolev, Iu. I. Machuev, A. Nazarov, E. V. Sokolov, L. A. Solodovnikova, and V. G. Fokin (Akademiiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Geliotehnika*, no. 2, 1978, p. 20-28. In Russian.

An analysis is presented of the symmetrical and obliquely symmetrical thermal deformations of a paraboloid-mirror concentrator. The concentrator is treated as a shell of revolution reinforced by radial and annular ribs and the thermal deformation of the reinforced structure is described by the differential equation of bending of an isotropic shell of revolution. As an illustration, attention is given to the thermal deformation of a concentrator with a diameter of 4.7 m. B.J.

A78-37946 # Converter of solar radiation to thermal energy designed on the basis of coaxial evacuated tubular elements with multilayer and selective coatings (Preobrazovatel' solnechnogo izlucheniia v teplovuiu energiiu na osnove koaksial'nykh vakuumirovannykh trubchatykh elementov s mnogosloinnyimi i selektivnymi pokrytiami). V. B. Eliseev, M. M. Koltun, O. A. Nevezhin, V. P. Matveev, I. P. Gavrilova, A. V. Romankevich, S. V. Riabikov, and E. M. Iurin (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotehnika*, no. 2, 1978, p. 29-40. 9 refs. In Russian.

A78-37947 # Characteristics of the utilization of N2O4 in solar gas-turbine power plants (Ob osobennostiakh primeneniia N2O4 v solnechnoi gazoturbinnnoi ustanovke). V. V. Chikovani and M. S. Dzitoev. *Geliotehnika*, no. 2, 1978, p. 41-45. 8 refs. In Russian.

The use of N2O4 as the working fluid in a solar gas-turbine power plant is evaluated experimentally. An analysis of the turbine cycle has shown that the optimal conditions of utilization of N2O4 are characterized by its dissociation in the compressor and heat supply with 'frozen' expansion at the turbine. The optimal utilization of N2O4 enables a significant reduction in temperature before the turbine without a reduction in the thermodynamic efficiency as compared with the utilization of a monatomic gas as working fluid. B.J.

A78-37948 # Experimental study of the joint operation of wind- and solar-plants (Eksperimental'noe issledovanie sovmestnoi raboty vetro- i gelioustanovok). B. I. Lemasov, I. G. Savchenko, A. N. Smirnova, and B. V. Tarnizhevskii (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotekhnika*, no. 2, 1978, p. 46-49. 5 refs. In Russian.

The paper presents results of a year-long investigation of wind-power and solar-photovoltaic plants (with nominal outputs of 140 and 200 W, respectively) operating on a common load. The aim of the study was to determine the capacity of storage equipment during independent and joint operation of the plants. It is found that joint operation is significantly better than independent operation if the yearly cycle is divided into three parts with different levels of daily energy consumption. This is because the required capacity and nonuniformity of user supply are significantly less than in the case of independent operation. B.J.

A78-37949 # Investigation of the dynamics of melting processes in a solar furnace (Izuchenie dinamiki protsessy plavleniya materialov na solnechnoi ustanovke). M. G. Shekoiian and V. V. Shakhparonian. *Geliotekhnika*, no. 2, 1978, p. 53-57. In Russian.

The paper presents results of an experimental investigation of the initial stages of melting of aluminum-oxide powder in a solar furnace with automatic control of radiative flux. The effect on the melting process of having the radiative flux emitted from different annular zones of the solar-concentrator surface is investigated. Attention is also given to the effect of cylindrical shading devices (an integral part of the flux-control system) on the melting process. B.J.

A78-37950 # Analysis of the characteristics of semiconductor photocells in the 100-400 K temperature range (Analiz kharakteristik poluprovodnikovyykh fotopreobrazovatelei v diapazone temperatur 100-400 K). L. I. Gromovoi, L. I. Tikhonov, M. V. Sedik, V. G. Doroshenko, and M. B. Zaks. *Geliotekhnika*, no. 2, 1978, p. 74-81. 9 refs. In Russian.

A78-38051 Solar architecture; Proceedings of the Aspen Energy Forum, Aspen, Colo., May 27-29, 1977. Forum sponsored by the Roaring Fork Resource Center. Edited by G. E. Franta and K. R. Olson (Roaring Fork Resource Center, Aspen, Colo.). Ann Arbor, Mich., Ann Arbor Science Publishers, Inc., 1978. 327 p. \$15.

While the main emphasis is on passive solar design, attention is also directed to greenhouse construction, active systems, alternative energy sources, and educational programs on solar energy. Topics include prediction of performance of passive solar-heated buildings, energy-processing building materials, self-inflating movable insulation, northern windows and solar architecture fallacies, energy flows in greenhouses, solar collector sizing, and wind power as a viable energy source. Case studies of projects in Colorado are reported, and solar energy resource centers and their programs are characterized. M.L.

A78-38054 Heat transfer and thermal control systems; Aerospace Sciences Meeting, 15th, Los Angeles, Calif., January 24-26, 1977 and Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Technical Papers. Meeting and Conference sponsored by the American Institute of Aeronautics and Astronautics. Edited by L. S. Fletcher (Virginia, University, Charlottesville, Va.). New York, American Institute of Aeronautics and Astronautics, Inc. (Progress in Astronautics and Aeronautics. Volume 60), 1978. 395 p. Members, \$20.; nonmembers, \$35.

Developments related to heat pipes are examined, taking into account axially grooved heat pipes, the effects of one-sided heat input and removal on axially grooved heat-pipe performance, a thermal diode heat pipe for cryogenic applications, two-phase working fluids for the temperature range from 100 to 350 C, excess liquid in heat-pipe vapor spaces, the performance of gravity-assisted heat pipes operated at small tilt angles, a zero-G variable-conductance heat pipe using bubble pump injection, and a reentrant groove heat

pipe. Topics concerned with thermal control systems are related to flexible deployable-retractable space radiators, the effects of space radiation on thin polymers and nonmetallics, instrument canister thermal control, a precise satellite thermal control system using cascaded heat pipes, a controllability analysis for passively and actively controlled heat pipes, and a low-temperature phase-change material package. Attention is also given to the influence of refractive index on emittance, a finite-element methodology for thermal analysis of convectively cooled structures, the effect of a conducting wall on a stratified fluid in a cylinder, and the effective conductivity of regularly packed spheres.

G.R.

A78-38055 The hydrogen energy economy: A realistic appraisal of prospects and impacts. E. M. Dickson, J. W. Ryan (Stanford Research Institute, Menlo Park, Calif.), and M. H. Smulyan. Research supported by the National Science Foundation; NSF Grant No. ERS-73-02706. New York, Praeger Publishers, Inc., 1977. 327 p. 460 refs. \$22.95.

Major conclusions and recommendations considered are related to the use of hydrogen, the transition to hydrogen, the future of hydrogen, and recommendations for research and development. The concept of technology assessment is considered along with aspects of hydrogen production, the storage of hydrogen, the distribution of hydrogen, the end-uses of hydrogen, questions of hydrogen safety, energy end-use alternatives to hydrogen, hydrogen costs and economic relationships to other fuels, impacts of hydrogen-fueled private and fleet automotive vehicles, and the consequences of a hydrogen economy for commercial aviation, the utilities, steel-making, and ammonia synthesis. Attention is given to energy and hydrogen in the future, transition scenarios in the transition to a hydrogen economy, and energy carrier, distribution, and storage alternatives to hydrogen. G.R.

A78-38068 # Contribution to the global analysis of an energy system - Optimum operation of solar electric-energy production (Contribution à l'analyse globale du système énergétique - Gestion optimale d'une production électro-solaire). E. Thiebaut. Toulouse III, Université, Docteur-Ingénieur Thesis, 1978. 138 p. 67 refs. In French.

Methods of analyzing energy systems are examined with attention to the energy balance. The modeling of systems is discussed, and a model for the central power station is adapted for problems of optimum command. Techniques for optimum calculation of random and dynamic features of solar energy station operation are described, and the results suggest certain constraints in the choice of the solar energy system. M.L.

A78-38108 Temperature sheaths on probes or electrodes in MHD plasmas. H. K. Messerle and A. Manglick (Sydney, University, Sydney, Australia). *Journal of Physics D - Applied Physics*, vol. 11, May 11, 1978, p. 1073-1084. 11 refs.

A simplified model which accounts for the temperature and electrostatic sheaths on probes or electrodes in MHD plasmas is developed. Based on model results and the findings of experiments carried out on argon as a carrier gas and potassium sulphate as seed material, it is found that the most important factor governing the nature of the electrostatic layer is the temperature gradient at the wall. This leads to a thin temperature sheath determined by the heat flux into the wall. The temperature sheath may be found by thermal and fluid dynamic layers. For currents of practical orders, sheath magnitude must electrically break down. This is primarily caused by the electric field in the sheath near the electrode. S.C.S.

A78-38200 Study of the thermodynamics of coal gasification (Untersuchungen zur Thermodynamik der Kohlevergasung). K.-K. Neumann (Uhde GmbH, Dortmund, West Germany). *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie*, vol. 31, May 1978, p. 228-233. 8 refs. In German.

The paper presents a method for estimating with a fairly simple thermodynamic model the process-variables for certain gas-producing processes and processes for the treatment of such gas mixtures. The mathematical model is based on a calculation of the simultaneous chemical equilibria. For coal gasification and methanization, equilibrium compositions and the temperature-dependence of the enthalpy are given for temperatures between 200 and 1200 C for 1 bar and for 40 bar. (Author)

A78-38245 Hydrogen sulfide as an air pollutant. D. F. S. Natusch and B. J. Slatt (Illinois, University, Urbana, Ill.). In: *Air pollution control. Part 3 - Measuring and monitoring air pollutants*. New York, Wiley-Interscience, 1978, p. 459-518. 288 refs.

Major sources of atmospheric hydrogen sulfide include kraft pulp mills, petroleum and natural gas refineries, coal gasification plants, viscose processing plants, and sewage disposal installations. These hydrogen sulfide sources require monitoring, which involves collection through absorption, adsorption or direct-sampling techniques, and evaluation through volumetric, gravimetric, spectrophotometric, electrochemical, radiochemical or gas chromatographic methods. Analytical determinations of hydrogen sulfide may be performed with indicator tubes, the methylene blue method, impregnated paper densitometry or hydrogen sulfide-sulfur dioxide UV analysis. Examples of sulfide corrosion of telephone relay contacts and rotary switch contacts are also discussed. J.M.B.

A78-38269 # Natural convection in compound parabolic concentrators - A finite-element solution. S. I. Abdel-Khalik, H.-W. Li, and K. R. Randall (Wisconsin, University, Madison, Wis.). *ASME, Transactions, Journal of Heat Transfer*, vol. 100, May 1978, p. 199-204. 14 refs. Contract No. E(11-1)-2588.

Natural convection heat transfer coefficients between absorber surfaces and cover plates for vertically oriented two-dimensional compound parabolic concentrators (CPC) are evaluated using finite-element techniques. Values of the critical Rayleigh number for different concentrations (C between 2 and 10) with 1/3, 2/3, and full CPC heights are determined. Generalized charts for estimating the average absorber plate Nusselt number as a function of Rayleigh number and concentration for both full and truncated CPC cavities are given. The results are useful for evaluating the convective loss coefficients from such collectors. (Author)

A78-38402 Modular approach for emergency and stand-by electric power in Northern Canada. D. McGuiness (Northern Canadian Power Commission, Canada). *Turbomachinery International*, vol. 19, Jan.-Feb. 1978, p. 40-43.

The article discusses a modular approach for providing emergency and stand-by electric power to Northern Canada. Various aspects involved in planning the project are identified, including climatic conditions, the local populations, transportation, community isolation, and costs. The modular units are described, noting specifications including mobility, internal temperature control, installation procedures, self-monitoring, required fuels, and the recovery of waste heat energy. The complete generating unit is outlined in terms of its three subsystems: the machinery, control, and exhaust modules. S.C.S.

A78-38403 Early coal hydrogenation catalysis. E. E. Donath and M. Hoering. *Fuel Processing Technology*, vol. 1, Aug. 1977, p. 3-20. 14 refs.

The early stages of research and development of coal hydrogenation catalysts and their use in hydrogenating coal to produce liquid fuels are reviewed. The preparation of sulfur-resistant hydrogenation catalysts allowed production of fuels that met petroleum-fuel specifications. The discussion is focused on catalyst development for the liquid and vapor phases. The catalysts used for the hydrogenation of brown coal tar residue in the liquid phase are described. The vapor phase is divided into the prehydrogenation (hydrorefining) and the splitting-hydrogenation (hydrocracking) steps. It is concluded that the continuing development of catalysts together with progress in the hydrogenation process and plant engineering are largely responsible for the rapid acceptance of the process. S.D.

A78-38404 New concepts and results concerning the mechanism of carbon monoxide hydrogenation. I - Organic oxygen compounds produced during medium-pressure synthesis with iron catalysts. II - Evolution of reaction steps on the basis of detailed product composition and other data. H. Schulz and A. Zein el Deen (Karlsruhe, Universität, Karlsruhe, West Germany). *Fuel Processing Technology*, vol. 1, Aug. 1977, p. 31-56. 61 refs.

The homologous series of straight-chain and branched alcohols, ketones and acids are determined in products of carbon monoxide hydrogenation through medium-pressure synthesis with iron catalysts in the fixed-bed and entrained phase processes. The various correlations of product composition confirm a reaction mechanism of chain growth in steps of addition of species with one carbon to the growing chain. Individual reaction steps of the Fischer-Tropsch synthesis are derived on the basis of product composition data and published information on this type of synthesis. S.D.

A78-38405 Residence time measurements in a coal hydrogenation process. J. M. Lytle, R. E. Wood, W. H. Wisser, and M. G. Madejovsky (Utah, University, Salt Lake City, Utah). *Fuel Processing Technology*, vol. 1, Jan. 1978, p. 95-102. 9 refs.

Residence time of coal in the University of Utah 'coiled tube' coal hydrogenation reactor has been measured. This has been done with an electronic device which detects a tracer (usually iron) as it passes specific places at the beginning and end of the reactor. The measured coal solids residence time in the reactor has varied from a few seconds to a few minutes. Calculated vapor and gas residence times are one or two seconds. Short vapor residence time terminates further hydrogenation of vapors and thus reduces gas production and hydrogen consumption. The relatively longer coal solids residence time permits further hydrogenation which increases liquid yields. (Author)

A78-38406 Desulfurization of petroleum residues and their carbonization properties. I. Mochida, K. Maeda, K. Takeshita (Kyushu University, Fukuoka, Japan), N. Kaji, Y. Suetsugu, and T. Yoshida (Nittetsu Chemical Industrial Co., Tokyo, Japan). *Fuel Processing Technology*, vol. 1, Jan. 1978, p. 103-115. 23 refs.

The desulfurization of petroleum residues of high sulfur content was carried out using three kinds of Lewis acids under a nitrogen flow of atmospheric pressure at 150 - 330 C. Considerable amounts of sulfur were eliminated from the residue as hydrogen sulfide with the aid of aluminum chloride at 150 C or higher temperatures. Ferric or zinc chloride was found also to eliminate sulfur from the residue in the form of the corresponding metal sulfides at 330 C without the evolution of hydrogen sulfide. Although the original residues gave

cokes with a mosaic arrangement of anisotropic domains, benzene-soluble fractions of the desulfurized residue gave a graphitizable needle coke. The desulfurized residues were further analyzed by chemical techniques to study the structural change brought about by acidic desulfurization. This kind of desulfurization was revealed to be carried out without decreasing the aromaticity of the residue, being different from the hydrodesulfurization with cobalt-molybdena catalysts. (Author)

A78-38407 Electrofluid gasification of coal with nuclear energy. A. H. Pulsifer and T. D. Wheelock (Iowa State University of Science and Technology, Ames, Iowa). *Fuel Processing Technology*, vol. 1, Jan. 1978, p. 117-132. 19 refs. Research supported by the Alexander von Humboldt Stiftung; Contract No. E(49-18)-479.

The gasification of coal by reaction with steam requires addition of large amounts of energy. This energy can be supplied by a high-temperature nuclear reactor which is coupled to a fluidized bed gasifier either thermally or electrically via an electrofluid gasifier. A comparison of the economics of supplying energy by these two alternatives demonstrates that electrofluid gasification in combination with a high-temperature nuclear reactor may in some circumstances be economically attractive. In addition, a review of recent experiments in small-scale electrofluid gasifiers indicates that this method of gasification is technically feasible. (Author)

A78-38417 On the trends in nuclear fusion research. B. Lehnert (Kungl. Tekniska Hogskolan, Stockholm, Sweden). *International Journal of Fusion Energy*, vol. 1, June 1977, p. 5-24. 49 refs.

The paper presents a broad outline of the trends in nuclear fusion research. Major areas of research are identified as plasma physics, reactor technology and full-scale operation. Several approaches to controlled fusion are reviewed including: (1) magnetic bottles such as tokamaks, stellarators and related devices, theta-pinch systems, toroidal screw pinches, ring systems, mirror-type systems, and cusp-type systems, (2) magnetically guided systems, and (3) nonmagnetic schemes including quasi-stationary systems and inertia systems. Major areas for future work are proposed. S.C.S.

A78-38418 An assessment of laser-driven fusion. *International Journal of Fusion Energy*, vol. 1, June 1977, p. 25-54.

An overview is presented of laser-driven fusion research. In terms of engineering and scientific feasibility, procedures for computing pellet parameters are noted along with required reactor power levels. Comparisons are made between research associated with laser-driven fusion and controlled thermonuclear fusion. A summary of ERDA funding of laser-fusion-power programs is given for the 1963-1977 period. Basic laboratory research concerning absorption mechanisms, energy flows from the laser deposition region, and pellet implosions is outlined. In terms of an engineering assessment, research is proposed in the areas of pellet design, first-wall design, nuclear core configuration, laser technology, gas production, fusion-fission hybrids, and a laser-assisted fusion engineering reactor facility. S.C.S.

A78-38419 Production of fusion energy by vortex structure compression. D. R. Wells (Miami University, Miami, Fla.) and P. Ziajka. *International Journal of Fusion Energy*, vol. 1, Winter 1978, p. 3-39. 46 refs.

The heating and confinement of stable force-free plasma vortex structures created by theta-pinch guns are discussed. The conceptual development of vortex motion theories is reviewed, noting vorticity in MHD and plasma physics, corotational and contrarotational plasma structures, vortex rings, force-free fields, and the production of collinear force-free structures. The evolution of plasma vortex theory is described with reference to orthovortex structures, the theoretical proof of vortex existence without using variational calculus, and the application of the vortex theory to controlled thermonuclear fusion. In the area of experimental work on plasma vortices, the TRISOPS program is described in terms of plasma

vortex formation, the interaction of two vortex structures, the role of the guide field, and the application of vortex structures to thermonuclear fusion. S.C.S.

A78-38426 Application of solar energy to a solvent reclamation system. B. Nimmo and A. Litka (Florida Technological University, Orlando, Fla.). *Arabian Journal for Science and Engineering*, vol. 3, Nov. 1977, p. 29-38. 9 refs.

An operating industrial acetone reclamation system is studied to determine whether or not solar collectors should be installed to supply a portion of the thermal energy required. Two possible solar systems were studied. Each of these systems assumed the use of commercially available flat plate solar collectors. Results of the analysis indicate that annual fuel savings of up to 31 percent can be realized compared to the present non solar operation. An economic analysis, however, indicates that the rate of return under present conditions would not favor installing the solar equipment. (Author)

A78-38550 SnO₂/Si solar cells - Heterostructure of Schottky-barrier or MIS-type device. A. K. Ghosh, C. Fishman, and T. Feng (Exxon Research and Engineering Co., Linden, N.J.). *Journal of Applied Physics*, vol. 49, June 1978, p. 3490-3498. 23 refs. Contract No. E(04-3)-1283.

The performance of SnO₂/Si solar cells has been measured and analyzed in detail. This has given us an insight into cell characteristics never revealed in previous studies. Though the device is a junction between two semiconducting materials, SnO₂ and Si, it performs like an MIS device and in the thin-oxide limit as a Schottky-barrier device. The dark I-V characteristics are attributed to a combination of thermionic and diffusion processes. The diode constant associated with the former is close to 2 or higher and that associated with the latter is unity. It has been demonstrated that under certain conditions the diode constant can be independent of the reverse-saturation current. An MIS-type model can explain the spectral-response curve, the short-circuit photocurrent, the open-circuit photovoltage, and the light and dark I-V characteristics. A theoretical limit of the efficiency is estimated for the device. (Author)

A78-38551 * Comparative radiation resistance calculation for graded- and constant-composition n Al_x/Ga_{1-x}/As-p Al_z/Ga_{1-z}/As solar cells. J. A. Hutchby (NASA, Langley Research Center, Hampton, Va.). *Journal of Applied Physics*, vol. 49, June 1978, p. 3499-3502. 12 refs.

The performance and radiation resistance of a new double-graded-band-gap solar cell are theoretically determined. The performance of this device is similar to that of the single-graded-band-gap cell. The power-conversion efficiencies of both graded-band-gap structures are shown to be less sensitive to minority-carrier lifetime degradation than a similar constant-composition heterostructure cell. (Author)

A78-38552 * A simple theory of back surface field (BSF) solar cells. O. von Roos (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Journal of Applied Physics*, vol. 49, June 1978, p. 3503-3511. 21 refs.

A theory of an n-p-p/+ junction is developed, entirely based on Shockley's depletion layer approximation. Under the further assumption of uniform doping the electrical characteristics of solar cells as a function of all relevant parameters (cell thickness, diffusion lengths, etc.) can quickly be ascertained with a minimum of computer time. Two effects contribute to the superior performance of a BSF cell (n-p-p/+ junction) as compared to an ordinary solar cell (n-p junction). The sharing of the applied voltage among the two junctions (the n-p and the p-p/+ junction) decreases the dark current and the reflection of minority carriers by the built-in electron field of the p-p/+ junction increases the short-circuit current. The theory predicts an increase in the open-circuit voltage (V_{oc}) with a decrease in cell thickness. Although the short-circuit current decreases at the

same time, the efficiency of the cell is virtually unaltered in going from a thickness of 200 microns to a thickness of 50 microns. The importance of this fact for space missions where large power-to-weight ratios are required is obvious. (Author)

A78-38553 **Ultrafine chromium particles for photothermal conversion of solar energy.** C. G. Granqvist and G. A. Niklasson (Chalmers Tekniska Högskola, Göteborg, Sweden). *Journal of Applied Physics*, vol. 49, June 1978, p. 3512-3520. 64 refs. Research supported by the Statens Naturvetenskapliga Forskningsrad.

Individually isolated chromium particles were prepared by evaporation onto KBr plates in a mixture of argon and air. Such coatings were taken as a model substance simulating the properties of electrodeposited chromium black - a well-known material for efficient photothermal conversion of solar energy. Median diameters of the particles were 5-13 nm; their shapes were spherical or cubelike. Optical transmittance at normal incidence was recorded by spectrophotometry in the interval 0.3-25 micrometers. Excellent spectral selectivity was documented with high absorptance over the wavelength range for solar radiation and high transmittance further out in the infrared. The optical data were interpreted within the Maxwell Garnett theory, which was generalized so as to encompass dipole-dipole coupling among aggregated spheres, cubelike shapes, and oxide pellicles. Agreement between theory and experiments was achieved by considering aggregation of spherical particles into linear chains. The effects of having cubic particles, as well as oxide-coated spherical ones, were calculated and found to be rather unimportant for understanding the spectral selectivity. (Author)

A78-38554 **Dynamics of a pistonless engine capable of utilizing solar energy.** S. C. Bhargava, R. Rup, R. P. Saxena, and P. K. Srivastava (Delhi, University, Delhi, India). *Journal of Applied Physics*, vol. 49, June 1978, p. 3521-3526.

The dynamics of a liquid piston engine capable of working at low temperature differences is discussed in detail. Two working fluids have been considered, viz., dry air and air saturated with water vapor. A resonance condition for the length of the liquid columns is obtained by solving the linearized equations of motion. In a study of the complete equations of motion, it is found that the engine using wet air is capable of delivering about 70% of its kinetic energy every second while operating at a temperature difference of only 40 C. It is also found that the dry-air engine operates at only very high temperature differences. (Author)

A78-38634 **Simplest physical model of a magnetohydrodynamic generator.** I. Ia. Plotnikov (Akademiiia Nauk SSSR, Institut Kosmofizicheskikh Issledovaniy i Aeronomii, Yakutsk, USSR). (*Geomagnetizm i Aeronomiya*, vol. 17, July-Aug. 1977, p. 772, 773.) *Geomagnetism and Aeronomy*, vol. 17, Feb. 1978, p. 517, 518. Translation.

A physical model is developed to study the ambiguity of the MHD approximation caused by the effects of the density of the vortical and static electromotive force. A stationary shear flow is constructed whose vortex lines are directed along an applied magnetic field with the shear flow formed by two parallel walls of a rectangular tube. The profile of the Couette flow obtained reveals the character of the local interaction of the magnetic field and the vortex flow where the magnetic field facilitates deceleration and reversal of the stream in the region of the stationary wall. S.C.S.

A78-38673 **Laminar flow of a conducting liquid between coaxial cylinders in a traveling magnetic field.** S. Kamiyama (Tohoku University, Sendai, Japan) and Y. Kawai (Kawasaki Steel Corp., Chiba, Japan). (*Magnitnaia Gidrodinamika*, vol. 13, July-Sept. 1977, p. 84-88.) *Magnetohydrodynamics*, vol. 13, no. 3, Jan. 1978, p. 325-329. 6 refs.

A numerical analysis is presented for the laminar flow of an incompressible conducting fluid. The fluid is located between coaxial

cylinders in a traveling magnetic field. Expressions are derived for the effect of inner core substances, the ratio of the inner radius to the outer radius, the ratio of the outer radius to the pole, the time-averaged velocity distribution, and the ideal efficiency of an induction MHD machine. S.C.S.

A78-38770 **Hydrothermal alteration in active geothermal fields.** P. R. L. Browne (New Zealand Geological Survey, Lower Hutt, New Zealand). In: Annual review of earth and planetary sciences. Volume 6. Palo Alto, Calif., Annual Reviews, Inc., 1978, p. 229-250. 119 refs.

Subsurface hydrothermal alteration refers to the reaction of geothermal fluids (i.e., hot springs) with rocks leading to changes in the compositions of both fluids and rocks. The paper presents a survey of hydrothermal alteration in several geothermal systems recently explored by drilling. Attention is given to systems in the Imperial and Mexicali Valleys, Yellowstone, Japan, and Iceland, and considers such parameters of the alteration process as fluid temperature and pressure, rock type, permeability, fluid composition, and duration of activity. B.J.

A78-38774 **Structure assembly demonstration slated.** C. Covault. *Aviation Week and Space Technology*, vol. 108, June 12, 1978, p. 49, 52, 53.

A proposal to test the large structures fabrication capability of the STS is presented with reference to a 10 x 30 meter structure that could be deployed as early as 1983 with a science/applications payload, or remain attached to the Shuttle. Attention is given to the prospect of deploying large antennas in both LEO and GEO, the first of which would be powered by a 25 kW module. The use of aluminum rolls, which could be processed into beams once in space, is viewed as the most likely approach to the problem of large structure fabrication. D.M.W.

A78-38775 **Aerospace aids fusion power concept.** C. A. Robinson, Jr. *Aviation Week and Space Technology*, vol. 108, June 12, 1978, p. 61-66.

Materials technology developed by the aerospace industry is applied to a scheme for tokamak power generation using throwaway modules. A module, called a Riggatron, would have an encapsulated lithium blanket surrounding a plasma core. Energy production on the order of 300 MW electrical is foreseen over a 30-day life cycle for a single module. At the end of 30 days, the Riggatron would be removed and submerged in a cooling pool for 24 days (the half-life of copper). The copper and other transmuted materials would then be reprocessed. Attention is given to the physics ignition and burn experiment (Philbex), designed to test the feasibility of plasma ignition through ohmic heating. The principle is compared to the operation of a bipropellant rocket engine, whereby an ignition current is used to achieve burn. A fusion power demonstration of 300 MW thermal over successive 2 sec pulsed periods is foreseen by 1982 at an overall cost of \$55 million, contingent upon congressional funding. D.M.W.

A78-38776 **Summer Computer Simulation Conference, Chicago, Ill., July 18-20, 1977, Proceedings.** Conference sponsored by AGU, AIAA, AMS, BMES, IAMCS, IEEE, ISA, SCS, and S.H.A.R.E. Montvale, N.J., AFIPS Press, 1977. 951 p. \$30.

Aspects of simulation methodology are discussed along with questions of simulation credibility. Applications of simulation in various areas are also considered, taking into account chemical sciences, physical sciences, environmental sciences, biomedical systems, managerial and social sciences, energy, system engineering, and simulation for training. The use of hybrid systems for simulation applications is also reported. Attention is given to a generalized

simulator for computerized manufacturing systems, the use of queuing diagrams and event file strategy for simulation, computer algorithms for controlling disturbances, an evaluation of a correction method for digital computer lag in hybrid systems, microprogramming and simulation, the improvement of real time aerodynamic models by high speed function generation, the Magdalen Islands wind turbine hybrid computer model, hybrid computer models as a design aid for gas turbine control systems for helicopters, the magnetic attitude control of the Atmosphere Explorer-E spacecraft, and the microprocessor implementation of advanced control modes. G.R.

A78-38781 Magdalen Islands wind turbine hybrid computer model. J. R. Amyot, R. E. Gagne, R. J. Templin, and R. S. Rangi (National Research Council, Ottawa, Canada). In: Summer Computer Simulation Conference, Chicago, Ill., July 18-20, 1977, Proceedings. Montvale, N.J., AFIPS Press, 1977, p. 196-204. 5 refs.

A hybrid computer model of a 200 kW vertical axis wind turbine prototype connected to the Magdalen Island power grid by an induction generator is described. The model was implemented to obtain operational experience and uncover potential system difficulties in advance of the prototype trials. The physical system is described briefly including wind turbine rotor and spoilers, rotor/generator coupling and gearing, brake, induction generator, flywheel, start-up transformer and control, circuit breaker and power system. The mathematical model used to represent the physical system is presented using information flow diagrams followed by a description of how it was implemented on a hybrid computer including analog/digital split, digital program organization and operator interaction. Typical simulation trial results are given. (Author)

A78-38790 Hierarchical modeling of solar heating and air conditioning systems. G. H. Marcus and D. Spalding (Analytic Services, Inc., Falls Church, Va.). In: Summer Computer Simulation Conference, Chicago, Ill., July 18-20, 1977, Proceedings. Montvale, N.J., AFIPS Press, 1977, p. 749-752. 5 refs.

A description is presented of three levels of model development. The first level abstracts the single family home solar system into a block diagram useful for creating a qualitative model. That model permits insight into the overall behavior of the system. The second level quantifies the first level model as simply as possible by using steady state submodels for each solar subsystem. The quantitative model is used to estimate the effect on performance of technological changes to solar subsystems. The third level develops the detail of the second level model by introducing time dependence for the solar system operation. The third level model is too precise relative to cost data which has been used with the model, but it does provide a means for verifying the range of validity of the second level model. G.R.

A78-38791 A simplified physics airflow model for evaluating wind power sites in complex terrain. R. G. Derickson (Go-Flow Consulting, Fort Collins, Colo.) and R. N. Meroney (Colorado State University, Fort Collins, Colo.). In: Summer Computer Simulation Conference, Chicago, Ill., July 18-20, 1977, Proceedings. Montvale, N.J., AFIPS Press, 1977, p. 763-769. 13 refs. Contract No. EY-76-S-06-2438.

It appears that numerical simulations may provide the most accurate and economical means for the assessment of prospective wind power generation sites, especially for regions with irregular terrain. A description is presented of an airflow model which has been developed to handle arbitrary specifications of topography and a wide range of meteorological conditions. Initial results show excellent agreement with wind tunnel measurements. The model consists essentially of a fully coupled, nonlinear system of steady state momentum and energy equations in which the physics are simplified by neglecting viscosity and explicit turbulence. The two-dimensional version of the model employs a stream function-

vorticity approach which is more convenient than the primitive momentum equations for 2-D. However, the 3-D version, still under development, requires use of the momentum equations since a stream function in the usual sense, does not apply to 3-D. G.R.

A78-38814 # Giant wind turbines (Riesen-Windturbine). U. Hütter (Stuttgart, Technische Universität, Stuttgart, West Germany). In: Problems of the theory of strength related to aircraft construction and civil engineering; Structural Mechanics Meeting, Ottobrunn, West Germany, June 1, 2, 1977, Lectures and Discussion Contributions. Braunschweig, Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, 1977, p. 230-244. 5 refs. In German.

The reasons for designing giant wind turbines and various problems that the construction and operation of such giant wind turbines entail are discussed. The possibility of turbines with self-deploying blades is discussed. P.T.H.

A78-38841 * The beamed power microwave transmitting antenna. R. M. Dickinson (California Institute of Technology, Jet Propulsion Laboratory, Telecommunications Science and Engineering Div., Pasadena, Calif.). *IEEE Transactions on Microwave Theory and Techniques*, vol. MTT-26, May 1978, p. 335-340. 19 refs. Contract No. NAS7-100.

Beamed power refers to radiation techniques employing directional antennas for purposes of transferring energy in microwave form from one place to another. The peaceful uses of beamed power as applied to electric utilities functions and transportation concepts are considered. An investigation is conducted regarding the design approaches and techniques which can be used by the microwave component engineer to render beamed power systems potentially safe for humans and other biota. High-power microwave transmission antennas are proposed for beaming power from earth-orbiting satellites to receiving antennas (rectennas) on earth. Other applications include beaming power to run helicopters, aircraft, and aerostats equipped with rectennas. System designs must provide for techniques to yield microwave radiation levels that do not exceed allowable limits. Attention is given to beam surveillance techniques and the effects of an implementation of these techniques on the beamed power systems. G.R.

A78-38893 Water dissociation by a thermochemical cycle - A thermodynamic analysis of principles and efficiencies (Dissociation de l'eau par cycle thermochimique - Une analyse thermodynamique des principes et des rendements). V. Kaiser (Compagnie Française d'Etudes et de Construction, France). *Entropie*, vol. 14, Mar.-Apr. 1978, p. 29-33. 8 refs. In French.

The article presents a theoretical analysis of water dissociation by a thermochemical process. The analysis is developed on the basis of fundamental laws of thermal cycles and a comparison to thermomechanical cycles. Expressions are derived for material, energy, and entropy balances. It is suggested that a combined thermoelectrical-thermochemical cycle has the greatest potential for industrial implementation. S.C.S.

A78-38933 # Optimization of the parameters of a Knudsen thermionic converter with Cs-Ba filler (Optimizatsiia parametrov Knudsenovskogo termoemissionnogo preobrazovatel'ia s Cs-Ba napolneniem). V. I. Babanin, V. I. Kuznetsov, A. S. Mustafae, V. I. Sitnov, and A. Ia. Ender (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). *Zhurnal Tekhnicheskoi Fiziki*, vol. 48, Apr. 1978, p. 754-766. 16 refs. In Russian.

Consideration is given to the optimization of the saturation current and the power of a Cs-Ba thermionic converter operating in the Knudsen mode with surface ionization. An analysis is presented of potential distribution in the region of transition from a super-

compensated to a subcompensated mode. A method for optimizing saturation current is presented and the maximum current of the thermionic converter is compared with the chaotic current in an equilibrium isothermal cavity. In developing a power-optimization procedure, a general volt-ampere characteristic is introduced which is used to determine the anodic work function and output power. Experimental data agree well with computational results and indicate that a Cs-Ba converter is highly efficient. B.J.

A78-38934 # The problem of optimizing the output characteristics of an ideal thermionic converter (K voprosu optimizatsii vykhodnykh kharakteristik ideal'nogo TEP). A. S. Titkov. *Zhurnal Tekhnicheskoi Fiziki*, vol. 48, Apr. 1978, p. 767-769. 5 refs. In Russian.

The problem of obtaining maximum output power is solved for an ideal thermionic converter with prescribed temperatures of emitter and collector and prescribed output current. An exact analytical expression is obtained for the limiting envelope of volt-ampere curves for an ideal converter; this expression can be used as a standard to evaluate the efficiency of real thermionic converters. As an example, calculations are conducted for the case of an emitter temperature of 2100 K and a collector temperature of 1050 K. A maximum output power of 5×10 to the 8th W/sq cm is obtained. B.J.

A78-38941 # Photocells based on AlGaAs heterostructure with a transition layer (Fotoelementy na osnove geterostruktur Al-Ga-As s 'perekhodnym' sloem). Zh. I. Alferov, V. M. Andreev, Iu. M. Zadiranov, V. I. Korol'kov, and T. S. Tabarov (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). *Pis'ma v Zhurnal Tekhnicheskoi Fiziki*, vol. 4, Mar. 26, 1978, p. 305-308. 11 refs. In Russian.

The paper describes the fabrication of solar cells on the basis of a smooth heterostructure, in which there is a transition layer of variable composition between a highly doped solid-solution layer and the substrate. Specifically, a thin (0.2-0.4 microns) layer of p-type solid solution, smoothly varying in composition from GaAs to Al(x)Ga(1-x)As (x is between 0.4 and 1.0), is located between a GaAs substrate and a highly doped layer of p-type Al(x)Ga(1-x) solid solution (x is between 0.85 and 1.0). An analysis of load characteristics shows that a high photocurrent density (19.1 mA/sq cm) is attained at a solar irradiation power density of 0.064 W/sq cm. Concentration of solar radiation has permitted the achievement of a conversion efficiency of 24.7%. B.J.

A78-38963 # Subsonic flow in an MHD channel (Dozvukovoe techenie v kanale MGD-generatora). N. P. Isakova and S. A. Medin (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplotfizika Vysokikh Temperatur*, vol. 16, Mar.-Apr. 1978, p. 377-383. 8 refs. In Russian.

An exact numerical solution to the three-dimensional magneto-hydrodynamics equations is obtained for the subsonic flow of a conducting gas in a large MHD channel with solid ideally segmented electrodes. It is assumed that the external magnetic field is known and that the induced fields may be neglected. The operational characteristics, current-voltage characteristics, and the gas dynamic and electrical parameters are determined. The strong influence of the Hall parameter on the local characteristics of the channel is demonstrated. V.P.

A78-38965 # Electrical conductivity of a plasma composed of the combustion products of hydrocarbon fuels with alkali additions (Elektroprovodnost' plazmy produktov sgoraniia uglevodородnykh topliv s shchelochnoi prisadkoi). V. A. Atrazhev, B. V. Zelener, and I. T. Iakubov (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplotfizika Vysokikh Temperatur*, vol. 16, Mar.-Apr. 1978, p. 396-410. 56 refs. In Russian.

The conductivity of various combustion product plasmas in electric and magnetic fields is analyzed. The electron-molecule scattering cross sections required in the numerical calculations are taken from the literature. The reliability of these data for conductivity calculations at temperatures between 2000 and 3000 K is assessed. Universal formulas for the conductivity and the Hall parameter are proposed for systematizing extensive experimental and numerical conductivity data over a wide range of pressures, temperatures, and alkali contents of the fuels. The influence of various factors, in particular of the type of addition, of the conductivity and the Hall parameter is evaluated. V.P.

A78-38968 # Development of a mathematical model for interelectrode breakdown in an MHD generator (K postroeniiu matematicheskoi modeli mezhelektrodnogo probioa v MGD-generatore). L. P. Poberezhskii (VNIIPtransprogress, USSR). *Teplotfizika Vysokikh Temperatur*, vol. 16, Mar.-Apr. 1978, p. 435-437. 19 refs. In Russian.

A78-38969 # The effect of the properties of the working fluid on the choice of electrode-surface temperature for an MHD generator channel (Vlianie svoistv rabocheho tela na vybor temperatury poverkhnosti elektrodov kanala MGD-generatora). A. V. Bagdonas, V. A. Bashilov, V. L. Bobrov, and Iu. V. Makarov. *Teplotfizika Vysokikh Temperatur*, vol. 16, Mar.-Apr. 1978, p. 438, 439. 6 refs. In Russian.

A78-38971 Use of heat pumps with solar collectors for domestic space heating in the United Kingdom. W. B. Gillett (University College, Cardiff, Wales). *Applied Energy*, vol. 4, July 1978, p. 187-197. 9 refs.

A78-38972 Fundamentals of wind energy. N. P. Cheremisinoff (Union Camp Corp., Princeton, N.J.). Ann Arbor, Mich., Ann Arbor Science Publishers, Inc., 1978. 173 p., 93 refs. \$6.95.

The book presents a broad overview of the fundamental principles and applications of wind energy systems. The historical development of wind machines is outlined. Several applications of wind energy are identified such as agricultural uses, rural and municipal uses, projects involving pumping and compressed gas, and large-scale energy production. Further consideration is given to wind machines and generators, noting horizontal-axis rotors, vertical-axis rotors, and cross-wind horizontal-axis rotors. The performance and design characteristics of wind energy systems are discussed and economic factors are identified. The major aspects influencing the selection of sites for wind-energy systems are presented. Systems for energy storage are proposed, including electrochemical, thermal, and mechanical energy storage. S.C.S.

A78-38998 Is solar power more dangerous than nuclear. H. Inhaber. *New Scientist*, vol. 78, May 18, 1978, p. 444-446.

In an evaluation of the comparative danger involved in the use of different energy systems, it is important to take into account all factors related to the provision of a certain amount of energy by means of a specific energy system. Values concerning the total risk per unit energy output for 10 energy systems are presented in a graph. It is found that electricity produced from natural gas has the lowest risk. It is a factor of about two lower than the next highest, nuclear power. Third is a nonconventional system, ocean thermal, which can convert the temperature difference of ocean layers into electricity. The higher risk values of systems based on the direct utilization of solar radiation are related to the large quantity of materials required for their construction in connection with the diffuse nature of the incoming energy. Coal and oil are found to have the highest risk, with values about 400 times that of natural gas. G.R.

A78-39123 Solar energy conversion through biology. Could it be a practical energy source. D. O. Hall (King's College, London, England). *Fuel*, vol. 57, June 1978, p. 322-333. 135 refs.

The article reviews the ways in which solar energy may be converted through biological systems both in terms of short-term and long-term goals. The efficiency of photosynthesis is discussed with reference to various high short-term dry weight yields of crops and their short-term photosynthetic efficiencies. Means for complete crop utilization for food, fuel, and fertilizer are proposed along with the development of energy farms and the feasibility studies which have been undertaken in the U.S., Brazil, Australia, and Europe. Consideration is also given to using cellulose as an energy source, the use of algal systems for food, fuel, and waste disposal, and the optimization of photosynthetic yield via selective plant breeding. The wide-scale use of controlled environments is described as are processes associated with nitrogen fixation and biocatalytic hydrogen-producing systems. S.C.S.

A78-39124 Pyrolysis of 1,2-diphenylethane in the presence of tetralin. B. M. Benjamin (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Fuel*, vol. 57, June 1978, p. 378. 7 refs. Research sponsored by the U.S. Department of Energy.

The pyrolysis of pure compounds in the presence of tetralin or other donor solvents is an important consideration in the chemical changes during the solvent refining of coal. By heating a mixture of 1,2-diphenylethane and tetralin at 400 C for one hour it was found that traces of toluene and naphthalene were present. After 24 hours 36% of the parent compound was consumed and the molar ratio of toluene to naphthalene was 1.83:1. For the case of stilbene heated with tetralin at 400 C for one hour, nearly half the stilbene was reduced. When 1,2-diphenylethane was heated alone for 24 hours at 400 C it yielded a product consisting of 71% toluene, 9% stilbene, and 20% starting material. The heating of stilbene at 400 C for 24 hours yielded 29% toluene, 24% 1,2-diphenylethane, 47% stilbene, and a black polymer. S.C.S.

A78-39125 Hydroconversion of a bituminous coal with CO-H₂O. D. S. Ross and J. E. Blessing (SRI International, Menlo Park, Calif.). *Fuel*, vol. 57, June 1978, p. 379, 380. 10 refs. Contract No. EF-76-01-2202.

A study is made of the hydroconversion of a bituminous coal with the production of a hydrogen-rich, benzene-soluble fraction in a CO-H₂O-KOH system without an organic vehicle solvent. For the experiments a 300 cu cm, 136 stainless steel, stirred batch reactor was used. Ten grams each of 85% aqueous KOH and dried coal were placed in the reactor. The system was charged to a given CO (or H₂) pressure; reactor temperature was maintained at 400 C for twenty minutes. After the reactor cooled, the product gases were analyzed and the reaction slurry was neutralized. The product was filtered, freed from water, and dried. The data indicate that approximately 50% of the organic sulfur content reduced along with 25% of the nitrogen content and 50% of the oxygen content. It is concluded that the CO-H₂O system with an additional base is an effective conversion system for bituminous coal. S.C.S.

A78-39179 # Experiments on flat-plate solar energy collectors. G. J. Hwang and T.-S. Ueng (National Tsing Hua University, Hsinchu, Nationalist China). *National Science Council, Proceedings*, vol. 2, Jan. 1, 1978, p. 53-59. 19 refs.

This paper presents experimental results of flat-plate solar energy collectors for cases of no-load and load conditions. For no-load test, three identical solar energy collectors, each with an absorption area of 50 x 50 cm, were built. Test data including variations in cover materials, air gaps, layer of cover glass, and side wall effects are shown. Based on the data from the no-load test, a flat-plate solar energy collector with an absorption area of 92 x 214 cm and including a storage tank, a rotameter, a check valve, and 26 thermocouples was constructed. The no-load and load data have been plotted and compared with the existing data. A reasonable agreement has been observed. (Author)

A78-39196 # Gasdynamic calculation of gas-turbine combustion chambers with successive air injection (Gazodinamicheskii raschet gazoturbinnykh kamer sgoraniia s posledovatel'nyim vvedom vozdukh). G. N. Liubchik, V. A. Khristich, and V. P. Kuts (Kievskii Politekhnikheskii Institut, Kiev, Ukrainian SSR). *Energetika*, vol. 21, Mar. 1978, p. 68-74. 7 refs. In Russian.

The paper analyzes the effects of heat transfer and mass flowrate on the gas dynamics of air flow in the constant-cross-section chamber of a small gas-turbine power plant. The analysis is based on equations of continuity, state and heat and is valid for low values of supercharging. B.J.

A78-39367 Advanced lasers for fusion applications. W. F. Krupke and E. V. George (California, University, Livermore, Calif.). *Optical Engineering*, vol. 17, May-June 1978, p. 238-246. 36 refs. Contract No. W-7405-eng-48.

Advanced laser subsystems performance requirements for a fusion power reactor are presented and analyzed in the context of an energy-storage laser medium. Three types of energy-storing laser media are identified: (1) Group VI atoms, (2) selected rare-earth doped solids, and (3) rare-earth molecular gases. The operating principles, basic parameters, and conceptual designs for high energy amplifiers are outlined for (a) atomic selenium pumped photo-lytically with rare-gas excimer radiation, (b) thulium-doped glass pumped with XeF excimer radiation, and (c) terbium chelate vapor pumped with KrF excimer radiation. (Author)

A78-39369 A novel square Fresnel lens design for illuminating circular solar cells. E. L. Burgess, D. L. Marchi (Sandia Laboratories, Albuquerque, N. Mex.), and H. Walter (Fresnel Optics, Inc., Rochester, N.Y.). *Optical Engineering*, vol. 17, May-June 1978, p. 299, 300. Research supported by the U.S. Department of Energy.

A78-39389 Plasma edge cooling during RF heating. S. Suckewer and R. J. Hawryluk (Princeton University, Princeton, N.J.). *Physical Review Letters*, vol. 40, June 19, 1978, p. 1649-1651. 15 refs. Contract No. EY-76-C-023073.

A new approach to prevent the influx of high-Z impurities into the core of a tokamak discharge by using RF power to modify the edge plasma temperature profile is discussed. This concept is based on spectroscopic measurements on PLT (Princeton Large Torus) during ohmic heating and ATC (Adiabatic Toroidal Compressor) during RF heating. (Author)

A78-39453 Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination, Airlie, Va., May 3-5, 1977. Conference sponsored by the U.S. Navy; Contract No. N00014-76-G-0057. Edited by A. Heller (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). Princeton, N.J., Electrochemical Society, Inc. (Electrochemical Society, Proceedings. Volume 77-3), 1977. 339 p. \$7.00.

Some of the subjects discussed are the principles of solar-cell operation, the diagnostics and chemistry of surfaces at semiconductor liquid junctions, the kinetics and mechanisms at semiconductor liquid interfaces, the stability of such interfaces, the photoelectrochemistry of nonaqueous solvents, materials for semiconductor liquid junction solar cells, and the photoelectrolysis of water. Particular papers are presented on a model for the I-V curve of photoexcited semiconductor electrodes, stabilization of n-type semiconductors to photoanodic dissolution by competitive electron transfer processes, competitive oxidation at semiconductor photoanodes, and n-CdS/n-GaAs voltage-enhanced photoanodes. B.J.

A78-39454 State of the art homojunction cells. J. M. Woodall (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). In: Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 20-27. 26 refs.

An assessment of Si and GaAs homojunction solar cells is presented, including both concentrator and low-cost cells. In addition, some recent results on a new fabrication technique ('etchback' epitaxy) for Ga(1-x)Al(x)As-GaAs high efficiency cells are presented. Recent developments in high efficiency Si and GaAs cells indicate their possible near-term use in concentrator systems for large-scale power generation. It is not clear at this time where the breakthroughs will be for low-cost moderate-efficiency cells in systems with no solar concentration. B.J.

A78-39455 Photoelectrochemical storage cells - The importance of the second and third electrodes. J. Manassen, G. Hodes, and D. Cahen (Weizmann Institute of Science, Rehovot, Israel). In: Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 34-37.

A bipolar design for series connection of photoelectrochemical cells is described. This design may be extended to accommodate various storage modes. Storage of the photogenerated electricity can be achieved by using a storage electrode (e.g. zinc) or through electrolysis of water by the photogenerated electricity to give H₂, which is electrochemically oxidized at a fuel cell electrode in the storage compartment of the cell in the dark. New counter electrodes of Cu₂S and PbS are described which can be made in porous forms by simple electroplating techniques. (Author)

A78-39456 Photocurrent spectroscopy of semiconductor electrodes in liquid junction solar cells. A. Heller, K.-C. Chang, and B. Miller (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). In: Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 54-66. 7 refs.

Photocurrent spectra obtained by a two beam spectroscopic method on the semiconductor electrode of liquid junction solar cells can vary with the level of irradiance. In cells with n-type CdS, CdSe, CdTe and GaAs photoanodes and chalcogenide anion solutions this irradiance dependence results from and sensitively detects the presence of carrier recombination centers. With semiconductors showing no detectable recombination centers by this technique, cells with external solar to electrical conversion efficiencies of 8-9% have been made. Poor short wavelength response is due to surface or near surface recombination centers and resembles p-n junction solar cells in this respect. Lowered long wavelength response is associated with shrinkage of the depletion region of imperfect and overdoped semiconductors. (Author)

A78-39457 A model for the current-voltage curve of photoexcited semiconductor electrodes. R. H. Wilson (General Electric Co., Schenectady, N.Y.). In: Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 67-83. 21 refs.

A model to describe the behavior of photoexcited electrodes in an electrochemical cell is developed. In addition to the bulk semiconductor properties the important parameters are a surface recombination parameter, $S_{\text{sub } r}$, and a surface electron transfer parameter, $S_{\text{sub } t}$. It is the electron transfer process across the

interface that leads to current in the external circuit. Using experimental curves for oxygen evolution at an n-type TiO₂ electrode and Hall-Shockley-Read recombination to determine $S_{\text{sub } r}$, it is shown that the I-V curve in anodic bias is controlled by the competition between $S_{\text{sub } r}$ and $S_{\text{sub } t}$. The physical basis for $S_{\text{sub } t}$ is discussed and experimented approaches to investigate surface reactions are suggested. (Author)

A78-39459 A new description of electrochemical kinetics. G. Beni (Bell Telephone Laboratories, Inc., Holmdel, N.J.). In: Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 108-119. 16 refs.

The mechanism of charge transfer at the electrode-electrolyte interface is described by extending the formalism of the small polaron theory. We obtain a general current-voltage relation for electrochemical processes, which holds for the adiabatic, nonadiabatic limits and all intermediate cases. As an illustration, we apply the model to the photoelectrolysis of water in a semiconductor-electrolyte-metal system and find that the minimum energy gap for hydrogen evolution must be at least approximately 2.5 eV. (Author)

A78-39461 Stable semiconductor liquid junction cell with 9% solar to electrical conversion efficiency. K. C. Chang, A. Heller, B. Schwartz, S. Menezes, and B. Miller (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). In: Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 132-137. 11 refs.

The semiconductor liquid junction cell n-GaAs/0.8F K₂Se₂-1F KOH/C has been shown to deliver 9% photovoltaic power conversion efficiency in sunlight. Accelerated tests under 3100 K light sources of several solar intensities indicate very low photocorrosion currents and high output stability. (Author)

A78-39462 * Stabilization of n-type semiconductors to photoanodic dissolution by competitive electron transfer processes. M. S. Wrighton, A. B. Bocarsly, J. M. Bolts, A. B. Ellis, and K. D. Legg (MIT, Cambridge, Mass.). In: Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 138-156. 19 refs. NASA-ERDA-supported research.

The behavior of n-type CdX (X = S, Se, Te) and GaP, GaAs, and InP in alkaline electrolytes containing X(-) and X_{sub n}(-) ions is reviewed. Of the 18 combinations of electrode and electrolyte, 12 alliances are completely stable to photoanodic dissolution of the n-type photoanode. In each case the oxidation of the chalcogenide species at the photoanode is reversed at the cathode to complete an electrochemical cycle involving no net chemical change. The best system in terms of light-to-electric energy conversion seems to be the CdTe-based cell employing the Te(-)/Te₂(-) electrolyte, with roughly 10% efficiency at an output voltage of 0.35 V for monochromatic 633 nm input optical energy at about 25 mW/sq cm. B.J.

A78-39464 Stability and voltammetry of illuminated semiconductor-liquid interfaces. B. Miller, S. Menezes, and A. Heller (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). In: Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 186-194. 15 refs.

The operation of semiconductor liquid junction solar cells in a regenerative mode has two primary chemical requisites: (1) no net change of the redox electrolyte concentration with time and (2) minimum photocorrosion rate of the semiconductor. If these conditions are not fulfilled, gross change of the electrolyte and/or loss of the semiconductor will result. Even more pressing for stability, surface degradation of the semiconductor may be sufficient to inhibit charge separation and transfer in the interfacial region and cause failure of the light-to-electric power conversion mechanism. The present paper elaborates a rotating electrode methodology for studying such processes and presents experimental results relating to CdS single-crystal disk specimens. B.J.

A78-39465 * Thermodynamic potential for the anodic dissolution of n-type semiconductors - A crucial factor controlling durability and efficiency in photoelectrochemical cells and an important criterion in the selection of new electrode/electrolyte systems. A. J. Bard (Texas, University, Austin, Tex.) and M. S. Wrighton (MIT, Cambridge, Mass.). In: *Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination*, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 195-209. 26 refs. NSF-NASA-supported research.

A78-39466 Competitive oxidation at semiconductor photoanodes. T. Inoue, T. Watanabe, A. Fujishima, and K. Honda (Tokyo, University, Tokyo, Japan). In: *Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination*, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 210-221. 6 refs.

The rotating ring-disk electrode (RRDE) technique has been applied to the study of photosensitized oxidation of redox agents in competition with the oxidation of water (on TiO₂ photoanode) or with the oxidative dissolution of the electrode (on CdS photoanode). The redox agents were competitively oxidized at potentials more anodic than the flatband potential of the semiconductor electrode. Percentages of competitive oxidation of redox agents were determined as a function of their concentration and/or the pH value of the electrolyte solution, and the results are discussed referring to their standard redox potentials. The dissolution of CdS photoanode was effectively suppressed through the competitive oxidation of reducing agents. (Author)

A78-39467 n-CdS/n-GaAs voltage-enhanced photoanode. S. Wagner and J. L. Shay (Bell Telephone Laboratories, Inc., Holmdel, N.J.). In: *Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination*, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 231-235. 9 refs.

A class of three-layer two-contact double-junction devices that contain two equipolar photodiodes in series is described. The device consists of two junctions with a common semiconductor layer, with one of the junctions forming an isotype heterodiode. The device is demonstrated with a photoelectrochemical solar cell that consists of an inert platinum-cathode, an aqueous polysulfide electrolyte and an n-CdS/n-GaAs photoanode. The heterodiode device raises output voltage and efficiency over those attainable with a simple n-CdS anode. B.J.

A78-39469 Solar conversion efficiency of pressure sintered cadmium selenide liquid junction cells. M. Robbins, B. Miller, A. Heller, S. Menezes, K. C. Chang, and J. Thomson, Jr. (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). In: *Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination*, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 261-271. 22 refs.

Pressure sintered electrodes of cadmium selenide subsequently doped with cadmium vapor have shown solar energy conversion efficiencies approaching 3/4 of those of single crystal specimens in sun-light experiments. The cell CdSe/1F Na₂S-1F S-1F NaOH/C has operated at 5.1% conversion efficiency under AM 2 conditions with polycrystalline electrodes. The relatively small sacrifice of efficiency from single crystal values of 7.5 plus or minus 0.5% suggests the possibility of substantial cost advantage. The temperature and pressure conditions, cadmium doping procedure, material characterization, and the voltammetric behavior of the cell are discussed.

(Author)

A78-39470 Optimal electrode properties and the selection of stabilizing electrolytes. R. E. Schwerzel, E. W. Brooman, R. A. Craig, and V. E. Wood (Battelle Columbus Laboratories, Columbus, Ohio). In: *Semiconductor liquid-junction solar cells; Proceedings of the Conference on the Electrochemistry and Physics of Semiconductor Liquid Interfaces under Illumination*, Airlie, Va., May 3-5, 1977. Princeton, N.J., Electrochemical Society, Inc., 1977, p. 293-314. 27 refs. Contract No. W-7405-eng-92. ERDA Task 95.

As part of a program evaluating the commercial feasibility of hydrogen production by the solar photoelectrolysis of water, a theoretical study was undertaken of the electrode material processes required for optimal photoelectrolysis efficiency and of the criteria governing the selection of redox electrolytes capable of stabilizing the photoactive electrodes and/or suppressing oxygen evolution. It is found that the effects of limiting electrolyte-exchange current density may be extremely important in setting practical lower limits of about 2.3 eV on the band gap of n-type oxide anode materials: this limitation effectively reduces the ultimate overall efficiency of the electrode from about 48 to 25%. The IR drop across such an electrode can be made negligibly small if the depletion layer is of the order of several microns and if the semiconductor itself is either highly conductive or no thicker than the depletion layer. In addition, it may be possible to identify effective electrode-stabilizing redox electrolytes in available raw-water supplies under certain conditions.

B.J.

A78-39567 * High-purity silicon for solar cell applications. V. D. Dosaj, L. P. Hunt (Dow Corning Corp., Midland, Mich.), and A. Schei (Elkem-Spigerverket A/S, Norway). *Journal of Metals*, vol. 30, June 1978, p. 8-13. 6 refs. Research supported by the U.S. Department of Energy; Contract No. JPL-954559.

The article discusses the production of solar cells from high-purity silicon. The process consists of reducing the level of impurities in the raw materials, preventing material contamination before and after entering the furnace, and performing orders-of-magnitude reduction of metal impurity concentrations. The high-purity raw materials are considered with reference to carbon reductants, silica, and graphite electrodes. Attention is also given to smelting experiments used to demonstrate, in an experimental-scale furnace, the production of high-purity SoG-Si. It is found that high-purity silicon may be produced from high-purity quartz and chemically purified charcoal in a 50-kVA arc furnace. The major contamination source is shown to be impurities from the carbon reducing materials. S.C.S.

A78-39636 * Flat-sided rectilinear trough as a solar concentrator - An analytical study. D. G. Burkhard, G. L. Strobel, and D. R. Burkhard (Georgia, University, Athens, Ga.). *Applied Optics*, vol. 17, June 15, 1978, p. 1870-1883. 11 refs. Research supported by the University of Georgia; Contract No. NAS8-32149.

Formulas are derived for the concentration factor and irradiance distribution at the base of the flat-sided linear trough. Performance is affected by the number of reflections the solar rays undergo before reaching the base, the cone apex angle, and the coefficient of reflection. Results are presented graphically in such a way that one can choose the optimum configuration, which is the minimum material required, to achieve a given concentration factor. Practical concentration factors range from 1.5 to 4 depending on the geometry and coefficient of reflection. (Author)

A78-39637 Effect of substrate on graphite and other solar selective surfaces. D. R. McKenzie (Sydney, University, Sydney, Australia). *Applied Optics*, vol. 17, June 15, 1978, p. 1884-1888. 6 refs. Research supported by the Australian Research Grants Committee.

Solar selective surfaces consisting of a substrate of copper, silver, or nickel underlying a single layer of material of refractive index $N = n + ik$ are compared using the criterion of maximum available power. Copper is shown to be slightly superior to silver, and both are shown to be superior to nickel for operating temperatures of 200 C. For operating temperatures of 100 C and below the three metals are comparable as substrates. The absorbance and emittance properties of graphite films on copper, silver, nickel, and titanium are found. The effect of aging of these films at temperatures up to 400 C is investigated and interpreted in terms of diffusion. Graphite films on copper and silver are candidates for high temperature evacuated collectors. (Author)

A78-39671 Solar energy prospects in Saudi Arabia. H. K. Abdel-Aal and F. Al-Somait (University of Petroleum and Minerals, Dhahran, Saudi Arabia). *Energy Communications*, vol. 4, no. 3, 1978, p. 271-291. 8 refs.

Potential applications and research developments in the field of solar energy for Saudi Arabia are examined. Water desalination, among other possible projects, has been treated in depth. The outline of a multi-purpose water desalination plant is described. The scheme, which utilizes direct solar radiation, would produce fresh water, a concentrated brine to be used as a feed stock for the chlor-alkali industry, and some valuable salts such as magnesium chloride. Other topics discussed include: heating and cooling for housing, deep water pumping, and the assessment of meteorological data pertinent to Saudi Arabia. (Author)

A78-39776 # Design of high efficiency flat plate solar collectors for space and water heating. T. A. Hewett, D. C. Hill, and R. W. McCullough (Union Carbide Corp., Tarrytown, N.Y.). *American Society of Mechanical Engineers, Design Engineering Conference and Show, Chicago, Ill., Apr. 17-20, 1978; Paper 78-DE-7*. 16 p. 30 refs. Members, \$1.50; nonmembers, \$3.00.

Solar energy utilization for space heating is emerging as a viable supplement to conventional space heating. Techniques for designing high efficiency flat-plate solar collectors, including such aspects as reduction of thermal losses, maximization of heat removal, and selection of materials, are discussed. The performance implications for air- and liquid-heating systems are evaluated. (Author)

A78-39783 Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volumes 1 & 2. Symposium sponsored by IEEE, DOE, ORNL, and ANS. Edited by M. S. Lubell and C. Whitmire, Jr. (Oak Ridge National Laboratory, Oak Ridge, Tenn.). Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977. Vol. 1, 939 p.; vol. 2, 929 p. Price of two volumes, members, \$56.25; nonmembers, \$75.

The topics considered are related to copper magnets and coil engineering, systems engineering, engineering problems of fusion reactors, energetic plasma and particle sources, superconducting magnets, instrumentation and data handling, homopolar generators and power supplies, tokamak plasma heating systems, engineering problems of future fusion reactors; conductor stability and systems in the case of superconducting magnets, energy storage and supply systems, vacuum engineering, neutral beam power supplies, conductors and ac losses in superconductivity applications, the engineering design of power reactor blankets, advanced reactor concepts and plasma engineering, components of devices for energy storage and supply, and materials problems in copper magnets and coil engineer-

ing. Attention is given to the role of fusion in the energy future of the U.S., the neutronics and thermal hydraulics of a tokamak hybrid blanket, and field, force, stress, and eddy calculations related to copper magnets and coil engineering. G.R.

A78-39784 The technology of mirror machines - LLL facilities for magnetic mirror fusion experiments. T. H. Batzer (California, University, Livermore, Calif.). In: *Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1*. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 2-12. 5 refs. Contract No. W-7405-eng-48.

Two new mirror experiments have been proposed to succeed the currently operating 2XIIB facility. The first of these called TMX (Tandem Mirror Experiment) has been approved and is currently under construction. TMX is designed to utilize the intrinsic positive plasma potential of two strong, and relatively small, minimum B mirror cells to enhance the confinement of a much larger, magnetically weaker, centrally-located mirror cell. The second facility, MFTF (Mirror Fusion Test Facility), is currently in preliminary design with line item approval anticipated for FY 78. MFTF is designed primarily to exploit the experimental and theoretical results derived from 2XIIB. Beyond that, MFTF will develop the technology for the transition from the present small mirror experiments to large steady-state devices such as the mirror FERF/FTR. (Author)

A78-39785 TFTR Toroidal Field coil design. G. E. Smith (Grumman Aerospace Corp., Bethpage, N.Y.) and W. F. B. PUNCHARD (Magnetic Corporation of America, Waltham, Mass.). In: *Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1*. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 15-19. Contract No. E(11-1)-3073.

This paper addresses the design of the Tokamak Fusion Test Reactor (TFTR) Toroidal Field (TF) magnetic coils. The TF coil is a 44-turn, spiral-wound, two-pancake, water-cooled configuration which, at a coil current of 73.3 kiloamperes, produces a 5.2-Tesla field at a major radius of 2.48 meters. The magnetic coils are installed in titanium cases, which transmit the loads generated in the coils to the adjacent supporting structure. The TFTR utilizes 20 of these coils, positioned radially at 18 deg intervals, to provide the required toroidal field. (Author)

A78-39789 Manufacture, assembly and test of the toroidal and poloidal magnetic field coils of ASDEX. E. Broser, J. Gernhardt, F. Hartz, M. Keilhacker, G. Klement, P. Krüger, T. v. Larcher, H. Niedermeyer, M. Pillsticker, and H. Wedler (EURATOM and Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany). In: *Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1*. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 39-43. 7 refs.

A78-39790 Design of the TEXT toroidal and poloidal field coils. P. Wildi, G. L. Cardwell, and D. F. Brower (Texas, University, Austin, Tex.). In: *Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1*. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 48-53.

The proposed Texas Fusion Plasma Research Tokamak (TEXT) has a major radius of 100 cm, a minor radius of 28 cm and a field intensity of 3 T at the center of the torus. Both toroidal and poloidal coil systems were initially designed to be powered by a homopolar rotational energy store and the coil design takes full advantage of the

high current, low voltage characteristic of this power source. The paper discusses the engineering aspects peculiar to a toroidal field coil matched to such a source. Alternatives to the chosen plate coil design are discussed and compared. The chosen design consists of 16 coils of 6 turns each, machined from solid copper plates. The coils are water cooled. Individual turns are insulated from each other with glass-epoxy which solidly bonds the individual turns. (Author)

A78-39791 The Alcator C magnetic coil systems. C. Weggel, W. Hamburger, B. Montgomery, and N. Pierce (MIT, Cambridge, Mass.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 54-58. Research sponsored by the U.S. Department of Energy.

The Alcator C toroidal, ohmic, and equilibrium coil systems are described. The toroidal field coil is a Bitter-type monolithic coil generating 14 T at a central major radius of 64 cm. The liquid nitrogen cooled coil operates from a 150 MW, 530 MJ rotating alternator driving SCR units capable of full inversion. The ohmic and equilibrium systems are air-core multicoil systems. The central ohmic heating coil is driven by a 36 MW SCR power supply and can supply 1.8 volt-seconds of flux in a single swing. The equilibrium field system is driven by a 15 MW unit and supplies sufficient field for a 1,000,000 ampere plasma. The dynamic response of the equilibrium field during constant plasma current operation is 0.4%/millisecond. (Author)

A78-39792 Stress and deflection analysis of the PLT-coil using ANSYS computer code. P. Rogoff (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 59-62. 7 refs. Contract No. E(11-1)-3073.

A new PLT-TF coil deflection and stress analysis is performed using the ANSYS computer code and STIF45 incompatible mode version isoparametric eight node elements. The coil is treated as an assembly of these elements where each turn of copper and epoxy is clearly and separately defined. This model offers the opportunity for turn by turn study of both spiral and circular configurations. Coil behavior due to various boundary conditions, material property changes and loading profiles are calculated, discussed and summarized. Final deflection results are compared with actual measurements which were obtained during the PLT machine power tests. Model inadequacies and possible improvements are discussed and suggested. (Author)

A78-39793 Establishment of design and performance requirements using cost and systems analysis. L. M. Waganer, L. A. Carosella, and D. A. Defreese (McDonnell Douglas Astronautics Co., St. Louis, Mo.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 63-70.

The current uncertainty in design approach and performance requirements for a commercial fusion power plant poses a problem for the designer in configuring the plant and for the utilities in analyzing the attractiveness of a future fusion power plant. To provide direction and insight in this area, a systems analysis model was constructed, utilizing fusion subsystem algorithms with subsystem cost-estimating relationships, into a self-consistent computerized model for several fusion reactor concepts. Using the computer model, sensitivities to plasma, reactor, and plant parameters are a few of the options that have been evaluated to yield recommended concepts/techniques/solutions. This is a very beneficial tool in assessing the impact of the fusion reactor on the electrical power community and charting the optimum developmental approach. (Author)

A78-39794 Impact of confinement physics on reactor design and economics. D. A. Defreese, R. B. Campbell, and L. M. Waganer (McDonnell Douglas Astronautics Co., St. Louis, Mo.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 71-75.

A variety of confinement laws were employed in a transient zero-dimensional plasma code which was coupled to the TOCOMO systems code. The purpose was to determine the impact of the confinement laws on reactor design, power costs, and changes in the utility interface. A satisfactory reactor and power plant has been defined for the large majority of combinations of confinement law, power plant size, and plasma shape. Trapped ion mode (TIM) has been the easiest to work with, since the plasma is thermally stable with a good power density and minimal alpha-particle buildup. Neoclassical and pseudoclassical along with TEM II result in satisfactory reactor performance, but require active feedback control (by injecting impurities) to prevent plasma-temperature excursions. These laws also require some form and degree of confinement-time spoiling to allow long burn times; otherwise, alpha particles build up to an unacceptable level. TEM I results in thermal equilibrium at 5 keV and must be driven to provide a reactor-quality plasma. (Author)

A78-39797 An approach to decision modeling for an ignition test reactor. H. R. Howland and T. C. Varljen (Westinghouse Electric Corp., Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 91-94. 8 refs. Contract No. W-7405-eng-26.

A comparison matrix decision model is applied to candidates for a D-T ignition tokamak (INS), including assessment of semiquantifiable or judgmental factors as well as quantitative ones. The results show that TNS is mission-sensitive with a choice implied between near-term achievability and reactor technology. (Author)

A78-39798 Tritium systems preliminary design for TNS. H. J. Garber (Westinghouse Electric Corp., Fusion Power Systems Dept., Pittsburgh, Pa.) and J. S. Watson (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 95-100.

The salient features of a tentative configuration for a fuel handling system were evolved in connection with the joint Oak Ridge National Laboratory-Westinghouse The Next Step (TNS) tokamak preconceptual design studies. The tritium-fuel system comprises seven main subsystems: tritium storage and supply, fuel fabrication and delivery, vacuum system spent fuel reprocessing, cryogenic distillation, detritiation of secondary containment, sweep gas, surface cleanup processing, and reactor-cell-atmosphere cleanup. Additionally, the tritium system has close tie-ins with other systems such as neutral-beam deuterium injection; torus vacuum pumping, including a divertor if this is required for impurity control; radioactive waste treatments; ventilation of experimental areas; vacuum vessel and shielding coolants; and central instrumentation and control. (Author)

A78-39800 Control system of plasma position and cross-sectional shape in large tokamak device. Y. Suzuki, A. Ogata, H. Ninomiya (Japan Atomic Research Institute, Tokai, Ibaraki, Japan), S. Nakagawa, N. Tsuzuki, and T. Yamagishi (Tokyo Shibaura Electric Co., Ltd., Fuchu, Japan). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977,

Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 112-116.

In the large tokamak device, JT-60, a control system for the plasma position and cross-sectional shape are required to avoid undesirable plasma contact with the limiter. This paper describes comparative investigations of two vertical-field control systems based on computer simulations. The physical model of the plasma is simplified on the assumption that the torus plasma has a circular cross section and large aspect ratio. Components of the control devices are taken into account. In the comparative investigations, systems properties of each system are also taken into consideration. (Author)

A78-39802 Engineering features of ISX-B. T. E. Smith, R. L. Dearstone, and P. L. Goranson (Union Carbide Corp., Nuclear Div., Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 121-124.

The ISX-B device will be a major modification of the existing ISX tokamak now in operation at Oak Ridge National Laboratory. This device will permit the study of intense neutral-particle heating and elongated plasmas in the 3-5% beta range. The modification will consist of replacing the ISX vacuum vessel, torque restraint system, and poloidal-field coils. The principal design features of the device are: major radius of 92 cm, minor radius of 27 cm with a plasma elongation of approximately 1.9 to 1, maximum toroidal field of 1.8 T, maximum vertical field of 0.1 T (with a toroidal field of 1.2 T), and maximum plasma current of 200 kA. Design of ISX-B began in February, 1977, with fabrication of major components starting in June, 1977. The present ISX-B schedule calls for completion of all tokamak components and shutdown of the existing ISX in February, 1978. The ISX-B device should begin operation in June, 1978. The program status at the present seems to support this anticipated startup. (Author)

A78-39805 TMX - A new facility. S. R. Thomas, Jr. (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 134-137. 8 refs. Contract No. W-7405-eng-48.

As a mirror fusion facility, the Tandem Mirror Experiment (TMX) at the Lawrence Livermore Laboratory is both new and different. It utilizes over 23,000 sq ft of work area in three buildings and consumes over 14 kWh of energy with each shot. As a systems design, the facility is broken into discreet functional regions. Among them are a mechanical vacuum pumping system, a liquid-nitrogen system, neutral-beam and magnet power supplies, tiered structures to support these supplies, a neutron-shielded vacuum vessel, a control area, and a diagnostics area. Constraints of space, time, and cost have all affected the design. (Author)

A78-39806 Design of an electrostatic end-plugged plasma-confinement device. R. W. Moir, T. J. Dolan, and W. L. Barr (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 138-143. Contract No. W-7405-eng-48.

A laboratory-scale experimental device having an outside diameter of 1.2 m has been designed to test the idea of electrostatic end plugging of an open-ended magnetic-field configuration. The configuration is a toroidal quadrupole having four very thin (less than 1 mm thick) line cusps produced by four circular copper coils. Iron is used to concentrate the magnetic flux density to 2.0 T; without the use of iron, the power consumption, which is about 1 MW, would be about 25 times higher. The use of iron also produces a precisely known

magnetic field and allows good access for diagnostics and pumping. Iron is also used for both the flux return path and the vacuum chamber. A hollow anode with an adjustable (nominally 1 mm wide) gap is biased from 10 to 20 kV. Plasma densities of about 10 trillion per cu cm and temperatures of about 1 keV might be produced by an electron beam and by electron cyclotron resonance heating. Higher-order multipoles (hexapoles and octopoles) are also described.

(Author)

A78-39810 Toroidal field ripple effects in TNS design. N. A. Uckan, J. D. Callen, K. T. Tsang, and J. R. Moore (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 169-172. 6 refs. Research sponsored by the U.S. Department of Energy.

In the design of TNS, the choice of the number of TF coils has been made on the basis of tradeoff studies among the plasma physics considerations and engineering design requirements. The theory of the magnetic-field ripple effects has been studied to include the effects of noncircular cross sections such as those encountered in high-beta equilibria. A computer simulation model (RIPPLE) was developed to examine the field ripple effects on plasma transport and scaling. The magnetic-field computer program BOVAL was used to calculate the magnetic field due to current flowing in a noncircular coil of finite rectangular cross section. The number of toroidal-field (TF) coils is then determined by calculating the maximum magnetic-field ripple that can be tolerated from plasma physics considerations. (Author)

A78-39812 Hybrid equilibrium field coils for the ORNL TNS. Y.-K. M. Peng, D. J. Strickler, and R. A. Dory (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 186-192. Research sponsored by the U.S. Department of Energy.

A comparative study is made of the power supplies required by interior and exterior (to the toroidal-field coils) equilibrium-field coils that are separately appropriate for high-beta D-shaped plasmas in TNS. It is shown that the interior coils need power supplies that are an order of magnitude below those required by the exterior coils (while the latter are much less difficult to build than the former). A hybrid EF coil concept is proposed that combines the interior and exterior coils to retain their advantages in avoiding large interior coils while lowering the power supplied to the exterior coils by an order of magnitude. (Author)

A78-39814 Advantages of iron core in a tokamak. E. S. Bettis, J. K. Ballou, W. R. Becraft, Y.-K. M. Peng, and H. L. Watts (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 198-205. 11 refs. Research sponsored by the U.S. Department of Energy.

A quantitative comparison of the iron core versus air core concepts was carried out on the basis of a representative tokamak reactor design. The results indicate substantial savings in power supply in the start-up phase by the use of an iron core, without impeding the required equilibrium fields for a D-shaped plasma. Further advantages which accrue from the use of iron cores are: elimination of the need for a complex superconducting poloidal coil system; by using shell-like high-beta EF coils, the need for OH coils is eliminated, and long pulse operation with saturated iron core becomes possible; and substantial simplifications in design and maintenance. V.P.

A78-39815 Direct energy conversion of exhaust fusion plasma by magnetic deflection. K. Denno (New Jersey Institute of Technology, Newark, N.J.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 206-210. 8 refs.

Energy extraction from the exhaust plasma of the divertor in the PRDM fusion reactor could be feasible by the action of magnetic separation and deflection. The exhaust chamber could be modified into a cylindrical form with the collecting electrodes lining its internal surface. Range of feasible deflecting radii, axial travel and angle of inclinations have been obtained for the impinging exhaust plasma electrons. (Author)

A78-39822 Impurity and gas throughput control for TNS. E. W. Sucof (Westinghouse Electric Corp., Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 243-249. 19 refs. Contract No. W-7405-eng-26.

A model of the interaction between an ignited plasma and a wall is utilized to study the impact of impurities, recycled fuel ions, and helium ash on the burn time of the plasma. The model indicates that the impurity concentration grows exponentially toward a maximum value determined by the confinement time for impurities, the sputtering coefficient, and the isolation coefficient. The time for the impurity concentration to reach a critical value and quench the plasma was determined for representative impurities, C, Mo, W, Fe, under various conditions of plasma temperature. Methods for extending the burn time by minimizing the effective sputtering coefficient of the wall and increasing the isolation of the plasma from the wall are reviewed. The carbides, B₄C and SiC, are found to have encouraging sputtering properties, but their thermal, chemical, and mechanical properties need to be evaluated before they can be recommended for use as first walls. The magnetic divertor is the preferred isolation scheme. Because the divertor carries impurities, leaked fuel, and helium ions to a burial chamber, required pumping speeds are found to be very high for TNS plasmas, so that supplemental particle-trapping systems must be introduced in order to reduce the required pump speed to attainable values. (Author)

A78-39832 Acceleration of one ampere negative ion beams to energies up to 120 keV. C. Lam and T. Sluyters (Brookhaven National Laboratory, Upton, N.Y.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 300-302. 5 refs. Research sponsored by the U.S. Department of Energy.

A 150-kV short-pulse test facility developed to accelerate one-ampere negative ion beams from a plasma source is described. In this close coupled accelerator structure (without prefocusing), the source is located immediately upstream the accelerator, as applied in short-pulsed low-density preinjectors for high-energy accelerators. In a first attempt, it proved possible to extract negative ions at approximately 15 keV and to accelerate them across a single gap to energies of 120 keV. The pertinent parameters of the 4-cm magnetron source and accelerator are tabulated. V.P.

A78-39834 Engineering of beam direct conversion for a 120-kV, 1-MW ion beam. W. L. Barr, J. N. Doggett, G. W. Hamilton, J. D. Kinney, and R. W. Moir (California University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 308-314. 7 refs. Contract No. W-7405-eng-48.

Practical systems for beam direct conversion are required to recover the energy from ion beams at high efficiency and at very high beam power densities in the environment of a high-power neutral-injection system. Such an experiment is now in progress using a 120-kV beam with a maximum total current of 20 A. After neutralization, the H(+) component to be recovered will have a power of approximately 1 MW. A system testing these concepts has been designed and tested at 15 kV, 2 kW in preparation for the full-power tests. The engineering problems involved in the full-power tests affect electron suppression, gas pumping, voltage holding, diagnostics, and measurement conditions. Planning for future experiments at higher power includes the use of cryopumping and electron suppression by a magnetic field rather than by an electrostatic field. Beam direct conversion for large fusion experiments and reactors will save millions of dollars in the cost of power supplies and electricity and will dispose of the charged beam under conditions that may not be possible by other techniques. (Author)

A78-39840 S.C. magnet design for 10 MJ homopolar machine. D. C. Litz, P. W. Eckels, and H. Riemersma (Westinghouse Research and Development Center, Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 344-348. 11 refs.

Westinghouse has designed a fast discharge, drum homopolar machine with superconducting field coils for use as an energy storage device for fusion experiments. The machine stores 10 MJ of energy inertially at 7330 rpm. At this speed, the machine develops a voltage of 719 volts and when delivering energy to the inductive load coil in 30 ms, the current crests at 1.46 MA. The machine utilizes a superconducting field excitation system. This paper describes the mechanical design, superconductor design, and the steady-state and transient cooling analysis of the superconducting field excitation system for the machine. (Author)

A78-39848 Application of homopolar generators for high voltage plasma experiments. W. H. Lupton, D. Conte, R. D. Ford, P. J. Turchi, and I. M. Vitkovitsky (U.S. Navy, Naval Research Laboratory, Washington, D.C.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 430-433. 8 refs.

Devices used to produce relativistic electron and ion beams use electrical pulse generators with voltages of megavolts. When the needed level of stored energy increases, it is desirable to exploit the economies of inertial and inductive energy storage. A design is developed for modification of the NRL inductive storage system to operate at one megavolt with 3.8 MJ of stored energy. The inductor is energized with 200 kA directly by a homopolar generator. Explosive switches opening in 70 microsec are matched to the generator and used for the primary switching to be followed by underwater exploding foil fuses to achieve high voltage. (Author)

A78-39855 Energy storage and transfer system for Experimental Power Reactor. J. N. Brooks, R. E. Fuja, R. L. Kustom, and W. F. Praeg (Argonne National Laboratory, Argonne, Ill.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 459-463. 6 refs. Research supported by the U.S. Department of Energy.

The energy storage and transfer system for the Experimental Power Reactor is designed to include homopolar generators to reverse the ohmic heating coil field and inductor/convertor bridge circuits to relay energy from the superconducting energy storage

inductor to the equilibrium field coil, the ohmic heating coil, and the neutral beam heating system. A peak power voltage of 30 kV and a peak current of 56 kA are planned for the homopolar generators of the ohmic heating system. The superconducting magnet system and homopolar generators should provide considerable economies and improved efficiency over the conventional motor-generator-flywheel sets with ac-dc convertors. J.M.B.

A78-39861 Design of the power amplifier for the HEGLF at LASL. J. Jansen and V. L. Zeigler (California, University, Los Alamos, N. Mex.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 489-493. Research sponsored by the U.S. Department of Energy.

The evolution of the principal design parameters for the Antares power amplifier is presented. It is shown how design requirements and constraints practically dictate the choice of the cross-sectional area of the pumped volume. Number of axial sections and length of the volume result from a trade-off study between amplifier and pulse generator parameters. (Author)

A78-39877 Design related RD&D assessment for TNS. T. C. Varljen and C. A. Flanagan (Westinghouse Electric Corp., Fusion Power Systems Dept., Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 586-589. Contract No. W-7405-eng-26.

The assessment of The Next Step (TNS) describes design issues and considers the scope, timing, and cost of their resolution. A total of 139 specific research, development and demonstration tasks were identified in the assessment, and the total cost is estimated to be \$179,000,000, exclusive of contingency, escalation, and technical management. Topics such as superconducting coil technology, poloidal field system, and plasma heating are summarized. M.L.

A78-39878 Engineering features of an upgradable ignition test reactor. P. Sager, J. Alcorn, D. Doll, R. Field, D. Vrabie, and T. Woods (General Atomic Co., San Diego, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 590-596. 6 refs. Contract No. EY-76-C-03-0167.

A conceptual design has been developed for an upgradable ignition test reactor (UITR) as part of a program to identify the next major tokamak device beyond Doublet III and TFTR. This reactor, which is based on the doublet plasma concept, has a major radius of 4.2 m, a minor radius of 1.2 m, and a plasma height-to-width ratio of 2.7. The plasma is contained in a water-cooled vacuum vessel. A 25-cm thick helium-cooled blanket made of 316 stainless steel is installed outboard of the plasma chamber. The field-shaping coil system, shielding system, toroidal field coils, and induction coil system are installed outside the blanket. In its ITR mode, the reactor operates in moderate length pulses (30 sec) with a duty factor of 0.1 (5 min cycles). For net power experimental power reactor (EPR) operating mode, the machine operates with 90 sec pulses and a duty factor of 0.78. (Author)

A78-39881 Fusion reactor development scenarios for the laser solenoid concept. P. H. Rose, L. C. Steinhauer, and R. T. Taussig (Mathematical Sciences Northwest, Inc., Bellevue, Wash.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 609-613. 22 refs.

A program for utilizing the fusion-fission hybrid or symbiotic

technology to produce fuel for the installed light water reactor capacity is proposed. In particular, the laser solenoid fusion concept is examined. The experimental status of the laser solenoid, which combines laser heating and magnetic confinement, is reviewed, and its suitability to the fusion hybrid breeder reactor (FHBR) is considered. Development programs for FHBR/fusion and for the laser solenoid are outlined. M.L.

A78-39884 Magnet conceptual design for a high field tokamak reactor. J. E. C. Williams, R. D. Hay (MIT, Francis Bitter National Magnet Laboratory, Cambridge, Mass.), and M. Okabayashi (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 625-629. Research supported by the U.S. Department of Energy.

A78-39887 The JET Project - Technical developments, status of the manufacturing work in industry, administrative and managerial aspects. E. Bertolini (U.K. Atomic Energy Authority, Culham Laboratory, Abingdon, Oxon, England). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 638-643. 11 refs.

The status of the Joint European Torus (JET) Project, aimed at developing a large tokamak device, is reviewed. Manufacture of the vacuum vessel bellows and rigid sectors, the toroidal field coil copper, and the toroidal magnet is in progress. More than 50% of the total JET expenditures have been contracted for, and costs remain within the original estimates. Unresolved questions about siting and management authority for the JET Project are presently causing delays. J.M.B.

A78-39888 System design for the new TMX machine. A. K. Chargin, M. O. Calderon, L. J. Mooney, and G. E. Vogtlin (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 644-648. 11 refs. Contract No. W-7405-eng-48.

The Tandem Mirror Experiment (TMX) is designed to test the physics of a new approach to Q-enhancement in open confinement systems. In the tandem mirror concept, the ends of a long solenoid are plugged electrostatically by means of ambipolar potential barriers created in two mirror machines or plugs, one at each end of the solenoid. The ambipolar potential in mirror machines develops as a consequence of the higher scattering rate of electrons and the balancing of electron and ion loss rates. The TMX experiment incorporates very few new engineering developments, but it does involve a new way of combining in an integrated system many previously developed ideas. The engineering task is to design the machine that would provide a proof-of-principle evaluation of the tandem mirror concept as rapidly as possible. The preliminary design was started in September 1976 and was completed by December 1976. It led to a cost estimate of \$11 million and a scheduled construction period of 18 months. (Author)

A78-39889 Design for the magnetic field requirements of the tandem mirror experiment. F. K. Chen and A. K. Chargin (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 649-654. 5 refs. Contract No. W-7405-eng-48.

The tandem mirror magnetic geometry is described, followed by an analysis of the magnet set designed to meet the requirements of

the TMX experiment. The final magnet line-up is composed of a baseball coil with two C coils for each plug, six solenoidal coils for the central cell, and two RC coils plus one octupole coil for each transition. (Author)

A78-39894 Economics of tokamak power systems. R. L. Reid and D. Steiner (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 675-680. 7 refs. Research sponsored by the U.S. Department of Energy.

In this study we determine the impact of plasma operating characteristics, engineering options, and technology on the capital cost trends of tokamak power plants. Tokamak power systems are compared to other advanced energy systems and found to be economically competitive. A three-phase strategy for demonstrating commercial feasibility of fusion power, based on a common-site multiple-unit concept, is presented. (Author)

A78-39895 Economic analysis of EBT reactor. J. T. Woo (MIT, Cambridge, Mass.; Rensselaer Polytechnic Institute, Troy, N.Y.), N. A. Uckan (Oak Ridge National Laboratory, Oak Ridge, Tenn.), and L. M. Lidsky (MIT, Cambridge, Mass.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 681-684. 6 refs. Research sponsored by the U. S. Department of Energy.

In order to establish the economic potential of the Elmo Bumpy Torus (EBT) reactor, two independent system-costing models have been developed. Both models predict capital costs of approximately \$400/kW(th). These relatively low costs reflect the simplicity of the EBT design. In particular, the modular nature of the individual blanket-shield segments, the low costs 'accelerator style' containment building, high beta, and steady-state operation lead to relatively low reactor costs. A detailed cost breakdown for subsystems is analyzed. High cost and high uncertainty subsystems are identified to direct further emphasis into those areas. The calculated capital costs for the EBT reactor are compared with those costs quoted for tokamak reactors. (Author)

A78-39896 Cryostabilization of large superconducting magnets using pool boiled helium II. S. W. Van Sciver (Wisconsin, University, Madison, Wis.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 690-694. 23 refs. ERDA-supported research.

Large superconducting magnets such as the toroidal field (TF) coils of tokamak reactors may have significantly improved performance if cooled with superfluid helium (T about 1.8 K) rather than normal atmospheric pool-boiled helium (T about 4.2 K). A comparison of the two methods of cooling is presented with emphasis on heat transfer. The basis for the analysis is a laboratory measurement of heat transfer from aluminum to He II, the important features of which are summarized. The UWMAK III TF coil conductor design is discussed as an example of improved design performance at 1.8 K compared to its planned use at 4.2 K. (Author)

A78-39897 Superconducting magnets for fusion reactors - The problem of a reliable and effective cooling system. G. Pasotti and M. Spadoni (Comitato Nazionale per l'Energia Nucleare, Laboratorio di Superconduttività, Frascati, Italy). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 700-702. 22 refs.

The today's situation of the experiment towards a fusion reactor seems to imply that in the next future a superconducting magnet system has to be used. A reliable and effective cabling system is one of the fundamental steps towards the reliability of the whole magnet system. This paper deals with the advantages of cooling systems based on forced circulation of liquid helium in hollow conductors. Available experimental data on forced flow of supercritical, sub-cooled and boiling helium are discussed. The analysis shows that, for the large superconducting magnets of a fusion reactor, forced circulation of two-phase helium seems to be very attractive. In view of the scatter of data, we are designing an experimental set up to study heat transfer, stabilization and hydrodynamic features in forced flow cooling. (Author)

A78-39901 The coil winder for the magnet of the Mirror Fusion Test Facility. R. C. Ling (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 728-732. Contract No. W-7405-eng-48.

A78-39902 * Potential damage to dc superconducting magnets due to high frequency electromagnetic waves. G. J. Gabriel (Notre Dame, University, Notre Dame, Ind.) and J. A. Burkhart (NASA, Lewis Research Center, Cleveland, Ohio). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 741-745. 7 refs. NASA-supported research.

Studies of a d.c. superconducting magnet coil indicate that the large coil behaves as a straight waveguide structure. Voltages between layers within the coil sometimes exceeded those recorded at terminals where protective resistors are located. Protection of magnet coils against these excessive voltages could be accomplished by impedance matching throughout the coil system. The wave phenomenon associated with superconducting magnetic coils may create an instability capable of converting the energy of a quiescent d.c. superconducting coil into dissipative a.c. energy, even in cases when dielectric breakdown does not take place. J.M.B.

A78-39905 Computational model for superconducting toroidal-field magnets for a tokamak reactor. L. R. Turner and M. A. Abdou (Argonne National Laboratory, Argonne, Ill.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1.

Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 762-766. 6 refs. Research supported by the U.S. Department of Energy.

A computational model for predicting the performance characteristics and cost of superconducting toroidal-field (TF) magnets in tokamak reactors is presented. The model can be used to compare the technical and economic merits of different approaches to the design of TF magnets for a reactor system. The model has been integrated into the ANL Systems Analysis Program. Samples of results obtainable with the model are presented. (Author)

A78-39908 Magnetic forces in the PDX toroidal field coils. S. A. Dreskin (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 797-801.

A complete mapping of the magnetic force distribution in the toroidal field of a tokamak fusion reactor is presented; families of curves are developed to show the functional relationship between the centering and vertical forces and the radius and angular position in

the curved regions. Three particular regions are examined: a solid current-carrying rod of rectangular cross-section; a circular coil of rectangular cross-section; and a region sufficiently close to the center of the torus to be characterized by well-known analytic expressions for the magnetic field. A total centering force of 1.6 million lbs is calculated for the entire toroidal field coil. J.M.E.

A78-39909 PDX PF power tests. G. M. Brown and P. J. Heitzenroeder, Jr. (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 814-816. Contract No. EY-76-C-02-3073.

Power tests have been performed on the poloidal coil systems of the PDX machine to verify the engineering designs. The tests included both steady-state and pulsed current operating modes. The steady-state current levels were gradually increased to their maximum ratings, which ranged from 1.0 to 3.0 kA and the outlet water temperature of each coil was measured. The thermally-induced strains were measured in the poloidal coil cans located within the vacuum vessel. Pulsed power tests were made at gradually increasing levels on individual magnetic systems until their design current ratings were attained. The current ratings vary from 7.0 to 22.0 kA with a maximum equivalent square wave time of 1.5 seconds and a 120 second repetition rate. Measurements of stresses and/or deflections and outlet water temperature vs. time were made on selected coils. The pulsed tests were repeated for various combinations of systems in simultaneous operation until normal simultaneous operation of all magnetic systems was attained. (Author)

A78-39915 Bending free toroidal shells for tokamak fusion reactors. W. H. Gray, W. C. T. Stoddart (Oak Ridge National Laboratory, Oak Ridge, Tenn.) and J. E. Akin (Tennessee University, Knoxville, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 855-861. 15 refs. Research sponsored by the U.S. Department of Energy.

Several authors have suggested a novel shape for the toroidal field coils of a tokamak fusion reactor. Collectively, these magnet shapes have been referred to as the 'Princeton D-coil'. This coil shape can be derived by assuming that for a thin conductor to be in a state of 'pure tension,' its radius of curvature must be proportional to the toroidal radius. A principal disadvantage of this derivation is that out-of-plane support is neglected. In this paper, a derivation of a bending free toroidal shell for a tokamak fusion reactor is presented. The out-of-plane structure is considered to be an integral part of the fusion reactor and therefore its shape is optimized to produce a bending free stress distribution. This shape, which is nearly circular for aspect ratios greater than 2.5, is derived by solving the equilibrium, constitutive, and kinematic relationships for a uniform toroidal membrane. This membrane is subjected to a magnetic pressure which is inversely proportional to the square of the toroidal radius. A comparison between this bending free shape and the D-shape is presented. (Author)

A78-39916 Lateral support structure for constant tension D-shaped coils in tokamak fusion devices. R. Fernandes (Westinghouse Electric Corp., Advanced Energy Systems Div., Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 862-864. Contract No. W-7405-eng-26.

A78-39918 Electrical design of TNS. F. M. Heck, J. H. Schultz, and G. S. Smeltzer (Westinghouse Electric Corp., Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research,

7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 870-873. Contract No. W-7405-eng-26.

The electrical design of the ORNL-Westinghouse next step (TNS) fusion reactor was begun in 1976, using a set of ground rules which were based on the overall program objectives. These objectives were to identify the design of reasonably-priced reactors, which would achieve ignition and be technology forcing. The term 'technology forcing' was understood to mean the desirability of a large number of ignited D-T pulses and the incorporation of superconducting toroidal field (TF) coils, if at all possible. A trade study methodology was developed to compare different machine sizes and TF coil technologies and to aid in the selection of system and subsystem design approaches. The logic which led from the program objectives to the design ground rules and from the ground rules to the circuit selection is described below. The circuit design approaches were generalized and these models were incorporated into a computer program (COAST) which was used to examine the cost of overall tokamak systems as key design parameters were varied. (Author)

A78-39920 A 25 megajoule energy storage and delivery system for the Shiva laser. W. L. Gagnon, P. R. Rupert, L. Berkbigler, B. M. Carder, D. G. Gritton, R. W. Holloway, M. M. Howland, and K. Whitham (California University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 880-885. Contract No. W-7405-eng-48.

A 25-megajoule, 20-kV capacitive energy storage and delivery system has been built and tested for Shiva - a 20-arm, 10-kJ, 20-TW neodymium glass fusion research laser. This system supplies over 3.5 megamperes to xenon flashlamps for optical pumping of the laser amplifier. About 15% of the energy is used to establish magnetic field within Faraday rotator glass. A digital based control and diagnostics scheme is employed through the entire pulse power system. This scheme utilizes a distributed digital data bus that addresses every element through two levels of optical isolation. The interfacing of low level circuitry to a pulse power environment is discussed, as well as the design and performance of the total system. The projected cost goal of 27 cents/joule, installed and operating, has been met. The general approach to the design, transient analysis, manufacture, and activation of this large power conditioning system are also discussed. (Author)

A78-39921 System engineering and design of a pulsed homopolar generator power supply for the Texas Experimental Tokamak. W. L. Bird, G. B. Grant, W. F. Weldon, H. G. Rylander, and H. H. Woodson (Texas University, Austin, Tex.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 1. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 886-890. ERDA-supported research.

A78-39928 General Electric conceptual design of a test coil for the large coil program. R. Quay, R. W. Bryant, R. F. Koenig, J. J. Ferrante, C. L. Linkinhoker, J. W. Donato (General Electric Co., Schenectady, N.Y.), J. P. Henrich, W. D. Markiewicz, B. A. Zeitlan, and R. L. Rhodenizer (Intermagetics General Corp., Guilderland, N.Y.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 926-930. 8 refs. ERDA-supported research.

A conceptual design for a toroidal field (TF) coil for a six coil test array has been developed. The electromagnetic, cryogenic, structural, manufacturing, quality assurance and verification testing

requirements have been analyzed. The bore is oval shaped and is 2.35 meters horizontally and 3.35 meters vertically. The coil is designed to operate at 8T peak field at rated current of 10450 amperes when the other 5 coils in the toroidal array are at 80% rated current. Using flat-wound NbTi conductor this pool-boiling, pancake wound coil is fully cryostable, and is enclosed in a 316LN stainless steel coil structure and helium container capable of supporting all expected in-plane loads and out-of-plane loads due to pulsed fields and unsymmetrical current distributions in the other 5 coils. (Author)

A78-39935 Pulse coil concepts for the LCP facility. B. E. Nelson and P. B. Burn (Union Carbide Corp., Nuclear Div., Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 962-965. Research sponsored by the U.S. Department of Energy.

The pulse coils described in this paper are resistive copper magnets driven by time-varying currents. They are included in the Large Coil Test Facility (LCTF) portion of the Large Coil Program (LCP) to simulate the pulsed field environment of the toroidal coils in a tokamak reactor. Since TNS (a 150 sec, 5MA, igniting tokamak) and the Oak Ridge EPR (Experimental Power Reactor) are representative of the first tokamaks to require the technology developed in LCP, the reference designs for these machines, especially TNS, are used to derive the magnetic criteria for the pulse coils. This criteria includes the magnitude, distribution, and rate of change of pulsed fields in the toroidal coil windings. Three pulse coil concepts are evaluated on the basis of magnetic criteria and factors such as versatility of design, ease of fabrication and cost of operation. The three concepts include (1) a pair of poloidal coils outside the LCTF torus, (2) a single poloidal coil threaded through the torus, and (3) a pair of vertical axis coil windings inside the bore of one or more of the toroidal test coils. (Author)

A78-39936 The helium liquefier-refrigerator and distribution system for the Large Coil Program Test Facility. C. G. Lawson and J. P. Kois (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 966-968. Research sponsored by the U.S. Department of Energy.

The liquid helium supply and cryogenic distribution system for the toroidal magnetic coils of advanced tokamaks is discussed. The system includes a 1050-kW, two-stage compressor, a refrigeration unit capable of delivering the gas at two thermodynamic states, and a 19,000-liter helium storage dewar. Either supercritical helium at temperatures to about 3.5 K or saturated liquid helium with temperatures down to about 3.5 K may be delivered by the refrigeration unit. The compressor is an oil-flooded screw device with a capacity of 30 to 300 g/sec of helium gas. J.M.B.

A78-39938 Performance of a turbomolecular pump in a pulsed magnetic field. W. Bieger, K. H. Dippel, F. Richter (EUR-ATOM and Kernforschungsanlage Jülich GmbH, Jülich, West Germany), and E. Usselmann (Leybold-Heraeus GmbH and Co., Cologne, West Germany). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 976-980.

Turbomolecular pumps used in fusion experiments may be subjected to rotor heating and destructive expansion by eddy currents when pulsed magnetic fields are present. A study indicates that a turbomolecular pump in homogeneous magnetic fields perpendicular to the rotor axis can operate without excessive rotor heating if the magnetic pulse length and repetition time are kept within certain limits. Shielding of the pump with a high-permeability casing is also discussed. J.M.B.

A78-39939 Remote leak detection for the TFTR. C. R. Walthers (Grumman Aerospace Corp., Bethpage, N.Y.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2.

Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 981-984. Contract No. E(11-1)-3073.

The planned design for the TFTR (Tokamak Fusion Test Reactor) remote leak detection system consists of a central console which controls the application of tracer gas to possible leak areas. Seals are tested by admitting tracer gas to machined cavities on the atmospheric side of the seal. The tracer gas is brought to the seal cavity by 1/8-inch diameter tubes which connect to local tracer gas/vacuum manifolds located outside the protective radiation shielding. Vacuum shell walls and welds are checked by flowing tracer gas through annular heating/cooling passages. The detector will be either an MSLD (mass spectrometer leak detector) or an RGA (residual gas analyzer), the location of which is not finalized. Feasibility tests performed and planned include response and sensitivity measurements of possible tubing/detector configurations with several tracer gases. (Author)

A78-39947 Constructing the vacuum vessel for J.E.T. /Joint European Torus/. G. H. Rappé (Atomic Energy Research Establishment, Culham Laboratory, Abingdon, Oxon, England). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1015-1020.

Engineering details of the all-welded vacuum vessel for the Joint European Torus (JET) are discussed. The 32 rigid and wedge-shaped metal components of the vessel are joined by parallel bellows to form a torus. Inconel 625 has been selected for the bellows because of its electrical resistivity properties, while Inconel 600, an alloy with good welding characteristics, is to be used for the rigid sections. A rolling process creates the convolutions in the bellows; a predetermined guidance system generates the D-shaped bellows profile. J.M.B.

A78-39951 Cryogenic supplies for the TFTR neutral beam line cryopanels. G. Pinter (Grumman Aerospace Corp., Bethpage, N.Y.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1035-1039. Contract No. E(11-1)-3073.

The neutral beam lines of the Tokamak Fusion Test Reactor make use of cryocondensing panels capable of providing a pumping speed of 2.5 million liters per sec of hydrogen or deuterium at 10 to the minus sixth or fifth power torr pressure levels. Operated at 3.8 or 4.5 K for hydrogen or deuterium pumping respectively, the cryocondensing panels are thermally shielded by liquid nitrogen panels and chevrons. The liquid helium system includes a distribution network carrying large quantities of liquid/gas mixtures over a distance of 500 feet. J.M.B.

A78-39952 Cryopumping system for TFTR neutral beam injectors. L. E. Valby (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1040-1044a. 9 refs. Contract No. W-7405-eng-48.

The neutral beam injectors of the Tokamak Fusion Test Reactor include cryocondensing pumping systems capable of pumping 2500 cu m of deuterium per second at 4.5 K. Eight modular cryopumps thermally protected by liquid nitrogen systems have been developed. The welded stainless steel framework and conduction-cooled black-

ened copper chevrons of the vacuum system are described; the liquid helium 'dewar' and manifolding are also considered. Cooling and steady-state operations of the cryocondensing pumping systems are reviewed, and the relief system designed to counteract the effects of a massive vacuum break and the accompanying rapid pressure rise is mentioned. J.M.B.

A78-39954 Pulsed power conversion with inductive storage. E. C. Cnare, M. Cowan, T. P. Wright, and W. K. Tucker (Sandia Laboratories, Albuquerque, N. Mex.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1049-1052. 8 refs.

The PULSAR compressed magnetic flux, pulse power generator system has applications as a topping stage in commercial power generation. A plasma armature mode of operation is described which could be powered by an inertially confined fusion reactor. The paper summarizes the development of a plasma armature and experimental results from its application in a PULSAR generator which utilizes a 0.5 m diameter superconducting magnet. A larger generator under construction which utilizes a 1 m diameter magnet is briefly described and estimates of its performance are given. (Author)

A78-39955 Design of the energy storage system for the high energy gas laser facility at LASL. K. B. Riepe and M. J. Kircher (California, University, Los Alamos, N. Mex.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1053-1055.

The Antares laser is being built in the High Energy Gas Laser Facility (HEGLF) at Los Alamos to continue laser fusion experiments at very high power. The laser medium will be pumped by an electrical discharge, which requires an energy input of about 5 MJ in a few microseconds at about 500 kV. The energy storage system which will provide the pulsed power will be a bank of high-voltage pulse-forming networks. Tradeoff studies have been performed comparing the performance of multi-mesh networks with single-mesh networks. The single-mesh network requires about 20% more energy than a two-mesh network, but will tolerate three times the inductance of a two-mesh network. Analysis also shows that amplifier gain is not sensitive to impedance mismatch among the pulse-forming network, the transmission cables, and the gas discharge. A prototype pulse-forming network is being built to test components and trigger performance. It is a Marx generator storing 300 kJ at 1.2 MV open circuit, with 3 microhenrys internal inductance. (Author)

A78-39956 Argonne national laboratory energy storage and transfer experimental program. R. L. Kustom, R. B. Wehrle, R. P. Smith, and R. E. Fuja (Argonne National Laboratory, Argonne, Ill.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1056-1059. Research supported by the U.S. Department of Energy.

The inductor-converter bridge and the homopolar generator have been suggested to minimize the amount of energy required from a power grid during a fusion-reactor cycle. The inductor-converter bridge has the advantage of permitting the transfer of energy at a controlled and variable rate; a microprocessor may be adopted to perform the control function. The homopolar generator is especially suited to the cycling of the ohmic heating coil current of a fusion reactor. Testing of a 40 kJ, 2500-A, air-supported, aluminum-drum homopolar generator is reported. J.M.B.

A78-39957 Design of the ZT-40 power crowbar system. W. C. Nunnally and G. P. Boicourt (California, University, Los Alamos, N. Mex.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1061-1065. ERDA-sponsored research.

A power crowbar system for fusion reactor applications has been designed to establish a current greater than 10 million amps in two plasma-coupled inductance loads and maintain the currents with less than a 7% variation for 250 microsec. The design selected for testing is a series-type system with a low-leakage transformer and a high-density 10-kV paper-oil capacitor bank. Adaptation of the system to the requirements of a changing plasma load is also discussed. J.M.B.

A78-39959 Dual 30 kA, HVDC interrupter test facility. E. M. Honig (California, University, Los Alamos, N. Mex.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1071-1075. Research sponsored by the U.S. Department of Energy.

A dual dc interrupter or switch test facility capable of either 30-kA, 60-kV independent operation or 60-kA, 60-kV parallel operation has been developed. The facility permits variation of such parameters as recovery voltage, event timing, saturable reactance and repetition rate. Switch reliability and lifetime assessments for switches in series and parallel, axial field switches, and hybrid switches may be performed on the test facility. J.M.B.

A78-39961 Voltage protection scheme for MG sets used to drive inductive energy storage systems. G. L. Campen and R. B. Easter (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1079-1081. Research sponsored by the U.S. Department of Energy.

A voltage protection scheme has been designed for the motor-generator sets which drive the ohmic heating coil of a tokamak. A vacuum interrupter equipped with a commutating capacitor bank and an ignitron switch is adopted for each output terminal of the generators; the interrupters permit negligible energy drain from the load while completely disconnecting the generators on both sides. In addition, suppression of high-voltage transients during both normal and fault conditions in the generators is analyzed through use of a computer study. J.M.B.

A78-39964 A 40-kV, 26-ms neutral-beam power supply for TMX. G. A. Leavitt (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1093-1095. Contract No. W-7405-eng-48.

A 40-kV, 80-A, 25-ms neutral-beam power supply has been developed for the Tandem Mirror Experiment. Modifications to the accelerating voltage, suppressor, arc and filament power supplies are discussed. The problems of anode heating on the series-regulator tetrode and faulty firing of the two pulse lines used to obtain a 25-ms pulse also receive attention. J.M.B.

A78-39965 Design and test of a series switch/regulator system for a 40-kV, 80-A, 10-ms neutral-beam power supply. G. G. North (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1096-1099. 5 refs. Contract No. W-7405-eng-48.

A78-39969 TTMP heating studies on Petula Tokamak. R. Bardet, M. Bernard, G. Briffod, M. Clement, A. Gauthier, M. Gregoire, P. Grelot, M. Hesse, R. Legardeur, and F. Parlange (EURATOM and Commissariat à l'Energie Atomique, Département de Physique du Plasma et de la Fusion Contrôlée, Grenoble, France). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1121-1124. 5 refs.

Compressional transit time magnetic pumping has been tested as a heating technique in the Petula Tokamak. To obtain clean walls for the transit time magnetic pumping experiment, the metallic vacuum vessel was replaced by a vessel made of alumina. In a further modification, modulation in space and time was provided for the toroidal field by six meridian RF coils located outside the vacuum vessel. Positioning the coils outside the vessel eliminates undesirable side effects such as arcing or outgassing from the coils when the RF power is turned on. J.M.B.

A78-39971 Parametric study of plasma startup systems for tokamaks. H. F. Vogel (California, University, Los Alamos, N. Mex.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1129-1131. Research supported by the U.S. Department of Energy.

Plasma initiation from a poloidal coil set is discussed for inducing the startup voltage where no magnetic flux is generated in the plasma region. A mathematical expression is reported which states the current distribution necessary in a toroidal shell for the zero field condition inside. The combination of the startup coil in one physical unit with the vertical field coil is considered. A flux plot is discussed for the case that the coil set is mounted outside the toroidal field coils and iron used for reducing the magnetic field energy. (Author)

A78-39972 A lower hybrid heating system for an ignition tokamak. J. Brooks, S. Harkness, J. Jung, B. Misra, A. Moretti, J. Norem, and H. Stevens (Argonne National Laboratory, Argonne, Ill.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1132-1137. 7 refs. Research supported by the U.S. Department of Energy.

An investigation was conducted of suitable approaches for plasma heating by means of radio frequency (RF) power in the lower hybrid frequency range. The reasons for this investigation are related to the availability of power in this frequency range (1 to 5 GHz), the experimental success of the grill launching structure proposed and studied by Brambilla (1976) and Lallia et al. (1976), the overall simplicity and flexibility of the resulting system, and the general compatibility of this system with the high-radiation environment. It has been assumed for the purposes of the investigation that the Lower Hybrid Resonance Heating System would be the only supplementary heating system. The launcher for supplying 50 MW of supplemental heating consists of about 40 narrow-height WR-430 waveguides forming a rectangular array, 4 waveguides high and 10 waveguides wide. Attention is given to problems of system engineering, the choice of waveguide materials, the problems associated with shielding the vacuum windows from the plasma, and the cooling of waveguides. G.R.

A78-39974 The design philosophy and use of high voltage power systems for multimegawatt ion beam accelerators. G. C. Barber, A. Y. Broverman, R. E. Hill, C. M. Loring, N. S. Ponte, G. Schilling, and R. E. Wright (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1142-1146. Research sponsored by the U.S. Department of Energy.

A78-39975 The Princeton neutral injection power supply system. D. L. Ashcroft and H. E. Zuvers (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1147-1150. Contract No. EY-76-C-02-3073.

Four ion-source power supplies developed for the neutral injection system of the Princeton Large Torus are described. The power supplies attain accelerating voltages of 44 kV in operation; a twelve-pulse ignitron rectifier with precise regulation performed by a series tetrode provides this accelerating voltage. Adoption of variable autotransformers instead of saturable reactors to adjust ac voltage presented to arc and filament rectifiers is discussed. Problems related to the slow startup of the accelerating voltage supplies also receive attention. J.M.B.

A78-39976 The TFTR neutral beam power system. A. Deitz, H. Murray, and R. Winje (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1151-1155.

The neutral beam power system for the Tokamak Fusion Test Reactor is designed to operate three ion sources. The neutral beam power supply provides both high-voltage pulses (120 kV) and long pulse widths (0.5 sec). Conversion of ac power for the reactor to unregulated high-voltage dc power, gating and regulation of power delivered to the ion sources, and the supply of arc and filament power to the ion sources are discussed. The high-voltage switch tube used in the gating and regulation of output power delivered to the ion sources has presented special development problems because it is required to hold off voltages approaching 200 kV and pass currents of 70 A for long pulses. J.M.B.

A78-39977 Poloidal field coil design for a fusion-fission breeder reactor. H. R. Howland, J. L. Kelly, and J. W. H. Chi (Westinghouse Electric Corp., Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1156-1160. Research sponsored by the Electric Power Research Institute.

Magnetic, structural and thermal design parameters are presented for superconducting poloidal field coils of a fusion-fission (hybrid) reactor. Plasma heating and shaping requirements, as well as the constraints imposed by long pulse (75 sec) and high duty cycle (83.3%) operation are taken into account in developing the poloidal field coils. The electrical design of the ohmic heating coil set and the shaping field coil set (which provides part of the flux swing) is described. The mechanical design of the field coils involved electrical and thermal insulation for the coils, structural support for forces generated within the coils, and enclosures and supports for the cryogenic cooling system. J.M.B.

A78-39978 A high thermal efficiency X-ray energy conversion scheme for advanced fusion reactors. D. C. Quimby, R. T. Taussig (Mathematical Sciences Northwest, Inc., Bellevue, Wash.), and A. Hertzberg (Washington, University, Seattle, Wash.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1161-1165. 11 refs. Research supported by the Electric Power Research Institute.

A radiation energy conversion scheme capable of transforming the X-ray output of steady fusion reactors to electricity with a high degree of thermal efficiency is discussed. The radiation energy conversion technique is compatible with reactors utilizing advanced neutron-free fusion fuels which yield 50% or more of their output energy in the form of X-rays. In the energy conversion scheme, the X-rays heat a working fluid in a boiler; the energy is subsequently

exchanged to a conventional turbine generator. A peak working fluid temperature between 2000 and 3000 K could be attained with a number of gases. Development of an efficient energy exchanger with high temperature capability is also necessary. J.M.B.

A78-39982 A tokamak hybrid blanket design. V. L. Teofilo, B. R. Leonard, Jr., R. T. Perry, M. C. C. Bampton, M. A. McKinnon, C. H. Bloomster, and L. L. Fassbender (Battelle Pacific Northwest Laboratories, Richland, Wash.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1181-1184. ERDA-supported research.

A modular blanket assembly has been developed for the Tokamak Engineering Test Reactor, which is designed to yield a high neutron flux for engineering and materials testing. Type 316 stainless steel was selected for the helium-cooled modular blanket assembly components. Dimensional constraints on the blanket assembly derived from the poloidal field coils, divertor channels, and neutral beam ports of the fusion driver system. The blanket could provide for the generation of 780 MW of thermal power and 760 kg of plutonium per year. J.M.B.

A78-39983 Tritium handling trade studies and design options for the GA/ANL TNS. J. M. Mintz (General Atomic Co., San Diego, Calif.), R. G. Clemmer, and V. A. Maroni (Argonne National Laboratory, Argonne, Ill.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1185-1190. 5 refs. Contract No. EY-76-C-03-0167. ERDA Project 38.

A comprehensive effort involving members of both the General Atomic Company (GA) and the Argonne National Laboratory (ANL) has been undertaken to define the objectives, criteria and potential systems design solutions that accrue to the tritium handling systems for the next logical step in tokamak reactor development (TNS). A primary focus of these activities has been a systematic analysis of fuel cycle parameters and trade studies on the sensitivity of these parameters to reactor design and operating conditions. Principal results of these analyses and an assembly of potentially useful design concepts for various subsystems of the fuel cycle are presented.

(Author)

A78-39985 Bundle divertor designs for the ILB advanced fuel tokamaks. G. M. Swift and F. H. Southworth (Illinois University, Urbana, Ill.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1198-1202. 10 refs. Research supported by the Electric Power Research Institute.

A divertor creates a region of low-density plasma between the reactor wall and the main plasma body. The region is magnetically connected to the outside. The divertor-produced effects can be used to reduce the plasma bombardment of the wall and to ionize and remove neutrals from the wall before they reach the main plasma. Other functions of the divertor are related to the removal of fusion products, the recovery of fusion fuel, and a provision of thermal insulation for the main plasma. The reported investigation is mainly concerned with still another function which has been envisioned for a divertor. This function involves the connection of a tokamak to a direct collector. Both poloidal and toroidal divertors have been suggested for this function. It appears, however, that the bundle divertor in connection with its geometric configuration is particularly suited for this task. The bundle divertor can be positioned on the outside of the tokamak and attached easily to an expander which is terminated with a direct collector, possibly of the venetian blind type. G.R.

A78-39986 CODAS - The proposed control and data acquisition system for JET. F. Bombi, D. Ciscato, S. Congiu, P. Noff, and D. Zimmermann (Atomic Energy Research Establishment, Culham Laboratory, Abingdon, Oxon, England). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1203-1208. 5 refs.

CODAS, a computerized control and data acquisition system, is being developed for the JET experiment, a proposed large tokamak experiment being designed by European scientists and engineers. The present paper deals with the organization of the system and its subdivision in a number of subsystems, each of which is serviced by a minicomputer. Each machine subsystem includes all the equipment needed to provide independent operation. The poloidal field subsystem, for example, comprises coils, power supplies, switching network, power amplifiers, and cooling system. The plasma diagnostics available from the beginning of the experimental phase will be grouped in five diagnostic subsystems. Additional diagnostics will be applied during the experimental phase and connected to CODAS in the same way. The solution (based on the use of two computers) proposed for the computer communication system is discussed, and the expected performance figures are given. V.P.

A78-39991 Some design aspects of computer based control systems for pulsed fusion experiments. H. R. Whittle, K. Fullard, E. G. Murphy, and D. Richardson (EURATOM and U.K. Atomic Energy Authority Association for Fusion Research, Culham Laboratory, Abingdon, Oxon, England). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1223-1227. 7 refs.

A78-40006 An apparatus to examine pulsed parallel field losses in large conductors. J. R. Miller and S. S. Shen (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1297-1300. Research sponsored by the U.S. Department of Energy.

In the case of most superconducting magnet applications, it has been sufficient to decouple the superconducting filaments from pulsed transverse fields. However, for conductors in toroidal field (TF) coils of tokamak machines losses due to transient field components parallel to the winding could also become very important. Measurements of such losses in small conductors have been carried out by Shen and Miller (1976) and Miller and Shen (1977). The reported investigation is concerned with an extension of these measurements to fairly large models of proposed TF coil conductors or elements of the full size conductors. Attention is given to the magnetic field environment of a tokamak, a conductor for the pulsed torus winding, the components of the toroidal coil form assembly, the slow ramp hysteresis loss, and the eddy current loss during fast discharge. G.R.

A78-40007 Time dependent study of eddy current loss in a superconducting composite. W. Y. Chen, W. E. Toffolo, and J. R. Purcell (General Atomic Co., San Diego, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1301-1304. 7 refs. Contract No. EY-76-C-03-0167.

A numerical technique which has been developed by Chen et al. (1977) to study the eddy current loss for the special case of a wide flat conductor is extended to cases involving a more conventional conductor. Calculations are conducted, taking into account the effective resistivity and a sinusoidal external field with no transport current in the conductor. To study a situation more resembling the operating condition in the tokamak toroidal field coils, a finite

duration ramp external field with a transport current flowing in the conductor is considered. The eddy current loss is computed for different values of the transport current. Saturation patterns in the conductor cross section for three values of transport current at different instants of time are shown in a graph. Another graph shows the eddy current power as a function of time for different values of transport current in the conductor. G.R.

A78-40008 Losses in a coil where the multifilamentary composite is subjected to simultaneous orthogonal and parallel induction variations. A. Fevrier and J. J. Peninou (Compagnie Générale d'Electricité, Marcoussis, Essonne, France). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1305-1309. 8 refs. Research supported by the Délégation Générale à la Recherche Scientifique et Technique.

The paper deals with measured and computed losses in a 'S-T coil', where the conductor that carries a time-dependent current experiences simultaneous orthogonal and parallel induction variations. The S-T coil consists of an inner solenoid of square cross section and a toroidal coil about the solenoid. The losses per cycle are plotted against the rate of transport-current variation. With respect to the experiment, the calculated values are accurate to within 10 percent. V.P.

A78-40009 Fast ramp superconductor for ohmic heating coils. M. S. Walker, B. A. Zeitlin (Intermagetics General Corp., Gunderland, N.Y.), and R. E. Schwall (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1310-1314. 11 refs. Research sponsored by the U.S. Department of Energy.

An investigation was conducted concerning practical 10,000 ampere conductor designs to meet the operating constraints for the ohmic heating coils of TNS ('The Next Step') and experimental tokamak reactors. It is pointed out that the conductor must simultaneously meet the requirements for mechanical support, cryostabilization, high overall winding current density, low mechanical and electrical losses, and mechanical and electrical integrity for cyclic pulsed operation from -7 T to +7 T in one second. A hybrid multilayer stacking of pancake-wound coils is considered as the preferred coil design. The ohmic heating coil consists of a fiberglass and epoxy central column, which is surrounded successively by thinner concentric epoxy-fiberglass shells. The recommended conductor is a flat braid. An approximately 10 micrometer diameter filament is suggested for the superconductor strands. To reduce coupling losses and retain an adequate intrastrand heat transfer capability, it is suggested that these filaments be placed in a mixed-matrix configuration incorporating comparable amounts of copper and NbTi in copper-clad filaments within a copper-10% nickel resistive matrix. G.R.

A78-40010 Superconducting energy storage coils. M. A. Janocko, J. H. Murphy, P. W. Eckels, D. C. Litz, and C. J. Heyne (Westinghouse Research and Development Center, Pittsburgh, Pa.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1315-1321. 37 refs. Research sponsored by the U.S. Department of Energy.

Design of a 300- and a 400-kJ rapidly pulsed, superconducting energy-storage coil is discussed. Elements of the conductor selection program include consideration of the conductor support structure, the degree of compaction, the type of electrical transposition, the stabilization requirements, the cooling method, and the electrical insulation. Particular attention is given to the influence of ac losses on the temperature profile within a superconducting winding, and to the effects of magnetic field and temperature on conductor

performance. The 400-kJ conductor design employs a multicomponent matrix of smaller diameter than the copper matrix of the 300-kJ conductor; adoption of the multicomponent matrix reduces per-cycle ac losses by a factor of three. J.M.B.

A78-40013 Magnetics design for ripple-assisted beam injection into the ISX-B and TFTR tokamaks. R. J. Goldston, D. L. Jassby, H. H. Townner (Princeton University, Princeton, N.J.), R. H. Fowler, J. F. Lyon, J. A. Rome (Oak Ridge National Laboratory, Oak Ridge, Tenn.), and T. Brown (Grumman Aerospace Corp., Bethpage, N.Y.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1333-1338. 11 refs. Research supported by U.S. Department of Energy.

A test of ripple-assisted neutral-beam injection will be performed on the ISX-B device in 1978-79, using a low-power beam with a beam energy of about 10 to 20 keV, and possibly also on the TFTR device around 1982 with a high-power 80-keV beam. In both cases, the optimal coil configuration for establishing the required vertically asymmetric toroidal-field (TF) ripple consists of a pair of trapezoidal current loops located between the TF coils and the vacuum vessel, and bracketing the vertically injected beam. This report describes the design of the ripple coils for ISX-B, the ripple contours in the elliptical ISX-B and circular TFTR plasmas, and the objectives and parameters of the ISX-B experiment. The formation of magnetic islands in the plasma is examined for an arbitrary number of ripple-injection locations. (Author)

A78-40014 Pulsed acceleration of exhaust plasma in a fusion-MHD power plant. K. Denno (New Jersey Institute of Technology, Newark, N.J.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1339-1342. 10 refs. Research supported by the New Jersey Institute of Technology.

Modification of the poloidal field divertor system of the Princeton Reference Design Model of a fusion power plant could render it serviceable as an accelerator-induction generator channel. In particular, the modification involves placing an accelerating dc field on the inward part of the divertor exhaust chamber and an ac exciting field on the outward part. The resultant MHD-induction generator would also add to the effective confinement of the separatrix surface. J.M.B.

A78-40019 Magnetic field computations for ISX using GFUN-3D. W. D. Cain (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1362-1366. Research sponsored by the U.S. Department of Energy.

Magnetic fields generated by an iron-core tokamak which uses rectangular water-cooled copper toroidal field coils are analyzed through adoption of a three-dimensional computer program. The three-dimensional computer program is capable of treating magnetic fields for conductors and nonlinear (variable permeability) magnetic materials. Various sizes and numbers of iron elements are employed for the iron yoke model; an intuitive understanding of the magnetization-vector behavior proves helpful in developing the magnetic field analyses. J.M.B.

A78-40026 Using computer graphics to analyze the placement of neutral-beam injectors for the Mirror Fusion Test Facility. J. A. Horvath (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2.

Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1400-1404. Contract No. W-7405-eng-48.

A78-40027 Performance of a developmental 120-keV, 10-A deuterium /14-A hydrogen/ neutral beam system. K. H. Berkner, W. S. Cooper, K. W. Ehlers, and R. V. Pyle (California, University, Berkeley, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1405-1407. 9 refs. Research sponsored by the U.S. Department of Energy.

A description is presented of the operation of a 120-kV, 0.5-sec injector module which, from an 8- x 10-cm accelerator-grid array, produces 14 A of hydrogen ions or 10 A of deuterium ions. This module was used to test the design concepts of the 10- x 40-cm, 120-kV, 65-A, 0.5-sec Tokamak Fusion Test Reactor (TFTR) which is currently under test. A cross-section of the injector module is shown in a graph. The ions are produced in a high-current low-voltage discharge with no externally applied magnetic field. A four-grid multiple-slot accelerator array is used. Ions are accelerated and electrostatically focused in the first two gaps. The third gap has a weak decelerating field to suppress down-stream electrons. Attention is given to calculated beam trajectories and equipotentials for a 120-kV accelerator, a typical beam-pulse sequence, and aspects of device performance. G.R.

A78-40032 Thermal-mechanical design of a 150-mA, direct-current, 400-keV accelerator for production of 14-MeV neutrons. C. L. Hanson (California, University, Livermore, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1431-1434. Contract No. W-7405-eng-48.

A78-40040 Mechanical and thermal design of a gas-cooled fusion blanket module. D. W. Kearney, D. W. Culver, J. A. Dalessandro, S. N. Rosenwasser, D. L. Vrible, and C. Wong (General Atomic Co., San Diego, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1483-1489. 8 refs. Contract No. EY-76-C-03-0167. ERDA Project 38.

A modular fusion blanket design is presented which utilizes an Inconel 718 structure, helium-cooling, and solid lithium compounds for breeding tritium. The mechanical features were chosen to minimize remote maintenance operations and to satisfy recognized design criteria. Quasi-equilibrium and transient thermal analysis results are presented to show the effectiveness of helium cooling over a range of wall loads. The extent and nature of coolant and first wall thermal fluctuations are examined from the viewpoint of steam generator, steam turbine, and first wall lifetimes. The concept is shown to be feasible on the basis of present considerations. (Author)

A78-40041 Blanket structure design for JAERI Experimental Fusion Reactor. K. Sako (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan) and A. Minato. In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1490-1494.

The design of the 200-ton blanket structure developed for the 100-MW Japan Atomic Energy Research Institute Experimental Fusion Reactor is described. Eight blanket modules, each consisting of 284 blanket vessels and a 1.2-m diameter aperture for neutral beam injection and evacuation, comprise the blanket structure. Stress analysis of a blanket vessel, an elastic analysis of a blanket vessel under internal pressure, and a study of temperature effects on the blanket structure are reported. Use of a protective wall to limit the temperature effects and the thermal stress expected during accidental plasma bursts are also investigated. J.M.B.

A78-40047 Dielectric breakdown of liquid and vapor helium in bulk and across epoxy insulation. K. F. Hwang and S. O. Hong (Wisconsin, University, Madison, Wis.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1531-1534. 10 refs. ERDA-supported research.

The dielectric strength of vapor and liquid He-4 under highly inhomogeneous fields is measured at 1.8 K and 4.2 K in saturated vapor pressure. The results show a strong polarity effect for both liquid and vapor helium. Paschen's law can be used to explain the vapor strength. In addition, the dielectric strength of epoxy-fiberglass in helium is measured. Preliminary results are presented. (Author)

A78-40049 Facility for the testing of the TFTR prototype neutral beam injector. J. M. Haughian (California, University, Berkeley, Calif.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1540-1544. 5 refs.

A description is presented of some of the features of the facility where the prototype neutral beam injection system for the Tokamak Fusion Test Reactor will be assembled and tested. The available working space at the facility is large enough to stage, assemble, and operate both a neutral beamline and the ion source's high-voltage power supply. The shielding enclosure for the neutral beamline is considered along with the control-computer area, the high voltage power supply areas, the cryogenic supply system for the cryopanel, the auxiliary vacuum system, and the utilities supply. The thickness of the concrete walls and roof of the shielding enclosure were determined by calculating the radiation flux that would come from the calorimeter in the injector vessel and the beamdump in the target chamber. G.R.

A78-40052 A computer program for parameter studies of a neutral injection beam line. J.-H. Feist (Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1554-1557. 6 refs.

Neutral injection heating experiments in the W 7a stellerator and in the ASDEX tokamak are studied by computer analysis, with attention to the influence of neutral beam line on the neutral power arriving at the plasma surface. Parameters influencing the available neutral power include: beam energy, ion current and species composition, ion source pressure, beam line geometry, pumping speeds, desorption of gas by fast particles, and beaming effects of the gas flow. An iterative solution for a system of nonlinear equations is solved to account for steady-state conditions. The performance of the ASDEX neutral line injectors is evaluated as an illustration of the analysis. D.M.W.

A78-40064 PLT OH system operation. E. H. Lefkowitz (Princeton University, Princeton, N.J.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1601-1604. Contract No. EY-76-C-02-3073.

The purpose of the ohmic heating (OH) system is to provide energy to a small amount of gas within the machine in order to complete ionization and establish a circulating current in the plasma which produces heating and a poloidal component of the confining field. A circuit diagram with the basic elements of the PLT OH system is presented. The rectifier is a unique twelve pulse design which can supply 22,000 A at about 1100 V for several seconds, and then has the capability of interrupting this current and withstanding a 20 kV maximum surge voltage. Attention is given to details of operational timing, the rectifier mode of operation, problems of system protection, the OH-dc system, the noise characteristics, control problems, and approaches for the enhancement of the reliability of ignitron operation. G.R.

A78-40065

A comparison between an air core and an iron core Ohmic Heating system for The Next Step. J. K. Ballou (Oak Ridge National Laboratory, Oak Ridge, Tenn.) and J. H. Schultz (Westinghouse Electric Corp., Pittsburgh, Pa.). In: *Symposium on Engineering Problems of Fusion Research*, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1605-1607. Research sponsored by the U.S. Department of Energy.

The reported investigation has the objective to compare the costs of the major components of an air core and iron core Ohmic Heating (OH) system. The comparison is conducted by replacing the air core OH magnets with a set of magnets operating with an iron core. The air core and iron core systems are required to supply the same volt-seconds on the same schedule, and both systems will use the same equilibrium field coil system. The comparison is not between two optimized systems but between two systems which differ only in the type of OH system they use. The comparison is made on the basis of the peak power required in the OH power supply circuits necessary for initiation of the plasma and on the basis of the peak stored magnetic energy. It is found that the peak power requirements can be substantially reduced by the use of an iron core to power levels handled by industry today. The cost of the power conversion system is expected to be less than that of an air core system (dual rectifier and dc switch). G.R.

A78-40072

Structural analysis of a two-component torus /TCT/ hybrid reactor first wall. M. C. C. Bampton and R. A. McCann (Battelle Pacific Northwest Laboratories, Richland, Wash.). In: *Symposium on Engineering Problems of Fusion Research*, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1637-1641. 10 refs. ERDA-sponsored research.

An analysis was conducted of the first wall of a tokamak fusion-fission reactor. Coolant line penetration problems were reduced by making the first wall a vacuum barrier. The first consideration in establishing the wall dimensions was the general stability of the surface under atmospheric pressure. A double wall held together by regularly spaced poloidal webs was selected and a logical system for coolant control was derived. A full toroidal model was used to evaluate the general stability characteristics of the shell. To arrive at localized stress levels, a simplified model was derived using the assumption that the major radius was infinite. A computer model was formulated to analyze the local stability of the shell inner wall between stiffeners. The analysis shows that the two wall concept for the class of thermal reactor under consideration will undoubtedly contain manufacturing complexities. The concept has, however, in compensation for these complexities aspects of considerable durability. G.R.

A78-40074

Tritium removal from liquid metals by sorption on yttrium. S. D. Clinton and J. S. Watson (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: *Symposium on Engineering Problems of Fusion Research*, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J.,

Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1647-1649. Research sponsored by the U.S. Department of Energy.

A technique is described for the recovery of tritium from liquid lithium or potassium by sorption onto a hydrogen-gettering material, i.e., yttrium. Tests conducted in a batch contactor at 300 and 400 C using metal sorbent samples of yttrium and zirconium are analyzed in terms of mass transfer rate at contact times of less than 30 minutes. It is found that tritium sorption rates from lithium (833 plus or minus 54 ppb) were substantially higher than those obtained with potassium. A mass transfer coefficient of 6×10^{-4} cm/sec was observed, with the ratio of yttrium surface area to lithium volume of 0.82 plus or minus 0.02 per cm. The estimated accumulation of tritium in the yttrium is recorded at 0.78 Ci, and the tritium recovered after dissolution of the yttrium sample is given as 0.90 Ci (27 ppm). It is noted that the mass transfer rate can be increased with forced convection. D.M.W.

A78-40075

TFTR tritium valve for pulsed gas feed, test results. J. W. Rockensies, B. Sue (Grumman Aerospace Corp., Bethpage, N.Y.), and R. Walls (Princeton University, Princeton, N.J.). In: *Symposium on Engineering Problems of Fusion Research*, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1650-1652. Contract No. E(11-1)-3073.

This paper presents the results of a test program currently being conducted at the PPPL (Princeton Plasma Physics Lab) to evaluate the design of an engineering-model valve to be used for controlling pulsed-feed tritium injection scenarios into the TFTR (tokamak) torus. The test program is designed to characterize the performance of the valve and determine throughput modulation and repeatability. Testing is being performed primarily with helium gas, but the capability to test with argon, deuterium, and hydrogen gases is available in order to provide an adequate data base to extrapolate to the tritium case. The TFTR proposed tritium feed system line configurations have also been simulated to evaluate dynamic effects of the pulsed feed. (Author)

A78-40081

Plasma engineering problems associated with superthermal fusion products. G. H. Miley, T. Petrie, P. R. Meka, L. Hively, and M. Wang (Illinois University, Urbana, Ill.). In: *Symposium on Engineering Problems of Fusion Research*, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1673-1677. 14 refs. Research supported by the U.S. Department of Energy.

In the present paper, the effects which might result from high-energy fusion products in reactor development are analyzed with particular reference to plasma heating, rotation, impurity buildup, first wall bombardment, and anomalous effects of possible induced instabilities. The analysis is based on computations of alpha-particle transport in tokamak systems. A wall detector experiment is proposed which would help to gain insight into the phenomena discussed. With energy discrimination, both the escape profile of first-orbit losses and any anomalous lower energy escape (instabilities) could be varied by this experiment. The wall detector observations could be complemented by additional measurements of induced fields, rotation, etc. to provide a better understanding of the physics of fusing plasma. V.P.

A78-40083

Ignition of catalyzed-D reactor from D-T burning. A. Iiyoshi, O. Motojima, and M. Ohnishi (Kyoto University, Uji, Japan). In: *Symposium on Engineering Problems of Fusion Research*, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1683-1687. 10 refs.

The dynamics of the transition from the D-T-burning mode to the catalyzed-deuterium (Cat-D) operating mode in a toroidal reactor is investigated. The thermal stability and transition dynamics in a

reactor containing an arbitrary D-T mixture (including Cat-D) are also analyzed, and ignition conditions for Cat-D, pure D-T, and an arbitrary D-T mixture are examined. A numerical analysis is performed which shows that the Cat-D operating mode can be achieved in roughly 300 sec by controlling the fuel injection rate and mixture. The required transition time is found to be restricted mainly by the time needed to reduce the tritium concentration to the level of the Cat-D mode that suppresses the temperature excursion. It is concluded that additional heating would not aid in reducing the transition time and that feedback control to maintain steady operation is one of the most important tasks for the Cat-D reactor since the plasma is always unstable with respect to density and temperature deviations. F.G.M.

A78-40093 High temperature blankets for the production of synthetic fuels. J. R. Powell, M. Steinberg, J. Fillo, and H. Makowitz (Brookhaven National Laboratory, Upton, N.Y.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1732-1735. 11 refs. Research sponsored by the U.S. Department of Energy.

The application of very high-temperature blankets to improved efficiency of electric power generation and production of H₂ and H₂-based synthetic fuels is described. The blanket modules have a low-temperature (300-400 C) structure (SS, V, Al, etc.) which serves as the vacuum/coolant pressure boundary, and a hot (exceeding 1000 C) thermally insulated interior. Approximately 50-70% of the fusion energy is deposited in the hot interior because of deep penetration by high-energy neutrons. Separate coolant circuits are used for the two temperature zones: water for the low-temperature structure and steam or He for the hot interior. Electric generation efficiencies of about 60% and H₂ production efficiencies of approximately 50-70%, depending on design, are projected for fusion reactors using these high-temperature blankets. (Author)

A78-40095 Mechanical design and analysis for a EPR first wall/blanket/shield system. H. C. Stevens, B. Misra, and C. K. Youngdahl (Argonne National Laboratory, Argonne, Ill.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1741-1748. Research supported by the U.S. Department of Energy.

Reducing costs, improving thermal efficiency and facilitating maintenance are among the goals in the development of an advanced first wall/blanket/shield and power conversion system for a tokamak-type Experimental Power Reactor. Features of the first wall/blanket design include a small number of components and few coolant connectors, high thermal plant efficiency through use of superheater blocks, ease of testing for the superheater modules, and measures to deal with eddy current effects. A simple stress analysis to evaluate cooling channel design, as well as more detailed stress analyses for the final blanket configuration, are mentioned. The shield has an inner block of B4C-stainless steel and a less expensive outer block of stainless steel-graphite-boron-lead mortar-aluminum. J.M.B.

A78-40096 A metallic contact, fast-closing, high current switch. P. Wildi and J. Gully (Texas University, Austin, Tex.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1749-1752.

A metallic-contact switch capable of carrying about 2 million amps with a rise time on the order of 2.9 times 10 to the ninth power amps/sec has been developed for the fast-discharge experiment of a controlled thermonuclear research program. The switch involves use of electromagnetic repulsion to drive a movable contact which, when in place, bridges two stationary electrodes. A very small internal resistance and minimal inductance characterize the closed switch. J.M.B.

A78-40099 High energy density, long life energy storage capacitor dielectric system. D. H. Nichols and S. R. Wilson (General Electric Co., Capacitor Products Dept., Hudson Falls, N.Y.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1760-1763.

Energy storage dielectric systems are discussed with reference to their development. Early designs including castor oil-paper systems and filter capacitors using a polypropylene-paper-phthalate ester based liquid are noted. Major failure mechanisms are identified as: localized heating caused by low insulation resistance, long-time electrification 'wear-out', dielectric breakdown caused by pad over-stressing, corona damage due to operating the system above corona inception voltage during the discharge regime, and defects in materials and manufacture. S.C.S.

A78-40108 Design and performance of large cryopumps for high power neutral injectors. J. R. Coupland, D. P. Hammond, and E. Thompson (EURATOM and U.K. Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1796-1800. 7 refs.

A78-40112 Cryosorption pumping of 95% deuterium-5% helium on molecular sieve-5A at 4.2 K. P. W. Fisher and J. S. Watson (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: Symposium on Engineering Problems of Fusion Research, 7th, Knoxville, Tenn., October 25-28, 1977, Proceedings. Volume 2. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1977, p. 1816-1819. 5 refs. Research sponsored by the U.S. Department of Energy.

Cryosorption pumping of a 95% deuterium-5% helium mixture has been studied in order to determine whether hydrogen isotopes and helium can be pumped by a single cryosorptive panel during fusion reactor plasma recovery. The cryosorption pump used here contains a molecular sieve adsorption panel cooled by liquid helium. Results of the investigation indicate that relatively stable pumping speeds may be obtained for operational pressures below about 5 times 10 to the minus fifth power torr. If stable operation at higher pressures cannot be effected through improvements in the adsorbent or modifications in the panel temperature, a compound pump option may be preferable to the single cryosorption panel. J.M.B.

A78-40221 The OMEGA fusion laser system. J. Hoose (Rochester University, Rochester, N.Y.). In: Systems integration and optical design II - Another look; Proceedings of the Seminar, Reston, Va., April 18-21, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p. 22-28.

The article describes the 30-terawatt, neodymium glass laser irradiation facility called OMEGA, used for fusion experiments. General system objectives are given in terms of characteristics and requirements (including energy over 6 KJ at 200 ps FWHM, variable pulse shape, 1.054-micron wavelength, 15-20 cm beam aperture, and 24 beams in spherical geometry). A schematic design of the operational interactions between the laser and target data base, the sponsors, and the users is presented along with a design plan of the entire laser system. A review is made of the functions of each of the subsystems which include the laser, alignment, control room and computer, target, facilities, and structures. S.C.S.

A78-40222 An automatic alignment system for a multi-beam laser system. A. L. Levine and G. Stadlander (Raytheon Co., Missile Systems Div., Bedford, Mass.). In: Systems integration and optical design II - Another look; Proceedings of the Seminar, Reston, Va., April 18-21, 1977. Bellingham, Wash.,

Society of Photo-Optical Instrumentation Engineers, 1977, p. 29-36.

Attention is given to the Optical Adjustment and Control Subsystem (OACS) used to align a multibeam laser system. The OACS baseline system consists of an amplifier and preamplifier, driver line, beam splitter array, 24 beam lines, end, injection, and turning mirrors, and a focusing lens. The system may be used for a variety of operations including: (1) alignment of master and test oscillators, (2) beam centering through the driver line, (3) driver-line alignment, (4) beam-line test-oscillator alignment, (5) beam-line centering to the mid-line sensor, (6) beam-line centering to the end mirror sensor, (7) beam-line centering to turning mirror sensor, (8) beam-line focusing on target, and (9) timing adjustment for each beam line. It is noted that the system requirements are pointing to plus or minus 5 ps at the target, focusing at plus or minus 5 microns at the target, centering at plus or minus 1 mm at each aperture, and timing at plus or minus 5 ps at the target. S.C.S.

A78-40223 Practical interferometry at 1.06 microns. J. L. McLaughlin (Itek Corp., Optical Systems Div., Lexington, Mass.). In: Systems integration and optical design II - Another look; Proceedings of the Seminar, Reston, Va., April 18-21, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p. 37-40.

The paper describes the Laser Unequal Path Interferometer designed for testing high-energy laser focusing lenses at 1.06 microns. The advantages of this configuration over equal-path interferometry are noted. Particular attention is given to the (1) refractive beam expander, (2) beam splitter, (3) swing-down reference flat, (4) diverger mounted on an X-Y-Z mount, and (5) projection lens. S.C.S.

A78-40224 Focusing systems for high energy glass lasers. S. Kumpan (Rochester, University, Rochester, N.Y.). In: Systems integration and optical design II - Another look; Proceedings of the Seminar, Reston, Va., April 18-21, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p. 41-47.

The focusing system designed for the Omega-Ten 30-TW glass laser system developed for fusion experiments is described. The baseline configuration consists of 24 four-element f/1.6 lenses in a symmetrical 4-8-8-4 configuration. Numerical models of the irradiation uniformly at the target surface for single- and multiple-lens systems are noted along with the lens design specifications including the prediction of ghost-images which may be formed within the lens elements. The mechanical design of the focusing system is outlined with reference to the support structure and the lens mount. S.C.S.

A78-40225 Diffraction analysis for multiple-beam pellet irradiance. J. M. Vanderhoff (Itek Corp., Optical Systems Div., Lexington, Mass.). In: Systems integration and optical design II - Another look; Proceedings of the Seminar, Reston, Va., April 18-21, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p. 48-56. 5 refs.

An analytical technique has been developed for the diffraction analysis of multiple-beam pellet irradiance. On the basis of geometrical optics, a diffraction-based point-spread function is used to determine single-beam irradiance profiles on spherical pellet surfaces. The function accounts for pellet absorption factors, measured wavefronts, apodization functions, and classical errors. The diffraction integral is written in polar coordinates so as to minimize boundary fitting errors in the numerical integration. On the basis of the single-beam analysis, computer codes are developed to determine multiple-beam irradiance contours on spherical pellet surfaces. A multiple point-spread function specifies the irradiance profiles for varying degrees of pointing error. Tolerance values may be found on the basis of the rms irradiance quality factor. S.C.S.

A78-40226 The Shiva laser - Nearing completion. J. A. Glaze and R. O. Godwin (California, University, Livermore, Calif.). In: Systems integration and optical design II - Another look; Proceedings of the Seminar, Reston, Va., April 18-21, 1977.

Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p. 57-66. 11 refs. Contract No. W-7405-eng-48.

Construction of the Shiva laser system is nearing completion. This laser will be operating in the fall of 1977 and will produce over 20 terawatts of focusable power in a subnanosecond pulse. Fusion experiments will begin early in 1978. It is anticipated that thermonuclear energy release equal to one percent that of the incident light energy will be achieved with submillimeter deuterium-tritium targets. From other experiments densities in excess of a thousand times that of liquid are also expected. (Author)

A78-40241 Applications of submillimeter waves in plasma physics and controlled fusion research. N. C. Luhmann, Jr. and A. Semet (California, University, Los Angeles, Calif.). In: Far infrared/submillimeter wave: Technology/applications; Proceedings of the Seminar, Reston, Va., April 18-21, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1977, p. 52-65. 5 refs. NSF Grant No. Eng-75-14452; Contract No. E(11-1)-GEN-10-PA-26.

The paper reviews the use of far-infrared laser and detection systems for the measurement of plasma parameters. Attention is given to such techniques as interferometry, synchrotron radiation measurements, the Thomson-scattering determination of ion temperature in fusion plasmas, the holographic imaging of plasmas, and FIR studies of nonlinear plasma parameters. It is noted that FIR systems have great potential for plasma diagnostics and nonlinear plasma wave experiments, but that many of these applications require significant advances over present FIR technology. B.J.

A78-40267 Microchannel plate response to hard X-rays. K. W. Dolan (Sandia Laboratories, Livermore, Calif.) and J. Chang (Sandia Laboratories, Albuquerque, N. Mex.). In: X-ray imaging; Proceedings of the Seminar, Reston, Va., April 18-21, 1977. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, p. 178-188. 7 refs. ERDA-supported research.

Measurements are presented for the current response and pulse response of a microchannel plate to hard X-rays incident at a 45-degree angle and in the 8-100 keV energy range. The data are used to determine X-ray detection efficiency, pulse height distributions, and the sensitive depth of the microchannel plate. The results indicate that: (1) current response is directly proportional to the gain at a given bias voltage, (2) efficiency does not depend on gain or bias voltage, (3) efficiency extrapolates to zero below 8 keV, (4) the efficiency in the 10-600 keV range is relatively constant, (5) pulse height distributions are proportional to pulse height to the -1.1 to -1.6 power, and (6) 90% of the current is produced in the initial 25-30% of the microchannel plate thickness. S.C.S.

A78-40301 Recent advances in engineering science; Proceedings of the Fourteenth Annual Meeting, Lehigh University, Bethlehem, Pa., November 14-16, 1977. Meeting sponsored by the Society of Engineering Science. Edited by G. C. Sih (Lehigh University, Bethlehem, Pa.). Bethlehem, Pa., Lehigh University, 1977. 1360 p. \$40.

Recent theoretical and experimental progress in penetration mechanics, elastodynamics, polymer science, composites and laminates, fatigue crack propagation, heat transfer, turbulent flow, nonlocal continuum mechanics, viscoelasticity, numerical methods, machinery noise, and wind and solar energy is documented. Individual studies include adhesive fracture in mixed-mode loading, crack stability in epoxy-bonded aluminum components, forced convection over nonisothermal surface by means of universal functions, structural model of the turbulent boundary layer, periodic fluid transients in MHD duct flows, symmetry groups in finite elasticity, statistical finite element analysis for composite materials, and vortex augmented wind energy conversion. P.T.H.

A78-40361 Vortex augmented wind energy conversion. P. M. Sforza (New York, Polytechnic Institute, Brooklyn, N.Y.). In: Recent advances in engineering science; Proceedings of the Fourteenth Annual Meeting, Bethlehem, Pa., November 14-16, 1977. Bethlehem, Pa., Lehigh University, 1977, p. 1233-1236. 8 refs. Research supported by the Polytechnic Institute of New York; Contract No. E(49-18)-2358.

It is pointed out that under certain predictable conditions vortices appear in a flowing fluid. An investigation is conducted regarding the utilization of the unusual aerodynamic characteristics of vortices for the development of improved wind energy conversion systems. Key factors for such a development are related to the generation and control of discrete vortices of high power density by appropriate interaction of aerodynamic surfaces with natural winds of relatively low power density. Suitably designed turbines are used to extract energy from this compacted vortex field. The considered idea is termed the Vortex Augmentor Concept (VAC). The vortex generating surface amplifies the wind speed within the vortex field in which the swirling flow tends to concentrate the low energy flux wind from a large upstream area into a high energy flux flow in a small (vortex) area. Attention is given to VAC wind tunnel studies, the construction of a rotor-test facility, and aspects of prototype development. G.R.

A78-40362 Electrofluid dynamic (EFD) wind driven generator research. J. E. Minardi and M. O. Lawson (Dayton, University, Dayton, Ohio). In: Recent advances in engineering science; Proceedings of the Fourteenth Annual Meeting, Bethlehem, Pa., November 14-16, 1977. Bethlehem, Pa., Lehigh University, 1977, p. 1237-1247. 10 refs. Contract No. E(11-1)-4130.

The theory of electrofluid dynamic (EFD) wind generators is based on an intimate combination of aerodynamic and electrical considerations. It has been shown by Minardi (1966) that a successful EFD generator must use colloid particles to achieve reasonable efficiencies. The basic equations of the theory constitute a combination of the relations of the ideal wind converter theory provided by Betz (1927) and the one-dimensional EFD theory developed by Lawson et al. (1961) for charged particles. The performance of the EFD wind generator as a function of mobility is shown in a graph. The performance characteristics for an EFD wind driven generator made of 1 ft tubes are also presented and attention is given to a computer study of suitable EFD wind generator configurations. G.R.

A78-40365 Experimental analysis of a straight bladed Darrieus wind turbine. P. G. Migliore, J. B. Fanucci, K. D. Kuhlke, and W. P. Wolfe (West Virginia University, Morgantown, W. Va.). In: Recent advances in engineering science; Proceedings of the Fourteenth Annual Meeting, Bethlehem, Pa., November 14-16, 1977. Bethlehem, Pa., Lehigh University, 1977, p. 1265-1269.

An experimental program for determining the aerodynamic characteristics of a straight bladed Darrieus wind turbine are described. Data presented show torque, power coefficients and zero lift drag coefficients. (Author)

A78-40366 Aerodynamic augmentation of wind turbines. R. A. Oman and J. T. Yen (Grumman Aerospace Corp., Bethpage, N.Y.). In: Recent advances in engineering science; Proceedings of the Fourteenth Annual Meeting, Bethlehem, Pa., November 14-16, 1977. Bethlehem, Pa., Lehigh University, 1977, p. 1271-1280. 11 refs. Contracts No. E(11-1)-2616; No. E(49-18)-2555.

In connection with the very low energy density of the wind and the dynamic problems associated with the use of the required large rotating elements, the employment of static surfaces as aerodynamic augmentors might become a decisive factor for a large-scale extension in the utilization of wind energy. The augmenting surfaces can reduce substantially the size and the dynamic loading of the large rotor blades necessary to produce large unit levels of power. The prospects of two augmentation concepts are investigated. In the

Diffuser Augmented Wind Turbine concept, the turbine is mounted at the inlet of a diverging shroud that recovers the kinetic energy in the turbine exhaust by converting it to a pressure rise. The Tornado Wind Turbine uses the low pressure at the core of a confined vortex to provide aerodynamic augmentation for a vertical axis turbine mounted in the floor of a large hollow tower in which the vortex is established. G.R.

A78-40367 Madaras Rotor Power Plant. D. H. Whitford, J. E. Minardi, F. L. Starner, and B. S. West (Dayton, University, Dayton, Ohio). In: Recent advances in engineering science; Proceedings of the Fourteenth Annual Meeting, Bethlehem, Pa., November 14-16, 1977. Bethlehem, Pa., Lehigh University, 1977, p. 1281-1290. Contract No. E(49-18)-2273.

The Madaras Rotor Power Plant project, investigated in the 1930 to 1934 time period, used 90-ft high by 22.2-ft diameter rotating, vertically-mounted cylinders to convert wind power to Magnus effect forces which propelled an endless train of cars around a closed track. Generators geared to the car axles produced electric power. An investigation has been conducted to modernize the design of and to evaluate the economic potential of a Madaras system at the present time. The investigation included a review of the major wind tunnel tests on rotating cylinders conducted since the mid 1920's and computer simulation studies of the system performance. It was found that the cylinder aerodynamic performance determined in a wind tunnel study fulfilled all expectations. Early 1934 cost estimates indicated that the Madaras system was economically competitive and the preliminary cost estimates based on the current work indicate that the Madaras system will be economical today. On the basis of an analysis it is concluded that the low-speed, high performance feature is the key to the promising potential of the Madaras concept. G.R.

A78-40368 The potential for geothermal and solar thermal power systems. J. H. Anderson (Sea Solar Power, Inc., York, Pa.). In: Recent advances in engineering science; Proceedings of the Fourteenth Annual Meeting, Bethlehem, Pa., November 14-16, 1977. Bethlehem, Pa., Lehigh University, 1977, p. 1297-1315. 17 refs.

An approximate evaluation of potential sources of energy in the world is made. It is concluded that geothermal power, and ocean thermal power have by far the greatest potential. A comparison of cooling requirements for various thermal power plants is made. The operating principles of vapor turbine geothermal and sea thermal power plants are discussed. Sea thermal power is concluded to be, by far, our largest potential source of future energy and provides many additional products, such as fresh water, food, fuels, fertilizer, and other chemicals. (Author)

A78-40369 New designs and applications of medium sized wind systems. D. E. Cromack and J. G. McGowan (Massachusetts, University, Amherst, Mass.). In: Recent advances in engineering science; Proceedings of the Fourteenth Annual Meeting, Bethlehem, Pa., November 14-16, 1977. Bethlehem, Pa., Lehigh University, 1977, p. 1317-1326. 8 refs.

This paper presents recent developments in and applications for medium sized (10 to 100 kW) wind driven systems. Applications discussed include residential, agricultural, and commercial heating as well as hybrid electrical-thermal energy generation. The status of currently available wind turbines is given, and on-going research on wind energy systems is summarized. (Author)

A78-40370 Solar heating and air conditioning for the southwestern United States. G. Darkazalli and T. J. Lawley (Texas, University, Arlington, Tex.). In: Recent advances in engineering science; Proceedings of the Fourteenth Annual Meeting, Bethlehem, Pa., November 14-16, 1977. Bethlehem, Pa., Lehigh University, 1977, p. 1327-1338.

This paper is a feasibility study of solar energy use for heating and cooling of residential dwellings in the southwest region of the United States. Performance results of solar heating and cooling systems are obtained from the experimental solar energy facilities at

the University of Texas campus at Arlington. The solar system consists of 42 concentrating solar collector panels with selective black chrome coating on copper absorber surfaces, a three ton Arkla absorption air conditioning unit, and three ton water to water two speed heat pump. (Author)

A78-40384 # Thermo-nuclear fusion study by glass laser 'Gekko II'. T. Sasaki, K. Tanaka, H. Azechi, T. Norimatsu, M. Suzuki, K. Aono, S. Oda, H. Hashizume, T. Kanabe, and T. Mochizuki (Osaka University, Osaka, Japan). *Osaka University, Technology Reports*, vol. 28, Mar. 1978, p. 169-183. 9 refs.

Two types of the experiments have been performed to investigate the energy transport and the implosion process as well as to obtain information on pellet design for laser fusion. The first is a physical simulation experiment of compression using multilayer thin film targets. The anomalous transmitted laser light was observed in the multilayer target of thin metal and polyethylene. The second is a spherical compression experiment of glass microballoon pellets pressurized by deuterium gas. Experiments of an exploding pusher type have been performed. The density scale length under the laser irradiation was estimated to be 1 or 2 microns. The optimum thickness of wall is used to obtain the maximum neutron yield.

(Author)

A78-40385 # Thermo-nuclear fusion plasma produced by CO₂ laser. H. Nishimura, H. Fujita, Y. Kawamura, N. Banjo, Y. Daido, Y. Yanase, T. Seki, K. Iba, M. Matoba, and S. Nakai (Osaka University, Osaka, Japan). *Osaka University, Technology Reports*, vol. 28, Mar. 1978, p. 185-192.

The coupling mechanism of CO₂ laser with plasma has been investigated. With respect to the laser power density, three different absorption regions are observed: the classical absorption, the parametric decay instability, and the resonant absorption. The resonant absorption is clearly testified by the spatial directivity of the scattered light due to the polarization of the light. In this power density region, total energy absorption coefficient is up to 80%.

(Author)

A78-40386 # Computer simulation on laser plasma compression. N. Kimura, T. Taguchi, K. Hosokawa, H. Takabe, K. Nishihara, and C. Yamanaka (Osaka University, Osaka, Japan). *Osaka University, Technology Reports*, vol. 28, Mar. 1978, p. 193-203. 6 refs.

The structure of implosion is studied on the basis of a one-dimensional Lagrangian hydrodynamic code which accounts for ion-electron energy exchange, classical electron thermal conductivity, bremsstrahlung loss, and classical absorption of laser light by inverse bremsstrahlung. The results of the simulation are compared to the theory of a stationary propagating deflagration wave, and good agreement is found. The dependence of compression efficiency on parameters including laser wavelength, incident laser intensity, and absorbed intensity is considered. It is found that hydrodynamic efficiency and shock speed are only functions of absorbed power.

S.C.S.

A78-40456 # The stationary regimes of open cycle MHD power units - A mathematical model. I. I. Cserveny, I. T. Dogaru, and L. J. Katona (ICPET, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série Electrotechnique et Energétique*, vol. 23, Apr.-June 1978, p. 285-299. 7 refs.

The paper presents a coherent mathematical model of the main nonconventional subassemblies of open cycle MHD power units. The model proposed for the MHD power unit can be easily split into models for the individual equipments. Real fluid properties are considered, including thermodynamical and transport properties of plasma taking into account the real variation of composition as function of static pressure and temperature. All possible stationary flow regimes are considered, including smooth transition from supersonic to subsonic flow velocities inside the conversion channel, or shock wave. (Author)

A78-40457 # Researches and experiments concerning the parameters influencing the application of the fluidized bed as burning technique of low-grade lignite. I. Nistor, I. Minea, L. Dragos, E. Sischin, M. Popa, G. Segă, and E. Damaceanu (ICPET, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série Electrotechnique et Energétique*, vol. 23, Apr.-June 1978, p. 301-310. 6 refs.

A78-40509 Large superconducting magnets - A key issue in commercialization of MHD. V. A. Ovcharenko (United Nations, Centre for Natural Resources, Energy and Transport, New York, N.Y.). *Cryogenics*, vol. 18, June 1978, p. 358-362. 12 refs.

Basic principles of the design and operation of large superconducting magnets in MHD generators are reviewed with reference to economic and environmental factors. It is noted that MHD plants are considerably more efficient than conventional plants in that they reject only one unit of heat per unit of generated electricity (thereby, also, reducing thermal pollution). Two types of MHD magnets are compared, saddle and race track, in terms of maximum channel field, dimensions, cold weight, and operational status. Attention is given to the U-25 pilot plant in the USSR, which is expected to produce 600 MW using magnetic field of 6 T inlet, and 3.5 T outlet. D.M.W.

A78-40531 Temperature dependence of flatband potentials at semiconductor-electrolyte interfaces. M. A. Butler and D. S. Ginley (Sandia Laboratories, Albuquerque, N. Mex.). *Nature*, vol. 273, June 15, 1978, p. 524, 525. 7 refs. Contract No. AT(29-1)-789.

Experiments concerning the effect of heat on solar energy conversion cells are described for single crystal TiO₂ electrodes cut perpendicular to the C-axis. The electrodes were reduced in a hydrogen atmosphere (700-800 C) and had bulk resistivities of 0.3 ohms/cm. The flatband potential was determined by measuring the photocurrent as a function of the potential, with the electrode illuminated with monochromatic light (3500 Å). The variation with temperature of the bandgap was measured, and found to decrease on the order of 0.01 eV between 20 and 90 C. The change in electron affinity is estimated at -0.005 eV. D.M.W.

A78-40534 Summary of 1977 geothermal drilling - Western United States. J. L. Smith, C. F. Iselhardt, and J. S. Matlick (Republic Geothermal, Inc., Santa Fe Springs, Calif.). *Geothermal Energy*, vol. 6, May 1978, p. 11-19.

A survey of geothermal drilling projects conducted in 1977 is presented. Geothermal field development in California is discussed with reference to the seven new wells in the Imperial Valley, the 32 wells drilled in the geyser region, and the Coso Hot Springs area. Drilling projects in Nevada, Idaho, Utah, and New Mexico are also reviewed. It is noted that in 1977 the primary concentration was on development drilling for new dry steam plants and flow testing to determine design characteristics for hot water resource power plants. S.C.S.

A78-40535 Geothermal energy resources map of the western United States. P. J. Grim (NOAA, National Geophysical and Solar Terrestrial Data Center, Boulder, Colo.). *Geothermal Energy*, vol. 6, May 1978, p. 37-43. 10 refs. ERDA-supported research.

A78-40592 Engineering development of a short residence time, coal hydropyrolysis process. M. I. Greene (Cities Service Research and Development Co., Cranbury, N.J.). (*American Chemical Society, Annual Meeting, Chicago, Ill., Aug. 28-Sept. 2, 1977.*) *Fuel Processing Technology*, vol. 1, June 1978, p. 169-185. 12 refs.

A process has been developed for the noncatalytic, vapor-phase, hydrogenation of carbonaceous feedstocks. The process is based upon the use of a short residence time hydrogenation procedure. The feedstocks considered include lignite, bituminous and subbituminous coals, oil shale, tar sands, and coal tars. A description is presented of investigations, involving the use of a bench-scale unit, which have been conducted to study suitable processing procedures for a North Dakota lignite. Attention is given to the experimental apparatus,

temperature and residence time measurements, aspects of coal preparation, material balance calculations, the mechanisms involved in the short residence time hydrolysis of coal, coal hydrogen reactions, the rate of conversion of rapid-rate carbon, aspects of coal drying, coal feeding, the reactor design, the multitube reactor concept, and the use of a molten metal heat exchanger system. G.R.

A78-40593 Economic evaluation of synthetic natural gas production by short residence time hydrolysis of coal. C. J. Ladelfa (Cities Service Co., Tulsa, Okla.) and M. I. Greene (Cities Service Research and Development Co., Cranbury, N.J.). *Fuel Processing Technology*, vol. 1, June 1978, p. 187-208. 6 refs. Research supported by the Cities Service Gas Co.

The considered process involves a 'slow' heating of coal to the incipient devolatilization temperature, a 'rapid' heating of coal from the incipient devolatilization temperature to hydrolysis temperature, and a use of the reactant, hydrogen, as the heat carrier. A turbulent fast-fluidized bed reactor is used. The product vapors are quenched in a process involving a total residence time of less than two seconds. After the completion of a design study concerning the implementation of the process, a multipart, bench-scale run plan was formulated to approximate the set of yield data postulated at the start of the design study. An overall process flow diagram for a conceptual plant producing pipeline gas and light aromatic liquid is presented. Attention is given to a new lignite drying process with coal moisture recovery, dense-phase coal feeding without lock hoppers, the development of a high throughput hydrolysis reactor, aspects of gas/liquor separation, gas purification, trim methanation, hydrogen recovery by cryogenic separation, and questions of thermal efficiency. G.R.

A78-40594 Combined gas chromatographic-mass spectrometric analyses of nitrogen bases in light oil from a coal liquefaction product. C. M. White, F. K. Schweighardt, and J. L. Shultz (U.S. Department of Energy, Pittsburgh Energy Research Center, Pittsburgh, Pa.). *Fuel Processing Technology*, vol. 1, June 1978, p. 209-215. 14 refs.

Nitrogen base components of light oil produced during the catalytic hydrodesulfurization of coal were isolated by precipitation with hydrogen chloride and analyzed by combined gas chromatography-mass spectrometry. Anilines and alkyl pyridines, 71 and 16 weight percent, respectively, were the major components. This is the first quantitative report of anilines and pyridines in materials produced by the hydrogenation of coal. Analytical techniques described provide a rapid and precise method for the analysis of pyridines and anilines. (Author)

A78-40595 Viscosity of coal-derived liquids. B. C. Bockrath, R. P. Noceti (U.S. Department of Energy, Pittsburgh Energy Research Center, Pittsburgh, Pa.), and R. B. LaCount (Waynesburg College, Waynesburg, Pa.). *Fuel Processing Technology*, vol. 1, June 1978, p. 217-226. 10 refs.

It is pointed out that viscosity is one of the important characteristics of interest in the case of liquid products derived from coal hydrogenation processes. An investigation is conducted concerning the quantitative relationships between viscosity and product composition. It is found that the natural logarithm of the viscosity ratio shows a linear dependence on the solution concentration within the examined range. This relationship provides a basis for the approximate estimation of the viscosities of liquids of varying asphaltene and toluene insolubles content. The toluene insolubles, on a weight basis, produce a viscosity about twice that found for the whole asphaltene fraction. The basic asphaltene subfraction has a greater effect on viscosity than either the acid-neutral subfraction or the whole asphaltene. G.R.

A78-40596 Non-catalytic hydrogenation of Australian coals. J. F. Cudmore (Australian Coal Industry Research Laboratories, Ltd., North Ryde, New South Wales, Australia). *Fuel Processing Technology*, vol. 1, June 1978, p. 227-241. 8 refs. Research supported by the National Coal Research Committee.

Thirteen Australian coals ranging from brown coals ($C = 67.11\%$ dry ash free (DAF)) to semi-anthracites ($C = 89.87\%$ DAF) were hydrogenated batchwise under prescribed conditions in a 4-liter stirred reactor using tetralin as vehicle. No catalysts were used. Conversion, and liquid product yield data for such coals and correlation of properties of the coals and characteristics of the hydrogenation products are described. (Author)

A78-40617 Lead-strontium alloys for battery grids. N. E. Bagshaw (Chloride Industrial Batteries, Ltd., Swinton, Manchester, England). *Journal of Power Sources*, vol. 2, May 1978, p. 337-350. 27 refs.

Lead-strontium alloys were studied with reference to their possible use in lead-acid battery grids. Hardness, tensile, creep, rapid anodic corrosion, and stress corrosion tests were performed, and castability and metallography were investigated. Alloys recommended for consideration are lead-0.1% strontium for standby batteries, lead-0.5% tin-0.1% strontium for automotive batteries, and lead-0.5% tin-0.01-0.25% silver-0.1% strontium for special motive power batteries if the cost could be afforded. A small addition of aluminum protected all alloys from loss of alloying constituents in the molten state by oxidation. The effects on alloy properties of various percentages of alloy constituents are reported. M.L.

A78-40618 Investigation of polymeric iron phthalocyanine as an electrocatalyst of oxygen reduction in acid electrolytes (Untersuchung von polymeren Eisenphthalocyaninen als Elektrokatalysatoren der Sauerstoffreduktion in sauren Elektrolyten). C. Kretzschmar, K. Wiesener (Dresden, Technische Universität, Dresden, East Germany), M. Musilova, J. Mrha (Ceskoslovenska Akademie Ved, Ustav Fyzikalni Chemie a Elektrochemie, Prague, Czechoslovakia), and R. Dabrowski (Wojkowska Akademia Techniczna, Warsaw, Poland). *Journal of Power Sources*, vol. 2, May 1978, p. 351-360. 9 refs. In German.

Different preparations of polymeric iron phthalocyanine in association with two types of single-layer diffusion electrodes were tested for their ability to reduce oxygen in 4.5 N H₂SO₄ with the long-range goal of determining the suitability of polymeric iron phthalocyanine as a cheap replacement for platinum for use in fuel cells. It was found that the carrier material strongly influences catalytic activity and that the efficiency of the electrodes was improved by the addition of acetylene black. The best preparation technique was precipitation of the phthalocyanine on carbon, but neither type of electrode was able to maintain the initially high activity. M.L.

A78-40619 Effect of active-layer composition on the catalytic efficacy of two-layer diffusion electrodes for the reduction of oxygen in acid electrolytes (Einfluss der Aktivschichtzusammensetzung auf die Katalytische Wirksamkeit von Zweischichtdiffusionselektroden für die Reduktion von Sauerstoff in saurem Elektrolyten). C. Kretzschmar, K. Wiesener (Dresden, Technische Universität, Dresden, East Germany), A. Kaisheva, and I. Iliev (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Elektrokhimichni Iztochnitsi na Tok, Sofia, Bulgaria). *Journal of Power Sources*, vol. 2, May 1978, p. 361-368. 5 refs. In German.

A78-40620 A lithium solid-state cell based on the Li₃75S0.75P0.25O₄ electrolyte. B. Di Pietro and B. Scrosati (Roma, Università, Rome, Italy). *Journal of Power Sources*, vol. 2, May 1978, p. 387, 388. Research supported by the Consiglio Nazionale delle Ricerche.

A78-40621 On the discharge mechanism of silver/alkylammonium polyiodide solid state cells. M. Lazari, B. Rivolta, and F. Bonino (CNR, Centro Studio Processi Elettrodici, Milan, Italy). *Journal of Power Sources*, vol. 2, May 1978, p. 389-391. 5 refs. Research supported by the Consiglio Nazionale delle Ricerche.

A78-40819 # A pressurized-liquid concept for solar-thermal energy storage. M. E. Talaat (Maryland, University, College Park, Md.). *Journal of Energy*, vol. 2, May-June 1978, p. 136-141. 5 refs.

The paper addresses the solution of the problem of solar energy irregularity by investigating the technical feasibility of efficiently storing solar-thermal energy at sufficiently high temperature levels to insure the operation of any thermal-to-mechanical or electrical energy conversion system continuously over the 24-hr period of the day and at good overall powerplant efficiencies. The concept of pressurized-liquid energy storage is analytically evaluated using a modular design of a laboratory-size system; this consists of a well-insulated energy storage pressure vessel, filled with pressurized liquid water at 170.1 atm, and a suitable parabolic cylindrical collector. The results indicate that it is feasible to design and operate a pressurized-liquid solar-thermal energy storage system to continuously supply a thermal power input to a thermomechanical energy conversion system, within cyclic maximum and minimum temperature levels that would yield reasonably good overall thermal efficiencies. S.D.

A78-40821 # Determination of optimum arrays of wind energy conversion devices. G. M. Bragg and W. L. Schmidt (Waterloo, University, Waterloo, Ontario, Canada). *Journal of Energy*, vol. 2, May-June 1978, p. 155-159. 9 refs.

This paper discusses the use of large-scale wind energy conversion systems consisting of arrays of individual wind machines. The arrays have been analyzed in some detail with the aid of a rough boundary-layer velocity profile model. The analysis indicates inter-machine spacings that will provide for maximum output from either the total array or individual machines within the array. These arrangements are not coincident. Using the results obtained, detailed optimization and economic analyses may be made for large-scale wind systems. (Author)

A78-40822 # Wind tunnel performance data for two- and three-bucket Savonius rotors. R. E. Sheldahl, L. V. Feltz (Sandia Laboratories, Albuquerque, N. Mex.), and B. F. Blackwell (Louisiana Tech University, Ruston, La.). *Journal of Energy*, vol. 2, May-June 1978, p. 160-164. 6 refs. Research supported by the U.S. Department of Energy.

Fifteen configurations of a Savonius rotor wind turbine were tested in a 4.9 x 6.1-m low-speed wind tunnel to determine aerodynamic performance. The range of values of the varied parameters was as follows: number of buckets, 2 and 3; nominal freestream velocity, 7 and 14 m/s; Reynolds number per meter, 4.32 times 10 to the 5th power and 8.67 times 10 to the 5th power; rotor height, 1 and 1.5 m; rotor diameter (nominal), 1 m; bucket overlap, 0.0-0.1 m. The measured test variables were torque, rotational speed, and tunnel conditions. It is concluded that increasing Reynolds number and/or aspect ratio improves performance. The recommended configuration consists of two sets of two-bucket rotors, rotated 90 deg apart, with each rotor having a dimensionless gap width of 0.1-0.15. (Author)

A78-40823 # Performance characteristics of compressed air energy storage systems. R. Decher and R. N. Davis (Washington, University, Seattle, Wash.). *Journal of Energy*, vol. 2, May-June 1978, p. 165-174. 8 refs.

The paper examines the thermodynamic performance potential of compressed-air energy-storage (CAES) systems considered as effective means of dealing with the peak-power problem because of the availability of required system components, minor need for new technology, and potentially attractive cost. The study focuses on a mathematical description of the CAES system and on identification of relevant parameters governing the system performance. The impact of power pulse shape and the role of thermodynamic parameters are stressed. For the small vessel, the problem of matching thermocomponents is discussed. The ratio of cyclic energy stored to the volume available is considered an important parameter governing the thermodynamic performance and cost. To maximize performance, intercooling the compressor is most effective, especially when vessel pressures are high. Regeneration is cost effective only

if the vessel pressure is low. A CAES system should be operated at an energy density per unit pressure as low as possible. S.D.

A78-40824 # The Lebest Wind Turbine - Laboratory tests and data analysis. M. I. Hoffert, G. L. Matloff, and B. A. Rugg (New York University, New York, N.Y.). *Journal of Energy*, vol. 2, May-June 1978, p. 175-181. 22 refs.

Previous research work on windmills suggests the desirability of wind energy machines with the advantages of a vertical axis and a flow-focusing housing or shroud. Such a vertical-axis device was proposed by Lebest (1977) and called Lebest Wind Turbine, which incorporates flow-focusing inlets fixed to a housing shroud surrounding blades rotating normal to the flow. In this paper, preliminary results are presented from a series of wind tunnel tests assessing the aerodynamic torque and power characteristics of the Lebest Wind Turbine, along with a comparison with other windmills. The advantages of the Lebest Wind Turbine for wind energy conversion include a relatively high power coefficient based on projected frontal area, a vertical rotation axis with concomitant reduction of gyroscopic forces as wind direction shifts, good load matching characteristics for hydraulic pump-type and brake-heating loads, reduced centrifugal rotor stresses, reduced bearing wear, operation in higher velocity winds owing to low rotation rates, and a high safety factor associated with the restraining influence of the housing structure. S.D.

A78-40826 * # Comment on 'Heat-pipe reactors for space power applications'. R. E. English (NASA, Lewis Research Center, Cleveland, Ohio). *Journal of Energy*, vol. 2, May-June 1978, p. 191, 192; Authors' Reply, p. 192.

A78-40834 # Optimization of the current profile in MHD generators. R. Ramberger (Innsbruck, Universität, Innsbruck, Austria). *AIAA Journal*, vol. 16, July 1978, p. 740-746. 28 refs. Research supported by the Scientific and Industrial Austrian Research Councils.

A method is discussed to reduce the extremely high current density at certain ends of the electrodes in a Faraday MHD generator caused by the Hall effect. To begin with, criteria are developed for improving the electric current profile. With the help of these criteria, a variational principle is formulated for numerically obtaining the 'optimal' profile for fixed gasdynamic flow. This optimum is compromising between maximal uniformity of the current pattern and the minimal electrode losses. It can be realized by choosing a suitable conductivity profile in the electrodes. The results of the numerical optimization with the finite element method show that it is indeed possible to achieve a reduction of the current concentration, but only to a certain extent, in order to avoid high potential drops in the electrodes. (Author)

A78-40864 Stationary and dynamic behavior of heat pipes (Stationäres und dynamisches Verhalten von Wärmerohren). J. Nestler and I. Tzivelekas. *Wissenschaftliche Berichte AEG-Telefunken*, vol. 51, no. 1, 1978, p. 25-29. 12 refs. In German. Research supported by the Bundesministerium für Forschung und Technologie.

A number of commercial heat pipes together with their design characteristics and their prices are listed in a table. Heat pipes for the transfer of thermal energy have power ratings up to 2 kW, in exceptional cases even up to 10 kW. Special constructional forms are supplied which insure the maintenance of a constant temperature for a greater number of constructional elements. Cooling elements for integrated circuits are available together with flexible heat pipes for vibrating superstructures. Particular attention is given to a heat pipe which has been provided by the manufacturer with a mounting plate for the attachment of the components which are to be cooled. A radiator for dissipating the heat has also been added. In the case of some heat pipes, ohmic heating resistors are used as heat sources to simplify the design used for providing the desired heating effects. G.R.

A78-40865 Transistor inverters for satellite onboard networks of higher power (Transistorwechselrichter für Satellitenbordnetze höherer Leistung). S. Aubram, P. Grumbrecht, and S. Rolle. *Wissenschaftliche Berichte AEG-Telefunken*, vol. 51, no. 1, 1978, p. 64-70. 5 refs. In German. Research supported by the Bundesministerium für Forschung und Technologie.

Several system variants for a-c voltage generation are discussed and a description is presented of various circuits for the static converter component and the filter designs. One concept is shown to represent the most favorable solution. Approaches for implementing the concept are described, taking into account aspects of the energy-distribution system and problems of circuit technology and construction. Data concerning the prototype of an inverter module are provided and oscillograms are shown of internal and external voltages and currents. The efficiency as a function of input voltage in the case of full load and constant output voltage are shown in a graph. It is characteristic for the considered device that the best efficiency with about 0.9 is reached for small input voltages. G.R.

A78-40866 Investigations concerning direct-current operated local-traffic vehicles with low reactive effects (Untersuchungen an rückwirkungsarmen, gleichstromgespeisten Nahverkehrsfahrzeugen). R. Schwarzenau. *Wissenschaftliche Berichte AEG-Telefunken*, vol. 51, no. 1, 1978, p. 71-76. 5 refs. In German. Research supported by the Bundesministerium für Forschung und Technologie.

It is the objective of power electronics in propulsion technology to transform with low losses electric energy into mechanical work by combining electronic power positioning elements with control devices and economic driving engines. With the aid of an example involving two prototype subway vehicles it is shown on the basis of various frequency analyses regarding the vehicle flow that the introduction of modern power electronics will, in addition to operational and traction-technological advantages, not have any significant effects on signal technology. The considered vehicles are equipped with a chopper and direct-current traction motors or asynchronous traction motors using static frequency changers. Measured data for thyristor vehicles are compared with data for comparable standard vehicles with conventional switch mechanism controls. G.R.

A78-40919 Microprocessor-based solar cell measurement system. L. Castañer, A. Alabau, M. Sanchez-Nonell, J. Cabestany, and J. Ventosa (Escuela Técnica Superior de Ingenieros de Telecomunicación, Barcelona, Spain). *IEEE Transactions on Instrumentation and Measurement*, vol. IM-27, June 1978, p. 152-156. 8 refs. Research supported by the Comisión Asesora de la Presidencia.

A microprocessor-based solar cell standard characteristics measurement system is described. Data acquisition and digital conversion of the current-to-voltage characteristics and the spectral response allows the performance of several operations as averaging, storage, minicomputer connection, and parameter determination of the theoretical models introduced. Several results are shown concerning the accuracy of the method on the determination of series resistance, reverse saturation current, and the minority carriers lifetime on the base region of solar cells. (Author)

A78-41000 Water in synthetic fuel production: The technology and alternatives. R. F. Probststein (Water Purification Associates, MIT, Cambridge, Mass.) and H. Gold (Water Purification Associates, Cambridge, Mass.). Research sponsored by the National Science Foundation. Cambridge, Mass., MIT Press, 1978. 296 p. 190 refs. \$14.95.

The book is intended to be a guide to understanding the role water plays in synthetic fuel production. It is pointed out that plants to manufacture synthetic fuels from coal and oil shale require large quantities of fresh water and produce large quantities of dirty water. In the U.S. this poses a problem. It is attempted to present the practically achievable technology that can be incorporated in synthetic fuel plants to minimize water consumption and pollution.

General considerations are examined, taking into account hydrogenation and other process water, mining, fuel preparation, residuals disposal, coal and shale deposits, water availability, and constraints. Coal and shale conversion fundamentals are discussed along with cooling fundamentals, gas production, liquid and solid fuel production, and water treatment. Resources and water requirements are considered, giving attention to coal and oil shale, western water resources, eastern and central water resources, water consumption and residual totals, and water requirements for synthetic fuel production. G.R.

A78-41217 Capturing sunlight - A revolution in collector design. A. L. Hammond and W. D. Metz. *Science*, vol. 201, July 7, 1978, p. 36-39.

In the last 5 years a modern technology of capturing sunlight has taken form. Collector designs range from low-cost, low-temperature versions to devices capable of concentrating sunlight 10,000 times. A few years ago the flat plate collector was the only type of collector available. But now flat plate collectors are facing growing competition. Passive systems are increasingly used for space heating of homes and commercial buildings. At least five distinct techniques are used in modern passive systems. The simplest is direct gain through extensive south-facing windows. Other techniques use a thermal storage wall, a roof pond, the circulation of a fluid in a natural convective loop, and a greenhouse built into or against a house. High-technology competitors of the flat-plate collector are evacuated tube collectors. Attention is also given to the employment of nonfocusing and focusing concentrators of solar energy and various systems of high temperature collectors. G.R.

A78-41221 Kinetics of thermal liquefaction of Belle Ayr subbituminous coal. D. C. Cronauer, R. G. Ruberto (Gulf Research and Development Co., Pittsburgh, Pa.), and Y. T. Shah (Gulf Research and Development Co., Pittsburgh, University, Pittsburgh, Pa.). *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 17, July 1978, p. 281-288. 17 refs. Research supported by the Electric Power Research Institute.

A kinetic study of thermal liquefaction of Belle Ayr subbituminous coal is reported. Experiments were performed in a laboratory-scale continuous stirred tank reactor, and data on coal conversion and the production of pre-asphaltenes, asphaltenes, oils, and gases such as C1 through C6 hydrocarbons, NH3, H2S, CO, CO2, and water are presented. Experimental conditions involved a temperature range of 400 to 470 C, space times of approximately 5 to 55 min, a total unit pressure of 2000 psig, and a coal-to-solvent ratio of 1:1.5. Two solvents, hydrogenated anthracene oil and hydrogenated phenanthrene, were studied. A kinetic model which assumes reaction rates to be pseudo-first order with respect to reacting species is found suitable at 400-450 C for all space times, and at 460 and 470 C for small space times. M.L.

A78-41222 Kinetics of catalytic liquefaction of Big Horn coal in a segmented bed reactor. Y. T. Shah (Gulf Research and Development Co., Pittsburgh, University, Pittsburgh, Pa.), D. C. Cronauer, H. G. McIlvried, and J. A. Paraskos (Gulf Research and Development Co., Pittsburgh, Pa.). *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 17, July 1978, p. 288-301. 22 refs.

A78-41223 Process variable effects in the conversion of methanol to gasoline in a fluid bed reactor. D. Liederman, S. M. Jacob, S. E. Voltz, and J. J. Wise (Mobil Research and Development Corp., Paulsboro, N.J.). *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 17, July 1978, p. 340-346. 18 refs. Research supported by the Mobil Research and Development Corp.; Contract No. E(49-18)-1773.

The conversion of methanol to high octane gasoline was studied in a fluid bed reactor. Some effects of temperature, pressure, and space velocity on methanol conversion and product yields were determined. Catalyst deactivation due to coke formation and

steaming were investigated during a kinetic aging test. The activity loss from coking can be regained by oxidative regeneration. Coupling the methanol conversion process with the commercially proven technology for the production of methanol from coal provides an alternate route for the conversion of coal to high octane gasoline.

(Author)

A78-41225 * Weight propagation and equivalent horsepower for alternate-engined cars. G. J. Klose and D. W. Kurtz (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich., Feb. 27-Mar. 3, 1978, Paper 780348*. 13 p.

In order to evaluate properly the consequences of replacing conventional Otto-cycle engines with alternate power systems, comparisons must be carried out at the vehicle level with functionally equivalent cars. This paper presents the development and application of a procedure for establishing equivalent vehicles. A systematic weight propagation methodology, based on detailed weight breakdowns and influence factors, yields the vehicle weight impacts due to changes in engine weight and power. Performance-matching criteria, utilizing a vehicle simulation program, are then employed to establish Otto-engine-equivalent vehicles, whose characteristics can form the basis for alternative engine evaluations.

(Author)

A78-41251 A study of production and growth of sulfate particles in plumes from a coal-fired power plant. A. C. Dittenhoefer and R. G. de Pena (Pennsylvania State University, University Park, Pa.). (*International Symposium on Sulfur in the Atmosphere, Dubrovnik, Yugoslavia, Sept. 7-14, 1977.*) *Atmospheric Environment*, vol. 12, no. 1-3, 1978, p. 297-306. 12 refs. Contract No. E(11-1)-2463.

A number of airborne plume sampling experiments designed to examine the importance of sulfate particle-generating chemical reactions within coal-burning power station plumes are described. The flights were conducted in western Pennsylvania. On-board aerosol sampling instrumentation included a condensation nucleus counter, an optical particle counter, and an electrical aerosol analyzer. A cascade impactor containing electron microscope copper grids coated with carbon film was used to collect particles at varying distances from the stacks. These samples were analyzed for sulfate content and particle size distribution. Measurements of SO₂ were made with a rapid-response pulsed fluorescent analyzer. Atmospheric pressure, temperature, dewpoint, winds and aircraft position were also monitored. For each flight, a vertical spiral aircraft sounding was made upwind of the power station to determine atmospheric stability and background aerosol particle and SO₂ concentrations. Downwind, the flight pattern consisted of a series of cross wind and longitudinal plume penetrations out to distances at which SO₂ reached background levels. It was found that when relative humidity was low, stability near-neutral, and solar radiation intense, the production of new Aitken particles was the primary mechanism of SO₂ oxidation.

(Author)

A78-41253 Nuclei formation rates in a coal-fired power plant plume. K. T. Whitby, B. K. Cantrell, and D. B. Kittelson (Minnesota, University, Minneapolis, Minn.). (*International Symposium on Sulfur in the Atmosphere, Dubrovnik, Yugoslavia, Sept. 7-14, 1977.*) *Atmospheric Environment*, vol. 12, no. 1-3, 1978, p. 313-321. 17 refs. U.S. Environmental Protection Agency Grant No. R-803851-02.

A78-41254 Aerosol size distributions and aerosol volume formation for a coal-fired power plant plume. B. K. Cantrell and K. T. Whitby (Minnesota, University, Minneapolis, Minn.). (*International Symposium on Sulfur in the Atmosphere, Dubrovnik, Yugoslavia, Sept. 7-14, 1977.*) *Atmospheric Environment*, vol. 12, no. 1-3, 1978, p. 323-333. 14 refs. U.S. Environmental Protection Agency Grant No. R-803851-02.

A78-41267 Sulphur emissions in Europe. A. Semb (Norwegian Institutt for Luftforskning, Lillestrom, Norway). (*International Symposium on Sulfur in the Atmosphere, Dubrovnik, Yugoslavia, Sept. 7-14, 1977.*) *Atmospheric Environment*, vol. 12, no. 1-3, 1978, p. 455-460. 22 refs.

Natural and man-made emissions of sulfur to the atmosphere are discussed. Within Europe the man-made emissions, which are closely associated with the consumption of fossil fuels, are overwhelmingly dominant. Emissions from the 11 countries participating in the OECD study were 8.8 M tonnes S in 1973, and have been estimated at about 25 M tonnes for the whole of Europe. Based on information from the participating countries, and from various other sources, an emission survey has been worked out. This gives the emissions in 1/2 deg latitude x 1 deg longitude geographical reference system which has been transferred to a 127 x 127 km grid used in dispersion model calculations.

(Author)

A78-41275 Sulfur budget of a power plant plume. R. B. Husar, D. E. Patterson, J. D. Husar, N. V. Gillani (Washington University, St. Louis, Mo.), and W. E. Wilson, Jr. (U.S. Environmental Protection Agency, Aerosol Research Branch, Research Triangle Park, N.C.). (*International Symposium on Sulfur in the Atmosphere, Dubrovnik, Yugoslavia, Sept. 7-14, 1977.*) *Atmospheric Environment*, vol. 12, no. 1-3, 1978, p. 549-568. 20 refs. U.S. Environmental Protection Agency Grant No. R-803896.

The summer sulfur budget of the plume of the 2400 MW coal-fired Labadie power plant near St. Louis is assessed by use of aircraft data, ground monitoring network data, and a two-box model. The particulate sulfur formation rates for noon hours and night are determined from three-dimensional plume mapping combined with a high time-resolution particulate sulfur sampling technique. Daytime and nighttime transport rates are reported. Plume sulfur budgets are estimated by means of a described two-box model which incorporates diurnally periodic rate constants for transformation and removal. Transformation and removal occur mainly during daytime, while transport is fastest at night. The study is part of the Midwest Interstate Sulfur Transformation and Transport study.

M.L.

A78-41284 MAP3S - An investigation of atmospheric, energy related pollutants in the northeastern United States. M. C. MacCracken (California, University, Livermore, Calif.). (*International Symposium on Sulfur in the Atmosphere, Dubrovnik, Yugoslavia, Sept. 7-14, 1977.*) *Atmospheric Environment*, vol. 12, no. 1-3, 1978, p. 649-659. 74 refs. Contract No. W-7405-eng-48.

The Multi-State Atmospheric Power Production Pollution Study (MAP3S) is a major atmospheric research program of the U.S. Energy Research and Development Administration. The goal of the MAP3S program is to develop and demonstrate an improved verified capability to simulate present and potential future changes in pollutant concentration, atmospheric behavior, and precipitation chemistry as a result of pollutant releases to the atmosphere from large-scale power production processes, primarily coal combustion. A major motivation of this program is to provide those agencies charged with the task of meeting the nation's energy needs with the knowledge required to assess alternative strategies for generating power, while ensuring ample protection of human health and adequate preservation of the natural environment. Since coal is the most abundant domestic fossil energy resource and since electric power production is a major and growing sector of the energy economy, this study focuses on the effects of emissions from coal-fired electric power plants, particularly sulfur oxide emissions. The study domain is the high-population energy-intensive northeastern quadrant of the United States. Research projects are underway to measure present sulfur oxide concentrations and composition, to assess the potential for long-range transport, and to investigate transformation processes in plumes from point and urban sources.

(Author)

A78-41466 Alternative automobile engines. D. G. Wilson (MIT, Cambridge, Mass.). *Scientific American*, vol. 239, July 1978, p. 39-49.

In connection with the objective to increase the efficiency of the automobile engine and to reduce the amount of air-polluting emissions, investigations have been conducted concerning the possibility to achieve the desired objectives by replacing the currently employed spark-ignition (Otto) engine with another propulsion system. Possible choices for such a replacement include the compression-ignition (Diesel) engine, the steam (Rankine) engine, the gas turbine (Brayton engine), the Stirling engine, and battery-electric drives. The operational characteristics of the considered systems are examined. It is pointed out that the proposed power plants may excel the present-day engine in efficiency, particularly under partial loads. However, the projected manufacturing costs are high with the possible exception of the gas turbine. The biggest present virtue of the considered power plants (the Diesel excepted) is low exhaust emissions. It is proposed that the Government should promote the development and the use of a better engine by placing a graduated tax on the measured emissions of each make and model of car and an energy tax increasing the price of fuel, or possibly a comparable energy-thrift tax on each model's measured fuel consumption. G.R.

A78-41506 Israel Conference on Mechanical Engineering, 11th, Technion - Israel Institute of Technology, Haifa, Israel, July 11, 12, 1977, Proceedings. *Israel Journal of Technology*, vol. 15, no. 4-5, 1977. 187 p.

Consideration is given to the development of aircraft engine design and the computer-aided design of radial gas turbines. Procedures are outlined for optimizing the cooling system of air-cooled internal combustion engines, simulating single and double-staged reciprocating compressor systems, and calculating jet misalignment in rocket nozzles. Turbulent diffusion from conditionally intermittent sources is discussed along with the optimum codes for sequential-system programmers, iron-based sintered friction materials, and a computer-controlled system for fatigue testing under simulated service loading. S.C.S.

A78-41518 Experimental work on oil shale at Lawrence Livermore Laboratory and predictions of retorting characteristics of oil shales. A. J. Rothman and A. E. Lewis (California, University, Livermore, Calif.). (Israel Conference on Mechanical Engineering, 11th, Haifa, Israel, July 11, 12, 1977.) *Israel Journal of Technology*, vol. 15, no. 4-5, 1977, p. 273-282. 12 refs. Contract No. W-7405-eng-48.

An experimental program is being carried out to advance oil-shale retorting technology. This paper summarizes some results of laboratory and pilot retorting and gives the reactions of oil-shale char with gases. A computer model of the retorting process has been compared with retort experiments and has been used to predict in situ retorts under various operating conditions. Finally, the results of a retort using Negev (Israel) oil shale are compared with those using Colorado oil shale. (Author)

A78-41521 Oil shale retorting - Effects of particle size and heating rate on oil evolution and intraparticle oil degradation. J. H. Campbell, G. H. Koskinas, N. D. Stout (California University, Livermore, Calif.), and T. T. Coburn (Boston, University, Boston, Mass.). *In Situ*, vol. 2, no. 1, 1978, p. 1-47. Contract No. W-7405-eng-48.

A study of the evolution of oil during pyrolysis of cylindrical blocks and powders of oil shale shows that coking reactions are the major source of intraparticle oil degradation and that particle size (up to 17.2 cm) and grade (14 to 49 gal/ton) have little effect on the degree of intraparticle oil degradation during shale retorting. The degree of coking depends strongly on the heating rate - for example, for both powders and 17.2-cm diameter blocks, a heating rate of 2 C/hr led to the collection of 83% of Fischer assay oil, while a heating rate of 180 C/hr produced a yield of 99%. The experimental results are analyzed by means of a simple mathematical model, and model

calculations for the rate of oil production, the degree of oil degradation, and the thermal profile through the material are found to agree very closely with the experimental data. M.L.

A78-41522 Instrumentation for in situ coal gasification. I - Background and overview. D. A. Northrop (Sandia Laboratories, Albuquerque, N. Mex.). *In Situ*, vol. 2, no. 2, 1978, p. 93-115. 7 refs. Research supported by the U.S. Department of Energy.

The Hanna II in situ coal gasification experiment was conducted during 1975-76. As part of this experiment, seven instrumentation techniques and several variations were designed, fielded, and evaluated. These belonged to two general classes: (1) diagnostic techniques (thermal, in-seam gas sampling and pressure, and overburden tilt and displacement) to obtain data for process characterization and (2) remote monitoring techniques (electrical, passive acoustic, and induced seismic) which are being developed to provide a continuous real-time map of the in situ process which would be used in a process control system. Assessments of these techniques have been made with respect to their feasibility, information obtainable, and future development and applications; in general, very positive assessments were obtained. Instrumentation development is continuing based upon these results, and a major effort has been designed and fielded for the Hanna IV experiment. (Author)

A78-41523 Shale oil retention on crushed unretorted shale. A. L. Hines (Colorado School of Mines, Golden, Colo.) and J. J. Duvall (U.S. Department of Energy, Laramie Energy Research Center, Laramie, Wyo.). *In Situ*, vol. 2, no. 2, 1978, p. 117-126. 9 refs.

The ability to predict the quantity of oil retained on unretorted shale is necessary if viable models of the retorting process are to be formulated. A knowledge of the amount of retained oil is important because a portion of it may be cracked and thus increase the quantity of carbon residue found on the spent shale. Carbon residue not only provides a significant portion of the energy needed to sustain retorting but also plays an important role in the kinetics of the process. In this study, retention data of oil on unretorted shale are presented for shale samples ranging in size from 1/2 inch to number 14 U.S. mesh. The data are correlated in terms of the residual saturation and capillary number. (Author)

A78-41524 Highlights of the LLL Hoe Creek No. 2 underground coal gasification experiment. D. R. Stephens, R. W. Hill, and C. B. Thorsness (California, University, Livermore, Calif.). *In Situ*, vol. 2, no. 2, 1978, p. 127-132.

A78-41795 Characterization of catalysts for fuel-cell electrodes with the aid of vacuum microbalances (Charakterisierung von Katalysatoren für Brennstoffzellen-Elektroden mit Hilfe von Vakuum-Mikrowaagen). H. Behret, H. Binder, and E. Robens (Battelle-Institut, Frankfurt am Main, West Germany). *Vakuum-Technik*, vol. 26, no. 5, 1977, p. 147, 148. In German.

An investigation was conducted concerning the selection and development of suitable cathode materials, without noble metals, which would catalyze oxygen conversion in acid electrolytes. Thermogravimetric methods were employed under microscale conditions to determine the parameters of the methods of preparation, the chemical characteristics of the material, and the properties of the pore structure. Inorganic compounds and organic polymers were thermally decomposed on the balance. Gravimetric sorption measurements were conducted for a determination of the specific surface and the pore structure of FeCo₂S₄ and a number of organic materials. The sorption measurements were conducted with nitrogen at 77 K with the aid of an automatic surface and pore measurement device. G.R.

A78-41812 A survey of applications of fusion power technology for the chemical and material processing industries. M. Steinberg, M. Beller, and J. R. Powell (Brookhaven National Laboratory, Upton, N.Y.). *Energy Sources*, vol. 3, no. 3-4, 1978, p. 207-253. 19 refs.

The forms of energy available in amounts of 30% or greater of the total power developed in a controlled thermonuclear reactor (CTR) operating on a deuterium-tritium fuel cycle are (1) high-temperature thermal energy, (2) electric energy-high voltage, and (3) neutron and gamma high-energy radiation. The thermal and electric forms of CTR energy can supply a significant fraction of the needs of a conventional heavy chemical and material processing industry. The minor forms of CTR energy, based on a deuterium-tritium fuel cycle, available in amounts less than 10% of the total power developed in CTR reactors, include ultraviolet energy from the plasma, secondary high-energy particle energy, and ionized particle energy from the blanket. These forms will be useful mainly as a byproduct from either thermal or electric CTR power generators. Eventually larger ultraviolet efficiencies may be available from the advanced deuterium-deuterium fuel cycle. (Author)

A78-41813 Hydroelectric solar energy conversion. R. L. Liboff (Cornell University, Ithaca, N.Y.). *Energy Sources*, vol. 3, no. 3-4, 1978, p. 255-261. 17 refs. Contract No. N00014-76-C-0030.

A means of direct conversion of solar energy to hydroelectric energy is discussed: The mechanism is appropriate to low-lying coastal desert regions with high potential evaporation rates. Formulas for output power are obtained. Climate and related data appropriate to suitable locations are included. (Author)

A78-41814 Characterization of nitrogen compounds in tar produced from underground coal gasification. S. B. King, C. F. Brandenburg, and W. J. Lanum (U.S. Department of Energy, Laramie Energy Research Center, Laramie, Wyo.). *Energy Sources*, vol. 3, no. 3-4, 1978, p. 263-275.

The composition of low-boiling coal tars, which contribute about 5% of the total energy produced in underground coal gasification, has been analyzed. Tar acid, tar base and neutral oil fractions were separated; the tar base fraction was found to consist primarily of nitrogen-containing alkyl pyridines. The relative concentrations of these compounds could be correlated with the gasification conditions. The coal tars boiled between 600 and 950 F and yielded little or no residue, as demonstrated by simulated distillation. The use of these coal tars as petrochemical feedstock is discussed. J.M.B.

A78-41815 Energy for agriculture and the gasification of crop residues. B. Horsfield and R. O. Williams (California, University, Davis, Calif.). *Energy Sources*, vol. 3, no. 3-4, 1978, p. 277-292. 27 refs.

Conversion of crop residues from corn, wheat, soybeans, sugar cane, cotton, rice and other products may provide the U.S. with up to 6.4 times 10 to the 15th power Btu per year, if suitable collection and processing facilities can be developed. Extraction of a combustible gas from crop residues by burning in a fixed bed with limited air supplies is proposed as the most efficient means for exploiting the residues. Updraft, downdraft and crossdraft gas producers are described, and applications of the gas producers to lumber milling, heating, cotton ginning and pumping irrigation water are mentioned. J.M.B.

A78-41816 * California's geothermal resource potential. L. P. Leibowitz (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Energy Sources*, vol. 3, no. 3-4, 1978, p. 293-311. 13 refs. Research sponsored by the California Energy Resource Conservation and Development Commission and ERDA; Contract No. NAS7-100.

According to a U.S. Geological Survey estimate, recoverable hydrothermal energy in California may amount to 19,000 MW of electric power for a 30-year period. At present, a geothermal installation in the Geysers region of the state provides 502 MWe of capacity; an additional 1500 MWe of electric generating capacity is

scheduled to be in operation in geothermal fields by 1985. In addition to hydrothermal energy sources, hot-igneous and conduction-dominated resources are under investigation for possible development. Land-use conflicts, environmental concerns and lack of risk capital may limit this development. J.M.B.

A78-41817 * Catalytic hydrosolvation process converts coal to low-sulfur liquid fuel. S. A. Qader (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Energy Sources*, vol. 3, no. 3-4, 1978, p. 323-337. 11 refs. ERDA-supported research.

Development of the catalytic hydrosolvation process for converting coal to low-sulfur fuel oil is described in this paper. Coal impregnated with catalyst was slurried with oil, and the mixture was hydrogenated at a temperature of 475 C, and 30 min residence time under 3600 psi pressure. A ton of coal yielded 3.5 bbl of fuel oil containing 0.2% sulfur, with naphtha and C1-C4 hydrocarbon gases as byproducts. A preliminary economic evaluation of the process indicated potential for further development. (Author)

A78-41818 Crop residues as energy sources - Assessing the cost and energy feasibility of direct firing. P. J. Starr (Minnesota, University, Minneapolis, Minn.), D. W. Finn-Carlson, and C. J. Nachtsheim. *Energy Sources*, vol. 3, no. 3-4, 1978, p. 353-373. 5 refs. Research sponsored by the Minnesota Pollution Control Agency and University of Minnesota.

The collection, shipping and preparation of crop residues for direct firing in currently operational coal-fired utility boilers may provide a significant energy source in some areas of the U.S. In particular, it is estimated that crop residues could supply more than 40% of the state of Minnesota's energy demand. For typical power plants, a low-cost strategy would incur an expense of \$0.34 per million Btus for delivered residue and an overall system operation cost of \$0.57 per million Btus. These cost figures compare well with the expenses involved in coal firing of the boilers. J.M.B.

A78-41819 Tar sand evaluation using geophysical well logs. W. H. Fertl (Continental Oil Co., Ponca City, Okla.) and G. V. Chilingarian (Southern California, University, Los Angeles, Calif.). *Energy Sources*, vol. 3, no. 3-4, 1978, p. 375-384. 8 refs.

Geophysical well logging can provide a record of the lithological variations and oil yield of tar sands. Probes lowered into bore holes at the end of insulated cables yield such records as the spontaneous potential log, the focused resistivity log, the gamma-ray log, the acoustic log and the neutron log. The accuracy of correlations between gamma-ray log response and fines content and between various log responses and tar content is discussed. An economical digital technique for log analysis of tar sand deposits is also described. J.M.B.

A78-41870 # The effect of coherent structures on open-cycle generators. M. H. Scott, J. B. Dicks, Jr., and B. Winkleman (Tennessee, University, Tullahoma, Tenn.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 11th, Seattle, Wash., July 10-12, 1978, Paper 78-1173*. 7 p. Contract No. EX-76-C-01-1760.

The fluid dynamic and electrical parameters measured in an open-cycle MHD generator and associated flow train have characteristic time-varying behavior that reflect such phenomena as the non-uniform properties of the combustion plasma. Experimental studies of time-varying characteristics of parameters have been conducted in order to characterize behavior that is ultimately required for process control as well as to delineate the nature of plasma non-uniformities and their effect on generator performance. It was determined that coherent structures created during the combustion process exert a significant effect on parameters in the system and hence the performance of the MHD generator. (Author)

A78-41909 Effect of Faraday rotation on stimulated Brillouin backscattering. Z. A. Pietrzyk and R. S. Massey (Washington, University, Seattle, Wash.). *Applied Physics Letters*, vol. 32, June 15, 1978, p. 796-798. 7 refs. ERDA-NSF-supported research.

Based on a laser-heated solenoid, the influence of Faraday rotation on stimulated Brillouin backscattering is examined. It is assumed that the long homogeneous plasma is located in a strong axial magnetic field and that the incident laser beam is linearly polarized. Values are given for the distance in which ion acoustic waves reduce their amplitude to zero due to two-wave interaction, and for the spectrum of backscattered radiation. It is concluded that the Faraday rotation effect in backscattering theory predicts a reduced level of backscattering for long columns and a broadening of the spectrum. S.C.S.

A78-41910 Selective absorption of solar energy in granular metals - The role of particle shape. C. G. Granqvist (Chalmers Tekniska Högskola, Göteborg, Sweden) and O. Hunderi (Norges Tekniske Høgskole, Trondheim, Norway). *Applied Physics Letters*, vol. 32, June 15, 1978, p. 798-800. 19 refs.

Coatings for efficient photothermal conversion of solar energy should have high absorption at wavelengths less than the critical wavelength and low absorption at wavelengths greater than the critical wavelength, where the critical wavelength is approximately 2 microns. For granular metals, it is shown by computation that the critical wavelength depends strongly on the shape of the metal particles. Increasing eccentricity of ellipsoidal grains is seen to displace the critical wavelength towards the infrared. A similar shift is found also for spherical metallic shells surrounding dielectric cores of increasing size. Some implications for practical absorber surfaces are pointed out. (Author)

A78-41913 Low-resistivity ZnCdS films for use as windows in heterojunction solar cells. N. Romeo, G. Sberveglieri, and L. Tarricone (CNR, Istituto di Fisica, Parma, Italy). *Applied Physics Letters*, vol. 32, June 15, 1978, p. 807-809. 8 refs. Research supported by the Consiglio Nazionale delle Ricerche.

A78-41931 # Gasification and residence time of hard-coal particles in a cyclone reaction chamber (Zgazowanie a czas pobytu cząstek węgla kamiennego w reakcyjnej komorze cyklonowej). J. Stasiak, P. Domanski, and M. A. M. Saudi (Gdansk, Politechnika, Gdansk, Poland). *Politechnika Gdanska, Zeszyty Naukowe, Mechanika*, no. 28, 1977, p. 89-100. 12 refs. In Polish.

The possibility of complete gasification of coal dust in a cyclone reactor is examined by comparing the gasification time with the residence time of coal in the reactor. An approximate method of calculating these times is given. P.T.H.

A78-42015 Ionization and recombination rate coefficients of highly ionized molybdenum ions from spectroscopy of tokamak plasmas. C. Breton, C. De Michelis, M. Finkenthal, and M. Mattioli (EURATOM and Commissariat à l'Énergie Atomique sur la Fusion, Département de Physique du Plasma et de la Fusion Contrôlée, Fontenay-aux-Roses, Hauts-de-Seine, France). *Physical Review Letters*, vol. 41, July 10, 1978, p. 110-113. 15 refs.

A78-42016 Ion-cyclotron instability in the TFR tokamak. J. Adam, J. F. Bonnal, A. Bresson, C. Breton, J. Breton, P. Brossier, J. P. Bussac, R. Cano, M. Chatelier, and M. Cotsaftis (EURATOM and Commissariat à l'Énergie Atomique sur la Fusion, Département de Physique du Plasma et de la Fusion Contrôlée, Fontenay-aux-Roses, Hauts-de-Seine, France). *Physical Review Letters*, vol. 41, July 10, 1978, p. 113-116. 12 refs.

Density fluctuations in the ion-cyclotron frequency range have been observed in the TFR tokamak by microwave scattering. The geometry was such that the selected fluctuation wave vector was

aligned across the confining magnetic field in the outside region of the torus. A threshold for the onset of the instability as a function of the discharge current has been observed. A plausible explanation of this instability in terms of current-driven ion-cyclotron electrostatic wave is discussed. (Author)

A78-42022 Shear stabilization of collisional drift instability. S. Inoue, K. Itoh (Tokyo, University, Tokyo, Japan), and S. Yoshikawa (Princeton University, Princeton, N.J.). *Physical Society of Japan, Journal*, vol. 44, May 1978, p. 1707-1710. 8 refs. Research supported by the Ministry of Education, Science and Culture of Japan.

The collisional drift waves of a slab plasma in a sheared magnetic field are estimated by application of the normal mode expansion. The growth rate of the collisional drift wave is proportional to the square root of the electron collision frequency. An eigenmode method is used to estimate the anomalous transport coefficient. Both the growth rate of the mode and the induced transport indicate that the collisional drift mode is responsible for a density limitation for high-density tokamaks even when a fairly strong shear is present. M.L.

A78-42030 Radiation transfer through specular passages - A simple approximation. A. Rabl (Argonne National Laboratory, Argonne, Ill.). *International Journal of Heat and Mass Transfer*, vol. 20, Apr. 1977, p. 323-330. 13 refs. ERDA-supported research.

A technique is developed for approximating exchange factors for specular radiation passages. It is shown that for a large class of configurations, even with curved reflector surfaces, the average number of reflections, $\text{avg } n$, can be calculated by a simple analytic formula and without any ray tracing. The fraction of radiation transmitted through the passage, τ (one of the exchange factors), can then be approximated by the formula τ is approximately equal to ρ raised to the power $\text{avg } n$ if the specular reflectivity (ρ) of the passage wall is high. A rigorous lower bound is derived which agrees with the exact result within a few percent for any reflector emissivity, provided the product of reflector emissivity and $\text{avg } n$ is not too large. Several examples are discussed, including cylindrical passages, V-troughs and compound parabolic concentrators. The method is particularly useful for calculating transmission and absorption of radiation in solar concentrators. (Author)

A78-42064 The natural circulation solar heater-models with linear and nonlinear temperature distributions. Y. Zvirin, A. Shitzer, and G. Grossman (Technion - Israel Institute of Technology, Haifa, Israel). *International Journal of Heat and Mass Transfer*, vol. 20, Sept. 1977, p. 997-999.

A78-42080 The effect of dike intrusion on free convection in conduction-dominated geothermal reservoirs. K. H. Lau (Hawaii, University, Hilo, Hawaii) and P. Cheng (Hawaii, University, Honolulu, Hawaii). *International Journal of Heat and Mass Transfer*, vol. 20, Nov. 1977, p. 1205-1210. 6 refs. NSF Grant No. GI-38319; Contract No. E(04-3)-1093.

A78-42101 National Solar Energy Convention, Jadavpur University, Calcutta, India, November 29-December 1, 1976, Proceedings. Convention sponsored by the Solar Energy Society of India. Edited by S. Deb (Jadavpur University, Calcutta, India). Calcutta, Jadavpur University, 1977. 274 p.

Solar energy research in India is examined. Most of the papers are concerned with equipment and techniques and are listed under the following headings: solar concentrator, photovoltaics, thermoelectric, photo, and biochemical conversion, instrumentation and environment, solar heating, solar collector, and solar distillation and cooling. Future solar energy use and costs are estimated. Industrial, domestic, and agricultural applications of solar energy in India are

discussed; topics considered include the testing of five solar cookers at Jodhpur and a commercial solar dryer for Indian conditions. Reports on research programs in some other countries are presented. M.L.

A78-42102 Key-note address - Solar energy research and development. A. Ramachandran (Department of Science and Technology, New Delhi, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 9-13.

Solar energy research and utilization in India are discussed. Desired rural sector applications include irrigation pumps, solar convective dryers, solar refrigeration devices, distillation plants, small electric stations, and domestic electric supply. Urban applications could include domestic and large-scale water heating systems, refrigeration facilities, dryers for tea, milk, and paper industries, and desalination plants. Advances in these areas are briefly surveyed, and research projects involving thermal devices and direct conversion are listed. It is suggested that the use of solar energy to provide low-grade heat for solar cookers or to operate directly heated air and water heating systems is economically viable, but that the conversion of solar energy into mechanical or electrical energy has a low thermal efficiency, and high-efficiency photovoltaic systems are far more costly than alternative systems. M.L.

A78-42103 Progress report from Central Electronics Ltd., Delhi. E. V. Bhaskar (Central Electronics, Ltd., Sahibabad, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 18-20.

Research projects involving solar cells, solar cell materials, and photogalvanic cells are surveyed with attention to the relation between research activities in India and research conducted in other countries. Solar-cell research areas considered include the conventional silicon solar cell, silicon ribbons for solar cells, polycrystalline silicon solar cells, the amorphous silicon solar cell, high-concentration GaAs solar cells, tracking and nontracking system for solar cells, CdS solar cells, and the MOS solar cell. Materials research in India includes the development of a reactive glass blowing method for preparing pure silicon, the preparation of pure CdS, and gallium extraction from Bayer's liquid. Photogalvanic cell research in India involves investigation of the use of thionine chloride and ferrite salts. M.L.

A78-42104 Solar energy for use as a source of power. S. Rangarajan, O. Chacko, and C. G. Rahalkar (Meteorological Office, Poona, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 24-29. 5 refs.

Regular measurements of global and diffuse solar radiation are made at several stations in India using thermoelectric pyranometers. From the data collected from 12 stations for periods up to 15 years, the horizontal and vertical components of radiation received directly from the sun have been computed. The values of these components on inclined surfaces and of the horizontal component on vertical surfaces facing different directions have been computed and the results discussed. The temporal and spatial distribution of irradiation on surfaces of different orientations has been presented from the point of view of the utilization of solar energy as a source of power. The spectral values of radiation received directly from the sun on inclined as well as vertical surfaces based on measurements made at Poona have been presented and their seasonal and diurnal variations discussed. (Author)

A78-42105 Progress in the utilization of solar energy in Chile. J. G. Hirschmann and B. Seifert (Valparaiso, Universidad Técnica, Valparaiso, Chile). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 29-37.

11 refs.

Solar energy research in Chile is discussed in terms of indirect and direct utilization. Solar evaporation, solar distillation, and solar heating are examples of indirect utilization. Specific projects involving the production of table salt from sea water are explained, and equipment used for solar desalination, cookers, and furnaces is described. Research on the direct utilization of solar energy includes studies of photovoltaic cells and of photosynthesis in plastic tents located in desert areas. The relation between university research and industrial application is considered. M.L.

A78-42106 Spectral distribution of global solar radiation at Poona. S. Rangarajan and C. G. Rahalkar (Meteorological Department, New Delhi and Poona, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 38-43.

Thermoelectric pyranometers with hemispherical glass filters as well as a photocell radiometer with a band pass ultraviolet filter were used to measure global solar radiation in the whole spectrum and in different spectral regions at Poona, India. Spot measurements of diffuse solar radiation were obtained by shading the global instruments. Results for 1974 are reported. Seasonal and diurnal variations for short-wave and long-wave radiation are described, and the effects of clouds and the monsoon season are considered. The proportion of short-wave radiation is minimum during the summer months and maximum during winter. Factors which affect the ratio of spectral to integral global solar radiation are examined. M.L.

A78-42107 Some data collected by experiments to be utilised for solar energy application. M. Ghosh. In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 44-48.

The paper contains some experimental data for solar energy work in its utilization in evaporation of water, heating of water, village industries, other village requirements and preservation of heat for its use when the sun is off. It also contains some data on (1) the maximum temperature raised with different sets of glass pane to allow solar energy into the Hot Box, and (2) the temperature variation in the Hot Box with the inclination of the sun at Jamshedpur - an industrial town - Lat. 22 deg 44 sec N and Longitude 86.2 deg E. It also discusses the comparative position of utilizing nuclear and solar energies as alternate sources to fossil fuels. (Author)

A78-42108 Research and Product Development programme in the area of solar thermal energy. H. N. Sharan (Bharat Heavy Electricals, Ltd., New Delhi, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 49-51.

Priority projects in the Solar Thermal Energy Research and Product Development Program in India are listed, and the status of current research is characterized. Collector development, domestic water heaters, cooling systems, solar vapor pumps, and a 10-kW solar electric power plant are considered with attention to the research activities of the Bharat Heavy Electricals Ltd. and the Central Electronics Ltd. It is concluded that it is too early to evaluate the technical performance and economic viability of solar energy projects in the Indian context. M.L.

A78-42109 Radiation measurements for solar energy utilization. A. Mani (Raman Research Institute, Bangalore, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 52-55.

Solar data requirement for various solar energy systems are tabulated. The relationship between global, direct and diffuse

radiation is explained. The principal types of instruments for measurement of solar radiation are briefly described and the accuracy achievable mentioned. The paucity of data required for solar energy utilization is pointed out and theoretical computation of terrestrial solar data from the available extraterrestrial ones, as a way out of this, is advocated. The need for coordination and standardization in solar data collection is particularly emphasized. (Author)

A78-42110 Solar energy reflector using metallised polystyrene. R. N. Mitra and A. N. Daw (Institute of Radio Physics and Electronics, Calcutta, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 56-58.

Efficient utilization of solar energy and its conversion to other forms of energy require among other things a reflector which will concentrate the energy on a suitably positioned energy converter. In this paper, a new method of fabrication of reflector is described. The reflector basically consists of a light, high impact polystyrene base coated with a shiny metallic layer by an electroless-cum-electroplating technique. It possesses the virtue of being light and cheap and can be fabricated on a large scale with the help of indigenous materials. The characteristics of the reflector are also studied and compared with those of existing types of reflectors.

(Author)

A78-42111 Non-tracking solar concentration for solar cell. C. M. Singal and S. K. Shil (Central Electronics, Ltd., Sahibabad, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 58-61. Research supported by the Department of Science and Technology of India.

A non-tracking type concentrator system utilizing a lens and a reflecting element is proposed. This system does away with the stringent conditions of accurate and continuous tracking generally needed for high concentration systems and requires periodic adjustments only. Further, it is also capable of working in diffused light. Two concentrator designs with concentration ratios of 25 and 100 are described.

(Author)

A78-42112 A non-tracking heat concentrator capable of giving concentration factor of the order of 20. Mr. Murlidhar, A. Gupta, and V. K. Tewary (Birla Institute of Technology and Science, Pilani, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 62, 63. Research supported by the Department of Science and Technology of India.

A78-42113 Design of a non-tracking solar heat concentrator/collector system. A. Agarwala and V. K. Tewary (Birla Institute of Technology and Science, Pilani, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 64, 65. Research supported by the Department of Science and Technology of India.

A novel design is proposed for a non-tracking solar concentrator which also serves as a very efficient collector and heat trap. It works as a body with high absorptivity and a very low emissivity. Thus, the heat trapping efficiency of such a device can be easily in excess of 70%. There is no theoretical limit to the concentration factor and solar rays incident at all angles are concentrated including the diffuse radiation. The design consists of a multiple coaxial system of reflecting cones. The angles and the lengths of the cones are adjusted in such a way that the annular space between the cones is enough to trap the incoming radiation.

(Author)

A78-42114 Design of a non-tracking concentrator which will distribute sunlight in a uniform manner over a flat receiving surface. A. Gupta, S. Kumar, and V. K. Tewary (Birla Institute of Technology and Science, Pilani, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University,

1977, p. 66, 67. 5 refs. Research supported by the Department of Science and Technology of India.

A78-42115 Semiconducting materials in solar energy conversion. N. Chaudhuri (Defence Institute of Stores Preservation and Packaging, Calcutta, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 69, 70.

The paper presents a brief account of different semiconducting materials useful for the direct conversion of solar energy into electrical power. A comparative study of the usefulness of the materials for the purpose has been reported. A brief account of the process involved in the fabrication of semiconductor solar cell has also been presented in the paper.

(Author)

A78-42116 Energy budget of single crystal silicon solar cells with the present state-of-art. A. Bhaskararao and S. Narahari (ECIL, Hyderabad, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 71-74.

The energy input for converting 1 kg of single crystal silicon into solar cells is estimated for 35 mm, and 75 mm diameter silicon single crystals, and the energy pay-back time in years at 10% conversion efficiency is estimated for the three sizes for 300-800 mWh/sq cm per day at 50, 70, and 90% production yields. The calculations indicate that a minimum of six years are required to achieve a break-even point in the energy budget. The processes for which energy input estimates are presented are described as polycrystalline silicon, single crystal growth, wafer preparation, p-n junction formation by diffusion, electrical contacts, AR coatings, and testing and evaluation. The breakdown of costs of silicon solar cell manufacture are considered.

M.L.

A78-42117 Effects of temperature on the performance of silicon solar cells. S. C. Bawa, T. B. Desai, K. S. Yadav, V. Holla, and B. R. Marathe (Central Electronics Engineering Research Institute, Pilani, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 75, 76. 5 refs.

The effects of temperature on 4.84-mm-sq p-n silicon solar cells was studied by determining changes in open-circuit voltage, short-circuit current, reverse saturation current, fill factor, diode factor, maximum power output, and internal cell resistance. The data indicate that a temperature rise of about 20 C above ambient temperature causes a power loss of about 2%, but a greater increase in temperature causes a much larger loss of power. For example, a temperature rise of about 100 C above ambient causes power dissipation of about 40%. The loss in output power and efficiency can be minimized by using higher light intensity in conjunction with a heat bath that limits heat increase to less than 2 C.

(Author)

A78-42118 Deviation in solar cell characteristics from their ideal behaviour. P. K. Bhatnagar (Delhi, University, Delhi, India) and S. R. Dhariwal (Government College, Ajmer, Rajasthan, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 76-78. 7 refs.

Deviations in solar cells due to dark properties of the junction or to nonlinearity in photo-generated currents are considered with reference to silicon p-n junctions, and their propensity for light trapping.

D.M.W.

A78-42119 A note on the performance of a Si solar cell under partial illumination. S. Mukherjee (Jadavpur University, Calcutta, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 79-82.

A practical photovoltaic solar array has often to operate under

partial illumination. Experimental results on the performance of a solar cell with partial illumination are rather meagre. A series of observations was, therefore, made in the laboratory with single crystal silicon cells - both gridded and ungridded. The results are described in the paper. Results show that both the short-circuit current and the open-circuit voltage appear to depend upon the total area exposed to radiation and not on the way the area is selected with respect either to the edges of the cells or the strips of the grid. The cells behave as if the photo-generated carriers spread out evenly over the entire cross-section of the cell. Semi-quantitative evidences in favor of the conclusion are also given. (Author)

A78-42120 Performance of the novel solar cell. S. C. Rastogi, R. C. Goel, and B. N. Sharma (M.M.M. Engineering College, Gorakhpur, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 82-84.

The paper deals with the design and performance characteristics of the novel solar cell, in which the solar radiations obtained from the sun have been utilized for the phase transformation of the crystal, developing a potential difference between the electrodes. Further investigations on the long life performance of the cell in respect of emf developed and available current as function of the temperature have been made. Suggestions to make improvement in shape, size and construction of the cell are also given. (Author)

A78-42121 Investigation on the non-uniform thickness of the skin region of a CdS solar cell. M. K. Mukherjee and S. N. Das (Jadavpur University, Calcutta, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 84-87. 7 refs. Research supported by the Alexander von Humboldt-Stiftung.

On the basis of the theoretical analysis of the spectral response of Cu(x)S-CdS solar cell, a nonuniform skin region of the cell has been proposed. An experimental work to verify the proposed structure was carried out by one of the authors in the University of Stuttgart, West-Germany. CdS cells were lapped and etched to expose grains and junction region. SEM pictures of such sections show that the thickness of the skin layer is highly nonuniform due to reaction at the grain boundaries. The present paper reports these along with the implications of such structures on the properties of the cell. (Author)

A78-42122 Evaporated CdS film based heterojunction solar cells. K. L. Chopra, S. R. Das, P. Nath, P. J. George, and A. Banerjee (Indian Institute of Technology, New Delhi, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 88-90. 8 refs. Research supported by the Department of Science and Technology and Central Electronics, Ltd.

A solid state reaction method using CdS films with a thickness of 4 microns is employed in the fabrication of heterojunction Cu₂S-CdS solar cells having an efficiency of 2-3%. The physical properties of the films are noted, including low resistivity (10 ohm/cm), high mobility (10 sq cm/V/sec), and sharp optical absorption edge. The preparation of the CdS films, using vacuum evaporation of pellets followed by dipping onto a glass substrate, is described. Two types of solar cells using the films were examined, the second type having a substantially thinner CdS layer. It is found that the second type is more stable and lasts longer, i.e., it exhibits no degradation after three months, while the first type showed degradation after a few weeks. D.M.W.

A78-42123 Sprayed CdS thin film solar cells. K. L. Chopra, A. Banerjee, S. R. Das, P. Nath, and V. Dutta (Indian Institute of Technology, New Delhi, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 91-93. 13 refs. Research supported by the Department

of Science and Technology and Central Electronics, Ltd.

An inexpensive spray technique has been developed to grow large-area cadmium sulphide films on different substrates. The as-deposited high resistivity films are photoconducting and exhibit a photoconducting gain of about 6 orders of magnitude. Subsequent annealing in vacuum yields films of low resistivity (10-100 ohm-cm) and high mobility (10-100 sq cm per volt per sec) suitable for fabrication of solar cells. Junctions have been formed by the conventional chemiplating method and a novel solid state reaction developed by the authors. Cells with maximum open-circuit voltage of 450 mV efficiency of about 2% have been reproducibly obtained. (Author)

A78-42124 Failure analysis of cadmium sulphide solar cells. N. R. Pillai and M. K. Mukherjee (Indian Space Research Organization, Vikram Sarabhai Space Centre, Trivandrum, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 94, 95.

Work has been carried out on the development of thin film CdS solar cells based on Mo and Kapton (a polyimide film) substrates. Cells processed on Mo substrate gave an open-circuit voltage of 450 mV and a short-circuit current of 5 mA/sq cm. Kapton has the advantage of having less weight and therefore higher power to weight ratio for cells based on this material. However, there are a number of factors, including environmental ones, that can cause damage to these cells. Accordingly, a study of such deterioration for CdS solar cells based on both Mo and Kapton substrates has been undertaken. The comparative data reveal very clearly the sources of failure of the cells as well as remedial measures to be taken that may enhance the cell reliability. (Author)

A78-42125 Power increase from solar cells under pyramidal-horn type concentrator. R. A. Mahabala, S. D. Gomkale, and R. L. Datta (Central Salt and Marine Chemicals Research Institute, Bhavnagar, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 96-100. 8 refs.

It is known that the current output from silicon or gallium arsenide solar cell increases almost linearly with the incident solar radiation. A pyramidal-horn type concentrator has been designed to concentrate solar radiation uniformly over the solar cell surface. It has been found that the short-circuit current has increased from 70 to 248 mA and the power output has been increased from 114 to 225 mW for opening area (concentrator aperture) to base area (target area), ratio of 10:1 for pyramidal-horn type concentrator having buffed aluminum reflectors. The open-circuit voltage dropped from 2.55 to 2.10 V while the temperature of the cell increased from 27 to 82 C. (Author)

A78-42126 Performance characteristics of a solar battery concentrator system using Si and CdS cells. S. Deb (Jadavpur University, Calcutta, India) and H. Saha (Kalyani, University, Kalyani, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 100-105. 8 refs.

The multifaceted role played by a concentrator when used in conjunction with a solar cell panel is first described. The various loss factors affecting the overall efficiency of the battery-concentrator system are evaluated for a typical concentrator using a quasi-cylindrical array of flat mirrors arranged in rows and columns. The problem of mismatching of the output with the variation in insolation is considered and possibilities of its reduction are discussed. The effect of regular diurnal variations of insolation on the battery output and its minimization through the use of optimum concentration in both Si and CdS solar cell panels are also described. The compatibility of the use of concentrators for optimum matching and smoothing of the output of a solar battery using Si and CdS cells are pointed out. Finally, the cost per watt and the effective cost

réduction factors for both Si and CdS solar batteries are estimated.
(Author)

A78-42127 Technology of Cu₂S-CdS solar cells - German state-of-the-art. W. H. Bloss and G. H. Hewig (Stuttgart, Universität, Stuttgart, West Germany). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 105-107. Research supported by the Bundesministerium für Forschung und Technologie.

Solar energy can be converted in different ways. The most attractive application is the direct conversion of solar radiation to electricity. For large-scale application large-area photovoltaic devices are necessary. Highly efficient solar cells can be produced on the basis of thin semiconducting films. An automated pilot line production for CdS layers, which are evaporated under high-vacuum conditions, and their subsequent treatment to get an encapsulated thin film solar cell are described. The thin-film solar cells with an area of 50 sq cm show efficiencies between 4 and 5%. On the basis of the results of pilot line production, an evaporation plant with a daily manufacturing rate of 60 sq m thin-film solar cells is proposed. Material costs and energy consumption of a large-scale production process for thin-film solar cells are estimated to be 20 dollars/sq m and 30 Wh/sq m, respectively.
(Author)

A78-42128 Dependence of Schottky barrier solar cell efficiency on the thickness of the interfacial layer. S. Srivastava, N. K. Swami, and H. M. Ghule (Birla Institute of Technology and Science, Pilani, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 107-110. Research supported by the Department of Science and Technology of India.

A78-42129 Effect of minority carrier diffusion length on efficiency of Schottky barrier solar cell. B. Bhaumik and R. Sharan (Indian Institute of Technology, Kanpur, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 111-113. 10 refs.

A78-42130 Back-wall Schottky barrier solar cells - with and without an interfacial layer. P. Basu, K. Bhattacharya, and H. Saha (Kalyani, University, Kalyani, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 114-118. 8 refs. Research supported by the University Grants Commission.

The relative merits and demerits of a conventional front-wall Schottky barrier solar cell are first pointed out. The possible advantages and limitations of a back-wall Schottky barrier solar cell are discussed. Transport equations are set up for the analysis of back-wall Schottky barrier solar cells assuming (1) negligible recombination/generation of photocarriers in the depletion region, and (2) negligible tunneling effect. Possible performances of Si, GaAs, CdTe and Cu₂S back-wall Schottky barrier solar cells are examined by studying the variation of maximum conversion efficiency with the thickness of the semiconductor layers having surface recombination velocity as parameter. It is seen that with realistic parametric values, conversion efficiency of the order of 5-6% should be obtainable for Si and GaAs cells if the potential barrier is nearly 1 eV and there is no interfacial layer. The presence of a suitable interfacial layer in Si and GaAs cells leads to the same value of efficiency even with a much lower value of potential barrier and to much greater efficiency if potential barrier is nearly 1 eV.
(Author)

A78-42131 Trap induced photovoltage in thin films of gold-cadmium sulphide-indium diodes. S. K. Srivastava, R. Dwivedi, and P. Lal (Banaras Hindu University, Varanasi, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 120, 121. 8 refs.

A78-42133 Utilisation of solar energy by thermoelectric generators. K. K. Gopinathan, V. Sundaram, and C. V. Suryanarayana (Central Electrochemical Research Institute, Karaikudi, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 126-128. 13 refs.

The article discusses the use of solar thermoelectric generators for energy production in India. It is noted that flat-plate collectors may be used for low temperatures (to 100 C). The coating materials of the heat-absorbing surfaces include Cr₂O₃, PbS, silicon, germanium, the mixed oxides of copper, and the mixed sulfides of zinc and nickel. For high temperatures, solar-energy concentration devices (such as paraboloids of revolution, circular cylinders, Fresnel lenses, and dual mirror systems) are used. Various commercial thermoelectric generator systems are described. Current research concerning the application of such generators in India is outlined.
S.C.S.

A78-42134 A plausible scheme to improve stability, life and efficiency of thermoelectric energy converters. A. R. Saha (Jadavpur University, Calcutta, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 128-131. 5 refs.

A method for optimizing the stability, life, and efficiency of thermoelectric energy converters is proposed. The adaptive thermal impedance of a gas-buffered heat-pipe system maintains a constant-temperature surface. Liquid sodium heat-pipe systems may be used to achieve constant temperatures near 500 C in thermoelectric generators constructed of materials having peak efficiency near 500 C. Various thermoelectric materials are classified into three groups on the basis of their operating range of temperatures.
S.C.S.

A78-42135 Photochemical and photoelectrochemical routes and solar energy conversion. P. N. Moorthy, J. P. Mittal, M. D. Karkhanavala, A. V. Sapre, T. Mukherjee, S. K. Sarkar, and P. V. Kamat. (Bhabha Atomic Research Centre, Bombay, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 131-134. 8 refs.

Photochemical mechanisms operating in ferrous-thionine photo-galvanic cells are discussed with reference to modifications aimed at enhancing the power output of the cells. One such modification is the solubilization of chlorophyll-a (in cells using that substance as the sensitizer) in the miscellar system and subsequent electrodeposition. Also discussed, in photochemical cells employing TiO₂ and other oxide films in various redox electrolytes, is triplet-triplet energy transfer from doubly excited naphthalene, giving H₂ as a product, and the photo-assisted electrolysis of water, producing both H₂ and O₂.
D.M.W.

A78-42136 Photochemical conversion and storage of solar energy /An overview/. U. Samanta, R. Tarafdar, and K. K. Rohatgi-Mukherjee (Jadavpur University, Calcutta, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 135-138. 20 refs.

It is noted that an important natural mechanism for the storage of solar energy is green plant photosynthesis. Three approaches involving the use of photochemical reactions in deliberate engineering schemes to store solar energy are discussed. In the first, photochemical endergonic reactions store energy in stable photo-products, e.g., Glauber's salt sensitized with CuCl, which release heat

energy later on, as needed. The second involves photoelectrochemical devices, e.g., Fe-thionine cells, which generate electrode-active species under illumination, and undergo a reverse reaction in the dark, generating an electrical current. Finally, a method is presented whereby a photosynthetic membrane having the properties of a semiconductor is used to separate photooxidized and photo-reduced forms, which can then couple as required through a recycling of electrons through an external circuit. D.M.W.

A78-42137 A study of biochemical fuel cells utilizing animal and kitchen waste as fuel. J. Singh and V. Dev Gupta (Punjab Agricultural University, Ludhiana, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 139-141.

A preliminary study has been carried out on experimental biochemical fuel cells, fueled with gobar in one and kitchen waste including starch in the second. The yeast is employed as catalyst in the biochemical reaction. The V-I, Power-I, Voltage-power and discharge characteristics have been studied for these cells. The peak power made available is 612 microW/sq cm with Cu-Zn electrodes and peak current drawn is 2.2 mA/sq cm. The open-circuit voltage available is 1 volt. (Author)

A78-42138 Solar energy and storage batteries /Invited Lecture/. G. Cooper (Chloride Technical, Ltd., Manchester, England). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 142-148.

A description is presented of a preliminary study which was carried out to obtain information regarding the state-of-the-art of solar cells, their storage battery requirements, and likely applications. A sodium thermoelectric generator considered operates at 800 C through the development of a temperature gradient across beta-alumina which is only conductive to sodium ions. A potential difference is developed across the ceramic. Thus electricity is produced directly from heat with no moving parts and with a projected efficiency of about 20%. The minimum cost system in the case of an employment of solar cells and storage batteries depends upon the relative prices of solar cells and storage batteries. If solar cells were cheap, then the solar array could be increased in size to eliminate the summer/winter storage cycle completely. The storage demand could then be reduced to that required at night or for a peak load situation, plus contingencies. To simplify the design procedure a computer program has been written which optimizes the design, with appropriate allowance for contingencies, given monthly solar radiation data and load requirements. Nickel cadmium and lead acid battery types are currently being considered for energy storage applications. G.R.

A78-42141 Flow-measurement using solar radiations. J. P. Tewari, K. A. Misra, and G. S. Srivastava (M.M.M. Engineering College, Gorakhpur, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 155, 156.

Accurate measurement of low flow rate is important for the efficient utilization of energy reserves in solar storage tanks. Two methods are presented, thermistors and thermocouples, for providing real-time (on the order of 1 sec) information on flow rate using electronic prediction. It is noted that the suitability of the filter unit depends on the noise level in the system. D.M.W.

A78-42143 Some aspects of radiation climatology in relation to applied solar energy. M. Chandra (Central Building Research Institute, Roorkee, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976,

Proceedings. Calcutta, Jadavpur University, 1977, p. 159-162. 12 refs.

The aim of this paper is to survey briefly the basic data which have been collected over the years by I.M.D. and to discuss them in the light of different aspects of radiation climatology important in solar energy utilization. Some of the measurements by the author at Roorkee are also discussed. The computational procedure of estimating solar radiation at places where no long-term observed data are available have been critically examined and described along with some of the author's own computations. Other important aspects of radiation climatology like frequencies of periods of radiation low enough to affect efficient utilization have also been briefly touched upon. (Author)

A78-42144 Cheap packed-bed solar air heaters. P. Singh (Punjab Agricultural University, Ludhiana, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 162-164. 11 refs.

Experimental investigation has been conducted on solar air heaters using cheap packed bed absorbers. These absorbers consist of iron wires and iron fillings which are available in abundance as waste material. Four models of single pass air heaters employing different absorbers, but identical in all other respects, were fabricated. Only single layer of glass sheet was used. Experiments were conducted regarding stagnation temperature and collection efficiencies on clear days. These packed bed absorbers were found to be very efficient. (Author)

A78-42145 Design and evaluation of an inexpensive heat pipe. Y. P. Gupta and D. Singh (Punjab Agricultural University, Ludhiana, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 164, 165.

An inexpensive heat pipe was fabricated out of indigenously available plastic pipes and kerosene lamp wicks. The effect of operating temperatures and the amount of charge on the performance of this heat pipe has been investigated. (Author)

A78-42146 A suggestion for improving the heat transfer from solar heaters. A. S. Zadaonkar (Government College of Engineering and Technology, Raipur, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 166, 167.

The paper investigates transient heat conduction rates in the storage tank of a solar water heater with different materials. To improve the heat transfer the materials, i.e., window glass and transparent plastic coated glass, were subjected to electric field. It is found that with the increase of electric field the heat transfer increases. As such it is found that the application of an electric field to solar heater materials will increase the heat transfer and also the efficiency of solar heaters. (Author)

A78-42147 Performance study of spray-type solar water heater. H. C. Agarwal and R. K. Shah (Indian Institute of Technology, Kanpur, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 168-170.

A new design of solar water heater working on forced circulation principle, suitable for large-scale applications, has been developed and tested. The design introduces spray nozzles inside the collector which sprays fluid in the form of fine particles upon the bottom surface of the black absorber plate which increases the heat exchange considerably. (Author)

A78-42148 A simple technique of fabrication of paraboloidal concentrators. M. Srinivasan, L. V. Kulkarni, and C. S. Pasupathy (Bhabha Atomic Research Centre, Bombay, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 173-176. 6 refs.

A technique for fabricating simple and compound paraboloidal concentrators for solar radiation, starting from a plane sheet of material has been evolved. Aluminized Mylar is an ideal reflector material for fabricating cheap solar concentrators for various applications. Pasted on thin sheet-metal backing, concentrators of various geometrical shapes such as cones, paraboloids and combinations, of these were fabricated. The focusing property of the concentrators was tested using a portable He-Ne laser. Water heating and boiling measurements at various times of the day established that the net efficiency of absorption of solar energy for the different sizes and designs of collectors tested varied up to about 40% depending on the concentrator and absorber vessel design. (Author)

A78-42149 Calculation procedure for determining the thermal performance of solar domestic hot water and space heating systems. V. Muthuveerappan, M. Kunchitapatham, A. Ramanathan (Annamalai University, Annamalaiagar, India), and M. Kathiresan (Pittsburgh, University, Pittsburgh, Pa.). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 176-180. 5 refs.

A78-42150 Optimum solar energy collection. S. K. Acharya and L. N. Misra (Regional Engineering College, Rourkela, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 181-185.

The optimum day and water flow rate for solar energy collection from a parabolic cylindrical concentrator are studied. The concentrator, consisting of a nickel-plated mild steel sheet, has a 3.24 sq m area. Aluminum, copper, and galvanized iron pipes serve as collectors. Daily and seasonal variations are simulated via manual rotation. It is found that: (1) collectors constructed out of materials with high thermal conductivity yield better solar energy collection, (2) blackened tubes improve collection efficiency, (3) stagnant water yields a higher rise in temperature and a lower rate of energy collection than flowing water, and (4) tilting arrangements yield improved collection efficiency. S.C.S.

A78-42151 Experimental studies of selective coatings for solar energy collectors. K. Singh and K. D. Mannan (Punjab Agricultural University, Ludhiana, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 186, 187.

A78-42152 Development of selective solar surfaces. A. Chandra and J. S. Puri (Central Building Research Institute, Roorkee, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 188, 189. 11 refs.

This paper discusses the reflectivity of a system consisting of a single dielectric layer deposited on a metallic substrate. From the condition of zero reflectance, a relationship between optical constant of dielectric film and metal is derived. The oxide layers developed on copper and aluminum is also reported. The temperature difference between selectively and lamp-black coated Al plate is 15 C. (Author)

A78-42153 Effect of buoyancy on heat transfer rates in a solar collector. M. L. Verma, B. K. Shapak (Government College of Engineering and Technology, Raipur, India), and P. K. Nag (Indian Institute of Technology, Kharagpur, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 190-192.

A78-42154 Experimental investigation of circular cylindrical solar heat collector of stationary type. K. Singh and K. D. Mannan (Punjab Agricultural University, Ludhiana, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 193-195.

The present study was undertaken to experimentally evaluate the suitability of circular cylindrical solar energy collector of stationary type for collection of solar energy in the temperature range of 80 to 140 C. A cylindrical concentrator of circular profile was fabricated having a length and aperture width as 245 cms and 101.4 cms respectively. The reflector was made of buffed aluminum sheets. The experiments were conducted with flat-plate target and triangular targets of three different sizes over a range of concentration ratios between 1.94 and 2.8. The solar energy collection efficiencies at various temperatures have been determined. (Author)

A78-42155 Determination of shading factor for flat-plate collectors. S. L. Daga (Central Salt and Marine Chemicals Research Institute, Bhavnagar, India) and C. P. Gupta (Roorkee, University, Roorkee, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 196-198.

Research supported by the Council of Scientific and Industrial Research.

A mathematical technique is presented which is designed to calculate the effects of shadow on both flat-plate and tilted solar collectors. In the case of the latter, an azimuth angle for the tilted surface is defined. Attention is given to the modeling of hourly variations in shadow for both types of collectors. D.M.W.

A78-42156 Condition for no shadow, and effective shadow due to plane reflectors. S. L. Daga (Central Salt and Marine Chemicals Research Institute, Bhavnagar, India) and C. P. Gupta (Roorkee, University, Roorkee, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 199-201. Research supported by the Council of Scientific and Industrial Research.

Plane reflectors with flat-plate collectors increase the amount of energy reaching the collectors and permit operation at higher temperatures (90-100 C). The classical system of Shuman, which has side mirrors on the north and south edges of the collector, is discussed in terms of a mathematical formulation for calculating the position and effect of shadow. Attention is given to optimizing collector position to ensure the greatest possible amount of no-shadow. D.M.W.

A78-42157 Flat-plate solar collector design for industrial air heating using design data hand book. V. Muthuveerappan, M. Ramalingam, G. Ambalavanan, and G. Kamaraj (Annamalai University, Annamalaiagar, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 201-204.

A78-42158 Solar energy Architectural imperative and problem of collectors. R. G. Sathyanarayan (Kudremukh Iron Ore Co., Ltd., Bangalore, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 204-206.

The basic problem in the use of solar energy involves its storage. Design criteria encountered by architects planning buildings which store solar energy are discussed, noting that it is considerably less difficult to construct a solar building from scratch than to add a solar unit to an existing building. D.M.W.

A78-42159 Analysis of solar space cooling systems suitable for tropical climates. M. C. Gupta and P. Gandhidasan (Indian Institute of Technology, Madras, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976,

Proceedings. Calcutta, Jadavpur University, 1977, p. 214-216. 9 refs.

Tropical climates are divided into two types, dry and humid, in an evaluation of the type of solar cooling systems suitable for each. Concentrating collectors are considered a better source of power for the dry tropics, while flat plate collectors are considered more suited for hot, humid regions. Attention is given to solar powered cooling systems using $H_2O-LiBr$ in a continuous cycle and $NH_3-NaSCN$ in an intermittent cycle. For the dry tropics, regenerative evaporative cooling is regarded as a simple and effective system. In the humid tropics, an open cycle cooling system is proposed, whereby water cooled to 7-12 C by partial evaporation in an elevator circulates through an absorber. D.M.W.

A78-42160 Air conditioning using ocean thermal gradients. K. D. Mannan and D. Singh (Punjab Agricultural University, Ludhiana, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 221, 222.

A large (1000 ton) centralized air conditioning facility is proposed for the city of Madras, India. The city has an average dry bulb temperature of 38.5 C in summer, with a relative humidity of 47%. The air conditioning facility, to be located 4.5 km offshore, would use the deep layers (below 1000 m) of sea water to provide indoor temperatures of 26 C and 65% relative humidity. The cost of manufacturing such a facility would be roughly equal to the cost of conventional air conditioning, but its energy requirements are expected to be 70% lower. Critical to the practicability of the scheme is the assumption that the water reaches the air conditioning unit at 59 F or less. D.M.W.

A78-42161 A new design of organic vapour engine for solar systems. R. M. Engira, K. D. Mannan, and A. Lal (Punjab Agricultural University, Ludhiana, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 223-225.

This paper describes the design construction and preliminary performance of vapor cycle engine which has desirable characteristics for use in solar power units. The essential features of this engine are the use of existing I. C. engines main components and modifying the valve and valve timing system. The new design permits adjustment of cut-off as per requirement and also involving no recompression of vapors. The inlet valve of this engine is a modified version of a double beat valve which permits the adjustment of cut-off as well as results in a leak-proof system. Preliminary testing of the engine has been performed and the information so obtained indicates superior performance of this engine over the conventional steam engines. (Author)

A78-42162 Solar energy operated oscillating heat engine. H. V. Rao (Indian Institute of Technology, Kharagpur, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 226-229.

An analogy is drawn between a drinking bird toy and an oscillating heat engine using reciprocating, rotary, or turbine expanders. It is pointed out that both devices rely on ambient air as a heat source, and water at thermodynamic wet-bulb temperature as a heat sink. Attention is given to the design of heat transfer areas in the engine in order to provide optimized thermodynamic flow. A water-lifting engine using solar collectors as a heat source is diagrammed in terms of an idealized thermodynamic cycle. D.M.W.

A78-42163 Solar sea power plants - Prospects and problems. D. K. Dixit and M. S. Ramaprasad (Visvesvaraya Regional College of Engineering, Nagpur, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 230-232. 8 refs.

The feasibility of energy production using solar sea power plants (SSPP) located off the coasts of tropical countries is discussed in terms of the basic physical principles involved in their operation. It is noted that the thermal efficiency of SSPP is low compared to that of conventional plants due to the smaller available temperature differential. Thus, boiler tube area must be increased. The expense of the increase is offset, however, by a reduction in tube thickness made possible by the lower vapor pressures encountered, and by the lower temperature in the tubes, which obviate the necessity of expensive alloys. The possibility of generating vapor by fluids other than water, e.g., ammonia or propane, is discussed. Hazards to SSPP are considered, especially microbial fouling (which can be dealt with using 0.25 ppm chlorine) and storms (whose effects are lessened by submergence). D.M.W.

A78-42164 Solar ponds for power production. D. K. Dixit and B. D. Shiwalkar (Visvesvaraya Regional College of Engineering, Nagpur, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 232-235. 6 refs.

The operation of a meter-deep, black-bottom water pool for the collection of solar thermal energy is discussed. Salt water is used in quantity near the bottom to maintain a density gradient. Water temperatures near 90 C can be obtained from the lower regions of the pool. Attention is given to the mechanisms of transient and steady-state temperature rise in the pool at various depths, optimization of water withdrawal rate, and overall thermal stability. D.M.W.

A78-42165 A domestic multi-purpose solar energy unit. M. K. Ghosh. In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 237-239.

The design of the unit is made on Hot-Box principle. The loss of the heat through the glass cover of the box has been reduced to a great extent by designing the cover of the cooking box with a kind of chamber. A mirror lining is also hinged on the inward side of the wooden cover for the protection of the glass panes of the cooking box, when not in use and fixed at different angles to get additional light through reflection from the mirror. The main body of the cooking box had been tried with different materials, e.g., timber, iron sheet, mud, brick and cement and all of them were found to serve the purpose with difference in efficiency. The unit was successfully tried for some other purposes viz. heating of water, boiling of paddy for husking rice etc. (Author)

A78-42166 Testing of five solar cookers. Jodhpur. H. P. Garg (Central Arid Zone Research Institute, Jodhpur, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 240-243. 15 refs.

The design and functional characteristics of solar cookers are described in terms of their effectiveness in cooking staple foods (chicken, fish, potatoes, etc.) and in boiling water for rice or cereals. The tests were conducted in a desert environment under clear sky conditions. Attention is given to different reflector types, e.g., silvered glass, Cr-plated, anodized Al, simple Al, and plain glass. It is reported that temperatures of 350 C are attainable under optimum conditions in summer using a box with plain glass reflectors, and that paraboloid and step-type reflectors using anodized aluminum can bring 1 liter of water to a boil in 25-30 minutes if wind speed remains below 4 kmh. D.M.W.

A78-42168 Solar energy for tractors. P. Som and J. S. Chatterjee (Jadavpur University, Calcutta, India). In: National Solar Energy Convention, Calcutta, India, November 29-December 1, 1976, Proceedings. Calcutta, Jadavpur University, 1977, p. 253, 254.

The paper deals with the production and the safe storage of hydrogen fuel for Tractor engines in the form of NaH , which reacts with water to produce hydrogen fuel and the by-product $NaOH$.

which is electrolyzed according to Castner's process to recycle the Na and H for producing NaH. The energy required for electrolysis is obtained by collecting solar energy for conversion into electrical power. Within the present scope of the paper authors study the feasibility of the land-use factor for collecting solar energy to ensure steady supply of NaH for tractor tilling 237.749 Macres cereal crop in India. (Author)

A78-42184 Energy perspectives for the year 2000 (Situations énergétiques à l'horizon 2000). M. Mentre and J.-R. Frisch (Electricité de France, Direction Générale, Paris, France). *ICF, SFEN, IFE, and AFTP, Rencontre sur les Situations Énergétiques à l'Horizon 2000, Paris, France, Feb. 22, 1978.* *Sciences et Techniques*, June 1978, p. 32-38. In French.

The paper presents a broad survey of projected energy resources and requirements throughout the world; noting world energy consumption during the 1950-1975 period. Perspectives for a national energy policy in France are proposed, with reference to energy conservation measures and areas for technological research. Individual energy sources are discussed with attention to present and projected availability including carbon, hydraulic power, petroleum, natural gas, and nuclear energy. S.C.S.

A78-42201 International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Symposium sponsored by the Kernforschungsanlage Jülich and Commission of the European Communities. Oxford and New York, Pergamon Press, 1977. 738 p. In English and German. \$65.

A variety of topics concerning plasma-wall interactions is discussed. Attention is given to divertor experiments for impurity control, plasma-wall charge-exchange interactions, a kinetic theory of plasmas in the limiter-shadow region, and models for impurity production in tokamaks. Papers are presented on impurity content and transport noting radial impurity transport and collision-dominated multiion diffusion. Surface effects are studied, including arcing surface phenomena, desorption of surface contaminants, blister formation, and wall erosion. Several diagnostic methods are described with reference to mass spectroscopy and resonance scattering in the vacuum ultraviolet. Methods to control plasma-wall interactions are proposed including surface cleaning, wall conditioning, and mechanical divertors. Potential first-wall problems in large confinement devices are identified. S.C.S.

A78-42202 Recent results on plasma-wall interaction in the T. F. R. tokamak. In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 3-20. 16 refs.

The paper reviews studies in plasma-wall interactions in the TFR tokamak. Impurity behavior during particle injection is discussed with reference to cold deuterium and oxygen injections and the injection of a powerful fast neutral beam. The influence of variations in limiter radius (20-12.5 cm) is evaluated in order to discriminate between the limiter and walls as the primary source of plasma pollution. Several experiments with boron carbide and graphite limiters are outlined noting the results of studies where the QWASS device was connected to the TFR tokamak. The results are examined in terms of edge diffusion, desorption, thermal load, sputtering, and chemical processes. S.C.S.

A78-42203 Divertors for impurity control and review of impurity effects in PPL tokamaks. D. M. Meade (Princeton University, Princeton, N.J.). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 21-37. 34 refs. Contract No. E(11-1)-3073.

Impurity effects on toroidal plasma and methods to reduce impurities have been studied at PPL on a variety of devices. The concentration of impurities has been measured directly using UV and X-ray spectroscopy and from the scattering of injected energetic

ions. These methods indicate the presence of both low-Z impurities such as oxygen and high-Z impurities such as iron or molybdenum. Impurity injection experiments of FM-1 and ATC are explained by a 'semi-classical' transport that is a superposition of classical collisional transport and anomalous transport. Methods to reduce impurities include wall control and divertors. In addition, the interior vacuum wall surface has been monitored during discharge cleaning and plasma operation in an attempt to correlate impurities with wall conditions. Analyses of surface conditions in PLT indicate a decrease in carbon impurities in the plasma as hydrocarbons are removed from the surface test sample. The principles of divertor operation are reviewed. Requirements and methods of obtaining a shielding divertor are described. (Author)

A78-42204 A review of work on plasma-wall interactions and divertor experiments on DITE. P. E. Stott, J. Burt, S. K. Erements, S. J. Fielding, D. H. J. Goodall, M. Hobby, J. Hugill, G. M. McCracken, J. W. M. Paul (EURATOM and U.K. Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England), and A. Pospieszczyk (EURATOM and U.K. Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England; EURATOM and Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 39-51. 13 refs.

Experimental results from DITE are reviewed, with particular emphasis on the study of plasma-wall interactions. The energy and particle fluxes to the walls and limiters, and the return flux of particles into the discharge, have been measured by several methods. The effect of the bundle divertor on these fluxes, and the resulting changes in the plasma parameters are discussed. (Author)

A78-42205 Energy flux and surface temperature measurements at surfaces in the DITE tokamak. D. H. J. Goodall (EURATOM and U.K. Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 53-58. 5 refs.

The surface temperature of a diagnostic probe and the target plate of the DITE bundle divertor, has been measured using an infra-red scanning camera. From the surface temperature measurements the incident energy flux on the surface is calculated. The spatial distribution of energy on the divertor target plate is non-uniform and the maximum energy flux is received near the centre line and the inside edge of the plate. The energy input to the plate reaches a maximum near the end of the discharge pulse. The energy flux to a probe has been obtained as a function of radial position in the shadow of a standard probe limiter. The diagnostic probe receives energy mainly at the beginning and end of the discharge for a normal pulse. (Author)

A78-42206 Wall analysis in TFR performed by QWASS. In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 59-61. 8 refs.

The paper reports measurements of Mo deposition onto a graphite sample. Results are given for an Mo limiter radius of 20 cm and for a graphite limiter inner radius of 19 cm. The amount of Mo deposited is evaluated as a function of sample position and the number of discharges at a fixed position near the plasma. The competing mechanisms of deposition and erosion are considered. S.C.S.

A78-42207 Plasma-wall charge-exchange interactions in the 2XIIIB magnetic mirror experiment. B. W. Stallard, F. H. Coensgen, W. F. Cummins, B. G. Logan, A. W. Molvik, W. E. Nexsen, T. C. Simonen, W. C. Turner (California, University, Livermore,

Calif.), and C. Gormezano (EURATOM and Commissariat à l'Énergie Atomique, Grenoble, France). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 63-68. 5 refs. Contract No. W-7405-eng-48.

Consideration is given to plasma-wall interactions by charge-density exchange wall bombardment in the 2XIIIB magnetic mirror experiment. The plasma is sustained by a neutral beam configuration with 12 neutral beam injectors having extraction energies up to 20 keV. The plasma is maintained in marginal stability with respect to the drift-cyclotron loss-cone instability. The charge energy flux is peaked near 90 degrees. An 11-channel analyzer in the 0.5-39.0 keV range analyzes the neutral-charge exchange flux from the plasma surface. The averaged backscattering coefficient is used to estimate the expected reflux coefficient. Time-dependent radial density profiles created by neutral beam injection are computed. It is noted that: (1) the plasma shield causes a reduced ion heat loss by cold-gas charge exchange, and (2) neutral beam trapping is not the only mechanism for supplying particle input to the plasma boundary.

S.C.S.

A78-42208 Effect of neutral injection heating on the impurity level in the W VII A Stellarator. J. H. Feist, W. Ott, and E. Speth (EURATOM and Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 69-73.

The effect of neutral injection in the MW range on the impurity content of the plasma in the W VII A device is calculated. The wall bombardment due to loss of injected particles and to plasma particles neutralized by charge exchange with the injected beam is calculated. The absolute value of the impurity influx does not depend very strongly on the plasma density, whereas the increase of the effective Z is considerably reduced for higher densities. For constant power absorbed by the plasma, the impurity increase becomes smaller with increasing beam energy. As a realistic example the increase of the effective Z is calculated for a plasma with an initial electron density of 10 to the 14th/cu cm and an effective Z of 2 and cold gas puffing during the discharge. A power of 1.5 MW, shared between the 30, 15 and 10 keV particles of the beam, is transferred to the plasma. For this case the effective Z rises within 100 msec to 2.4, which is considered a reasonably small increase. (Author)

A78-42209 Review of the work on plasma-wall interaction in tokamak plasma confinement at JAERI. Y. Suzuki (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 75-93. 16 refs.

A review is presented on the research activities at Japan Atomic Energy Research Institute on plasma-wall interaction in tokamak plasma confinement. It describes experimental studies in this field made in the existing tokamak devices JFT-2 and JFT-2a/DIVA, basic tests and evaluation on various methods for impurity control made in the design studies of JT-60, and current progress in the design of JT-4. It further presents the results of measurements of basic particle-surface interaction processes and theoretical studies on the impurity-related processes in plasmas. (Author)

A78-42210 Surface and impurity studies in ORMAK and ISX. R. J. Colchin, R. E. Clausing, L. C. Emerson, L. Heatherly, and R. C. Isler (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 95-104. 12 refs. ERDA-sponsored research.

A study is made of surface and impurity studies in the ORMAK and ISX devices. For the ORMAK device it is noted that hydrocarbons initially contaminate the gold surface. Carbon ceases to be an important contaminant following oxygen discharge cleaning. Residual hydrocarbons are controlled by hydrogen or oxygen

discharge cleaning. Results from soft X-ray appearance potential spectroscopy indicate that the iron oxides appearing on the liner surface may originate via diffusion through the one-micron-thick gold surface. The primary light-ion contaminant is oxygen and the primary heavy contaminant is iron. The ISX tokamak includes an ultrahigh vacuum system for surface and plasma impurity studies.

S.C.S.

A78-42211 Alumina-plasma interaction in the Petula tokamak. R. Bardet, M. Bernard, G. Briffod, M. Clement, R. Frank, A. Gauthier, M. Gregoire, P. Grelot, M. Hesse, and G. Lamboley (EURATOM and Commissariat à l'Énergie Atomique, Département de Physique du Plasma et de la Fusion Contrôlée, Grenoble, France). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings.

Oxford and New York, Pergamon Press, 1977, p. 105-114. 8 refs.

In connection with the construction of an alumina vacuum vessel on the Petula tokamak, measurements of the outgassing properties of alumina and studies of alumina-plasma interaction have been undertaken. Outgassing rates of 10 to the -11th and 10 to the -12th torr l/s sq cm are achieved for baking temperature ranging between 150 and 200 C. Two categories of results have been obtained from the studies of alumina-plasma interaction depending on the plasma interacting with the alumina. For dense and cold plasmas (with electron density of about 10 to the 13th and electron temperature of a few eV), impurity concentrations lower than 1 percent are measured - the Elisa experiment. For dense and hot plasmas, a comparison between discharges produced with tungsten and alumina limiters shows an improvement of plasma characteristics in the case of alumina: ohmic power and oxygen contamination are significantly reduced. (Author)

A78-42212 Kinetic theory of plasma in the limiter-shadow region. U. Daybelge and B. Bein (Ruhr-Universität, Bochum, West Germany). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings.

Oxford and New York, Pergamon Press, 1977, p. 117-124.

In this paper, using a simplified model, an analysis for the structure of the plasma boundary layer in the neighborhood of the limiter-aperture edge is given. In this layer, the plasma is assumed to consist of weakly collisional ions and collisional electrons. This assumption requires a rather hot (or clean) plasma. An asymptotic solution to the ion drift-kinetic equation with a full Fokker-Planck term is obtained. The influence of the loss-regions in velocity space upon the collision processes is properly accounted for. From the solution of the boundary layer problem, plasma particle and energy losses to the limiter are calculated. Limiter load profiles as functions of the poloidal angle are given. Results represent boundary conditions on plasma transport inside the core, which may be used in tokamak transport codes for the calculation of the confinement times. (Author)

A78-42213 Screening property of the limiter shadow region for heavy wall impurities. H. A. Claassen and H. Repp (EURATOM and Kernforschungsanlage Jülich GmbH, Institut für Plasmaphysik, Jülich, West Germany). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 125-130.

The impurity problem in the plasma scrape-off layer of a tokamak discharge with a poloidal limiter is considered. In a preliminary study the migration of iron impurities leaving the vacuum wall (liner) with a half-Maxwellian distribution is investigated. Their density and temperature are assumed to be low in comparison to the plasma density and the plasma ion temperature respectively. For the plasma parameters a density of 2×10 to the 12th/cu cm, an electron temperature of 20 eV, and an ion temperature of 100 eV are assumed. The production and motion of the various ion states of impurity are described by a system of

coupled drift-kinetic equations. To calculate the impact ionization rates, the electron density profile, which is taken from an analysis similar to that given by Hinton and Hazeltine for the divertor case is used. (Author)

A78-42214 Protection of walls from hard disruptions in large tokamaks. A. Sestero (EURATOM and Comitato Nazionale per l'Energia Nucleare sulla Fusione, Centro Gas Ionizzati, Frascati, Italy). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 131-136. 5 refs.

During hard disruptions, dangerous overheatings of the limiter can be avoided if the latter is protected by a dense, cold, high-Z plasma blanket - the virtual limiter, as we shall term it here - whose function is to intercept the particles escaping from the hot plasma, and radiate away the absorbed energy as a flux of soft X-rays. A virtual limiter could be artificially produced by various means; but it could also occur spontaneously, as a result of the vapourization of the small amount of limiter material in the early stages of the disruption. The density inside the virtual limiter can be determined by exploiting the requirement that it should be able to slow down the energetic particles originating from the hot plasma. The average state of ionization and the temperature can be in turn determined by investigating the ionization and energy balances. The virtual limiter turns out not to be in coronal equilibrium, due to the vigorous interaction with the hot plasma. The theory of the virtual limiter can also be relevant to the problem of the interaction of a hot plasma with probes and plans-de-preuve. (Author)

A78-42215 The effect of electric field in the divertor scrape-off layer. K. M. Srivastava and A. El Nadi (Ruhr-Universität, Bochum, West Germany). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 137-145. Deutsche Forschungsgemeinschaft Contract No. SFB-162; Contract No. EURATOM-JET-B-GK-78.

The effect of the radial electric field on the particle orbits in the scrape-off layer in a tokamak with an axisymmetric poloidal divertor is investigated. It is assumed that the ions are hot and collisionless and that the electrons are cold and collisional. A wider range of the ratio of electron temperature to ion temperature, i.e., from 1 to .6 has been considered. The ion density, electrostatic potential and electric field in the scrape-off layer are obtained. Plasma diffusion across the separatrix and the particle flow to the collector plates through the drift kinetic equation are considered. The effect of the electric field is seen to be predominant in the boundary layer. The particle and energy fluxes to the collector plates in presence of the radial electric field have been calculated. (Author)

A78-42216 Neutral particle emission of the pulsator plasma during high-density discharges. F. Wagner and H. M. Mayer (Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 149-154. 6 refs.

Experimentally determined absolute values of the fast hydrogen flux are compared with the predictions of a 6-regime-transport code. Remarkable agreement is obtained. By varying the location of the pulsed gas inlet it was shown that the emitted flux decays markedly with toroidal distance from the position of the gas inflow by an amount which is fairly independent of particle energy. Radial profiles of ion temperature and particle flux show a high degree of symmetry. The observed ion temperature at the plasma edge is 190 eV which is attributed to a considerable number of fast neutrals which are reflected from the container wall. (Author)

A78-42217 Models for impurity production and transport in tokamaks. J. T. Hogan (Oak Ridge National Laboratory, Oak Ridge, Tenn.). In: International Symposium on Plasma Wall Inter-

action, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 155-165. 9 refs. ERDA-sponsored research.

Computer models for impurity production and transport in tokamaks are described. A model based on the Oak Ridge Tokamak Code for edge effects is used to describe the time evolution of the energy and densities of electrons in the near-limiter and vacuum chamber wall regions. Measurements used to test the neoclassical impurity diffusion model are presented for two cases. In the first case, estimates provided by central impurity densities for the anomalous spreading usually added to neoclassical impurity diffusion rates are evaluated. In the second case, the interaction of the tokamak's MHD stability and a large oxygen flux is investigated. S.C.S.

A78-42218 Investigation of plasma-wall interaction by the aid of a plasma accelerator. C. Martin, K. G. Müller, and B. Tuczek (Universität Essen-Gesamthochschule, Essen, West Germany). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 167-170. Research supported by the Deutsche Forschungsgemeinschaft.

A plasma beam is produced by the quasicontinuous plasma accelerator 'KOBRA' and impinges on a metallic target. The plasma in front of the wall is influenced by the electric field and by emitted and reflected particles. The working principle of KOBRA and preliminary results of the diagnostic of the plasma are presented. (Author)

A78-42221 Relative importance of different impurity sources in tokamak reactors as estimated from particle balance equations. H. Vernickel, B. U. U. Scherzer, R. Behrisch (EURATOM and Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany), and J. Bohdansky. In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 209-217. 14 refs.

A78-42227 Thermochemistry of the reactions of the metals Nb, V, and Mo with the residual gases of a vacuum (Thermochemie von Reaktionen der Metalle Nb, V und Mo mit Restgasen des Vakuums). H. Migge (Hahn-Meitner-Institut für Kernforschung Berlin GmbH, Berlin, West Germany). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 275-283. 11 refs. In German.

The paper reports a study of the reaction of the refractory metals Nb, V, and Mo with CO, CO₂, H₂, H₂O, and CH₄ - gases that might continue to be present after evacuation of a fusion reactor vacuum chamber. One concern is that if the solid solubility limit is reached, oxides or carbides might be precipitated. Thermochemical calculations concerning the Nb-O-C, V-O-C, and Mo-O-C systems are presented. The stability ranges of the metals and their pure oxides and carbides are indicated in isothermal phase diagrams for 1000 and 1500 K as a function of the partial pressure of CO and of the ratio of the partial pressures of water and hydrogen. The effects of methane on stability are considered. The data are applied in a discussion of metal damage reported to occur in reactor metals exposed to vacuum conditions. M.L.

A78-42242 On toroidal divertors for tokamaks. H. Gerhauser, H. Kever, and A. Rogister (EURATOM and Kernforschungsanlage Jülich GmbH, Institut für Plasmaphysik, Jülich, West Germany). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 551-557.

Consideration is given to the implementation of toroidal divertors in tokamak devices. The influence of a toroidal divertor on

particle balance in the scrape-off layer is discussed with reference to numerical expressions for the fraction of trapped particles, the change in the total number of trapped particles, and the thickness of the scrape-off layer. The influence of a toroidal divertor on plasma stability is reviewed. Means to overcome the effects of a toroidal divertor are proposed, including increasing the toroidal magnetic field, reducing the longitudinal current, and increasing neutral injection heating. S.C.S.

A78-42245 First wall surface treating in the Frascati Tokamak FT. A. Boschi, C. Ferro (EURATOM and Comitato Nazionale per l'Energia Nucleare sulla Fusione, Centro Gas Ionizzati, Frascati, Italy), G. Luzzi, and L. Papagno (Calabria, Università, Cosenza, Italy). In: International Symposium on Plasma Wall Interaction, Jülich, West Germany, October 18-22, 1976, Proceedings. Oxford and New York, Pergamon Press, 1977, p. 583-588. 6 refs.

A high-field, medium-size tokamak, the Frascati Torus, is being assembled at the Centro Gas Ionizzati. Due to the high fields, a strong plasma-wall interaction is expected. In order to reduce the amount of impurities released from the walls, attention has been given to vacuum design and the surface treatments. These treatments include degreasing, bright-dipping, and baking. Very low outgassing rates have been achieved. Samples of the materials selected for the first wall, subjected to different treatments, have been comparatively analyzed by means of AES combined with ion bombarding erosion. Many monolayers of oxygen have been found, although in quite different amounts, depending on the quality of the material and the kind of treatment. (Author)

A78-42257 Symbiotic system of a fusion and a fission reactor with very simple fuel reprocessing. V. L. Blinkin and V. M. Novikov (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Nuclear Fusion*, vol. 18, July 1978, p. 893-900. 12 refs. Translation.

The paper discusses a symbiotic fusion and fission reactor system. The method is based on producing U-233 in the blanket of the fusion reactor from thorium which circulates as ThF₄ in a mixture of sodium and beryllium fluoride melts. The U-233 produced in the blanket supplies a fission reactor and generates fuel for additional symbiotic installations. Electric power and breed fuel with a doubling time of 4-5 years are produced when the ratio of thermal capacities of the fusion and fission reactor is 1:11. The reprocessing system consists of removing U-233 from the salt circulating in the reactor blanket and removing xenon from the fuel salt of the molten-salt reactor. It is also noted that tritium is produced in the fission reactor, the fusion reactor blanket is almost clean, and in principle all the thorium in the fusion reactor blanket can be used to produce U-233. S.C.S.

A78-42258 Transport calculations for a wall-confined liner-compressed plasma. R. E. Waltz (General Atomic Co., San Diego, Calif.). *Nuclear Fusion*, vol. 18, July 1978, p. 901-916. 41 refs. Research supported by the Electric Power Research Institute.

Theory and computations for a wall-confined slow-liner-compressed plasma are presented. The liner device considered has axial open-ended field lines. The numerical calculations include cross-field diffusion of magnetic field, heat, and impurities; compressional effects; heat loss to materially plugged ends; and radiation loss (including coronal impurity radiation). Both insulating and conducting liner boundary conditions are treated. The formation of a cold dense boundary layer is particularly severe in the former case. The heat transport is treated classically with some comparison to possible anomalous behaviour. While impurities are driven out of a straight high-beta plasma by thermal forces, critical trace level amounts present at injection can be catastrophic. Some simple scaling laws for various loss mechanisms are given. (Author)

A78-42259 The ambipolarity paradox in toroidal diffusion, revisited. S. P. Hirshman (Princeton University, Princeton,

N.J.). *Nuclear Fusion*, vol. 18, July 1978, p. 917-927. 24 refs. Contract No. EY-76-C-02-3073.

The radial current in an axisymmetric toroidal plasma is shown to damp away because of parallel ion viscosity on the ion-ion collision time scale. After this transient phase, the electrostatic potential is quasi-statically related to the toroidal angular momentum of each flux surface, and the cross-field particle fluxes are ambipolar and independent of the radial electric field. (Author)

A78-42260 Initial numerical studies of the behaviour of Z-pinch plasma under liner implosion conditions. I. R. Lindemuth (California, University, Livermore, Calif.) and T. R. Jarboe (California, University, Los Alamos, N. Mex.). *Nuclear Fusion*, vol. 18, July 1978, p. 929-938. 21 refs. Contract No. W-7405-eng-48.

A numerical analysis is made of the behavior of a Z-pinch plasma under linear implosion conditions. A time-dependent two-dimensional MHD plasma model is used. The model includes ionization, radiation, resistive diffusion, and thermal conduction. A computer code using implicit generalized Eulerian finite-difference methods solves the MHD partial differential equations. The calculations are based on assumed parameters of plasma volume 10-cm long and initially 30-cm in diameter, and constant linear velocity of 1 cm/microsec. Two-dimensional effects including the formation of a relatively cold dense region on the axis and the development of a wall-induced instability at the liner are noted. Comparisons are made with infinite-cylinder one- and two-dimensional calculations. S.C.S.

A78-42261 Tearing-mode-stable diffuse-pinch configurations. D. C. Robinson (EURATOM and U.K. Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England). *Nuclear Fusion*, vol. 18, July 1978, p. 939-953. 43 refs.

It is demonstrated that tearing-mode-stable diffuse-pinch configurations of the reverse-field pinch type exist at zero beta for a current-carrying column surrounded by a small vacuum region. The conducting wall plays a vital role in this stability both to $m = 0$ and $m = 1$ modes. The core of the plasma, which has to satisfy a resistive-stability criterion, is of the form given by Taylor for a minimum-energy state but the outer region is quite different. Values of the pinch configuration parameter up to 3 are possible, permitting strong ohmic heating with zero or low current densities near the wall. Such configurations can be stable to ideal hydromagnetic modes for central values of beta of up to 17% (average beta 35%). (Author)

A78-42262 Cyclotron oscillations of a large-Larmor-radius plasma. A. V. Timofeev (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Nuclear Fusion*, vol. 18, July 1978, p. 955-963. 9 refs. Translation.

A method is proposed for investigating plasma oscillations in axially symmetric systems with a longitudinal magnetic field, which can be used for an arbitrary ratio of the Larmor radius of charged particles to the radius of the system. An anisotropic ion cyclotron instability and a modified negative-mass instability are analysed with this method. The analysis was performed for a system with parameters similar to those of the Ogra-3 device. It is shown, in particular, that in the case of a modified negative-mass instability, the threshold density for oscillations of the first azimuthal mode has a lower value than for the zero mode. This result corresponds to experimental data. (Author)

A78-42263 Two-component, multiple-mirror reactor with depressed ion temperature. S. T. Yang and M. A. Lieberman (California, University, Berkeley, Calif.). *Nuclear Fusion*, vol. 18, July 1978, p. 965-969. 18 refs. NSF Grant No. ENG-75-02709; Contract No. E(04-3)-34-PA-215.

The power balance equations for a two-component multiple-mirror reactor have been solved. The electron- and warm-ion-component power flows are treated separately. Significant depression of the ion temperature is found, slowing the multiple-mirror losses. For P (net electrical) = P (beam), a typical calculated reactor length is 230 m for a midplane field of 9.3 T. (Author)

A78-42264 Non-resonant pump field modification of the sidescatter threshold. P. N. Guzdar (Princeton University, Princeton, N.J.) and A. Sen (MIT, Cambridge, Mass.; Physical Research Laboratory, Ahmedabad, India). *Nuclear Fusion*, vol. 18, July 1978, p. 970, 971. 5 refs.

The modification of the dispersion relation for the ion-acoustic wave in the presence of an electromagnetic pump wave obliquely incident on the plasma is studied. Furthermore, its effect on the Brillouin sidescatter threshold is examined. (Author)

A78-42265 Sequences of neutron and X-ray flashes during a long-lasting current in a plasma focus device. J. Salge, U. Braunsberger, B. Fell (Braunschweig, Technische Universität, Braunschweig, West Germany), I. Ueno (Tokyo, University, Tokyo, Japan), and H. Conrads (EURATOM and Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Nuclear Fusion*, vol. 18, July 1978, p. 972-974. 6 refs. Research sponsored by the Deutsche Forschungsgemeinschaft and Alexander-von-Humboldt-Stiftung.

The possibility of increasing the neutron yield of a dense plasma focus by several focus events during a single discharge of an energy store is discussed. On a small focus device supplied with a long-lasting current pulse from an inductive energy store, experiments were carried out where several radiation flashes in rapid succession during one discharge could be observed. By the time-of-flight method the generation of fast neutrons was proved. (Author)

A78-42266 Reversed-field pinch-burn dynamics. H. R. Stimpson and G. H. Miley (Illinois, University, Urbana, Ill.). *Nuclear Fusion*, vol. 18, July 1978, p. 974-977. 12 refs. ERDA-sponsored research.

The behaviour of a plasma contained in a reversed-field pinch device has been described in a global computer code which uses a helical-current model. The potential stability of the plasma during the burn is monitored. Results show that proper selection of key initial parameters, particularly plasma radius and imposed magnetic field, is essential if the burn is to be initiated with the most favourable conditions for prolonged stability and the associated enhanced energy multiplication. (Author)

A78-42267 Experimental transfer function analysis of a dissipative and a reactive mode. D. P. Grubb and G. A. Emmert (Wisconsin, University, Madison, Wis.). *Nuclear Fusion*, vol. 18, July 1978, p. 977-981. NSF-supported research.

Experimental measurements of the transfer function of both a dissipative and a reactive instability in the same device - the Linear Multi-Mirror experiment - are reported. The results illustrate clearly the dissipative and reactive nature of each mode and are consistent with the theoretical form of the transfer function. (Author)

A78-42268 Electron and ion heating by neutral injection in the DITE tokamak. K. B. Axon, R. D. Gill, R. S. Hemsworth, J. Hugill, P. J. Lomas, J. W. M. Paul, B. A. Powell, R. Prentice, P. E. Stott, and D. D. R. Summers (EURATOM and U.K. Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, England). *Nuclear Fusion*, vol. 18, July 1978, p. 981-984. 8 refs.

Neutral-injection heating experiments are reported in which an ion temperature increase of 52% and a central electron temperature increase of 75% were observed. It is shown that the rise in electron temperature is consistent with the added neutral-injection power and that the heating occurs without an increase in impurity level in the plasma. (Author)

A78-42269 Fusion reactor design. II - Report on the Second IAEA Technical Committee Meeting and Workshop, Madison, Wisconsin, USA, 10-21 October 1977. R. W. Conn, G. L. Kulcinski (Wisconsin, University, Madison, Wis.), T. G. Frank (U.S. Department of Energy; California, University, Los Alamos, N. Mex.), R. Hancox (Atomic Energy Research Establishment, Culham Laboratory, Abingdon, Oxon, England), K. H. Schmitter (Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany), and W. M. Stacey, Jr. (Georgia Institute of Technology, Atlanta, Ga.). *Nuclear Fusion*, vol. 18, July 1978, p. 985-1016. 5 refs.

A summary is given of the experimental, demonstration and commercial fusion reactor concepts presented at the Second IAEA Technical Committee Meeting and Workshop on Fusion Reactor Design. The potential role of fusion power as an inexhaustible energy source is discussed, the advances and trends in fusion reactor design assessed, and the major conclusions and recommendations of five workshop groups given. At present, designs for tokamaks are most heavily represented, with the emphasis on near-term reactor studies. Conceptual commercial reactors are becoming compact, high-power-density units. Reactor concepts are also presented for Q-enhanced mirror machines, alternate magnetic fusion concepts, and laser- and electron-beam-driven inertial confinement reactors. The fusion-fission hybrid concepts open up several approaches to fusion power, and special-topic papers cover technology problems and fusion commercialization. (Author)

A78-42415 Photocells with intermediate radiation conversion and enhanced concentration of solar radiation ($K=2500$). Zh. I. Alferov, V. M. Andreev, D. Z. Garbuzov, V. R. Larionov, and V. D. Rumiantsev (Akademii Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). (*Pisma v Zhurnal Tekhnicheskoi Fiziki*, vol. 3, Oct. 26, 1977, p. 1090-1093.) *Soviet Technical Physics Letters*, vol. 3, Oct. 1977, p. 449, 450. 6 refs. Translation.

The manufacture and properties of heterojunction photocells with intermediate conversion of radiation are described. Al and Zn are heated with a n-GaAs:Te substrate, and four epitaxial layers, distinguished by their concentrations of AlAs and Zn, are produced. The composition and p-n characteristics of the layers are explained, and the spectrum of the photoresponse, with a peak at about 780 nm, is shown. The volt-ampere characteristics for varying degrees (from 236- to 2470-fold) of concentration of solar radiation are also indicated and discussed. M.L.

A78-42417 The influence of blade thickness on the output of vertical axis wind turbines. J. V. Healy (Belfast, Queen's University, Belfast, Northern Ireland). *Wind Engineering*, vol. 2, no. 1; 1978, p. 1-9.

Data in NACA TR 586 were used to compute power coefficients for NACA profiles 0009, 0012, 0015, and 0018 for a wide range of turbine Reynolds numbers and tip speed ratios from 2.25 upwards. Lift and drag matrices are determined from the data, and a standard subroutine was used to interpolate for the lift and drag coefficients for given values of angle of attack and blade Reynolds number. The computer program is based on the multiple-stream tube model, and takes inflow into account. The maximum power coefficient is about 0.5 at the highest turbine Reynolds number used (2,000,000), and is approximately the same for all profiles. The maximum occurs at a solidity of about 0.27 and a tip speed ratio around 3. In general, thicker profiles are better at low turbine Reynolds numbers. Effects of reduced drag for the 0012 profile are considered. M.L.

A78-42418 Cost-effective electric power generation from the wind - A system linking wind-power with hydroelectric storage and long-distance transmission. C. J. Todd, R. L. Eddy, R. C. James, and W. E. Howell (U.S. Bureau of Reclamation, Engineering and Research Center, Denver, Colo.). *Wind Engineering*, vol. 2, no. 1, 1978, p. 10-24. 15 refs.

The generation of windpower at the windiest available sites in the U.S. is considered in association with pumped-storage hydroelectric plants for load-leveling and existing types of transmission lines for interconnecting the windfarms and energy-storage sites with load centers up to 2000 km away. Potential energy harvest from windfarm sites in the 17 western states is estimated at well over 100 GW, and the yield in Arctic North America is estimated to be many times this much. At the 100-GW level of development, it is estimated that bus bar cost at the windfarm would be about 3 mills/MJ (10 mills/kWh), energy storage for load leveling would be about 1.8 mills/MJ, and transmission costs would be about 2.1 mills/MJ, for a total cost at the load center of 6 mills/MJ (21 mills/kWh), in 1976 dollars. M.L.

A78-42419 Calculation of the geometry and performance of a high-speed wind rotor. Y. Mercadier (Sherbrooke, Université, Sherbrooke, Quebec, Canada). *Wind Engineering*, vol. 2, no. 1, 1978, p. 25-36.

Methods of calculating rotor geometry and rotor performance are presented. The procedure involves blade element theory combined with conservation principles applied to flow through a disk. Calculated data on rotor performance efficiency as a function of the operating parameter, power as a function of wind speed and rotational speed, and shaft torque as a function of wind speed and rotational speed are presented. It is suggested that modern materials and fabrication techniques permit the construction of rotors of maximum efficiency. Successful design requires assessment of the performance over the whole range of operating conditions. M.L.

A78-42420 Secondary parameters affecting the performance of resistance-type vertical-axis wind rotors. S. Sivasegaram (University of Sri Lanka, Paradeniya, Sri Lanka). *Wind Engineering*, vol. 2, no. 1, 1978, p. 49-58. 11 refs.

An experimental study of the effect of four parameters - Reynolds number, wake aspect ratio, the size of the end plate, and the shaft diameter - on resistance-type vertical-axis wind rotors is described. The optimum diameter of the end plate is found to be just in excess of the wake width, and the shaft's adverse effect upon performance is found to become significant only when the shaft diameter is relatively large. Design profiles of some resistance-type vertical-axis rotors are shown, and differences in their characteristics are considered. M.L.

A78-42446 High-power lasers. J. P. Reilly. *Technology Review*, vol. 80, June-July 1978, p. 57-63. 6 refs.

In the earliest lasers, the waste heat generated in the course of lasing limited the average power of the device's beam to very low amounts. The heat produced at the center of a tube laser had to diffuse to the walls of the tube. The limit on average power was relieved by designing lasers in which the laser medium flows. The heat transfer by convection involved made it possible to remove heat 100,000 times more rapidly than it can be removed in a laser in which the medium is stationary. Gasdynamic lasers were scaled up in 1967 and 1968 from 8 to 135 kilowatts of laser output. With the additional advantage of running on power from an ordinary electrical outlet, the high-power continuous electric discharge laser, operating at up to 20-kilowatt output, has opened the way to an extraordinary variety of new industrial uses of the laser in the field of metalworking. A single laser can weld, cut, surface harden, and surface alloy. Attention is also given to problems of laser-induced fusion, the use of infrared chemical lasers in connection with the magnetic confinement fusion concept, and laser beam transmission in the atmosphere. G.R.

A78-42475 Views change on power satellite work. C. Covault. *Aviation Week and Space Technology*, vol. 109, July 17, 1978, p. 42, 43, 45, 46.

Two concepts of SSPS are discussed in terms of their similarities and differences. The first, proposed by the Marshall Space Flight Center, envisions a 5 GW microwave antenna positioned in the center of a 21.3 x 3.8 km focusing solar array. The structure is to be assembled entirely in geosynchronous orbit using an electric orbital transfer vehicle to ferry men and supplies from LEO. The other proposal, advanced by the Johnson Space Center, differs from the Marshall concept in that modules of the geosynchronous SSPS would first be assembled in LEO; and in the positioning of the microwave antenna(s), i.e., either one or two 5 GW antennas would be mounted at one or both ends of a 21 x 5 km unfocused solar array. Both systems would use a 100 sq km rectenna as an earth station for the actual generation of electric power, and both would rely on a 400 ton-payload HLLV for the initial transport of crew and construction materials. Either system, or a combination of both, could be online by the turn of the century, producing electricity at a user cost of 40 mill/kwh. D.M.W.

A78-42482 Classical diffusion in large-aspect toroidal plasmas. Y.-P. Pao (New York University, New York, N.Y.). *Physics of Fluids*, vol. 21, July 1978, p. 1120-1126. 9 refs. Contract No. E(11-1)-3077.

The problem of time-dependent classical diffusion of toroidal plasmas is considered for the case of a large-aspect ratio and a circular cross section. The parallel heat conductivity is assumed to be much larger than the other transport coefficients. Explicit calculations for the high-beta case indicate that toroidal effects are insignificant. For the low-beta case, fast and slow phases are considered, noting the difference between the slow phase and the quasi-stationary theory. S.C.S.

A78-42487 Turbulence theory for the dissipative trapped electron instability. K. T. Tsang, J. D. Callen (Oak Ridge National Laboratory, Oak Ridge, Tenn.), and G. Vahala (College of William and Mary, Williamsburg, Va.). *Physics of Fluids*, vol. 21, July 1978, p. 1172-1180. 22 refs. Contracts No. W-7405-eng-26; No. E(04-1)-5260.

A theory is developed for the turbulent response of the trapped electrons from a bounce averaged drift kinetic equation. It is noted that the turbulence influences the trapped electron nonadiabatic response primarily via turbulent collisions. The nonlinear dispersion relation is found and the turbulent response of trapped electrons is considered perturbatively. It is found that turbulence-induced collisions on trapped electrons are important in the nonlinear saturation of the dissipative trapped electron instability, particularly for a plasma deep in the banana regime. Numerical examples are compared with experimental results and the distinction between strong and weak turbulence is discussed. S.C.S.

A78-42491 Finite Larmor radius equations in an arbitrary near-theta pinch geometry. L. D. Pearlstein (California, University, Livermore, Calif.) and J. P. Freidberg (California, University, Los Alamos, N. Mex.). *Physics of Fluids*, vol. 21, July 1978, p. 1218-1226. 16 refs.

A set of fluid-like equations is derived which describes the stability of a diffuse, high-beta, arbitrary, near-theta pinch configuration. The equations simultaneously include geometric effects which drive ideal magnetohydrodynamic instabilities and kinetic effects which give rise to finite Larmor radius stabilization. A simple heuristic procedure is given for determining these equations in addition to a full derivation starting from basic principles. (Author)

A78-42492 Reversed-field configuration generated by a rotating relativistic electron beam. J. D. Sethian, D. A. Hammer, K. A. Gerber, D. N. Spector, A. E. Robson (U.S. Navy, Naval Research Laboratory, Washington, D.C.), and G. C. Goldenbaum (Maryland, University, College Park, Md.). *Physics of Fluids*, vol. 21, July 1978, p. 1227-1235. 22 refs. Navy-supported research.

A reversed-field plasma confinement geometry has been produced by plasma currents induced by a rotating relativistic electron beam injected into 85 mTorr neutral hydrogen. The resulting belt-pinch-like configuration has a rectangular cross section, with length-to-width ratio of 20, and midplane of 0.5. An equilibrium model, fitted to measurements of the excluded flux and induced axial and azimuthal magnetic fields, is in agreement with the annular plasma observed with radial Thomson scattering scans, CO₂ interferometry, and end-on streak photographs. After beam passage, the induced axial magnetic field remains constant for 5 microsec until the azimuthal magnetic field becomes small; at which time the plasma collapses radially. The observed decay times of the 4 microsec and concurrent increase in electron temperature (from 5 to 10 eV) are consistent with classical dissipation of the induced currents. (Author)

A78-42509 Platform designed for numerous uses. C. Covault. *Aviation Week and Space Technology*, vol. 108, June 19, 1978, p. 67, 68, 73.

An 82 x 31 meter GEO platform, expected to be operational by 1986, is described in terms of the antennas it will carry. It is noted that the platform is designed to be able to take over the function of more than a dozen communications and meteorological satellites now serving North America. Primary hardware on the platform includes: a 30 m dia C-band antenna capable of directing 37 spot beams to the 48 contiguous states and one beam each to Alaska, Hawaii, and Puerto Rico; one 12 m Ku-band antenna and 4 independently gimballed Ku-band antennas of 4.5 m each, permitting direct-broadcast to earth receivers as small as 1.6 m; S- and K-band capability; and an L-band system for use both in conjunction with the Marisat, Marots, and Aerosat programs, and for direct broadcast links to mobile receivers, e.g. automobiles. The platform would be assembled on two external Shuttle tanks over the course of three Space Shuttle missions. D.M.W.

A78-42638 # Design of a heat pipe with separate ducts for vapor and fluid (Raschet teplovoy trubyy s razdel'nymi kanalami dlya para i zhidkosti). Iu. E. Dolgirev, Iu. F. Gerasimov, Iu. F. Maidanik, and V. M. Kiseev (Ural'skii Politekhnikeskii Institut, Sverdlovsk, USSR). *Inzhenerno-Fizicheskii Zhurnal*, vol. 34, June 1978, p. 988-993. In Russian.

The heat transfer capacity and operating conditions of an antivibration heat pipe, with separate ducts for vapor and liquid, operating in evaporation regime, are calculated. The initial data for the calculation are the height of the heat pipe, geometric dimensions, characteristics of the capillary-porous structure of the pipe, and the temperature of the vapor and condensate arriving at the feed. The temperature drop at the barrier wall of the wick is determined and the condition for nonboiling of the liquid in the equalizing gap is verified. The dependence of heat pipe operation on temperature drop at the barrier wall of the wick, dP/dT of the heat carrier at a given temperature, and hydraulic resistance of the outer circuit is determined. Computer calculations for a specific heat pipe were performed, and agreement with experimental data was good. P.T.H.

A78-42773 Union Oil gets up steam for geothermal energy. J. Quirt. *Fortune*, vol. 98, July 31, 1978, p. 94-96.

Union Oil has drilled almost 300 wells in the U.S. and Canada in an effort to find reliable sources of geothermal power. The capital investment has thus far been on the order of \$150 million, with an additional \$100 million foreseen in the near future. Up till now, the return has been substantially less than the original investment (between \$15-20 million), but is expected to begin yielding a profit in the mid-eighties. A prime customer for the power generated by geothermal steam has been Pacific Gas and Electric, which erected a series of generating plants at geothermal sites having a combined output of 396,000 kW. Also mentioned is a series of three geothermal plants in the Philippines, which is expected to furnish one third of Manila's electrical needs by 1980. D.M.W.

A78-42807 # Computer aided two-dimensional analysis of junction type solar cells. A. M. Mazzone (CNR, Laboratorio LAMEL, Bologna, Italy). *Alta Frequenza (English Edition)*, vol. 47, May 1978, p. 285 E-292 E. 12 refs. Research supported by the Consiglio Nazionale delle Ricerche.

A two-dimensional modeling of the active region of a junction cell has been performed: having recourse to gradual assumptions the structure has been simulated through an aggregate of one-dimensional devices coupled through the current flowing in the surface region. This analysis accounts for phenomena such as drift and diffusion currents, recombination effects, field and doping dependent mobilities and non-ideal contacts. The method is here employed to evaluate the efficiency of cells having different doping profiles under one- or multi-sun exposure for different values of the distance between contact fingers. (Author)

A78-42858 Application of laser fusion to the radiolytic production of hydrogen. N. Vagelatos, N. A. Lurie, D. A. Vroom, D. H. Houston, R. D. Baird, and V. C. Rogers (IRT Corp., San Diego,

Calif.). *International Journal of Hydrogen Energy*, vol. 3, June 30, 1978, p. 177-201. 46 refs. ERDA-supported research.

A proposed design for a plant which would produce hydrogen by laser-fusion-induced steam radiolysis consists of a suppressed ablation lithium wetted wall cavity surrounded by pure and borated steam regions. Fusion neutrons deposit a substantial fraction of their energy in the steam regions, which causes nuclear heating in the steam and structural materials, as well as radiolysis of water molecules. Energy characteristics were determined by coupled photon-neutron transport calculations, and costs are estimated by an economic analysis. M.L.

A78-42859 Experimental and theoretical investigation of thermochemical hydrogen production. K. F. Knoche, H. Cremer, D. Breywisch, S. Hegels, G. Steinborn, and G. Wüster (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *International Journal of Hydrogen Energy*, vol. 3, June 30, 1978, p. 209-216. 6 refs. Research supported by the Deutsche Forschungsgemeinschaft.

Hydrolysis, chlorination and the reverse Deacon reaction as steps of thermochemical water splitting cycles have been investigated in a laboratory scale with respect to feasibility and chemical engineering aspects. The results are discussed. Some general theoretical considerations concerning the efficiency of thermochemical water splitting cycles are presented. Using general criteria, some chemical reactions of proposed schemes of water splitting processes are selected and compared. (Author)

A78-42860 * Air terminals and liquid hydrogen commercial air transports. P. F. Korycinski (NASA, Langley Research Center, Hampton, Va.). *International Journal of Hydrogen Energy*, vol. 3, June 30, 1978, p. 231-250. 9 refs.

An initial appraisal is made of results of two studies of the ground requirements of liquid hydrogen (LH2) air transports. Each hypothesized the use of a 400-passenger 5500 nautical mile range subsonic commercial LH2 transport. Two of the world's busiest commercial airports, Chicago O'Hare International and San Francisco International, were selected for study. The current and predicted wide-body traffic at these airports was assumed to simulate the LH2 transport traffic at these airports in the 1990-1995 time period. Both studies produced conceptual designs for facilities to generate the required quantities of fuel from pipeline gaseous hydrogen and to deliver liquid hydrogen to the airplanes. Although the LH2 and jet fuel facilities were kept apart, both study teams found it practical to converge the fuel supply lines so that with proper safety and operational procedures, and specialized LH2 equipment both LH2 and jet fuel transports can use common ramp and gate facilities. (Author)

A78-42890 Daily input modelling for solar collectors and systems. B. J. Brinkworth (University College, Cardiff, Wales). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Quarter, 1978, p. 4-7. 11 refs.

A technique for determining a solar energy input function applicable to system modeling is proposed. The function, which may be derived for the effective insolation at a particular location, represents the daily variation with time of insolation which would yield the same long-term output as actual insolation. The function takes into account collector characteristics and the system to which it is connected. S.C.S.

A78-42891 Solar energy for industrial processes - A simplified design method. F. Butera, G. Cannistraro, and G. Silvestrini (Palermo, Università, Palermo, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Quarter, 1978, p. 8-14. 15 refs.

A simulation model is developed to predict the long-term thermal output of solar energy systems for industrial applications. The systems are assumed to use liquids as energy transfers and storage media and flat plate collectors. The mathematical model accounts for the collectors, heat exchangers, circulating pumps, and pump controllers. Measurements of dry bulb temperature and total and diffusive solar radiation on a horizontal surface are used as hourly data. Various factors influencing optimal economical designs of solar energy systems are identified, including heat transfer media capacitance rate, storage tank size, monthly load pattern, fuel cost, and the weather characteristics of the particular site. It is noted that the model may be used in Mediterranean climates for systems operating at temperatures to 100 C. S.C.S.

A78-42892 Study of the performance of flat plate collectors in the transient regime (Contribution à l'étude du comportement des capteurs plans en régime transitoire). R. Gicquel, B. Bourges, and D. Schmoll (Paris, Ecole Nationale Supérieure des Mines, Paris, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Quarter, 1978, p. 15-19. In French.

One- and two-temperature mathematical models are developed to describe the performance of flat-plate collectors in the transient regime. The models yield first-order partial-differential equations which may be used in global studies of solar energy systems. The numerical results are compared to experimental curves. S.C.S.

A78-42893 The theoretical and experimental performance of a solar heater equipped with flat plate collectors (Performances théoriques et expérimentales d'une chaudière solaire à capteurs plans). R. Ployart and J. Colomes (Commissariat à l'Energie Atomique, Centre d'Etudes Nucléaires de Saclay, Gif-sur-Yvette, Essonne, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Quarter, 1978, p. 20-28. In French.

A comparison is made between the results obtained for a 320-sq-m solar heater equipped with flat plate collectors and the results determined by the ORIENT computer program which simulates solar heater performance. Consideration is given to the origin of thermal inertia, noting that larger solar heaters yield less heat per unit area than smaller units. The performance of a solar heater is discussed in terms of its operation at 80 and 100 C. S.C.S.

A78-42894 A 400 kW high temperature solar test facility. J. D. Walton, S. H. Boimar, C. T. Brown, and N. E. Poulos (Georgia Institute of Technology, Atlanta, Ga.). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Quarter, 1978, p. 29-32. 6 refs.

The paper discusses a 400-kW(th), high-temperature, receiver-type solar test facility located in Georgia. The facility employs 550 circular, back-silvered mirrors that are 111-cm in diameter and 3-mm thick. The mirrors, which may be operated in flat or focused configurations, are arranged in an octagonal pattern. The receiver is located 20 meters above the center of the field. Actual total thermal energy yield is a function of the number of mirrors, the incident direct solar radiation, the time of year, and the time of day. Studies during the initial stages of operation will concentrate on (1) the efficiency of the heliostat drive system, (2) the efficiency of the boiler-superheater, (3) the range of feedwater flow rates and pressures, and (4) the resulting steam conditions. S.C.S.

A78-42895 Experimental determination of optimal operating conditions for circular-profile solar concentrators (Détermination expérimentale des conditions d'emploi optimales de concentrateurs solaires à section circulaire). J. Robin, J. Pivot, J. A. Roger, and C. H. S. Dupuy (Lyon I, Université, Villeurbanne, Rhône, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Quarter, 1978, p. 40-43. In French.

A simulation technique has been employed for the determination of the optimal operating conditions of a cylindrical mirror with a circular profile. A 100-W lamp represents the apparent solar angle.

Results are presented for the variation in concentration as a function of mirror size, the variation in concentration strength as a function of defocalization, and the influence of mirror size on the density of the concentration region. S.C.S.

A78-42896 Algae cultures and methanization - The role of these techniques in the bioconversion of solar energy (Cultures d'algues et méthanisation - Place de ces techniques dans la bioconversion de l'énergie solaire). F. Sauze (Institut National de la Recherche Agronomique, Narbonne, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Quarter, 1978, p. 44-48. 19 refs. In French.

The paper discusses the potential exploitation of algae cultures for energy production noting urban, agricultural, and industrial liquid wastes. It is suggested that the physical-chemical characteristics of the effluents may be improved by processes including pH correction, nitrogen enrichment, and polyphenol elimination. The effluent sources are considered in terms of potential annual yield of algae, protein, and methane. The potential costs of developing bioconversion facilities are outlined and prospects for other biomass-based energy-production schemes are proposed. S.C.S.

A78-42897 Fluids serving as heat transfer agents in solar energy conversion (Les fluides caloporteurs dans la conversion de l'énergie solaire). M. de Moncuit (Rhône-Poulenc Industries, Décines, Rhône, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Quarter, 1978, p. 56, 57. In French.

Consideration is given to solar energy conversion on the basis of fluids serving as heat transfer agents, noting heat collection, transfer, and utilization processes. Two collection procedures are identified: pressure and trapping between two surfaces, and concentration using convergent mirrors. The primary factors influencing the choice of a heat-transfer fluid are given with reference to those which may be utilized to 120 C (aqueous and anhydrous fluids), from 120 to 400 C (organic fluids), and above 400 C (nitrate mixtures). S.C.S.

A78-42902 Emissions and energy conservation in residential oil heating. A. C. S. Hayden, R. W. Braaten, and T. D. Brown (Department of Energy, Mines and Resources, Ottawa, Canada). *Air Pollution Control Association, Journal*, vol. 28, July 1978, p. 669-672.

Emissions from oil-fired residential heating equipment can be reduced by improved steady running and cyclic efficiencies. Techniques which reduce the heating demand (thermostat cut-back) or reduce envelope losses (chimney damper) lead to reductions in SO₂ and NO emissions proportional to the fuel saving. Higher savings in CO and particulates result from cyclic modification. Reductions in nozzle size lead to an increase in unit cycle duration, reducing the off-cycle losses, with emissions reduced similarly. Changing the thermostat anticipator yields little reduction in fuel, SO₂ or NO, but significantly reduces CO and particulate emissions, by decreasing the number of cycles. Improved burner performance, with combustion at low excess air, offers the largest fuel savings, with commensurate reductions in SO₂ and NO, and greater reductions in CO and particulates. (Author)

A78-42906 Efficiency and reliability of sulfur dioxide scrubbers. W. H. Megonnell. *Air Pollution Control Association, Journal*, vol. 28, July 1978, p. 725-731. 19 refs.

Characteristics of 32 utility company flue gas desulfurization units classified as operational are summarized, and performance data for these units are examined. Data on reported fuel sulfur contents and removal efficiencies are presented. Measured removal efficiencies of 90% or greater were reported for only two units. The performance data, described in terms of availability, reliability, operability, and utilization, seem to suggest that present flue gas desulfurization systems would be unable to operate continuously in compliance with EPA's draft proposed standards. M.L.

A78-42978 # Fuel-combustion control in the combustion chamber of an MHD generator (Regulirovanie protsessy szhiganiia topliva v kamere sgoraniia MGD generatora). M. S. Pinkhasik, V. D. Mironov, Iu. A. Zakharko, A. I. Plavinskii, and N. A. Miniaev (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur; Vsesoiuznyi Nauchno-Issledovatel'skii Teplo tekhnicheskii Institut, Moscow, USSR). *Teploenergetika*, May 1978, p. 41-44, 6 refs. In Russian.

The combustion chamber of the U-25 MHD power plant is experimentally studied as a control plant; functional relations between the input and output parameters of the combustion chamber, as control plant, are examined. An analysis of the static and dynamic characteristics of the plant indicates that the governing parameter in the controlled process is the oxidizer-excess coefficient, α . The control system must assure operation in the α range of 0.9-1.0. A transfer function is obtained for this range of α .

B.J.

A78-43026 Modeling and simulation. Volume 8 - Proceedings of the Eighth Annual Pittsburgh Conference, University of Pittsburgh, Pittsburgh, Pa., April 21, 22, 1977. Parts 1 & 2. Conference sponsored by the University of Pittsburgh. Edited by W. G. Vogt and M. H. Mickle. Pittsburgh, Pa., Instrument Society of America, 1977. Pt. 1, 648 p.; pt. 2, 544 p. Price of each part, \$37.50.

The papers in this volume present and discuss new models for analysis in the fields of energy systems, transportation systems, vehicle dynamics, estimation and control theory, reliability, network analysis, signal processing, computer systems, biomedical systems, ecosystems, societal decision making, urban and regional planning, and economics. Individual studies include turbulence and stability estimates in atmospheric dispersion modeling, station analysis of a personal rapid transit system, hybrid technique for spacecraft attitude interpolation with arbitrary attitude data gaps, Routh approximations in state space, optimal preventive maintenance and replacement strategies under Markovian deterioration, vector processing in simulation, hierarchy of simulation models for a turboprop gas engine, and a high-speed programmable computer monitoring, simulation, and analysis system using distributed microprocessor techniques.

P.T.H.

A78-43044 Simulation study of a flywheel powered electric vehicle utilizing the modern high energy density energy storage flywheel. D. R. Markus and R. Krutz (Carnegie-Mellon University; Pittsburgh, Pa.). In: Modeling and simulation. Volume 8 - Proceedings of the Eighth Annual Pittsburgh Conference, Pittsburgh, Pa., April 21, 22, 1977. Part 1. Pittsburgh, Pa., Instrument Society of America, 1977, p. 287-292. 8 refs.

Modern inertial energy storage devices offer attractive possibilities as a power source in electric vehicles. To demonstrate this, a flywheel powered electric vehicle is designed and simulated in detail. Simulation is carried out subject to the characteristics of commercially available equipment; where actual device characteristic curves are used whenever possible. Hence, the effects of component nonlinearities and variable efficiencies as well as system constraints are included. Based upon this approach, vehicle performance may be evaluated in greater breadth and depth than traditionally done.

(Author)

A78-43072 Energy resources. J. T. McMullan, R. Morgan, and R. B. Murray (Ulster, New University, Coleraine, Northern Ireland). New York, Halsted Press, 1977. 183 p. 39 refs. \$7.95.

The book presents a survey of energy resources and of the technologies by which they can be exploited. Energy resources, their practicality, and their distribution are considered with attention to recent features in the pattern of energy use. The basic laws of energy conversion are explained, and examples of their application to energy problems are presented. Power from natural sources (solar, water, wind, sea, and geothermal) is discussed, and the theory, development, and application of nuclear power is analyzed. Topics associated with power production inefficiencies, including waste heat, waste products, the heat pump, insulation, transport, and investment in energy saving, are examined.

M.L.

A78-43101 Baseload reliability in a combustion turbine. V. Cooper and R. Duncan (Electric Power Research Institute, Palo Alto, Calif.). *EPRI Journal*, vol. 3, June 1978, p. 17-21.

Combustion turbines in connection with their low capital cost and short construction lead time have found increasing application in electric utility systems to supply peak demand power. However, the combustion turbine has a low fuel economy and a high operating cost, and is not counted on for long-run reliability or operating economy. The considered turbine is basically the same unit that powers the world's jet aircraft. The difference in service conditions for utility turbines and aircraft turbines is investigated and approaches are discussed for improving the performance and efficiency of the ground-based turbines. From earlier exploratory studies has emerged a multiphase program to develop a new combustion-turbine-combined-cycle configuration that has inherent baseload reliability and is capable of economical operation of a broad spectrum of fuels.

G.R.

A78-43176 Open-cycle MHD energy conversion - Prospects and developments for central station power generation. F. Hals, S. Petty, D. Stickler, and A. Solbes (Avco Everett Research Laboratory, Inc., Everett, Mass.). *Illinois Institute of Technology, American Power Conference, Chicago, Ill., Apr. 18-20, 1977, Paper*. 13 p. 7 refs.

The principles of MHD, MHD research projects, and the conservational and environmental benefits offered by MHD are described. Topics discussed include the MHD channel, the superconducting magnet, coal combustion for an MHD plant, air preheaters, seed recovery and regeneration, and a bottoming plant including NOx emission control. It is concluded that significant progress has been achieved in the development of open-cycle MHD; an experimental MHD generator has been tested under conditions which realistically simulate those of projected full-scale coal-burning MHD generators. The development of a pilot-scale engineering test facility is considered.

M.L.

A78-43270 Modeling the sectors of production and energy transformation - The situation in France (Modélisation des secteurs de production et de transformation de l'énergie - Le cas Français). D. Babusiaux, P. Offant, and M. Valais (Institut Français du Pétrole, Rueil-Malmaison, Hauts-de-Seine, France). *Institut Français du Pétrole, Revue*, vol. 33, Mar.-Apr. 1978, p. 177-190. In French.

The paper describes a dynamic linear model which represents all energy production and energy transformation sectors in France. The purpose of the model is to help determine investment plans which would fulfill, at the least cost, consumption demands which change in a known manner over time. While the model is linear, the submodels concerned with electric power stations or refinery units are calibrated by more sophisticated means. The modeling of the petroleum sector and of the electric sector are first presented in terms of a static model. The multienergy dynamic model is then explained, and, as an example, predictions of the proportions of different kinds of refineries and electric power plants for each year over the 1980-1996 period are presented.

M.L.

A78-43276 Unrealities in the energy R & D program. R. W. Schmitt and P. J. Stewart (GE Corporate Research and Development Center, Schenectady, N.Y.). *Research Management*, vol. 21, July 1978, p. 7-9.

It is suggested that the large increase in federal funding of energy R & D will cause the fraction of new technical developments actually commercialized to go down, and the risk of commercialization of new energy technologies to individual companies to go up. An increase in research funds might foster prolonged research projects and delay decisions as to which techniques should be developed for commercial purposes. The multiplicity of technologies developed as a result of federal sponsorship might fragment and confuse the market, so that the risk of commercial development of any single technology would be increased. It is suggested that the

Federal Government use its resources to support and develop an adequate knowledge base for a limited number of the most promising technologies - some short term, others long term - and to develop a reasonable number of demonstration projects. At this point normal market and competitive forces could take over except for national security needs.

M.L.

A78-43287 Air flow in the central valley of Maui, Hawaii. P. A. Daniels and T. A. Schroeder (Hawaii, University, Honolulu, Hawaii). *Journal of Applied Meteorology*, vol. 17, June 1978, p. 812-818. 19 refs. NSF Grant No. AER-76-05596; Contract No. EG-77-6-03-1617.

Low-level winds in the central valley of the island of Maui were investigated in a field program during August 1976. Forty-one sites were occupied using three mobile stations during a period of persistent trade winds. Contemporaneous data from the Kahului Weather Service Office as well as other Hawaiian stations were collected to relate field observations to large-scale events. Streamline analyses reflect the diurnal variation of the low-level circulation which is profoundly influenced by Haleakala and West Maui volcanoes. The field survey was utilized in planning new fixed stations to monitor wind characteristics for wind power applications. Preliminary fixed station results are discussed. The importance of diurnal mesoscale patterns on wind power planning was emphasized.

(Author)

A78-43291 A preliminary numerical study into the effects of coal development on cloud and precipitation processes to the northern Great Plains. M. R. Hjelmfelt, R. D. Farley, and P. C. S. Chen (South Dakota School of Mines and Technology, Rapid City, S. Dak.). *Journal of Applied Meteorology*, vol. 17, June 1978, p. 846-857. 60 refs. NSF Grants No. 36910X; No. DES-75-03882.

The paper reports a numerical simulation study of the possible effects of air pollution from coal-fired power plants on cloud and precipitation processes in the northern Great Plains. The ice phase is not considered. Observational data are used to develop natural and polluted particulate distributions, and cloud droplet growth on these distributions is simulated in a condensation model. The results indicate that the number concentration and dispersion coefficient (breadth) of the cloud droplet size distributions are increased by the addition of pollutant particles. Coalescence calculations show that the rate of production of large drops, while being slowed by an increase in the number concentration, is hastened by an increase in the dispersion coefficient; the two effects nearly cancel each other out. The dispersion coefficient and warm cloud precipitation are dependent on pollutant particle size distribution and chemical composition.

M.L.

A78-43296 Development of a new combustion system /MCA-jet/ in gasoline engine. Y. Nakamura, Y. Kiyota, K. Akishino, Y. Tsukamoto, K. Hori, T. Nakagami, and T. Ohinoue (Mitsubishi Motors Corp., Japan). *Mitsubishi Heavy Industries Technical Review*, vol. 15, Feb. 1978, p. 46-53.

The article discusses the jet-controlled lean combustion system. Particular attention is given to (1) fuel consumption versus air-fuel ratios under 40 km/h road-load, (2) the effects of EGR conforming to severe NOx regulations, and (3) the effects of jet port diameter and jet flow direction on fuel consumption.

S.C.S.

STAR ENTRIES

N78-22149* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

CLOSED LOOP SOLAR ARRAY-ION THRUSTER SYSTEM WITH POWER CONTROL CIRCUITRY Patent Application Robert P. Gruber, inventor (to NASA) Filed 29 Mar. 1978 20 p

(NASA-Case-LEW-12780-1; US-Patent-Appl-SN-891370) Avail: NTIS HC A02/MF A01 CSCL 21C

A solar array-ion thruster system is described which includes a power control circuit that permits use of the thruster itself in operating the solar array at the maximum power point. The power control circuit, connected between the solar array and the ion thruster and receiving voltage and current signals from the former, multiplies the voltage and current signals together to produce a power signal which is differentiated with respect to time. The differentiator output is detected by a zero crossing detector and, after suitable shaping, the detector output is phase compared with a clock in a phase demodulator. An integrator receives no output from the phase demodulator when the operating point is at the maximum power point, but is driven toward the maximum power point for non-optimum operation. A ramp generator provides minor variations in the beam current reference signal produced by the integrator in order to obtain the first derivative of power. NASA

N78-22184* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **COMPATIBILITY STUDIES OF VARIOUS REFRACTORY MATERIALS IN CONTACT WITH MOLTEN SILICON**

T. O'Donnell, M. Leipold, and M. Hagan 1 Mar. 1978 119 p refs Prepared for DOE

(Contract NAS7-100)

(NASA-CR-156181; JPL-Pub-78-18; DOE/JPL-1012-77/6) Avail: NTIS HC A06/MF A01 CSCL 07D

The production of low cost, efficient solar cells for terrestrial electric power generation involves the manipulation of molten silicon with a present need for noncontaminating, high temperature refractories to be used as containment vessels, ribbon-production dies, and dip-coated substrates. Studies were conducted on the wetting behavior and chemical/physical interactions between molten silicon and various refractory materials. Author

N78-22243* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL EVALUATION OF FUEL PREPARATION SYSTEMS FOR AN AUTOMOTIVE GAS TURBINE CATALYTIC COMBUSTOR

Robert R. Tacina 1977 22 p refs Presented at the 2d Workshop on Catalytic Combust., Raleigh, N. C.; sponsored by EPA Prepared for DOE

(NASA-TM-78856; DOE/NASA-1011-78/23; E-9585) Avail: NTIS HC A02/MF A01 CSCL 21D

Spatial fuel distributions, degree of vaporization, pressure drop and air velocity profiles were measured. Three airblast injectors and an air-assist nozzle were tested. Air swirlers were used to improve the spatial fuel-air distribution. The work was done in a 12 cm tubular duct. Test conditions were: a pressure of 0.3 and 0.5 MPa, inlet air temperatures up to 800 K, air velocities of 10 to 20 m/s and fuel-air ratios up to 0.020. The fuel was Jet A. The best results were obtained with an airblast configuration that used multiple cones to provide high velocity

air for atomization and also straightened the inlet airflow. With this configuration, uniform spatial fuel-air distributions were obtained with mixing lengths greater than 17.8 cm. In this length, vaporization of the fuel was 98.5 percent complete at an inlet air temperature of 700 K. The total pressure loss was 1.0 percent with a reference velocity of 20 m/s and 0.25 percent at 10 m/s. The air velocity was uniform across the duct and no autoignition reactions were observed. Author

N78-22386* Booz-Allen and Hamilton, Inc., Bethesda, Md. Transportation Consulting Div.

TRANSIT BUS PROPULSION SYSTEMS ALTERNATE POWER PLANT INSTALLATION Final Report

Sep. 1977 42 p

(Contract DOT-UT-10008)

(PB-276612/9; UMTA-IT-06-0025-78-2) Avail: NTIS

HC A03/MF A01 CSCL 13F

Installation characteristics of the most suitable engines for each of the three prototype Transbus designs are presented. Listed and illustrated are: (1) the engine compartments of the three prototype Transbus designs; (2) the candidate engines; and (3) the candidate engines fitted into the three prototypes. The results presented show that two engine types, the 4-cycle diesel engine and the gas turbine engine, may challenge the 2 cycle diesel engine for the transit coach market. Author

N78-22435* Geological Survey, Denver, Colo.

THERMAL SURVEILLANCE OF ACTIVE VOLCANOES USING THE LANDSAT-1 DATA COLLECTION SYSTEM. PART 3: HEAT DISCHARGE FROM MOUNT ST. HELENS, WASHINGTON Final Report, 1972 - 1975

Jules D. Friedman and David Frank, Principal Investigators May 1977 34 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS

(NASA Order S-70243-AG)

(E78-10122; NASA-CR-156972) Avail: NTIS HC A03/MF A01 CSCL 08K

The author has identified the following significant results. Two thermal anomalies, A at 2740 m altitude on the north slope, and B between 2650 and 2750 m altitude on the southwest slope at the contact of the dacite summit dome of Mount St. Helens, Washington were confirmed by aerial infrared scanner surveys between 1971 and 1973. LANDSAT 1 data collection platform 6166, emplaced at site B anomaly, transmitted 482 sets of temperature values in 1973 and 1974, suitable for estimating the differential radiant emission as 84 W/sq m, approximately equivalent to the Fourier conductive flux of 89 W/sq m in the upper 15 cm below the surface. The differential geothermal flux, including heat loss via evaporation and convection, was estimated at 376 W/sq m. Total energy yield of Mount St. Helens probably ranges between 0.1 and 0.4 x 10 to the 6th power W.

N78-22439* Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.

STRATEGIC PETROLEUM RESERVE: FINAL ENVIRONMENTAL IMPACT STATEMENT FOR KLEER MINE

Sep. 1977 598 p refs

(FES-77-2; FEA/S-77/324) Avail: NTIS HC A25/MF A01

This site-specific Environmental Impact Statement has identified particularly sensitive environmental parameters for the Kleer Mine, Texas Early Storage site. The most sensitive parameters to be affected by oil storage development appear to be water quality, air quality, and socioeconomic factors. The significant adverse impacts to the physical environment that could result from the program include: degradation of surface water quality due to sedimentation from runoff and erosion during pipeline construction activities; a moderate increase in hydrocarbon emissions during transfer and temporary storage of oil in the Winnsboro storage tanks; locally significant increases in hydrocarbon emissions during transport of oil from the Gulf of Mexico to Winnsboro Terminal; and the potential for an increase in the frequency of oil spills along the transportation corridors. Changes

in water quality would have a short term impact on the aquatic organisms. Author

N78-22451# Cornell Univ., Ithaca, N. Y. Dept. of Agricultural Economics.

ENHANCED OIL RECOVERY: THE IMPACT OF POLICY OPTIONS

Robert J. Kalter Jul. 1977 30 p refs
(Grant NSF SIA-74-21846)
(PB-276763/O; STAFF-PAPER-77-27; NSF/RA-770324) Avail: NTIS HC A03/MF A01 CSCL 10A

Enhanced recovery processes are evaluated under the assumption of information certainty, using forecasts of production, price and cost profiles for selected reservoirs. Alternative public policy options, designed to foster private sector development, are evaluated under this assumption. A second analysis, using subjective probability distribution of key input variables, is conducted in an effort to ascertain the impact of these and other policy alternatives designed for situations of uncertainty. The following potential public policy actions are analyzed and evaluated: (1) alternative regulated and/or market price levels; (2) price and/or purchase guarantees for enhanced oil production over the lifetime of a producing facility and (3) alternative taxation policies. GRA

N78-22452# Office of Technology Assessment, Washington, D. C.

ENHANCED OIL RECOVERY POTENTIAL IN THE UNITED STATES

Jan. 1978 232 p
(PB-276594/9; OTA-E-59; LC-77-600063) Avail: NTIS HC A11/MF A01 CSCL 081

The potential for increasing domestic production from known reservoirs using enhanced oil recovery (EOR) techniques is discussed. The study examines five EOR processes, including in situ combustion, steam injection, and flooding. The report discusses the economic, environmental, and legal impacts of enhanced oil recovery, and includes appendices on the oil resource and supporting materials for enhanced oil recovery projections, as well as additional information on the legal aspects of EOR. GRA

N78-22458 Pittsburgh Univ., Pa.
DEVELOPMENT OF A Ti/Fe REDOX COUPLE FLOW BATTERY SYSTEM Ph.D. Thesis

Robert Francis Savinell 1977 243 p
Avail: Univ. Microfilms Order No. 78-01888

A flow redox cell with graphite foil electrodes and an anion permeable membrane separator were designed, constructed and operated. The Fe/Ti redox couple reaction was employed. Both the flow cell and a stationary cell were used to evaluate the limiting factors of this battery system. The effects of polarizations on the cell performance were investigated. These polarizations included those from diffusion, activation and internal resistance. It was found that this battery system was not diffusion controlled and was greatly affected by activation. The activation influence was attributed to the oxidation reaction of titanous chloride. The internal resistance polarization was more dominant for cells with large electrode surface area. The application of a pulsating flow to the flow battery system did not affect or improve the battery performance. However, the use of different electrode material showed a marked difference in the performance of the stationary cell. Dissert. Abstr.

N78-22462 Iowa State Univ. of Science and Technology, Ames.
EFFECTS OF LARGE INTERCONNECTED WIND GENERATORS ON THE ELECTRIC POWER SYSTEM Ph.D. Thesis

David Kelly Pantalone 1977 135 p
Avail: Univ. Microfilms Order No. 78-05966

When one considers the direct interfacing of wind generator systems (WGSs) with the electric power system, there is an interest in WGS dynamics and compatibility with the power system. Two general effects that may occur as a result of the presence of many large WGSs in the system were considered.

The first effect deals with the possibility of contributing to dynamic instability in the large interconnected power system. A modal analysis of a set of WGSs on a radial line was used to examine this possibility. The effect of certain components, parameters, and conditions on the eigenvalues was studied. The second effect deals with a load tracking constraint in automatic generation control as affected by the power spectrum of the wind. A frequency response analysis was used to determine the frequency content of the WGS output. Dissert. Abstr.

N78-22464*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HISTORICAL EVIDENCE OF IMPORTANCE TO THE INDUSTRIALIZATION OF FLAT-PLATE SILICON PHOTO-VOLTAIC SYSTEMS, VOLUME 2

Jeffrey L. Smith, William R. Gates, and Tom Lee Apr. 1978 67 p refs Sponsored by NASA Prepared for JPL
(NASA-CR-156185; DOE/JPL-1012-78/1-Vol-2; JPL-Pub-78-36-Vol-2; Rept-5104-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 10A

Problems which may arise as the low cost silicon solar array (LSSA) project attempts to industrialize the production technologies are defined. The charge to insure an annual production capability of 500 MW peak for the photovoltaic supply industry by 1986 was critically examined, and focused on one of the motivations behind this goal-concern over the timely development of industrial capacity to supply anticipated demand. Conclusions from the analysis are utilized in a discussion of LSSA's industrialization plans, particularly the plans for pilot, demonstration and commercial scale production plants. Specific recommendations for the implementation of an industrialization task and the disposition of the project quantity goal were derived. Author

N78-22465*# IBM Federal Systems Div., Huntsville, Ala.
SYSTEM DESIGN PACKAGE FOR SIMS PROTOTYPE SYSTEM 2, SOLAR HOT WATER

Dec. 1977 112 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150521) Avail: NTIS HC A06/MF A01 CSCL 10A

Information necessary to evaluate the design and assembly of a solar hot water system is presented. A prototype system designed for use in a single family dwelling is investigated in terms of the following subsystems: collector, storage, energy transport, and control. M.V.

N78-22466*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.
INDOOR THERMAL PERFORMANCE EVALUATION OF THE SEPSCO AIR COLLECTOR

Sep. 1977 35 p Revised Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150631; TR-531-11-Rev-B) Avail: NTIS HC A03/MF A01 CSCL 10A

The procedures used and the results obtained during the evaluation test program on the Solaron solar air collector, model EF-212, under simulated conditions for comparison with data collected in outdoor tests on the same collector are given. The test article was a single glazed collector with a nonsensitive absorber plate, aluminum box frame, and one inch isocyanurate foam insulation. Author

N78-22467*# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.

SOLAR HEATING AND COOLING SYSTEM DESIGN AND DEVELOPMENT Quarterly Report, 1 Oct. - 31 Dec. 1977

10 Mar. 1978 9 p Prepared for DOE
(Contract NAS8-32093)
(NASA-CR-150640; F3437-QR-108) Avail: NTIS HC A02/MF A01 CSCL 10A

The progress of the program during the sixth program quarter is reported. The program calls for the development and delivery of eight prototype solar heating and cooling systems for installation and operational test. The William O'Brien single-family heating system was installed and is operational. The New Castle

single-family heating residence is under construction. The Kansas University (KU) system is in the final design stages. The 25 ton cooling subsystem for KU is the debugging stage. Pressure drops that were greater than anticipated were encountered. The 3 ton simulation work is being finalized and the design parameters for the Rankine system were determined from simulation output.

Author

N78-22488* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

KINE-PAK: A SELF-CONTAINED, ELECTRICAL POWER GENERATOR SYSTEM Patent Application

David C. Grana and Richard T. Wilem, inventors (to NASA) Filed 3 Mar. 1978 9 p

(NASA-Case-LAR-11551-1; US-Patent-Appl-SN-883090) Avail: NTIS HC A02/MF A01 CSCL 10A

A self contained electrical generator which is powered by random environmental movement such as wave action is described. The self contained generator is used in a buoy, or other devices, to generate electrical power to operate test equipment or weather observation equipment and eliminate or reduce the replacement rate of batteries. The generator is comprised of a rotor, a stator, a helical spring, and a housing. The rotor is rotated relative to the stator and electrical current is generated as the armature winding cuts the lines of magnetic force. The current is supplied to batteries or instruments. NASA

N78-22489* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

WIND WHEEL ELECTRIC POWER GENERATOR Patent Application

John W. Kaufman, inventor (to NASA) Filed 24 Feb. 1978 16 p

(NASA-Case-MFS-23515-1; US-Patent-Appl-SN-880726) Avail: NTIS HC A02/MF A01 CSCL 10A

An electric generator driven by the wind is described. Primary and auxiliary funnel-type, venturi ducts are mounted upon a housing for capturing wind currents and conducting the currents to a bladed wheel connected to generator apparatus. Additional air flows are also conducted onto the bladed wheel, rotating the wheel. The auxiliary ducts are disposed at an acute angle with respect to the longitudinal axis of the housing, and together with the rotatability of the housing and the ducts, permits capture of wind currents within a variable directional range. NASA

N78-22470* National Aeronautics and Space Administration, Pasadena Office, Calif.

DOUBLE-SIDED SOLAR CELL PACKAGE Patent Application

Benjamin Shelpuk, inventor (to NASA) (JPL) Filed 29 Mar. 1978 17 p

(Contract NAS7-100)

(NASA-Case-NPO-14199-1; NASA-Case-NPO-14200-1; US-Patent-Appl-SN-891243) Avail: NTIS HC A02/MF A01 CSCL 10A

A solar cell array for terrestrial use is described. The solar cell package consists of a double sided photovoltaic cell having a metallized P contact and N contact provided on opposite faces of the cell; a transparent tubular body forming a transparent enclosure for the cell; a supporting pedestal formed of conductive metallic material electrically connected with the cell; and a reflector having a surface disposed in substantially opposed relation with one face of the cell for redirecting light to impinge thereon whereby the cell is subjected to incident radiation at each of the opposite faces thereof. By employing the double sided solar cell supported by a pedestal forming a path for heat and electrical currents, the overall efficiency of the array was enhanced. NASA

N78-22472* CALMAC Mfg. Co., Englewood, N. J.

PRELIMINARY DESIGN PACKAGE FOR SOLAR COLLECTOR AND SOLAR PUMP

Apr. 1978 41 p Prepared for DOE

(Contract NAS8-32253)

(NASA-CR-150630) Avail: NTIS HC A03/MF A01 CSCL 10A

A solar-operated pump using an existing solar collector, for use on solar heating and cooling and hot water systems is described. Preliminary design criteria of the collector and solar-powered pump is given including: design drawings, verification plans, and hazard analysis.

Author

N78-22473* Sigma Research, Inc., Richland, Wash.

PRELIMINARY DESIGN PACKAGE FOR MAXI-THERM HEAT EXCHANGER MODULE

Apr. 1978 30 p refs Prepared for DOE

(Contract NAS8-32260)

(NASA-CR-150620) Avail: NTIS HC A03/MF A01 CSCL 10A

Heat exchangers were developed for use in a solar heating and cooling system installed in a single family dwelling. Each of the three exchangers consisted of a heating and cooling module and a submersed electric water heating element. Information necessary to evaluate the preliminary design of the heat exchanger is presented in terms of the development and verification plans, performance specifications, installation and maintenance, and hazard analysis.

Author

N78-22474* IBM Federal Systems Div., Huntsville, Ala.

INSTALLATION PACKAGE FOR SIMS PROTOTYPE SYSTEM 2, SOLAR HOT WATER

Jan. 1978 22 p Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150639) Avail: NTIS HC A02/MF A01 CSCL 10A

The prototype system 2 solar hot water was designed for use in a single family dwelling and consists of the following subsystems: collector, storage, energy transport, and control. Guidelines are presented for utilization in the development of detailed installation plans and specifications. Instruction on operation, maintenance, and repair of the system is discussed.

Author

N78-22475* Owens-Illinois, Inc., Toledo, Ohio.

AIR-LIQUID SOLAR COLLECTOR FOR SOLAR HEATING, COMBINED HEATING AND COOLING, AND HOT WATER SUBSYSTEMS Contractor Report, 1 Nov. 1976 - 31 Oct. 1977

Mar. 1978 79 p refs Prepared for DOE

(Contract NAS8-32259)

(NASA-CR-150569) Avail: NTIS HC A05/MF A01 CSCL 10A

A collection of quarterly reports consisting of the installation and layout design of the air collector system for commercial applications, completion of the preliminary design review, detailed design efforts, and preparation of the verification test plan are given. Performance specifications and performance testing of a prototype model of a two manifold, 144 tube air collector array is presented.

Author

N78-22476* American Univ., Washington, D. C.

DEFINITION OF CHEMICAL AND ELECTROCHEMICAL PROPERTIES OF A FUEL CELL ELECTROLYTE Interim Technical Report, 25 Mar. - 24 Dec. 1977

T. Sarada, John F. McIntyre, and R. T. Foley Feb. 1978 46 p refs

(Contract DAAK70-77-C-0080)

(AD-A050920) Avail: NTIS HC A03/MF A01 CSCL 10/2

The present research is oriented toward the task of developing an improved electrolyte for the hydrocarbon-air fuel cell. A literature study of the properties of organic acids indicated that the following types of compounds warranted further investigation: Aromatic poly carboxylic acids partially neutralized perfluoroaliphatic carboxylic acids, Mono, di and poly sulfonic acids and substituted sulfonic acids. This was followed by an experimental program wherein the vapor pressure, wetting characteristics, electrical conductivity, chemical stability, and electrochemical stability were measured.

Author (GRA)

N78-22477# North Dakota Legislative Council, Bismarck.
LEGISLATIVE HANDBOOK ON ENERGY-RELATED TOPICS
 1977 63 p

(Grant NSF ISP-76-10209)

(PB-276766/3; NSF/RA-770010)

Avail: NTIS

HC A04/MF A01 CSCL 10A

Activities are highlighted of the seven task forces created by the States of North Dakota, South Dakota, Montana, and Wyoming to study the interstate effects of the Fort Union Coal Formation which underlies parts of each of these states. Topics studied included air quality, water quality, water allocation, plant siting, energy development, reclamation, taxation, and social and economic impact. The task forces examined methods to assist member states in problem solving as well as acquainting the members with the energy development positions and accompanying laws and regulations of their sister states. Brief summaries outlining the research performed for each task, as well as a list of the members in each group, are presented. GRA

N78-22478# City of Davis, Calif.
DAVIS ENERGY CONSERVATION REPORT, PRACTICAL USE OF THE SUN Final Report
 Mar. 1977 136 p

(Grant HUD-B-75-S1-06-001)

(PB-276616/0; DAC/PL-77/101)

Avail: NTIS

HC A07/MF A01 CSCL 10A

A comprehensive energy conservation program for the City of Davis is described, including: Building Code, planning, solar houses, and public education. GRA

N78-22480# Purdue Univ., Lafayette, Ind.
SYSTEMS STUDIES OF COAL CONVERSION PROCESSES USING A REFERENCE SIMULATOR

G. V. Reklaitis, J. M. Woods, F. Kayihan, and M. Sood Jul. 1977 41 p refs

(Contract EX-76-C-01-2275)

(FE-2275-4) Avail: NTIS HC A03/MF A01

Preliminary user's manuals were prepared for the physical properties code package and for the process block material balancing code. The equipment calculation system was linked with the properties package and expansion of the module library was proceeding. Development work continued on the equipment costing system and the hydrotreating models. The cost data files were implemented on the computer and work was in progress on the file manipulation and costing subroutines. Literature review was complete on the hydrotreating section and semiempirical model equations have been assembled and fitted to available data. ERA

N78-22482# European Space Agency, Paris (France).
SOME EXPERIMENTAL RESULTS ON SELECTIVE ABSORBING SURFACES FOR LOW TEMPERATURE SOLAR COLLECTORS

Georg Paul Goerler Feb. 1978 66 p refs Transl. into ENGLISH of 'Einige Messungen an selektiv absorbierenden Oberflächen fuer Niedertemperatur-Solarkollektoren', DFVLR, Cologne Report DLR-FB-77-23, 27 May 1977 Original report in GERMAN previously announced as N78-14686 Original German report available from DFVLR, Cologne DM 25 (ESA-TT-432; DLR-FB-77-23) Avail: NTIS HC A04/MF A01

The efficiency of a flat plate solar collector can be greatly enhanced by the use of a selectively absorbing layer, that is, a surface with high absorptance for the solar spectrum and low emittance for thermal radiation. From various methods known from literature for realizing coatings with these properties, the process of electroplating selective black nickel coatings was chosen and studied in detail. One finding of this investigation was that the effectiveness of these layers results from optical interference. With the production of black nickel two-layer coatings on a copper substrate one obtains surfaces with an absorptance as high as 0.95 when weighted with the terrestrial solar spectrum. The simultaneous emittance is in the order of 0.05. The superiority of absorber plates with such values, in comparison with nonselective solar collectors is outlined using the results of a numerical calculation. Author (ESA)

N78-22483# Colorado Dept. of Local Affairs, Denver.
COLORADO ENERGY IMPACT ASSISTANCE PLAN

Ross M. Bolt, Lydia Watkins, and John M. Fernandez, ed. Jan. 1977 108 p

(Contract EDA-05-09-01600)

(PB-276587/3; EDA-78-016) Avail: NTIS HC A06/MF A01 CSCL 10A

A plan was developed to assist the people of Colorado in their attempts to minimize the adverse effects of energy resource development on the communities in the state. The plan provided those communities affected by energy projects with a clear, documented process for identifying their service and capital needs. Technical and financial assistance programs available to local jurisdictions are outlined, as are the varied roles of local, state and federal governments and industry to be adopted in marshalling resources to solve impact problems. GRA

N78-22484# Brookhaven National Lab., Upton, N. Y.
HEALTH AND ECONOMIC COSTS OF ALTERNATIVE ENERGY SOURCES

L. D. Hamilton and A. S. Manne (Stanford Univ.) 1977 19 p refs Presented at Intern. Conf. on Nucl. Power and its Fuel Cycles, Salzburg, Austria, 2-13 May 1977; sponsored by IAEA Sponsored by ERDA

(IAEA-CN-36/448; Conf-770505-72)

Avail: NTIS

HC A02/MF A01

Biomedical and environmental costs of energy production and use, including new technologies, are being considered. Beginning with a compilation of pollutants from the energy system, the various paths to man are traced and health effects evaluated. Excess mortality and morbidity in the U.S. attributable to a total fuel cycle to produce 6.6×10^9 to the 9th power kwh are being estimated. Estimates are provided of relative impacts to identifying where the important health hazards in each fuel cycle arise, thereby identifying key areas for judging the total costs of alternative energy sources, and those areas of research likely to improve the accuracy of the estimates. It was estimated that the production of electric power from all sources in the U.S. in 1975 was associated with between in U.S. ages 1 to 74. The differences in the year 2000 between health impacts of the U.S. energy system under normal growth expectations and under conditions of a nuclear moratorium were estimated. ERA

N78-22487# Federal Energy Administration, Washington, D. C.
STRATEGIC PETROLEUM RESERVE. TEXOMA GROUP SALT DOMES. DRAFT ENVIRONMENTAL IMPACT STATEMENT. VOLUME 1: WEST HACKBERRY EXPANSION, BLACK BAYOU, VINTON, BIG HILL

Sep. 1977 387 p refs

(FEA/S-77/323-Vol-1; DES-77-8-Vol-1)

Avail: NTIS

HC A17/MF A01

A site specific Environmental Impact Statement (EIS) is presented for four proposed candidate sites from the Texoma group of salt domes located in the Gulf Coast region of southwestern Louisiana and southeastern Texas. The primary site for Strategic Petroleum Reserve (SPR) development in this group is an expansion of the West Hackberry Early Storage Reserve

(ESR) facility located in Cameron, Parish, Louisiana. The three other candidates are new sites. They are the Black Bayou salt dome located in Cameron Parish, Louisiana, the Vinton salt dome in Calcasieu Parish, Louisiana, and the Big Hill salt dome in Jefferson County, Texas. One or a combination of these three sites may be developed as an alternative to the expansion of the West Hackberry ESR facility. This site specific EIS analyzes the environmental impacts caused by site preparation and operation at each of the four locations. Author

N78-22488# Federal Energy Administration, Washington, D. C. **STRATEGIC PETROLEUM RESERVE. TEXOMA GROUP SALT DOMES. DRAFT ENVIRONMENTAL IMPACT STATEMENT. VOLUME 2, APPENDICES A AND B: WEST HACKBERRY EXPANSION, BLACK BAYOU, VINTON, BIG HILL**

Sep. 1977 440 p refs
(FEA/S-77/323-Vol-2; DES-77-8-Vol-2) Avail: NTIS
HC A19/MF A01

A description is given of the regional environment of the proposed salt dome site, West Hackberry, and the environment of the three alternate sites - Black Bayou, Vinton, and Big Hill. Regional geology, water environment, climatology, air quality, ecosystems, natural and scenic resources, archaeological and historical resources, and socioeconomic characteristics are discussed. The environmental setting of the sites, the crude oil distribution systems, brine disposal systems, and the displacement/leaching water systems are also discussed. The oil storage facilities are presently in the preliminary design stage. Engineering feasibility analyses were prepared as the basis for evaluation of the socioeconomic and environmental impacts of the project. Author

N78-22490# Federal Energy Administration, Washington, D. C. **STRATEGIC PETROLEUM RESERVE. TEXOMA GROUP SALT DOMES. DRAFT ENVIRONMENTAL IMPACT STATEMENT. VOLUME 4, APPENDICES D-S: WEST HACKBERRY EXPANSION, BLACK BAYOU, VINTON, BIG HILL**

Sep. 1977 657 p refs
(FEA/S-77/323-Vol-4; DES-77-8) Avail: NTIS
HC A99/MF A01

Precipitation data are given for the areas of Texas and Louisiana in which primary and secondary sites would be located. The possibilities of oil spills occurring and their ecological consequences are discussed. Additional data are given on possible effects of brine spills, tanker collisions, hydrocarbon emissions and other environmental hazards associated with the project. P.R.A.

N78-22495# Southern Research Inst., Birmingham, Ala. **PARTICULATE CONTROL HIGHLIGHTS: RESEARCH ON ELECTROSTATIC PRECIPITATOR TECHNOLOGY Final Report, Nov. 1976 - Nov. 1977**

S. Oglesby, Jr. and G. Nichols Dec. 1977 23 p refs
(Contract EPA-68-02-2114)
(PB-276643/4; SORI-EAS-77-677; EPA-600/8-77-020a) Avail:
NTIS HC A02/MF A01 CSCL 13B

Highlights are given of a major EPA research program on electrostatic precipitator (ESP) technology, directed toward improving the performance of ESPs in controlling industrial particulate emissions, notably fly ash from coal combustion in electric power plants. Relationships between electrical effects, such as reverse corona, caused by high resistivity of the deposited fly ash, were investigated. The influence of fly ash particle size and chemical composition on the resistivity and dielectric strength of the deposited fly ash was also studied. Relationships were between fly ash resistivity and chemical composition, especially its alkali metal content, for ESP operating temperatures below about 250C. Based on these relationships, a mechanism for ionic surface conduction was that complements the ionic mechanism in bulk conduction in fly ash particles at higher operating temperatures. The efficacy of conditioning fly ash by adding SO₃ to flue gas (to lower fly ash resistivity) was established in trials at electric power plants. GRA

N78-22497# Cottrell Environmental Systems, Inc., Bound Brook, N. J.

DEVELOPMENT OF A HIGH-TEMPERATURE/HIGH-PRESSURE ELECTROSTATIC PRECIPITATOR Final Report, Aug. 1975 - Aug. 1977

J. R. Bush, R. L. Feldman, and M. Robinson Nov. 1977 85 p refs

(Contract EPA-68-02-2104)
(PB-276626/9; EPA-600/7-77-132) Avail: NTIS
HC A05/MF A01 CSCL 13B

Results are given of a laboratory test demonstrating the feasibility of electrostatic precipitation at high temperatures and pressures. Corona currents were stable at all temperatures. Detailed current/voltage characteristics under negative and positive polarity were obtained in dry air, in a simulated combustion gas, and in a substitute fuel gas for each temperature and pressure level. Major effects of temperature, pressure, and electrode geometry on precipitator design characteristics (sparking voltages, corona starting voltages, and current levels) were evaluated. It is established that no practical temperature or pressure limitation exists to the levels tested. A preliminary cost estimate is presented for a commercial-size precipitator design applied to a commercial fluidized-bed combustor and turbine system. GRA

N78-22500# Environmental Protection Agency, Research Triangle Park, N.C. Emissions Standards and Engineering Div. **CONTROL OF VOLATILE ORGANIC EMISSIONS FROM STORAGE OF PETROLEUM LIQUIDS IN FIXED ROOF TANKS**

Richard K. Burr, Kerri C. Brothers, and Robert Quaney Dec. 1977 44 p refs
(PB-276749/9; EPA-450/2-77-036; OAQPS-1.2-089) Avail:
NTIS HC A03/MF A01 CSCL 13B

This report provides the necessary guidance for development of regulations limiting emissions of volatile organic compounds (VOC) from the storage of petroleum liquids in fixed roof tanks. Reasonably available control technology (RACT) is defined in this document; cost analysis for RACT is included for evaluating the cost effectiveness of controlling fixed roof storage tank resources. GRA

N78-22534# Bendix Field Engineering Corp., Grand Junction, Colo.

PRELIMINARY STUDY OF THE FAVORABILITY FOR URANIUM IN SELECTED AREAS IN THE BASIN AND RANGE PROVINCE, NEVADA

G. M. Cupp, S. H. Leedom, T. P. Mitchell, K. D. Kiloh, and R. C. Horton Oct. 1977 115 p refs
(Contract EY-76-C-13-1664)
(GJBX-74(77)) Avail: NTIS HC A06/MF A01

In the Virgin Valley area, the Canyon Rhyolite Formation contained as much as 27 ppm U₃₀₈ and was an excellent source rock. Uranium deposits in the underlying Virgin Valley Formation were small but larger deposits may exist. The northern portion of the Reese River Valley contained several small uranium deposits but none of mineable grade or size. Rhyolitic volcanic rocks in the area contained above-average amounts of uranium, and larger deposits may lie beneath these potential source rocks. The East Walker River area may be part of a larger uranium province. Intrusive and extrusive rocks in the area contained above-average amounts of uranium and low-grade supergene deposits were found. Large areas of potential source rocks and host rocks, and two small uranium deposits, were found in the Coaldale area. Many rhyolite plugs were also found. The Carol R prospect was an isolated uranium occurrence in Tertiary lacustrine rocks. Uranium deposits in Meadow Valley were in the Panaca Formation, a Pliocene lacustrine formation of varied lithology. The uranium deposits were small and low grade. ERA

N78-22915# Oak Ridge National Lab., Tenn. **COMMERCIAL FEASIBILITY OF FUSION POWER BASED ON THE TOKAMAK CONCEPT**

R. L. Reid and Don Steiner 1977 21 p refs Presented at ANS Winter Meeting, San Francisco, 27 Nov. 1977

(Contract W-7405-eng-26)

(CONF-771109-55) Avail: NTIS HC A02/MF A01

The impact of plasma operating characteristics, engineering options, and technology on the capital cost trends of Tokamak power plants was determined. Tokamak power systems were compared to other advanced energy systems and found to be economically competitive. A three phase strategy for demonstrating commercial feasibility of fusion power, based on a common site multiple unit concept, is presented. ERA

N78-22968# Committee of the Whole House on the State of the Union (U. S. House).

ENERGY TRANSPORTATION SECURITY ACT OF 1977

Washington GPO 1977 87 p Report on H.R. 1037 together with additional views presented by the Comm. on Merchant Marine and Fisheries to the Comm. of the Whole House on the State of the Union, 95th Congr., 1st Sess., 26 Aug. 1977 (H-Rept-95-589; GPO-89-006) Avail: U.S. Capitol, House Document Room

The legislative history of a bill requiring that a percentage of the United States oil imports be carried on U.S. flag commercial vessels is reviewed. Benefits of the bill are discussed as well as the cost of the legislation as determined by the General Accounting Office. A.R.H.

N78-22970* Ford Motor Co., Dearborn, Mich.

AUTOMOTIVE STIRLING ENGINE DEVELOPMENT PROGRAM Quarterly Technical Progress Report, Oct. 1977 - Dec. 1977

Ernest W. Kitzner Jan. 1978 98 p Sponsored in part by NASA

(Contract EC-77-C-02-4396)

(NASA-CR-135331; CONS/4396-1; QTPR-1) Avail: NTIS HC A05/MF A01 CSCL 13F

The Ford/DOE automotive Stirling engine development program is directed towards establishing the technological and developmental base that would enable a decision on whether an engineering program should be directed at Stirling engine production. The fuel economy assessment aims to achieve, with a high degree of confidence, the ERDA proposal estimate of 20.6 MPG (gasoline) for a 4500 lb 1WC Stirling engine passenger car. The current M-H fuel economy projection for the 170 HP Stirling engine is 15.7 MPG. The confidence level for this projection is 32%. A confidence level of 29% is projected for a 22.1 MPG estimate. If all of the planned analyses and test work is accomplished at the end of the one year effort, and the projected improvements are substantiated, the confidence levels would rise to 59% for the 20.6 MPG projection and 54% for the 22.1 MPG projection. Progress achieved thus far during the fuel economy assessment is discussed. Author

N78-22979# CH2M/Hill, Bellevue, Wash.

MARKET ANALYSIS OF RECOVERED MATERIALS AND ENERGY FROM SOLID WASTE, EXECUTIVE SUMMARY

Jan. 1977 219 p Sponsored by Washington State Dept. of Ecology

(PB-277143/4; LC-77-624084)

Avail: NTIS

HC A10/MF A01 CSCL 13B

Existing and potential market conditions for material and energy recovered from solid wastes are described and the quantity and composition of residential and commercial wastes available for material and energy recovery from specific geographic waste shed areas in the State of Washington are presented. Major aspects of various resource recovery processes were listed and their suitability for specific waste sheds in the state were listed. The existing markets for material resources were identified and quantified, and the resource recovery potential of existing (1976) and (1980 and 1990) material and energy markets was evaluated. Author

N78-23072# Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.

SITUATION OF AIR TRAFFIC IN COMPARISON TO GROUND TRANSPORTATION NOTING ESPECIALLY**ENERGETIC PROBLEMS [DIE SITUATION DES LUFTVERKEHRS IM VERGLEICH ZU DEN BODENGEBUNDENEN VERKEHRSMITTELN UNTER BESONDERER BERUECKSICHTIGUNG ENERGETISCHER PROBLEME]**

K. Dieter Kricke 1977 191 p refs In GERMAN

(ILR-20; ISBN-3-7983-0588-9)

Avail: NTIS

HC A09/MF A01

The effects of increasing fuel costs on the future development of air traffic in competition with ground transportation were investigated, also taking into account other factors. Possibilities of fuel economies by operational and technical savings measures are discussed, and limits in technical feasibility (effort) and economical effect (profits) are indicated. The effects of increasing fuel prices on the competitive position of air traffic vis-a-vis ground traffic are not considered serious from the present point of view, and limitations in future expansion of air traffic are not confirmed. ESA

N78-23238# California Univ., Livermore. Lawrence Livermore Lab.

MATERIALS EVALUATION FOR GEOTHERMAL APPLICATIONS: TURBINE MATERIALS

A. Goldberg and R. E. Garrison 13 Apr. 1977 4 p refs Presented at Geothermal Resources Council, San Diego, Calif., 9 May 1977

(Contract W-7405-eng-48)

(UCRL-79360; Conf-770569-2)

Avail: NTIS

HC A02/MF A01

A number of candidate turbine materials were evaluated for their resistance to erosion, corrosion, and stress corrosion cracking (SCC) in geothermal brines. These materials include Fe-, Ni-, Co and Ti-base alloys, coatings and ceramics. Tapered wearblades, simulating the leading edge of a turbine blade, are exposed to the direct impact of a two-phase nozzle exhaust. Bent beam SCC specimens, which were constrained in fixtures attached to the wearblade holders, were also exposed to the exhaust. Results of a test series were reported in which acidified liquid brine expanded to atmospheric pressure are reported. Evaluation of the exposed materials indicates that Ti-base alloys show the most promise for turbine wheel components in the high salinity geothermal environments. ERA

N78-23249# Argonne National Lab., Ill.

MODIFICATIONS AND COSTS OF CONVERTING TO LOW SULFUR WESTERN COALS

G. N. Reddy and G. C. Krohm 1977 19 p refs Presented at NCA/BCR Coal Conf., Louisville, Ky., 19 Oct. 1977

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

(CONF-771024-3) Avail: NTIS HC A02/MF A01

It thus appears that the conversion of existing boilers burning high sulfur Midwestern coals to low-sulfur Western coals is not a simple matter. The difficulties of burning this fuel can be traced to the inherent problems of operating the boiler outside of its designed operating limits. The operating parameters that are affected by coal characteristics are summarized. These factors must be considered carefully when planning conversion of a power plant to burn Western coal: Excessive dusting of coal enroute to power plant; reduced conveyor belt capacity (10-20%); loss of boiler efficiency due to increased moisture (up to 30%); water-side scale buildup due to decreased slagging; increased fouling with high sodium coal; larger dust handling system requirements within the boiler; carbon carryover; decreased electrostatic precipitators efficiency because of the decrease in sulfur trioxide concentrations in the flue gases. ERA

N78-23250# Institute of Gas Technology, Chicago, Ill.

RISER CRACKING OF COAL TO OIL AND GAS

Dennis A. Duncan, Justin L. Beeson, and R. Donald Oberle 1977 8 p refs Presented at Ann. Am. Chem. Soc. Meeting, Chicago, 28 Aug. - 2 Sep. 1977

(Contract EX-76-C-01-1221)

(CONF-770814-10) Avail: NTIS HC A02/MF A01

A short residence time entrained flow process for converting low-rank coal to gases and hydrocarbon liquids that can be used as gasoline blending stock and fuel oil was investigated. In the hydropyrolysis process, lignite was heated concurrently

with hydrogen at a high pressure in a helical coil reactor having a predetermined temperature profile to yield ethylene, pyrolysis gasoline, and other products. Results indicate that: (1) fifty percent of the carbon in the feed lignite can be converted to oils and gases at a system operating pressure of 2000 psig, a coil out temperature of from 1400 to 1500 F, and a residence time of approximately 2 second; (2) approximately 15% of the feed carbon reports as oils, and by choice of temperature and hydrogen dilution, some selectivity with respect to the constituents present in the make oil is possible; and (3) high operating temperatures and hydrogen dilutions tend to suppress the appearance of phenol, toluene, and xylene in the make oil. It is concluded that high yields of methane, hydrocarbon oils, and blending gasoline constituents make the hydrolysis process economically favorable to pyrolysis of coal. ERA

N78-23251# Los Alamos Scientific Lab., N. Mex.
FUSION ENERGY APPLIED TO SYNTHETIC FUEL PRODUCTION: A REPORT TO THE DOE DIVISION OF MAGNETIC FUSION ENERGY BASED ON A PRELIMINARY STUDY BY AN AD-HOC ADVISORY GROUP

Lawrence A. Booth Oct. 1977 125 p refs Presented at the Conf. on Fusion Energy Appl. to Syn. Fuel Production, Germantown, Md., 9 May 1977

(Contract W-7405-eng-36)
 (CONF-770593) Avail: NTIS HC A06/MF A01

The general conclusion is that the potential for utilization of fusion energy for synthetic fuel production is favorable. Three basic methods of hydrogen production are identified: (1) high-temperature electrolysis, (2) thermochemical cycles, and (3) direct radiolysis. Combinations of these and their use as in combined cycles for electric power generation were considered.

Author (ERA)

N78-23253# Intergroup Consulting Economists Ltd., Winnipeg (Manitoba).

ECONOMIC PRE-FEASIBILITY STUDY: LARGE-SCALE METHANOL FUEL PRODUCTION FROM SURPLUS CANADIAN FOREST BIOMASS. PART 2: WORKING PAPERS
 Sep. 1976 249 p refs Prepared in cooperation with SNC, Inc., Montreal (Quebec), Chainell (Gordon S.) and Associates, Vancouver (British Columbia) and Gardiner (S. G.) Engineering Services Ltd., Vancouver (British Columbia)

(NP-22159/2) Avail: NTIS (US Sales Only) HC A11/MF A01;
 ERDA Depository Libraries

The practicability of using methanol produced from surplus renewable Canadian forest roundwood as a substitute for non-renewable hydrocarbons in meeting Canadian energy requirements is addressed. Titles of the five working papers are: methanol plant technologies, characteristics and costs; resource harvesting; opportunity costs; product demand analysis; and alternative feedstocks for methanol production. ERA

N78-23261# Miami Univ., Coral Gables, Fla. Dept. of Mechanical Engineering.

CHARACTERIZATION OF METHANOL/GASOLINE BLENDS AS AUTOMOTIVE FUEL: PERFORMANCE AND EMISSIONS CHARACTERISTICS

R. R. Adt, Jr., K. A. Chester, C. N. Kurucz, J. Pappas, S. Rajan, and M. Swain Jul. 1977 204 p refs
 (Contract EPA-R-803401-01-3)

(PB-277135/O; EPA-460/3-77-012a) Avail: NTIS
 HC A10/MF A01 CSCL 21D

Recent concern about environmental problems and the eventual shortage of conventional petroleum based fuels coupled with the potential of obtaining methyl alcohol (methanol) as a product of coal gasification has brought about a recent interest in the use of methanol as a fuel. In order to assess the feasibility of using methanol as a motor vehicle fuel, either alone (neat) or as a blend in gasoline type base stocks, its performance, emissions and practical use characteristics must be ascertained. A series of experiments was conducted to determine methanol blend fuel engine characteristics information. GRA

N78-23263 National Technical Information Service, Springfield, Va.

OFFSHORE PIPELINES. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Jan. 1978

Guy E. Habercom, Jr. Mar. 1978 126 p Supersedes NTIS/PS-77/0098

(NTIS/PS-78/0179/8; NTIS/PS-77/0098) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 13J

Citations on construction, utilization, wave action, and environmental aspects of offshore pipelines are presented. Hydrodynamics, benefit costs of underwater pipeline transportation, and risk analysis are among the parameters researched. This updated bibliography contains 121 abstracts. GRA

N78-23378 Cornell Univ., Ithaca, N. Y.

GEOTHERMAL ENERGY-RELATED PROBLEMS OF NATURAL CONVECTION IN POROUS MEDIA Ph.D. Thesis

Robert John Ribando 1977 179 p
 Avail: Univ. Microfilms Order No. 7805723

The effects of a number of variables on natural convection in a two-dimensional saturated porous layer are assessed. The effects of constant temperature and constant heat flux lower thermal boundary conditions are contrasted, as are the effects of permeable and impermeable upper boundaries. Cases with spatially varying permeability are presented. The critical Rayleigh number is derived for several sets of boundary conditions, and results at several values of Rayleigh number are presented for nearly all the sets of boundary conditions considered. The surface heat fluxes computed in these saturated layer cases are used to interpret the sinusoidally-varying heat fluxes measured in the ocean floor transverse to the axis of a mid-ocean spreading center. The results show that barring hot springs, the convective component of surface heat flux is very small even with mass flow through a permeable upper boundary. Dissert. Abstr.

N78-23384*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

HIGH TEMPERATURE HEAT PIPE RESEARCH AT NASA LEWIS RESEARCH CENTER

L. K. Tower and W. B. Kaufman 1978 15 p refs Presented at the 3d Intern. Heat Pipe Conf., Palo Alto, Calif., 22-24 May 1978; sponsored by AIAA

(NASA-TM-78832; E-9537) Avail: NTIS HC A02/MF A01
 CSCL 20D

High temperature refractory metal heat pipes with alkali metal working fluids, for use in thermionic space power systems, were studied. The main effort involved a concept for an out-of-core thermionic nuclear reactor power system. For this a lithium filled heat pipe of 335 cm length with 18 kW capacity was built in several modifications; one of them ultimately tested. Fabrication studies included the manufacture of a heat pipe tube of wire reinforced tantalum by chemical vapor deposition (CVD) and the extension to a reinforced pipe with integral arteries made by the CVD process. A lithium-filled CVD tungsten heat pipe of about 3 kW capacity ran several thousand hours above 1800 K. Materials compatibility studies of several liquid metals in tantalum alloy pipes were performed. Author

N78-23440# Oak Ridge National Lab., Tenn.

REPORT OF SURVEY OF VALVE INDUSTRY CAPABILITIES

W. A. Bush and E. C. Slade 1977 24 p refs Presented at Workshop on Valves for Solids Handling Service in Coal Conversion, Morgantown, West Virginia, 14 Nov. 1977
 (Contract W-7405-eng-26)

(CONF-771145-2) Avail: NTIS HC A02/MF A01

To evaluate the valve requirements associated with coal conversion, seven prospective coal conversion design concepts were studied; and flow streams were determined; valve types were assigned and the valves were sized. At present, it appears that the coal conversion processes operate in the range of the present petrochemical industry, except for that portion of the process where the coal is converted to gas and oil. The analysis resulted in the identification of twenty four high temperature

valve applications that appeared more stringent than the petrochemical industry needs. ERA

N78-23441# Consolidated Controls Corp., El Segundo, Calif.
COAL GASIFICATION VALVES, PHASE 2 Quarterly Technical Progress Report, Jun. - Aug. 1977
Oct. 1977 30 p
(Contract EX-76-C-01-2355)
(FE-2355-2-Rev-D) Avail: NTIS HC A03/MF A01

Efforts in the design of valves to operate at high temperature in coal gasification plants are detailed. The properties of materials, such as ceramics, which may be satisfactory at these temperatures were determined. The particular properties measured were porosity, permeability, thermal expansion, resistance to mechanical and thermal shock, etc. With these properties known, the problem then was to design the valves to operate within the limits of these properties. Prototype valves are being designed and fabricated for testing. Author (ERA)

N78-23442# Ford Motor Co., Dearborn, Mich. Engineering and Research Staff.
STIRLING ENGINE FEASIBILITY STUDY OF AN 80 TO 100 hp ENGINE OF IMPROVEMENT POTENTIAL FOR EMISSIONS AND FUEL ECONOMY Final Report
D. W. Barton, R. C. Belaire, J. E. Bradley, W. R. Chase, J. R. Corcoran, D. D. Dodge, E. F. Dore, J. E. Fenton, R. K. Fenzan, and L. L. Fobes Nov. 1977 136 p
(Contract EY-76-C-02-2631)
(COO-2631-22) Avail: NTIS HC A07/MF A01

A study was made to evaluate the potential of a Stirling engine for significant improvement in emissions and fuel economy over the present day internal combustion engine and to initiate, on the basis of the experience gained in the Ford/Philips 170 hp Stirling engine development program, the design of an engine in the 80 to 100 hp range suitable for use in a passenger car in the 2,500 to 3,000 lb weight class. The final report given covers two major tasks: testing of a 170 hp Stirling engine powered Torino passenger vehicle; and a design study of an 80 to 100 hp engine in a passenger car in the 2,500 to 3,000 lb weight class based on the 170 hp Torino installation. Despite optimization of the engine to achieve minimum length, the Stirling powered compact car was 89 mm (3.5 inches) longer than its Pinto baseline. Fuel economy of the swashplate engine was adversely affected by attempts to fit it within the Pinto engine compartment. ERA

N78-23498# Geological Survey, Denver, Colo.
THERMAL SURVEILLANCE OF ACTIVE VOLCANOES USING THE LANDSAT-1 DATA COLLECTION SYSTEM. PREFACE AND PART 1: THE SURTSEY, ICELAND, TEMPERATURE DATA RELAY EXPERIMENT VIA LANDSAT-1 Final Report, 1972 - 1975
Jules D. Friedman, David Frank, Duane M. Preble, and Sveinn Jakobsson, Principal Investigators (Museum of Natural History, Reykjavik, Iceland) Dec. 1975 89 p refs Submitted for publication Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-70243-AG)
(E78-10121; NASA-CR-156971) Avail: NTIS HC A05/MF A01 CSCL 08K

The author has identified the following significant results. Combined aerial IR surveys and DCP heat flux estimates at Mt. Baker, Washington, revealed that recurrent snow, ice, and debris avalanches were in part induced by subglacial geothermal emission and led to the prediction that geothermally-induced volcanic events would occur again at Mt. Baker. On March 10, 1975, the prediction was substantiated when significant and sudden increase in subglacial steam emission perforated the crater glacier in Sherman Crater at Mt. Baker. Analysis of stereographic pairs of LANDSAT MSS images led to the discovery of three large ring structures (the largest, 34 km in diameter) that were interpreted as volcanic centers and possible collapsed calderas or volcanotectonic depressions of post Miocene age in Lassen volcanic region.

N78-23499# Geological Survey, Denver, Colo.
THERMAL SURVEILLANCE OF ACTIVE VOLCANOES USING THE LANDSAT-1 DATA COLLECTION SYSTEM. PART 4: LASSEN VOLCANIC REGION Final Report, 1972 - 1975
Jules D. Friedman and David Frank, Principal Investigators Apr. 1978 83 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-70243-AG)
(E78-10123; NASA-CR-156973) Avail: NTIS HC A05/MF A01 CSCL 08K

The author has identified the following significant results. Analysis of LANDSAT 1 MSS images of October 6, 24, and 25, 1972 of the Lassen volcanic region, California, revealed the existence of three large geomorphic rings between Lassen Peak and Lake Almanor. Ring 1, about 16 x 33 km and 490 sq km in area, was centered on the North Branch of the North Fork of the Feather River. Ring 2, 18 x 20.5 km and 300 sq km in area, was concentric to and enclosed by ring 1. Ring 3, 23 x 11 km and 230 sq km in area, was centered on Butt Mountain and cuts ring 1 on the south. All three rings consisted of composite curvilinear features that represent geologic features of two categories: (1) geologically mapped structures and volcanic landforms, and (2) landforms and lines of geomorphic origin that were inferred to represent the surface expression of subsurface structures. Stream-valley and lake-shoreline continuations of mapped faults, escarpments, and aligned segments of stream valleys were included in the 2d category. The rings overlap a gravity low 5300 sq km in area, and might be the surface expression of volcanotectonic collapse structures that followed eruption of voluminous ash flow tuffs beginning in Miocene times.

N78-23500# Geological Survey, Denver, Colo.
THERMAL SURVEILLANCE OF ACTIVE VOLCANOES USING THE LANDSAT-1 DATA COLLECTION SYSTEM. PART 6: ELECTRONIC THERMAL SENSOR AND DATA COLLECTION PLATFORM TECHNOLOGY Final Report, 1972 - 1975
Duane M. Preble, Jules D. Friedman, and David Frank, Principal Investigators Feb. 1976 64 p refs ERTS
(NASA Order S-70243-AG)
(E78-10124; NASA-CR-156974) Avail: NTIS HC A04/MF A01 CSCL 08K

The author has identified the following significant results. Five LANDSAT data collection platforms were integrated electronically with thermal sensing systems, emplaced and operated in an analog mode at selected thermal significant volcanic and geothermal sites. The DCP's transmitted 3260 messages comprising 26,080 ambient, surface, and near surface temperature records at an accuracy of + or - 1.15 C for 1121 instrument days between November 14, 1972 and April 17, 1974. In harsh, windy, high altitude volcanic environments, the DCP functioned best with a small dipole antenna. Sixteen kg of alkaline batteries provided a viable power supply for the DCP systems, operated at a low duty cycle, for 5 to 8 months.

N78-23539# Kewanee Oil Co., Tulsa, Okla.
NORTH STANLEY POLYMER DEMONSTRATION PROJECT First Annual Report
Jarl P. Johnson, J. W. Cunningham, and B. M. DuBois 26 Jul. 1976 169 p refs
(Contract EY-76-C-02-0029)
(COO-0029-1) Avail: NTIS HC A08/MF A01

The efficiency and economics of recovering tertiary oil from a highly heterogeneous reservoir by injecting a polymer slug of tapered concentrations to improve the sweep efficiency of the reservoir were demonstrated. All injection wells were equipped with plastic coated tubing, and packers were set approximately 100 ft above the Burbank sand to prevent the possibility of subsequent casing leaks thiefing off injected polymer. Producing wells were worked over to insure maximum producing capability. The necessary surface facility changes were made to allow the injection of fresh water only and to provide for the disposal of 35,000 BPD of produced water. Polymer storage and blending facilities were constructed in such a manner as to allow control

of the mixing process with a minimum of supervision and manpower. A one well mini-injection test was conducted which included a fresh water preflush period, injection of 5,000 lb of Pusher 700 at 1,000 ppm followed by 1,000 lb of Pusher 1,000 at 100 ppm, and a fresh water afterflush period. The mini test established that there would be no significant well bore problems associated with the injection of the polymer. ERA

N78-23554 Oregon State Univ., Corvallis.

HEAT TRANSFER EFFECTS IN FORCED GEOHEAT RECOVERY SYSTEMS Ph.D. Thesis

Jonathan Mackey Hanson 1978 226 p
 Avail: Univ. Microfilms Order No. 7805355

Forced geoheat recovery using naturally occurring fluid conductors, viz., fault zones, basaltic dikes, and open formation contacts, is considered in terms of the system physical-economic feasibility. The heat transfer surface area required for an economically viable forced recovery system for direct contact heating applications is estimated based on various geologic and economic parameters. The heat transfer surface area reflects the required dimensions of the subsurface system and therefore serves as an indicator of the feasibility of the system. The results indicate that, under current economic conditions and regional geothermal gradients of 50 C/km or more, the minimum heat transfer surface area per injection/production borehole pair required for an economically viable direct-contact heating system with a 10 to 20 year system lifetime is less than 1 sq km.

Dissert. Abstr.

N78-23555* Aerospace Corp., El Segundo, Calif. Advanced Orbital Systems Div.

HIGH EFFICIENCY SOLAR PHOTOVOLTAIC POWER MODULE CONCEPT Final Report

I. Bekey Mar. 1978 151 p refs
 (Contract NASw-3078)
 (NASA-CR-157002; ATR-78(7666)-1) Avail: NTIS
 HC A08/MF A01 CSCL 10A

The investigation of a preliminary concept for high efficiency solar power generation in space is presented. The concept was a synergistic combination of spectral splitting, tailored bandgap cells, high concentration ratios, and cool cell areas. Author

N78-23556* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COMPARISON OF COMPUTER CODES FOR CALCULATING DYNAMIC LOADS IN WIND TURBINES

David A. Spera 1977 39 p refs Presented at the 3d Bien. Conf. and Workshop on Wind Energy Conversion Systems, Washington, D. C., 19-21 Sep. 1977
 (Contract E(49-26)-1028)
 (NASA-TM-73773; DOE/NASA/1028-78/16; E-9577) Avail:
 NTIS HC A03/MF A01 CSCL 10B

Seven computer codes for analyzing performance and loads in large, horizontal axis wind turbines were used to calculate blade bending moment loads for two operational conditions of the 100 kW Mod-0 wind turbine. Results were compared with test data on the basis of cyclic loads, peak loads, and harmonic contents. Four of the seven codes include rotor-tower interaction and three were limited to rotor analysis. With a few exceptions, all calculated loads were within 25 percent of nominal test data. Author

N78-23557* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PERFORMANCE POTENTIAL OF COMBINED CYCLES INTEGRATED WITH LOW-Btu GASIFIERS FOR FUTURE ELECTRIC UTILITY APPLICATIONS

Joseph J. Nainiger and Raymond K. Burns [1977] 42 p refs Presented at the 69th Ann. Meeting of the Am. Inst. of Chem. Engr., Chicago, 28 Nov. - 2 Dec. 1976
 (NASA-TM-73775; E-9567) Avail: NTIS HC A03/MF A01 CSCL 10A

A comparison and an assessment of 10 advanced utility power systems on a consistent basis and to a common level of detail were analyzed. Substantial emphasis was given to a

combined cycle systems integrated with low-Btu gasifiers. Performance and cost results from that study were presented for these combined cycle systems, together with a comparative evaluation. The effect of the gasifier type and performance and the interface between the gasifier and the power system were discussed.

Author

N78-23558* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

WAKE CHARACTERISTICS OF A TOWER FOR THE DOE-NASA MOD-1 WIND TURBINE

Joseph M. Savino, Lee H. Wagner, and Mary Nash Apr. 1978 76 p refs
 (Contract E(49-26)-1028)
 (NASA-TM-78853; E-9575; DOE/NASA/1028-78/17) Avail:
 NTIS HC A05/MF A01 CSCL 10A

A 1/40th scale model of a tower concept designed for a MOD-1 wind power turbine was tested in a low speed wind tunnel. Wake wind speed profiles were measured, and from these were determined local values of wake minimum velocity ratio, average velocity ratio, and width over a range of tower elevations and wind approach angles. Comparison with results from two other all tubular models (MOD-0 and eight leg designs) tested earlier in the same tunnel indicated that wake width and flow blockage at the rotor plane of rotation were slightly larger for the MOD-1 tower than for the other two models. The differences in wake characteristics were attributed to differences in tower geometry and member dimensions. Author

N78-23559* Kaman Aerospace Corp., Bloomfield, Conn.

DESIGN STUDY OF WIND TURBINES, 50 kW TO 3000 kW FOR ELECTRIC UTILITY APPLICATIONS: EXECUTIVE SUMMARY Final Report

Jul. 1977 95 p
 (Contracts NAS3-19404; E(49-26)-1010)
 (NASA-CR-134936; R-1382; DOE/NASA/9404-7611) Avail:
 NTIS HC A05/MF A01 CSCL 10A

Preliminary designs of low power (50 to 500 kW) and high power (500 to 3000 kW) wind generator systems (WGS) for electric utility applications were developed. These designs provide the bases for detail design, fabrication, and experimental demonstration testing of these units at selected utility sites. Several feasible WGS configurations were evaluated, and the concept offering the lowest energy cost potential and minimum technical risk for utility applications was selected. The selected concept was optimized utilizing a parametric computer program prepared for this purpose. The utility requirements evaluation task examined the economic, operational and institutional factors affecting the WGS in a utility environment, and provided additional guidance for the preliminary design effort. Results of the conceptual design task indicated that a rotor operating at constant speed, driving an AC generator through a gear transmission is the most cost effective WGS configuration. Author

N78-23560* Kaman Aerospace Corp., Bloomfield, Conn.

DESIGN STUDY OF WIND TURBINES 50 kW TO 3000 kW FOR ELECTRIC UTILITY APPLICATIONS: ANALYSIS AND DESIGN Final Report

Feb. 1976 567 p refs
 (Contracts NAS3-10094; E(49-26)-1010)
 (NASA-CR-134937; R-1382; DOE/NASA/9404-76/2) Avail:
 NTIS HC A24/MF A01 CSCL 10A

In the conceptual design task, several feasible wind generator systems (WGS) configurations were evaluated, and the concept offering the lowest energy cost potential and minimum technical risk for utility applications was selected. In the optimization task, the selected concept was optimized utilizing a parametric computer program prepared for this purpose. In the preliminary design task, the optimized selected concept was designed and analyzed in detail. The utility requirements evaluation task examined the economic, operational, and institutional factors affecting the WGS in a utility environment, and provided additional guidance for the preliminary design effort. Results of the conceptual design task indicated that a rotor operating at constant speed, driving an AC generator through a gear transmission is the most cost effective WGS configuration. The optimization task results led

to the selection of a 500 kW rating for the low power WGS and a 1500 kW rating for the high power WGS. Author

N78-23561*# Lamar Univ., Beaumont, Tex. Chemical Engineering Dept.

PROCESS FEASIBILITY STUDY IN SUPPORT OF SILICON MATERIAL TASK 1 Quarterly Technical Progress Report C. S. Fang, Keith C. Hansen, Joseph W. Miller, Jr., and Carl L. Yaws Mar. 1978 81 p refs (Contract JPL-954343)

(NASA-CR-157030; ERDA/JPL-954343-78/1; QTPR-1) Avail: NTIS HC A05/MF A01 CSCL 10A

Initial results for gas thermal conductivity of silicon tetrafluoride and trichlorosilane are reported in respective temperature ranges of 25 to 400 C and 50 to 400 C. For chemical engineering analyses, the preliminary process design for the original silane process of Union Carbide was completed for Cases A and B, Regular and Minimum Process Storage. Included are raw material usage, utility requirements, major process equipment lists, and production labor requirements. Because of the large differences in surge tankage between major unit operations the fixed capital investment varied from \$19,094,000 to \$11,138,000 for Cases A and B, respectively. For the silane process the original flowsheet was revised for a more optimum arrangement of major equipment, raw materials and operating conditions. The initial issue of the revised flowsheet (Case C) for the silane process indicated favorable cost benefits over the original scheme. Author

N78-23562*# Texas Instruments, Inc., Dallas. **AUTOMATED ARRAY ASSEMBLY TASK, PHASE 1** Final Report

Bernard G. Carbajal Oct. 1977 213 p. refs Prepared for DOE

(Contract JPL-954405) (NASA-CR-156985; ERDA/JPL-954405-77/7; TI-03-77-44) Avail: NTIS HC A10/MF A01 CSCL 10A

State-of-the-art technologies applicable to silicon solar cell and solar cell module fabrication were assessed. The assessment consisted of a technical feasibility evaluation and a cost projection for high volume production of solar cell modules. Design equations based on minimum power loss were used as a tool in the evaluation of metallization technologies. A solar cell process sensitivity study using models, computer calculations, and experimental data was used to identify process step variation and cell output variation correlations. Author

N78-23563*# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.

LOW COST SILICON SOLAR ARRAY PROJECT LARGE AREA SILICON SHEET TASK: SILICON WEB PROCESS DEVELOPMENT Quarterly Report

C. S. Duncan, R. G. Seidensticker, J. P. McHugh, P. D. Blais, and J. R. Davis, Jr. 31 Dec. 1977 54 p refs Prepared for JPL, Pasadena, Calif.

(Contracts NAS7-100; JPL-954654) (NASA-CR-156984; ERDA/JPL-954654-77/3; QR-3) Avail: NTIS HC A04/MF A01 CSCL 10A

Growth configurations were developed which produced crystals having low residual stress levels. The properties of a 106 mm diameter round crucible were evaluated and it was found that this design had greatly enhanced temperature fluctuations arising from convection in the melt. Thermal modeling efforts were directed to developing finite element models of the 106 mm round crucible and an elongated susceptor/crucible configuration. Also, the thermal model for the heat loss modes from the dendritic web was examined for guidance in reducing the thermal stress in the web. An economic analysis was prepared to evaluate the silicon web process in relation to price goals. Author

N78-23566*# ARCO Solar, Inc., Chatsworth, Calif. **TERRESTRIAL SOLAR CELL MODULE AUTOMATED ARRAY ASSEMBLY, TASK 4** Final Report

Jan. 1978 27 p Prepared for JPL Sponsored in part by DOE (NASA-CR-156982; ERDA/JPL-954751-78/1; ASI-1277-1) Avail: NTIS HC A03/MF A01 CSCL 10A

A cost effective design and manufacturing process which would produce solar cell modules capable of meeting qualification test criteria was developed. Emphasis was placed on the development of an aluminum paste back contact process. Author

N78-23566# Comptroller General of the United States, Washington, D.C.

AN EVALUATION OF THE NATIONAL ENERGY PLAN Report to the Congress

25 Jul. 1977 185 p refs (EMD-77-48) Avail: NTIS MF A01; GAO HC \$1.00

An analysis of the National Energy Plan was made by the General Accounting Office. Recommendations were made for increasing energy conservation if satisfactory progress is not made in achieving the energy goals. Additional recommendations were made to strengthen the plan. Specific suggestions include: adopting a set of national energy goals and designing a program to meet these goals, establishing a set of milestones upon which to judge progress in meeting these goals and, establishing a set of standby initiatives. Many of these alternatives will have to be mandatory if the milestones indicate that satisfactory progress is not made. P.R.A.

N78-23567*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

COMBINED SOLAR COLLECTOR AND ENERGY STORAGE SYSTEM Patent Application

Ronald N. Jensen, inventor (to NASA) Filed 28 Apr. 1978 12 p

(NASA-Case-LAR-12205-1; US-Patent-Appl-SN-900843) Avail: NTIS HC A02/MF A01 CSCL 10A

A solar heating system comprised of a combined solar energy collector, fluid chiller and energy storage system was developed. A movable interior insulated panel in a storage tank is positionable flush against the storage tank wall to insulate the tank for energy storage. The movable interior insulated panel is alternately positionable to form a solar collector or fluid chiller through which the fluid flows by natural circulation. NASA

N78-23568# Oregon State Univ., Corvallis. Engineering Experiment Station.

AN EVALUATION OF USES FOR LOW TO INTERMEDIATE TEMPERATURE GEOTHERMAL FLUIDS IN THE KLAMATH BASIN, OREGON

Gordon M. Reistad, Wilson E. Schmisser, J. Ralph Shay, and James B. Fitch Mar. 1978 137 p refs Sponsored by the Pacific Northwest Regional Commission (Bull-55) Avail: NTIS HC A07/MF A01

The potential is considered of using geothermal energy in the low to intermediate temperature range (30 to 150 C) for industrial and agricultural processes in the Klamath Basin in Oregon. Resource-based industries that could utilize hot water in an integrated or cascaded system were emphasized. Integrated systems for geothermal fluid use are those in which the fluid is shared jointly between several processes and cascaded from higher to successively lower temperature uses. A wide variety of processes were screened. From this initial screening, nine were identified for more extensive engineering and economic analysis: greenhouse tree seedling production, greenhouse tomato

production, controlled environment swine production, barley malting, methane generation from swine wastes, lumber drying, potato flake dehydration, fish protein concentration, and catfish production in heated ponds. Author

N78-23569# Committee on Agriculture, Nutrition, and Forestry (U. S. Senate).

ENERGY POLICY AND STRATEGY FOR RURAL DEVELOPMENT, PART 1

Washington GPO 1977 237 p refs Hearings before Subcomm. on Rural Development of the Comm. on Agriculture, Nutrition, and Forestry, 95th Congr., 1st Sess., 13-14 Jul. 1977 (GPO-94-275) Avail: Subcomm. on Rural Development

Addressed are the energy problems and strategies developed to combat the Nation's energy problems as they affect rural development. Witnesses from various organizations, primarily the U.S. Department of Agriculture and Energy Research and Development Administration, offer testimonies and answer questions concerning the energy problems and strategies. G.Y.

N78-23570# Committee on Agriculture, Nutrition, and Forestry (U. S. Senate).

ENERGY POLICY AND STRATEGY FOR RURAL DEVELOPMENT, PART 2

Washington GPO 1977 56 p refs Hearings before Subcomm. on Rural Development of the Comm. on Agriculture, Nutrition, and Forestry, 95th Congr., 1st Sess., 13 Sep. 1977 (GPO-97-394) Avail: Subcomm. on Rural Development

For abstract, see N78-23569.

N78-23577# California Univ., Berkeley. Lawrence Berkeley Lab.

ERDA GEOTHERMAL COMPONENT TEST FACILITY (GCTF), EAST MESA, IMPERIAL VALLEY, CALIFORNIA. TEST OPERATIONS MANAGEMENT PLAN

1976 22 p refs

(Contract W-7405-eng-48)

(TID-28010) Avail: NTIS HC A02/MF A01

Discussion of the operation of the geothermal component test facility, established for testing heat extraction and energy conversion equipment and materials, is presented under the following section headings: purposes of the facility; operating policies; service, conflicts, safety and environmental, investigator activities, shops and equipment, and test certification; organization; chart; organization, responsibilities, individual responsibilities, and funding. ERA

N78-23578# Brookhaven National Lab., Upton, N. Y.

ENERGETICS OF THE UNITED STATES OF AMERICA: AN ATLAS

F. R. Drysdale and C. E. Calef Oct. 1977 447 p refs

(Contract EY-76-C-02-0016)

(BNL-50501-R) Avail: NTIS HC A19/MF A01

A description of the United States' energy system is presented in the form of maps and major tables. The country was chosen as the basic unit for reporting estimations of many energy, demographic and economic variables. The variables include production of all fuels (including hydroelectricity), uses of fuels and electricity broken down by sector and end-use, existing and planned electricity generation capacity, refinery capacities, and emissions of air pollutants from fuel use. ERA

N78-23579# Brookhaven National Lab., Upton, N. Y.

ENERGY INFORMATION AND ANALYTIC SYSTEM FOR NEW YORK STATE

T. O. Carroll, J. Allentuck, M. D. Goldberg, R. Nathans, P. F. Palmedo, R. Pouder, and D. Svei 9 Aug. 1976 98 p refs Prepared in cooperation with State Univ. of New York, Stony Brook

(Contract EY-76-C-02-0016)

(BNL-22677) Avail: NTIS HC A05/MF A01

A review of energy information needs and activities in New York and in 20 other states provided background for the types of policy issues and data critical to the design of an energy information/analytic system. The system was structured as a

set of four basic elements: a broad base of state specified data and information, a computerized retrieval system with easy terminal access to national data bases, adaptation of useful analytical models, and a modular construction which will allow sequential development of full capacities of the total system. Author

N78-23580# Department of Energy, Washington, D. C.

ENERGY EMERGENCY PLANNING GUIDE: WINTER 1977 - 1978

Nov. 1977 177 p

(DOE/ERA/0031) Avail: NTIS HC A09/MF A01

This guide was prepared in order to identify and evaluate actions available to deal with energy emergencies this winter; provide an advance indication to the public of those actions considered most likely to be taken by the government, and provide industry, state, and local governments with suggestions about actions which they can take to deal with energy emergencies. Flexible implementation guidelines are proposed for natural gas, petroleum, electricity/coal, and propane shortages. ERA

N78-23581# Hudson Inst., Inc., Croton-on-Hudson, N. Y.

SUGGESTIONS FOR A PHASE-2 NATIONAL ENERGY POLICY Final Report, Mar. - Sep. 1977

W. M. Brown and H. Kahn Sep. 1977 236 p

(Contract EF-77-C-01-2660)

(FE-2660-1) Avail: NTIS HC A11/MF A01

In order to obtain sufficient and secure long term supplies of oil and gas at stable prices a number of suggestions were made for the next phase of the U.S. energy program. The discussion emphasizes those relevant to the early requirements for the proposed synfuels program, the current domestic issues; particularly regulatory policy in the changing sociopolitical milieu, and some international approaches involving cooperation with the IEA and other fuel-importing countries, and the potential for cooperation as well as confrontation with OPEC. ERA

N78-23582# Argonne National Lab., Ill.

TRANSITION TO DECENTRALIZED ENERGY SYSTEMS

J. Cavallo and G. C. Krohm 1977 8 p refs Presented from 5th Natl. Conf. on Energy and the Environ. Cincinnati, 31 Oct. 1977

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

(CONF-7710101-1) Avail: NTIS HC A02/MF A01

Alternative system designs were compared for annualized costs and reliability. The alternative base and intermediate load generating plants tested were conventional large nuclear and coal units and small (120 MW) fluidized bed coal combustion units. ERA

N78-23583# Battelle Pacific Northwest Labs., Richland, Wash.

DEVELOPMENT, CHARACTERIZATION, AND EVALUATION OF MATERIALS FOR OPEN CYCLE MHD Quarterly Report, Mar. 1977

J. L. Bates Jun. 1977 112 p refs

(Contract EY-76-C-06-1830)

(BNWL-2004-6) Avail: NTIS HC A06/MF A01

Program objectives were to develop, test, characterize, and evaluate materials for open cycle, coal fired MHD power generators. The specific immediate goals emphasized electrode and insulator materials, including: (1) testing and evaluation of the enhanced effects of alkali seed on materials in a dc electric field; (2) development and testing of improved electrodes and insulators with controlled microstructures, compositions and properties; and (3) characterization and evaluation of materials relating to both the US MHD Program and the US-USSR Cooperative Program for MHD power generators. ERA

N78-23584# Argonne National Lab., Ill.

LONG-TERM AVAILABILITY OF WATER RESOURCES FOR ENERGY DEVELOPMENT IN THE CENTRAL UNITED STATES

L. J. Habegger, S. Y. Chiu, and L. J. Hoover 1977 9 p Presented at 5th Natl. Conf. on Energy and the Environ. Cincinnati, 31 Oct. 1977

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

(CONF-7710101-5) Avail: NTIS HC A02/MF A01

An analysis was made of water resources and demands over the next 40 to 50 years in the Central U.S. Various subregions in which significant water shortages are likely to occur were identified. These shortages would constrain energy development patterns, restrict development of competing water uses, or alternatively, require implementation of water resource enhancement options. ERA

N78-23585# Energy Research and Development Administration, Washington, D. C. Div. of Physical Research.

FOSSIL ENERGY RESEARCH MEETING

R. H. Kropschot and G. C. Phillips Dec. 1977 560 p Presented at Fossil Energy Research Meeting, Wash., D. C. (CONF-7706100) Avail: NTIS HC A24/MF A01

Research programs in fossil energy were reviewed with brief descriptions, budgets, etc. Discussions related to the capabilities for such research of national laboratories, universities, energy centers, etc. are presented. ERA

N78-23587# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM. PHASE 1, CRDL ITEM 2: PILOT PLANT PRELIMINARY DESIGN REPORT. VOLUME 3, BOOK 2: COLLECTOR SUBSYSTEM

Raymon W. Hallet, Jr. and Robert L. Gervais Oct. 1977 454 p refs (Contract EY-76-C-03-1108)

(SAN/1108-8/3; MDC-G-6776-Vol-3-Bk-2) Avail: NTIS HC A20/MF A01

The methods and plans for the manufacture of the 10 MW collector heliostats and associated controls for the pilot plant are given. An in depth description of the production, installation, and verification testing of heliostats for the pilot plant is presented. Specifications for the performance, design, and test requirements for the pilot plant collector subsystem are included. Also, a heliostat location summary report is given. ERA

N78-23588# Chase Manhattan Bank, New York. Energy Consulting Div.

US OIL AND NATURAL GAS FINDING COSTS. VOLUME 2: STATISTICAL APPENDIX

Jul. 1977 322 p Sponsored in part by DOE

(Contract FEA-CR-05-60731-00)

(FEA/G-77/357-Vol-2) Avail: NTIS HC A14/MF A01

Costs were established for U.S. oil and gas exploration efforts historically, and the level of such costs in 1980, 1985, and 1990 were projected. Data were developed for 17 onshore and 2 offshore regions in the Continental U.S. where the petroleum industry had traditionally focused its operations. Onshore and offshore sectors of Alaska as well as the offshore Atlantic Coast region that are the focal points of exploratory activity, were also examined. The research results are presented in terms of total dollar costs per foot drilled for oil and gas wells. ERA

N78-23589# Kentucky Univ., Lexington.

SURFACE STRUCTURE AND MECHANISMS OF GASIFICATION CATALYST DEACTIVATION Quarterly Report, Jan. - Apr. 1977

P. J. Reucroft, E. B. Bradley, R. J. DeAngelis, and G. A. Sargent Aug. 1977 72 p

(Contract EX-76-C-01-2229).

(FE-2229-5) Avail: NTIS HC A04/MF A01

NiS was found to have very little surface charging and small chemical shifts, compared to the Ni metal. A quantitative analysis of the L140 catalysts revealed that particle sizes did not change greatly with increasing metal loading; binding energies and peak shapes corresponded to a nickel aluminate complex. Catalysts were studied in order to assess the effects of exposure to synthesis gas and presulfiding. The presulfiding treatment effectively saturated the catalyst with sulfur. Thermal gravimetric analysis was used to study the effects of temperature and hydrogen flow rates on the reduction kinetics of NiO dispersed on silica and alumina supports. ERA

N78-23590# Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.

STUDIES ON THE SEPARATION OF COAL EXTRACT FROM SOLID RESIDUE IN LIQUEFIED COAL Final Report

D. E. Briggs, D. B. McAlpine, C. D. Bedford, Benedict Ho, Phillip J. Johnson, Jeffrey A. McKeen, Uptal SenGupta, J. Andrew Stirling, Peter A. S. Smith, John R. Cameron et al Sep. 1977 458 p refs

(Grant NSF AER-75-15213; DRDA Proj. 013722)

(NSF/AER-75-15213) Avail: NTIS HC A20/MF A01

Coal liquefaction residues from the SYNTHOIL (Pittsburgh Seam) and H-Coal (Illinois No. 6) processes were fractionated by solvent extraction into oils and resins, asphaltenes, pre-asphaltenes, and mineral solids for adsorption, filtration, surface tension, and viscosity measurements. Suspended solids in liquefied coal range in size from less than 0.05 microns to greater than 1 microns. The specific resistance of filter cakes varies as an inverse function of the number average particle size. At temperatures below 200 C, the H-Coal filter cake compressibility was 0.36. The specific filtration resistance is temperature dependent above 200 C, being from 50 to 100 percent higher at 232 C than at 177 C. Surface tension and reduced viscosity data for oils, resins, and asphaltenes in tetralin indicate intermolecular association and colloid micellization. ERA

N78-23591# Institute of Gas Technology, Chicago, Ill.

PREPARATION OF A COAL CONVERSION SYSTEMS TECHNICAL DATA BOOK Monthly Status Report, 1-31 Aug. 1977

Oct. 1977 50 p refs

(Contract EX-76-C-01-2286; Proj. 8979)

(FE-2286-21) Avail: NTIS HC A03/MF A01

Various correlations for estimating the calorific value of coal from its elemental composition were compared using an extended data base of American coals. Charts that give partial pressures of NH3 and H2S in the NH3-H3S-H2O subsystem are presented. The equilibrium constants for reactions of interest in coal conversion processes are presented as functions of temperature. Correlations for saltation velocity in horizontal gas-solid transport are evaluated using available data on saltation velocities. Heat transfer coefficient curves are presented as functions of temperature for various solvent/coal ratios and fluid velocities. ERA

N78-23593# Sandia Corp., Albuquerque, N. Mex. Computer-Aided Design Div.

PVSS: A PHOTOVOLTAIC SYSTEM SIMULATION PROGRAM MANUAL

Lawrence H. Goldstein and Glenn R. Case Jun. 1977 46 p refs

(Contract EY-76-C-04-0789)

(SAND-77-0814) Avail: NTIS MF A01

The PVSS code was developed to accurately simulate the performance of a photovoltaic system. System configurations were modeled using such components as batteries, inverters, dc-voltage regulators, and maximum power point trackers. Data describing incident light intensity and load demand was supplied and, the PVSS program computed the power available at the output terminals of each system component, the energy surplus produced or deficit incurred by the system as a whole, and the battery state of charge for systems possessing battery storage. Procedures for defining a photovoltaic system and specifying a simulation are discussed. ERA

N78-23594# Resource Planning Associates, Inc., Washington, D. C.

COMPREHENSIVE COMMUNITY PLANNING FOR ENERGY MANAGEMENT AND CONSERVATION: DEVELOPING AND APPLYING A COORDINATED APPROACH TO ENERGY-RELATED COMMUNITY DEVELOPMENT, VOLUME 1

14 Oct. 1977 140 p

(Contracts EX-76-C-10-3879; E(49-1)-3879)

(HCP/M3879-Vol-1; RA-77-0319)

Avail: NTIS HC A07/MF A01

Physical and institutional characteristics that determine a community's levels and patterns of energy use were defined

and methods of coordinating its energy systems established. The characteristic problems of rapid growth are described and their causes traced. A number of domestic and European community development approaches that might be applicable to managing rapid growth in the boomtown context are surveyed. ERA

N78-23595# Resource Planning Associates, Inc., Washington, D. C.

COMPREHENSIVE COMMUNITY PLANNING FOR ENERGY MANAGEMENT AND CONSERVATION: DEVELOPING AND APPLYING A COORDINATED APPROACH TO ENERGY-RELATED COMMUNITY DEVELOPMENT, VOLUME 2

14 Oct. 1977 336 p
(Contracts EX-76-C-10-3879; E(49-1)-3879)
(HCP/M3879-1-Vol-2; RA-77-0319) Avail: NTIS HC A15/MF A01

Analytical outputs that shaped the general approach and its adaptation to the selected target community (Mercer County, North Dakota) were produced. Methodologies of the development of analytical tools and investigation of community-development approaches and the selection of communities are given. ERA

N78-23596# Resource Planning Associates, Inc., Washington, D. C.

COMPREHENSIVE COMMUNITY PLANNING FOR ENERGY MANAGEMENT AND CONSERVATION: DEVELOPING AND APPLYING A COORDINATED APPROACH TO ENERGY-RELATED COMMUNITY DEVELOPMENT: EXECUTIVE SUMMARY

Dec. 1977 36 p
(Contract E(49-1)-3879)
(HCP/M3879-0003) Avail: NTIS HC A03/MF A01

This summary highlights and condenses the community development process and formulates an organizational approach to resolving the institutional and financial issues arising from energy related community development. ERA

N78-23597# Battelle Pacific Northwest Labs., Richland, Wash.
EFFECT OF GENERALIZED WIND CHARACTERISTICS ON ANNUAL POWER ESTIMATES FROM WIND TURBINE GENERATORS

William C. Cliff Oct. 1977, 57 p refs
(Contract EY-76-C-06-1830)
(PNL-2436) Avail: NTIS HC A04/MF A01

A technique is presented for estimating the average power output of a wind turbine using the mean annual wind magnitude. Hourly wind speeds were assumed to have a Rayleigh frequency distribution which required a single parameter input. Based upon a general shape, for the wind speed versus machine output, a generic set of curves was developed to estimate the average power output of wind turbines. ERA

N78-23598# Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.

THE MODULAR SOLAR ENERGY SATELLITE. PROJECT PROPOSAL AND DEVELOPMENT STRATEGY

Jan Ruth and Wolfgang Westphal [1977] 21 p refs In GERMAN; ENGLISH summary
Avail: NTIS HC A02/MF A01

The concept of a modular solar energy satellite (MOSES) for microwave energy transmission to earth is discussed. Economics can be obtained by using the modular concept proposed combined with part completion in space. The basic advantages and disadvantages of the modular type structure are exemplified and a description is given of the range of the most suitable module forms. Research on possible construction methods shows that with advancing technologies an increasing use in time of space manufacturing will be feasible. An evolutionary development strategy is presented based on the use of the space shuttle/Spacelab research platform. ESA

N78-23599# Istituto Superiore di Sanita, Rome (Italy). Lab. delle Radiazioni.

HEALTH AND ENVIRONMENTAL ASPECTS OF ENERGY DEVELOPMENT

G. Campos Venuti, S. Frullani, E. Tabet, and P. Vecchia 30 Apr. 1977 67 p refs In ITALIAN; ENGLISH summary Presented at the 2d Intern. Meeting on Environ. Policy and Energy Crisis, Turin, 26-29 Apr. 1977
(ISS-P-77/2) Avail: NTIS HC A04/MF A01

Health and environmental aspects related to different energy sources were examined, both for those which are at present employed (fossil fuels and fission) and those still under development (solar, geothermal, fusion). The advantages of energy saving by using energy more efficiently are also analyzed. Author (ESA)

N78-23600# International Institute for Applied Systems Analysis, Laxenburg (Austria).

WHICH WAY TO GO? OBSERVATIONS BASED ON DISCUSSION ON GLOBAL PERSPECTIVES AND ENERGY STRATEGIES

W. Sassini, A. Lovins (Friends of the Earth), D. Meadows (Dartmouth Coll.), and P. Penczynski Sep. 1977 13 p refs (IIASA-PP-77-9) Avail: NTIS HC A02/MF A01

An attempt is made to trace some of the roots of the divergence of views on the approach to securing future energy demands. Research topics which could help to clarify the implications of alternate paths have been included. ESA

N78-23601# International Institute for Applied Systems Analysis, Laxenburg (Austria).

REPORT TO THE ADVISORY COMMITTEE OF IIASA'S ENERGY PROGRAM

W. Haefele, H. Porias, ed. et al Sep. 1977 42 p refs (IIASA-RM-77-42) Avail: NTIS HC A03/MF A01

The general time scale, the general aims and concepts, and the present status of the ENP (Energy Systems Program) are reviewed. Specific activities and results of the ENP in energy models, coal potential, energy production and climate, and risk assessment are summarized. ESA

N78-23602# National Physical Lab., Teddington (England).
ENERGY AUDIT SCHEME Progress Report, 1 Jun. 1975 - 30 Nov. 1976

Aug. 1977 21 p refs
(NPL-Chem-72: PR-1) Avail: NTIS HC A02/MF A01

Progress on the Department of Industry Energy Audit Scheme (EAS) is reported. The scheme seeks to measure the energy used in the different stages of manufacture of industrial products, to identify areas of intensive wasteful energy use, and to provide information on the needs for research and development on the more efficient use of energy in industry. Industrial sectors covered are non-ferrous metals, mechanical engineering, electrical engineering, textiles, ceramics, paper, glass, and paint. Energy audits for all these sectors, except the paint sector, are presented. ESA

N78-23603# Oregon State Univ., Corvallis. Engineering Experiments Station.

SIMULATING OREGON'S FUTURE ELECTRICAL ENERGY DEMAND

W. D. Devine, Jr., C. C. Calligan, and O. D. Osborne Jul. 1977 232 p Sponsored by the Pacific Northwest Regional Commission
(PB-276970/1; BULL-54) Avail: NTIS HCA11/MF A01 CSCL 10B

An overview of the Oregon State Simulation Model (OSSIM), detailed documentation of OSSIM's energy component, a summary of liaison and training activities, and a discussion of model implementation are presented. GRA

N78-23604# Argonne National Lab., Ill.
SUPPORTIVE STUDIES IN FLUIDIZED-BED COMBUSTION Annual Report, Jul. 1976 - Jun. 1977

A. Jonke, G. Vogel, I. Johnson, S. Lee, J. Lenc, A. Lescarret, J. Montagna, F. Nunes, J. Shearer, and R. Snyder Dec. 1977 212 p refs
(Contract EPA-IA-G-D5-a681)
(PB-276974/3; ANL/CEN/FE-77-3; EPA-600/7-77-138) Avail: NTIS HC A10/MF A01 CSCL 07A

The report gives results of studies supporting the development of atmospheric and pressurized fluidized-bed combustion (FBC) of coal. It includes laboratory and bench-scale studies to provide needed information on combustion optimization, regeneration process development, solid waste disposal, synthetic SO₂-sorber studies, emission control and other tasks. It includes characterization of a variety of limestone and dolomites from various parts of the U.S. for suitability in FBC combustors. Reduction in solid waste volumes to reduce the environmental impact of the waste sulfated limestone is a major goal of this program.

GRA

N78-23605# General Accounting Office, Washington, D. C. Energy and Minerals Div.

THE MAGNITUDE OF THE FEDERAL SOLAR ENERGY PROGRAM AND THE EFFECTS OF DIFFERENT LEVELS OF FUNDING

2 Feb. 1978 66 p
(PB-277018/8; EMD-78-27) Avail: NTIS HC A04/MF A01 CSCL 10A

The Federal solar energy program, its objectives, and major efforts are discussed; projected program costs through 1983; effects of increased/decreased funding on the solar energy program; and, mechanisms available to encourage the use of solar energy.

GRA

N78-23607 National Technical Information Service, Springfield, Va.

FLUIDIZED BED COMBUSTION, VOLUME 2. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1970 - 1976

Diane M. Cavagnaro Mar. 1978 212 p
(NTIS/PS-78/0195/4) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 21B

This bibliography of worldwide research reports includes fluidized bed processes and processors for the combustion of oil, coal, and industrial as well as municipal wastes. The citations cover sludge incineration, fluidized bed boilers, and air pollution abatement by fluidized bed combustion.

GRA

N78-23608 National Technical Information Service, Springfield, Va.

FLUIDIZED BED COMBUSTION, VOLUME 1. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1977 - Mar. 1978

Diane M. Cavagnaro Mar. 1978 110 p Supersedes NTIS/PS-77/0195 and NTIS/PS-76/0162
(NTIS/PS-78/0196/2; NTIS/PS-77-0195; NTIS/PS-76/0162) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 21B
For abstract, see N78-23607.

N78-23609 National Technical Information Service, Springfield, Va.

FLUIDIZED BED COMBUSTION, VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1977 - Mar. 1978

Diane M. Cavagnaro Mar. 1978 135 p Supersedes NTIS/PS-77/0194; NTIS/PS-76/0161 and NTIS/PS-75/256
(NTIS/PS-78/0197/0; NTIS/PS-77/0194; NTIS/PS-76/0161; NTIS/PS-75/256) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 21B

The bibliography cites studies on fluidized bed processes and processors for the combustion of coal, oil, and industrial and municipal wastes. It also covers sludge incineration, fluidized bed boilers, nuclear fuel reprocessing, and air pollution control by fluidized bed combustion.

GRA

N78-23614# Meteorology Research, Inc., Altadena, Calif.
OXIDANT MEASUREMENTS IN WESTERN POWER PLANT PLUMES. VOLUME 1: TECHNICAL ANALYSIS Final Report

J. A. Ogren, D. L. Blumenthal, and A. H. Vanderpol Jul. 1977 119 p refs Sponsored by EPRI
(EPRI-EA-421-Vol-1) Avail: NTIS HC A06/MF A01

Airborne measurements were carried out at fossil fuel power plants in northwestern New Mexico. The extent of ozone formation

in power plant plumes was ascertained. The formation of secondary pollutants NO₂, SO₄ was also studied.

ERA

N78-23623 National Technical Information Service, Springfield, Va.

AUTOMOBILE AIR POLLUTION: NEW AUTOMOTIVE ENGINES AND ENGINE IMPROVEMENTS. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1970 - Mar. 1978

Diane M. Cavagnaro Mar. 1978 186 p Supersedes NTIS/PS-77/0227; NTIS/PS-76/0187; NTIS/PS-75/312
(NTIS/PS-78/0208/5; NTIS/PS-77/0227; NTIS/PS-76/0187; NTIS/PS-75/312) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 13B

Designs of automobile engines are presented. The engine types include gas turbines; stratified charged engines; steam engines; hybrid engines using electric motors of flywheels; and rotary engines. Improving fuel economy while lowering emissions were examined, and retrofit devices were excluded.

GRA

N78-23627 National Technical Information Service, Springfield, Va.

AUTOMOBILE AIR POLLUTION: AUTOMOTIVE FUELS. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1970 - Mar. 1978

Diane M. Cavagnaro Mar. 1978 214 p Supersedes NTIS/PS-77/0230; NTIS/PS-76/0188 and NTIS/PS-75/313
(NTIS/PS-78/0235/8; NTIS/PS-77/0230; NTIS/PS-76/0188; NTIS/PS-75/313) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 07D

The use of fuels and fuel additives to reduce pollution from automobiles is covered in this bibliography. The use of methyl alcohol, natural gas, methane, and hydrogen is reported. Improvements to gasoline and its properties which affect air pollution are discussed, along with studies on lead additives.

GRA

N78-23666# North Carolina Univ., Chapel Hill. Dept. of Geology.

TECTONIC ATLAS OF URANIUM POTENTIAL IN CRYSTALLINE ROCKS OF THE EASTERN US

Jeffrey K. Greenberg, Stephen A. Hauck, Paul C. Ragland, and John J. W. Rogers Jun. 1977 98 p refs
(Contract EY-76-C-13-1661)
(GJBX-69(77)) Avail: NTIS HC A05/MF A01

The atlas format includes all areas of uranium exploration potential shown by state. Tectonic divisions are shown and explained on the tectonic index map. Each entry (locality) on the state maps has a number referring to its place on the descriptive tables. Each tabulated entry includes the locality name, county(ies), latitude and longitude, tectonic affinity, exploration potential, ore host rock, ore type, alteration, important mineralogy, age, trace element data, and a key to pertinent references listed at the end of the section. Cross reference listing of localities by exploration potential and by tectonic affinity are also included. A listing of aeroradiation survey references used in evaluating the Eastern U.S. is included.

ERA

N78-23899# Los Alamos Scientific Lab., N. Mex.
REACTOR TECHNOLOGY Progress Report, Apr. - Jun. 1977

John L. Warren, comp. Aug. 1977 50 p refs
(Contract W-7405-eng-36)
(LA-6931-PR) Avail: NTIS HC A03/MF A01

Progress is reported in eight program areas. Steady progress was made on defining the design of space electric power supply components. There were three significant advances in heat pipe technology. Criteria were set forth for the selection of compatible combinations of ceramics and metal coats for heat pipes. A system to avoid molecular absorption of the laser light in sodium vapor lasers was devised and tested. A mercury heat pipe to remove heat from stored fuel elements is being fabricated. Work

continues on the evaluation of computer codes used in the analysis of gas-cooled nuclear reactors to be used for nuclear process heat. Work is nearly complete on a model of a gas core reactor power plant. Criticality experiments are being run in the plasma core critical assembly. Several other critical assemblies are in routine use for verifying calculations and supporting research being done by other groups in the laboratory. ERA

N78-23900# Department of Energy, Washington, D. C. Div. of Magnetic Fusion Energy.
PERSPECTIVES ON THE DEVELOPMENT OF FUSION POWER BY MAGNETIC CONFINEMENT, 1977
 1977. 7 p.
 (DOE/ET/0002) Avail: NTIS HC A02/MF A01

The Committee concludes: that recent progress of the magnetic fusion energy program provides a tangible basis for the belief that the development of fusion power will prove feasible; that the primary near-term objective of the program should now be to demonstrate actual reactor-level conditions; and that the potential long-term benefits of fusion power are sufficiently great to warrant a sustained national effort to advance the fusion power option to the stage of commercial availability at an early time. ERA

N78-23927# Florida Univ., Gainesville. Dept. of Engineering Sciences.
TWO-PHASE HARTMANN FLOWS IN THE MHD GENERATOR CONFIGURATION Annual Report, Dec. 1976 - Dec. 1977

Rush E. Elkins, III, U. H. Kurzweg, Thomas A. Trivillion, and E. Rune Lindgren Feb. 1978 59 p refs
 (Contract N00014-76-C-0410)
 (AD-A051450) Avail: NTIS HC A04/MF A01 CSCL 10/2

Since the mass density and viscosity of the liquid in a two-phase Faraday generator are much greater than those of the gas, consideration of the liquid phase alone should lead to a good description of force distribution in the generator. Averaging the motion over the liquid phase gives us a set of equations which is similar to equations describing a steady flow of a fluid with spatially variable properties. Solutions of these equations are discussed first in the limit of negligible inertia and viscosity, and then in the limit of negligible inertia and non-zero viscosity. The cross stream pinch pressure gradient and its possible effects on the two-phase flow are discussed. The wall region in Faraday generators is a region of very large shear and is important in determining efficient generator operation, as is demonstrated in finite difference calculations carried out under a variety of conditions and also in an analytical boundary layer approximation which has been developed. A section has also been devoted to the possibilities of improved generator efficiency by subpartitioning the generator duct. The last section concerns similitude between two-phase generators and two-phase gravity flows. There are two velocity scales in the systems which must be scaled separately. GRA

N78-23988# Mound Lab., Miamisburg, Ohio.
INTERACTIVE DATA MANAGEMENT AND ANALYSIS SYSTEM FOR THE EASTERN GAS SHALE PROGRAM
 Purtle W. Seabaugh and Ronald E. Zielinski 1977 8 p refs
 Presented at the Eastern Gas Shale Program Conf., Morgantown, W.Va., 17 Oct. 1977
 (Contract EY-76-C-04-0053)
 (MLM-2469(OP); Conf-771038-5) Avail: NTIS
 HC A02/MF A01

A versatile, easy to use data base system is described. The system provides flexibility in display formats as well as input and output options such as format compatibility adaptive to field data. Versatility is attained through logical, Boolean, and arithmetic expressions. Consequently, computational capability is available so that data input can be minimized. Browsing and recursive searches are available through a search criteria command that allows the user to modify and narrow the request without restart. The system provides plotting options; data can be plotted in a well profile format. Through GEOLOG, a software synergistic log system, well log data can be integrated with geochemical

and geophysical experimental data. This integration will provide a more accurate assessment of the resources potential of the well. Utilization of these features provides not only a fully interactive data management system but also an enhanced statistical capability for data analysis. ERA

N78-23992# Committee on Banking, Housing and Urban Affairs (U. S. Senate).

NATIONAL ENERGY CONSERVATION POLICY ACT

Washington GPO 1977 385 p refs Hearings on S. 1469 before Comm. on Banking, Housing, and Urban Affairs, 95th Congr., 1st Sess., 27-29 Jun. 1977
 (GPO-94-843) Avail: Comm. on Banking, Housing, and Urban Affairs

Representatives from Government and private agencies met to discuss and propose a Bill on energy conservation in residential buildings. Of primary concern was the use of insulations to control energy use and how through Government and private loans and tax incentives this program could be implemented. The proposed Bill was outlined as follows: Part 1 - Energy Conservation for Existing Residential Buildings - Utility Program, Financing Program; Part 2 - Energy Efficiency of Consumer Products - Energy Efficiency Standards for Consumer Products other than Automobiles, Disclosure of Automobile Fuel Efficiency Tax, and Disclosure of Automobile Fuel Efficiency Rebate; Part 3 - Energy Conservation Program for Schools and Hospitals; Part 4 - Natural Gas; Part 5 - Public Utility Regulatory Policies - General Provisions, National Electric Rate Design Policies, Bulk Power Supply, Natural Gas Rate Design Policies; Part 6 - Amendments to the Energy Supply and Environmental Coordination Act; Part 7 - Federal Energy Initiatives - Federal Vanpooling Program, Amendments to Section 381 of the Energy Policy and Conservation Act, Demonstration of Solar Heating and Cooling in Federal Buildings. G.Y.

N78-24003# Culp/Wesner/Culp Clean Water Consultants, Santa Ana, Calif.

ENERGY REQUIREMENTS FOR MUNICIPAL POLLUTION CONTROL FACILITIES Final Report

Nov. 1977 86 p refs
 (Contract EPA-68-03-2186)
 (PB-276989/1; EPA-600/2-77-214) Avail: NTIS
 HC A05/MF A01 CSCL 21D

Information is presented on energy requirements in municipal pollution control facilities for several major areas of interest: (1) pumping energy for filtration and granular carbon adsorption of secondary effluent; Pump of the filtration process. (3) Utilization of anaerobic digester gas; cost estimates are presented for cleaning and storing digester gas, and for use as fuel in internal combustion engines that are coupled to pumps, blowers or electrical generators. (4) Secondary energy requirements; estimations were made for off-site production of some of the consumables used in waste water treatment processes. GRA

N78-24128# Association Aeronautique et Astronautique de France, Paris.

HELICOPTERS AND ENERGY SAVINGS [LES HELICOPTERES ET LES ECONOMIES D'ENERGIE]

Georges Petit 1977 35 p In FRENCH Presented at the 13th Intern. Aeron. Congr., Paris, 2-3 Jun. 1977
 (AAAF-NT-77-25; ISBN-2-7170-0450-5) Avail: NTIS
 HC A03/MF A01; CEDOCAR, Paris FF 25 (France and EEC)
 FF 29 (others)

Possibilities of reducing the energy consumption of helicopters are discussed. The order of magnitude of the problem, i.e., the part helicopters play in total energy consumption, was established. The share of fuel consumption in comparison with total operational costs is dealt with. The energy balance of the helicopters Gazelle, Dauphin, and Puma is presented. Proposals for energy reduction are made which might lead to a 30% reduction due to engine improvements and 15% reduction resulting from aerodynamic improvements. Finally, a comparison with competitive aircraft, i.e., vertical takeoff aircraft, is made. ESA

N78-24131# Association Aeronautique et Astronautique de France, Paris.

SUPERSONIC TRANSPORTATION FACED WITH ENERGY SAVINGS [LE TRANSPORT SUPERSONIQUE FACE AUX ECONOMIES D'ENERGIE]

G. Cormery 1977 20 p In FRENCH Presented at the 13th Intern. Aeron. Congr., Paris, 2-3 Jun. 1977

(AAAF-NT-77-28; ISBN-2-7170-0453-X) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

Energy savings aspects for supersonic aircraft are dealt with. Topics include air transportation and energy; supersonic transportation and air transportation; short and medium term technological innovation; and long term technological innovation. ESA

N78-24237*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **DEVELOPMENT OF A UNIFIED CRITERION FOR SOLAR COLLECTOR SELECTION**

F. L. Lansing In *its* The Deep Space Network 15 Apr. 1978 p 224-235 refs

Avail: NTIS HC A14/MF A01 CSDL 10A

To assist in making engineering or management decisions, the possibility of building a single selection criterion was explored to distinguish between different solar collector subsystems for a specific application or between different complete solar-powered systems. The development of two analogous criteria are discussed. The criteria combined both performance and unit area costs, and presented the dollar per unit power and the dollar per unit energy produced from a solar plant. Typical values for current focusing and nonfocusing solar collectors were included. The first phase development showed that the criteria evaluation was in need of more data about the annual dynamic behavior of the collector subsystem only, the transit site-specific parameters such as solar flux, wind, and ambient temperature. Author

N78-24255*# Little (Arthur D.), Inc., Cambridge, Mass. **IMPACTS AND BENEFITS OF A SATELLITE POWER SYSTEM ON THE ELECTRIC UTILITY INDUSTRY Final Report.**

B. M. Winer 14 Jul. 1977 136 p refs Sponsored by NASA Prepared for JPL (Contract JPL-954639)

(NASA-CR-157157; C-80020) Avail: NTIS HC A07/MF A01 CSDL 10A

The purpose of this limited study was to investigate six specific issues associated with interfacing a Satellite Power System (5 GW) with large (by present standards) terrestrial power pools to a depth sufficient to determine if certain interface problems and/or benefits exist and what future studies of these problems are required. The issues investigated are as follows: (1) Stability of Power Pools Containing a 5 GWe SPS; (2) Extra Reserve Margin Required to Maintain the Reliability of Power Pools Containing a 5 GWe SPS; (3) Use of the SPS in Load Following Service (i.e. in two independent pools whose times of peak demand differ by three hours); (4) Ownership of the SPS and its effect on SPS Usage and Utility Costs; (5) Utility Sharing of SPS related RD and D Costs; (6) Utility Liability for SPS Related Hazards. Author

N78-24324# Energy Research and Development Administration, Bartlesville, Okla.

GLC ANALYSIS OF N-PARAFFIN DISTRIBUTIONS IN CRUDE OILS AND TOPPED CRUDE OILS FOR OIL IDENTIFICATION

P. L. Grizzle and H. J. Coleman Oct. 1977 25 p refs (BERC/RI-77/12) Avail: NTIS HC A02/MF A01

Weight-percent distributions of normal paraffins obtained from gas-liquid chromatographic analyses were evaluated for their importance in oil identification. By use of statistical analysis, the weight percents for the C11 through C35 n-paraffins were determined to be significant variables for the differentiation of unweathered crude oil samples. Similarly, the ratios of pristane

to n-heptadecane, phytane to n-octadecane, and phytane to pristane were determined to be important. By use of weight-percent distributions, two numerical methods were evaluated for reducing the variations in the analytical data between weathered crude oil samples and corresponding unweathered crude oils, resulting from environmental weathering. ERA

N78-24325# Energy Resources Co., Inc., Cambridge, Mass. **STUDY TO DETERMINE THE TECHNICAL AND ECONOMIC FEASIBILITY OF RECLAIMING CHEMICALS USED IN MICELLAR POLYMER AND LOW TENSION SURFACTANT FLOODING Progress Report, 24 Apr. - 20 May 1977**

Vaqar Zakaria May 1977 7 p

(Contract EF-77-C-01-2600)

(FE-2600-1) Avail: NTIS HC A02/MF A01

Laboratory procedures for formation and analysis of emulsions were developed, and pilot units for evaluation of recovery techniques were test run: A state-of-the-art review of oil/water separation technologies is well on the way. ERA

N78-24326# Energy Resources Co., Inc., Cambridge, Mass. **STUDY TO DETERMINE THE TECHNICAL AND ECONOMIC FEASIBILITY OF RECLAIMING CHEMICALS USED IN MICELLAR POLYMER AND LOW TENSION SURFACTANT FLOODING Progress Report, 20 May - 17 Jun. 1977**

Richard H. Stephens Jun. 1977 7 p

(Contract EF-77-C-01-2600)

(FE-2600-2) Avail: NTIS HC A02/MF A01

The literature search to review and evaluate the state-of-the-art oil/water separation was completed except for obtaining vendor information on specific oil field equipment. Preliminary ultrafiltration runs of oil-water-surfactant mixtures and reverse osmosis of surfactant/water solutions were made to evaluate the testing procedure and the analytical techniques. ERA

N78-24366 South African Bureau of Standards, Pretoria. **CODE OF PRACTICE FOR THE PETROLEUM INDUSTRY. PART 1: THE HANDLING, STORAGE, AND DISTRIBUTION OF PETROLEUM PRODUCTS**

Jun. 1977 165 p In AFRIKAANS and ENGLISH

(SABS-089-1977-Pt-1; ISBN-0-626-04348-4) Copyright. Avail: Issuing Activity

Practices are recommended for the layout, design, and operation of petroleum marketing installations and depots, and for the installation of equipment of the types normally used for the handling, storage, and distribution of petroleum products and their derivatives, other than of equipment used for storage, and dispensing at consumer premises (including service stations). Author

N78-24369*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

IMPACT OF FUTURE FUEL PROPERTIES ON AIRCRAFT ENGINES AND FUEL SYSTEMS

R. A. Rudey and J. S. Grobman 1978 33 p refs To be presented at Lecture Ser. 96, Paris, Munich, and London, 12-20 Oct. 1978; sponsored by AGARD

(NASA-TM-78866; E-9597) Avail: NTIS HC A03/MF A01 CSDL 21D

This paper describes and discusses the propulsion-system problems that will most likely be encountered if the specifications of hydrocarbon-based jet fuels must undergo significant changes in the future and, correspondingly, the advances in technology that will be required to minimize the adverse impact of these problems. Several investigations conducted are summarized. Illustrations are used to describe the relative effects of selected fuel properties on the behavior of propulsion-system components and fuel systems. The selected fuel properties are those that are most likely to be relaxed in future fuel specifications. Illustrations are also used to describe technological advances that may be needed in the future. Finally, the technological areas needing the most attention are described, and programs that are under way to address these needs are briefly discussed. Author

N78-24370* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

CHARACTERISTICS AND COMBUSTION OF FUTURE HYDROCARBON FUELS

R. A. Rudey and J. S. Grobman 1978 26 p Proposed for presentation at Lecture Series 96, Paris, Munich, London, 12-20 Oct. 1978; sponsored by AGARD (NASA-TM-78865; E-9596) Avail: NTIS HC A03/MF A01 CSDL 21D

As the world supply of petroleum crude oil is being depleted, the supply of high-quality crude oil is also dwindling. This dwindling supply is beginning to manifest itself in the form of crude oils containing higher percentages of aromatic compounds, sulphur, nitrogen, and trace constituents. The result of this trend is described and the change in important crude oil characteristics, as related to aircraft fuels, is discussed. As available petroleum is further depleted, the use of synthetic crude oils (those derived from coal and oil shale) may be required. The principal properties of these syncrudes and the fuels that can be derived from them are described. In addition to the changes in the supply of crude oil, increasing competition for middle-distillate fuels may require that specifications be broadened in future fuels. The impact that the resultant potential changes in fuel properties may have on combustion and thermal stability characteristics is illustrated and discussed in terms of ignition, soot formation, carbon deposition flame radiation, and emissions. Author

N78-24372* Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

THE DETERMINANTS OF THE DEMAND FOR RESIDUAL FUEL OIL IN THE U.S. EAST COAST MARKET, 1960-1976 M.S. Thesis

Ray Martin Cole, Jr. Dec. 1977, 146 p refs In SPANISH; ENGLISH summary (AD-A051131; AFIT-CI-78-19) Avail: NTIS HC A07/MF A01 CSDL 21/4

This thesis is a study of the demand for a primary export product of Venezuela which is, as well, an important imported fuel with respect to the East Coast of the U.S. The objectives are: (1) to determine the most likely factors which bear upon the demand for fuel oil on the East Coast; (2) to pose and estimate an econometric model for the demand; and (3) to attempt short-range forecasts with the model. A prior economic study reveals the most likely variables which are then incorporated in two possible models which are thought to reflect the reality of the demand. The best specified models reveal that the essential factors of the demand are: (1) the lagged demand; (2) the price spread between fuel oil and coal; and (3) income per capita. Subsequent forecasts of the demand, given the same historical conditions which are the basis for the model, signal a reduction through 1980. This conclusion is important to Venezuela because of her position as a marginal supplier and a certain inflexibility in her hydrocarbon export package. Author (GRA)

N78-24375* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **STEAM REFORMING OF METHYL FUEL, PHASE 1 Final Report**

D. J. Cerini, R. D. Shah, and G. E. Voecks Jun. 1977 142 p (AD-A044787; JPL-5030-131) Avail: NTIS HC A07/MF A01 CSDL 07/3

An experimental study was made on the effects of gasoline contamination of methanol relative to steam reforming of the mixture. At the conventional steam reforming temperature of 350-400 F soot was produced with a 90/10 mixture of methanol and gasoline by weight. A parametric study was conducted to evaluate the effects of higher temperature and higher steam to carbon ratio with four different catalysts. Soot-free operation was obtained with Girdler catalyst T-2107 at an operating temperature of 750 F at a steam to total carbon ratio of 3.8. Essentially all the gasoline is converted into light gaseous hydrocarbons, primarily methane. A trace of light-yellow oil droplets could be detected in the cooled product gas condensate. A 100 hour test showed no deterioration of the T-2107 catalyst activity under the above conditions. Author (GRA)

N78-24382* Institute of Gas Technology, Chicago, Ill. **RESEARCH AND DEVELOPMENT OF RAPID HYDROGENATION FOR COAL CONVERSION TO SYNTHETIC MOTOR FUELS (RISER CRACKING OF COAL) Annual Report, 1 Apr. 1976 - 31 Mar. 1977**

D. A. Duncan, J. L. Beeson, and R. D. Oberle Jun. 1977 54 p refs

(Contract EX-76-C-01-2307)

(FE-2307-17) Avail: NTIS HC A04/MF A01

The use of a short residence-time riser reactor, of the type used in contemporary catalytic cracking was extended to the conversion of coals and lignites to gaseous and liquid products by reaction with gases such as hydrogen, synthesis gas, or mixtures of carbon monoxide and steam. The gases also carry the feed coal through the riser reactor. A maximized production of high-octane gasoline constituents (C4 to 400 F boiling range including BTX) is an important aspect of this investigation. Light gases (C1 to C3) will also be produced and will contain substantial proportions of methane and other light hydrocarbons that could be used either for fuel or for petrochemical feedstock. Spent char would be used for synthesis gas or hydrogen production for use in the riser reactor. ERA

N78-24383* Sandia Labs., Albuquerque, N. Mex.

POTENTIAL FUEL PRODUCTION FROM MAGMA

C. J. M. Northrup, Jr., T. M. Gerlach, P. J. Modreski, and J. K. Galt Jun. 1977 33 p refs

(Contract EY-76-C-04-0789)

(SAND-77-0509) Avail: NTIS HC A03/MF A01

Recent calculations and measurements indicate that basaltic magma is a new, extensive source for fuels (hydrogen, carbon monoxide, and methane). The fuel production processes are found to occur in nature as well as the laboratory and as a result, the work indicates that current concepts of geothermal energy can be broadened beyond producing only steam and heat. When magma is considered as a geothermal resource, its use for the direct production of fuels should be included. It is possible to generate several mole percent hydrogen when water-rich fluid is equilibrated with the ferrous and ferric iron in magma. The basis of the fuel production processes, the fuel yields for injected water and water plus natural organic matter, and the increased geothermal resources that would be made available by these processes are described. ERA

N78-24387* National Aeronautics and Space Administration, Pasadena Office, Calif.

UNDERGROUND MINERAL EXTRACTION Patent Application

Charles G. Miller (JPL) and James B. Stephens, inventors (to NASA) Filed 19 Apr. 1978 27 p

(Contract NAS7-100)

(NASA-Case-NPO-14140-1; NASA-Case-NPO-14381-1; US-Patent-Appl-SN-897832) Avail: NTIS HC A03/MF A01 CSDL 081

A method is described for mining coal or other minerals from underground seams without requiring personnel underground. The method involves a jet head which emits a high pressure water stream in a coal seam to comminute the coal around the jet head as it moves along a passage that is cuts in the seam. The jet head is connected to a pipeline that extends along the passage and up to the surface of the earth where a pumper rig pumps water from a water line into the pipeline. The coal slurry resulting from the mixture of water and comminuted coal, flows down an inclined passage to a previously cut drain gallery that carries the slurry to a lifting apparatus so it can be pumped into a slurry pipeline. Each passage cut in the coal seam is formed by advancing the jet head forwardly, while the head emits water in a forward direction to cut a pilot hole. Then the jet head retreats along the pilot hole while emitting water sideways to comminute coal along a wide passage. The effectiveness of the jet head in breaking up coal is increased by injecting droplets of an explodable material into the water stream. The droplet vaporizes to produce an explosion that drives a water slug into cracks in the seam and helps fracture the coal. NASA

N78-24431# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
ESTIMATES OF SATELLITE-TO-EARTH MICROWAVE ATTENUATION BY CLOUD, RAIN, OXYGEN, AND WATER VAPOR

Allen R. Davis Apr. 1977 26 p refs
 (AD-A052581; USAFETAC-8345) Avail: NTIS
 HC A03/MF A01 CSCL 20/14

This paper provides estimates of attenuation of space-to-earth radar transmissions due to cloud, rain, and gaseous factors. Attenuation of microwaves of 58-62 GHz and 92-96 GHz are examined. Attenuations through the atmosphere for elevation angles of 50.69 deg to 90 deg are calculated and 50, 95, and 99 percentile levels provided. Estimates are based on climatological frequencies of cloud amounts, rain rates, and water vapor, and are provided for two locations: one high-latitude temperate; the other, tropical. Author (GRA)

N78-24511# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland).

DESIGN STUDY OF AN EXPERIMENT COOLING SYSTEM WITH LIQUID/AIR HEAT EXCHANGER FOR SPACELAB PAYLOADS (ECLA) Final Report

Felix Berner Paris ESA Aug. 1977 158 p refs
 (Contract ESTEC-2886/76-NL-PP(SCI))
 (F4.W-FO-1378; ESA-CR(P)-1002) Avail: NTIS
 HC A08/MF A01

Results are presented of a detailed study of a particular fluid loop which will be used on Spacelab. Its purpose is to control the temperature of experiments by the judicious removal of heat by means of a liquid coolant which circulates in a closed loop and to transfer this heat to the Spacelab's avionics air loop. A modular liquid/air crossflow heat exchanger constitutes the thermal link between coolant and air loops. The control of the heat pump operation for minimum power consumption was investigated, and solutions are given for the case that this control becomes unstable. The optimization of the fluid loop design for selected operating conditions is also dealt with. The conclusion from an integration study is that a fluid loop without heat pump can be mounted in a single module rack but a fluid loop with heat pump must probably be mounted in a double rack on Spacelab if reasonable space is to be available for the payload. Author (ESA)

N78-24545* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

AUTOMOTIVE GAS TURBINE FUEL CONTROL Patent

Harold Gold, inventor (to NASA) Issued 14 Mar. 1978. 14 p
 Filed 8 Nov. 1976 Supersedes N77-13426 (15 - 04, p 0477)
 (NASA-Case-LEW-12785-1; US-Patent-4,078,378;
 US-Patent-Appl-SN-739909; US-Patent-Class-60-39,28R) Avail:
 US Patent Office CSCL 21A

A fuel control system is reported for automotive-type gas turbines and particularly advanced gas turbines utilizing variable geometry components to improve mileage and reduce pollution emission. The fuel control system compensates for fuel density variations, inlet temperature variations, turbine vane actuation, acceleration, and turbine braking. These parameters are utilized to control various orifices, spool valves and pistons.

Official Gazette of the U.S. Patent Office

N78-24549 South African Bureau of Standards, Pretoria.
STANDARD SPECIFICATION FOR CAST IRON GATE VALVES FOR GENERAL PURPOSES

8 Mar. 1978 48 p In ENGLISH and AFRIKAANS
 (SABS-665-1978; ISBN-0-626-04552-5) Copyright. Avail:
 Issuing Activity

This specification covers the material and constructional requirements for cast iron gate valves (50-600 mm nominal bores) for the control of water (at a temperature not exceeding 50 C) in general purpose (mining, industrial, and irrigation) applications. Author

N78-24564# Maine Dept. of Transportation, Bangor. Material and Research Div.

ENERGY USE AND OTHER COMPARISONS BETWEEN DIESEL AND GASOLINE PICKUP TRUCKS Interim Report, Oct. 1976 - Jun. 1977

Kenneth M. Jacobs Jan. 1978 25 p refs
 (Contract DOT-TSC-1299)
 (PB-277464; DOT-TSC-OST-77-6) Avail: NTIS
 HC A02/MF A01 CSCL 13F

The State of Maine Department of Transportation (MDOT) was planning to acquire 28 new pickup trucks in the fall of 1976. When the U.S. Department of Transportation's Transportation Systems Center became aware of this, preliminary discussions were initiated relative to the possibility of an energy and cost study being completed on these units. It was believed that if 14 diesel and 14 gasoline units were ordered and monitored it would provide a good base for analyzing these two factors. GRA

N78-24597# Council on Environmental Quality, Washington, D.C.

OIL AND GAS IN COASTAL LANDS AND WATERS

Katherine Gillman Apr. 1977 159 p refs
 Avail: NTIS HC A08/MF A01

The most promising domestic sources for yet undiscovered oil are, first, onshore Alaska and, next, the continental shelves in the Gulf of Alaska, the Gulf of Mexico, the Atlantic, and Pacific. The conflicts between energy needs and other vital interests of people and the coastal environments in which they live are clear. The impacts of oil on the coastal zone are described, so far as they are known, and possible effects of new development are discussed. Ways in which energy sources can be exploited with the least harm to the environment and most benefit to man are discussed. Author

N78-24601# Committee on Energy and Natural Resources (U. S. Senate).

ALASKA NATURAL RESOURCE ISSUES

Washington GPO 1977 212 p refs Hearings on S. 499, S. 1500 and S. 1546 before Comm. on Energy and Natural Resources, 95th Congr., 1st Sess., 17 and 20 Jun. 1977
 (GPO-95-110) Avail: Comm. on Energy and Natural Resources

Hearings were held to provide the Committee on Energy and Natural Resources with an overview of the Department of the Interior's perceptions of Alaska natural resource issues. Specific issues addressed were: (1) the Alaska national interest lands legislation; (2) the Alaska Native Claims Settlement Act; (3) route selection for the Alaska natural gas pipeline; (4) procedures for the startup and operation of the trans-Alaska pipeline system; (5) plans for oil and gas development on the outer continental shelf off Alaska; (6) exploration, planning, and administration of the national petroleum reserve; and (7) the Department of the Interior's efforts to relate each of these issues to a general strategy for the conservation, development, and transportation of Alaska's natural resources. P.R.A.

N78-24608* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

ENERGY STORAGE APPARATUS Patent

Philip A. Studer and Harold E. Evans, inventors (to NASA) Issued 7 Mar. 1978 9 p Filed 30 Jul. 1976 Supersedes N76-30652 (14 - 21, p 2749)
 (NASA-Case-GSC-12030-1; US-Patent-4,077,678;
 US-Patent-Appl-SN-710035; US-Patent-Class-308-10;
 US-Patent-Class-310-153; US-Patent-Class-310-269;
 US-Patent-Class-310-154; US-Patent-Class-310-178) Avail: US Patent Office CSCL 10B

A high efficiency, flywheel type energy storage device which comprises an electronically commutated d.c. motor/generator unit having a massive flywheel rotor magnetically suspended around a ring shaped stator is presented. During periods of low energy demand, the storage devices were operated as a motor, and the flywheel motor was brought up to operating speed. Energy was drawn from the device functioning as a generator as the flywheel rotor rotated during high energy demand periods.

Official Gazette of the U.S. Patent Office

N78-24609* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

PROCESS FOR UTILIZING LOW-COST GRAPHITE SUBSTRATES FOR POLYCRYSTALLINE SOLAR CELLS
Patent

Ting L. Chu, inventor (to NASA) (Southern Methodist Univ.) Issued 7 Mar. 1978 16 p Filed 4 Jun. 1976 Supersedes N76-26695 (14 - 17, p 2218) Continuation-in-part of US Patent Appl. SN-576488 filed 12 May 1975, US Patent-3,961,997 Sponsored by NASA

(NASA-Case-GSC-12022-2; US-Patent-4,077,818; US-Patent-Appl-SN-693074; US-Patent-Class-148-174; US-Patent-Class-29-572; US-Patent-Class-136-89SG; US-Patent-Class-357-30; US-Patent-Class-357-59; US-Patent-Class-427-86; US-Patent-Class-427-113; US-Patent-Class-427-248J; US-Patent-Class-427-249; US-Patent-3,961,997; US-Patent-Appl-SN-576488) Avail: US Patent Office CSCL 10A

Low cost polycrystalline silicon solar cells supported on substrates were prepared by depositing successive layers of polycrystalline silicon containing appropriate dopants over supporting substrates of a member selected from the group consisting of metallurgical grade polycrystalline silicon, graphite and steel coated with a diffusion barrier of silica, borosilicate, phosphosilicate, or mixtures thereof such that p-n junction devices were formed which effectively convert solar energy to electrical energy. To improve the conversion efficiency of the polycrystalline silicon solar cells, the crystallite size in the silicon was substantially increased by melting and solidifying a base layer of polycrystalline silicon before depositing the layers which form the p-n junction.

Official Gazette of the U.S. Patent Office

N78-24610* Contemporary Systems, Inc., Jaffrey, N. H.
PRELIMINARY DESIGN PACKAGE FOR PROTOTYPE SOLAR HEATING SYSTEM

23 Nov. 1976 54 p Prepared for DOE

(Contract NAS8-32243)

(NASA-CR-150615) Avail: NTIS HC A04/MF A01 CSCL 10A

A preliminary design review on the development of a prototype solar heating system for single family dwellings is presented. The collector, storage, transport, control, and site data acquisition subsystems are described.

Author

N78-24611* RHO Sigma, Inc., North Hollywood, Calif.
PRELIMINARY DESIGN PACKAGE FOR RS600 MICRO-PROCESSOR CONTROL SUBSYSTEM

1978 15 p Prepared for DOE

(Contract NAS8-32256)

(NASA-CR-150628) Avail: NTIS HC A02/MF A01 CSCL 10A

Microprocessor control subsystems developed for use in heating, heating and cooling, and/or hot water systems for single family, multi-family, or commercial applications are described.

Author

N78-24613* Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.

INDOOR TEST FOR THERMAL PERFORMANCE EVALUATION ON THE SUNWORKS (AIR) SOLAR COLLECTOR

Jan. 1978 34 p refs Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150666; WYLE-TR-531-17) Avail: NTIS HC A03/MF A01 CSCL 10A

The test procedure used and the results obtained from an evaluation test program conducted to obtain thermal performance data on a Sunworks single glazed air solar collector under simulated conditions are described. A time constant test and incident angle modifier test were conducted to determine the transient effect and the incident angle effect on the collector. These results and the results of the collector load test are also discussed.

Author

N78-24614* Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.

OUTDOOR THERMAL EFFICIENCY EVALUATION OF THE YING SOLAR COLLECTOR

14 Mar. 1978 17 p ref Revised Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150675; WYLE-TR-531-21-Rev-A) Avail: NTIS HC A02/MF A01 CSCL 10A

The test procedure used and the test results obtained during an evaluation test program to obtain thermal efficiency performance data are presented. The flat plate collector used water/ prestone antifreeze solution as the working fluid.

Author

N78-24616* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

RAPID, EFFICIENT CHARGING OF LEAD-ACID AND NICKEL-ZINC TRACTION CELLS

John J. Smithrick 1978 9 p refs To be presented at the 13th Intersoc. Energy Conversion Eng. Conf., San Diego, Calif., 20-25 Aug. 1978

(Contract EC-77-A-31-1011)

(NASA-TM-78901; E-9637; DOE/NASA/1011-78/26) Avail: NTIS HC A02/MF A01 CSCL 10C

Lead-acid and nickel-zinc traction cells were rapidly and efficiently charged using a high rate tapered direct current (HRTDC) charge method which could possibly be used for on-the-road service recharge of electric vehicles. The HRTDC method takes advantage of initial high cell charge acceptance and uses cell gassing rate and temperature as an indicator of charging efficiency. On the average, in these preliminary tests, 300 amp-hour nickel-zinc traction cells were given a HRTDC (initial current 500 amps, final current 100 amps) to 78 percent of rated amp-hour capacity within 53 minutes at an amp-hour efficiency of 92 percent and an energy efficiency of 52 percent. Three hundred amp-hour lead-acid traction cells were charged to 69 percent of rated amp-hour capacity within 46 minutes at an amp-hour efficiency of 91 percent with an energy efficiency of 64 percent. In order to find ways to further decrease the recharge times, the effect of periodically (0 to 400 Hz) pulse discharging cells during a constant current charging process (94% duty cycle) was investigated. Preliminary data indicate no significant effect of this type of pulse discharging during charge on charge acceptance of lead-acid or nickel-zinc cells.

Author

N78-24618* Institute of Gas Technology, Chicago, Ill.

MOLTEN SALT THERMAL ENERGY STORAGE SYSTEMS
Final Report

Hansraj C. Maru, John F. Dullea, Alan Kardas, Larry Paul, Leonard G. Marianowski, Estela Ong, Viji Sampath, Vincent M. Huang, and Jerome C. Wolak Mar. 1978 129 p refs Sponsored by NASA

(Contract EY-76-C-02-2888; Proj. 8981)

(NASA-CR-135419; COO-2888-3)

Avail: NTIS

HC A07/MF A01 CSCL 10C

The feasibility of storing thermal energy at temperatures of 450 C to 535 C in the form of latent heat of fusion was examined for over 30 inorganic salts and salt mixtures. Alkali carbonate mixtures were chosen as phase-change storage materials in this temperature range because of their relatively high storage capacity, and thermal conductivity, moderate cost, low volumetric expansion upon melting, low corrosivity, and good chemical stability. Means of improving heat conduction through the solid salt were explored.

Author

N78-24619* Joint Economic Committee (U. S. Congress).

THE IMPACT OF THE PRESIDENT'S ENERGY PLAN ON THE NORTHEAST

Washington GPO 1977 138 p refs Hearing before the Subcomm. on Energy of the Joint Economic Comm., 95th Congr., 1st Sess., 13 May 1977

(GPO-97-013) Avail: SOD HC

Conversion from oil to coal, transportation of coal, gasoline consumption targets, incentives for development of solar energy, and energy-efficient homes, electrical appliances, and automobiles

are considered in terms of the regional economic impact of the national energy plan. Emphasis is placed on establishing equity of energy costs among regions. J.M.S.

N78-24622*# Westinghouse Electric Corp., Pittsburgh, Pa.
SILICON MATERIALS TASK OF THE LOW COST SOLAR ARRAY PROJECT, PHASE 2 Quarterly Report, 1 Oct. - 31 Dec. 1977

R. H. Hopkins, J. R. Davis, Jr., P. D. Blais, A. Rohatgi, P. Rai-Choudhury, M. H. Hanes, and J. R. McCormick (Dow Corning Corp., Midland, Mich.) 31 Dec. 1977 96 p refs Sponsored in part by DOE Prepared for JPL (Contracts NAS7-100; JPL-954331) (NASA-CR-157082; DOE/JPL-954431-78/1; QR-9) Avail: NTIS HC A05/MF A01 CSCL 10A

The object of phase 2 of this program is to investigate and define the effects of various processes, contaminants and process-contaminant interactions in the performance of terrestrial solar cells. The major effort this quarter was in the areas of crystal growth and thermal processing, comparison of impurity effects in low and high resistivity silicon, modeling the behavior of p-type ingots containing Mo, and C and, quantitative analysis of bulk lifetime and junction degradation effects in contaminated solar cells. The performance of solar cells fabricated on silicon web crystals grown from melts containing about 10 to the 18th power/cu cm of Cr, Mn, Fe, Ni, Ti, and V, respectively were measured. Deep level spectroscopy of metal-contaminated ingots was employed to determine the level and density of recombination centers due to Ti, V, Ni, and Cr. Author

N78-24627*# Honeywell Corporate Material Sciences Center, Bloomington, Minn.

DIP-COATING PROCESS: SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE-AREA SILICON SHEET TASK OF THE LOW-COST SILICON SOLAR ARRAY PROJECT Quarterly Report, 20 Sep. - 27 Nov. 1977

J. D. Zook, J. D. Heaps, R. B. Maciolek, B. Koepke, C. D. Gutter, and S. B. Schuldt 30 Dec. 1977 59 p refs Sponsored in part by ERDA Prepared for JPL (Contracts NAS7-100; JPL-954356) (NASA-CR-157072; ERDA/JPL-954356-77/4; HONEYWELL-QR-7) Avail: NTIS HC A04/MF A01 CSCL 10A

The objective of this research program is to investigate the technical and economic feasibility of producing solar-cell-quality sheet silicon by coating one surface of carbonized ceramic substrates with a thin layer of large-grain polycrystalline silicon from the melt. The past quarter demonstrated significant progress in several areas. Seeded growth of silicon-on-ceramic (SOC) with an EFG ribbon seed was demonstrated. Different types of mullite were successfully coated with silicon. A new method of deriving minority carrier diffusion length, $L_{sub n}$ from spectral response measurements was evaluated. ECOMOD cost projections were found to be in good agreement with the interim SAMIS method proposed by JPL. On the less positive side, there was a decrease in cell performance which we believe to be due to an unidentified source of impurities. Author

N78-24629*# Varian Associates, Lexington, Mass. Vacuum Div.

SLICING OF SILICON INTO SHEET MATERIAL SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SILICON SHEET TASK OF THE LOW COST SILICON SOLAR ARRAY PROJECT Quarterly Report, 19 Sep. - 17 Dec. 1977

S. C. Holden and J. R. Fleming 12 Jan. 1978 118 p Sponsored in part by ERDA Prepared for JPL (Contracts NAS7-100; JPL-954374) (NASA-CR-157080; ERDA/JPL-954374-77/4; QR-7) Avail: NTIS HC A06/MF A01 CSCL 10A

Fabrication of a prototype large capacity multiple blade slurry saw is considered. Design of the bladehead which will tension up to 1000 blades, and cut a 45 cm long silicon ingot as large

as 12 cm in diameter is given. The large blade tensioning force of 270,000 kg is applied through two bolts acting on a pair of scissor toggles, significantly reducing operator set-up time. Tests with an upside-down cutting technique resulted in 100% wafering yields and the highest wafer accuracy yet experienced with MS slicing. Variations in oil and abrasives resulted only in degraded slicing results. A technique of continuous abrasive slurry separation to remove silicon debris is described. Author

N78-24630*# Motorola, Inc., Phoenix, Ariz.
LASER-ZONE GROWTH IN A RIBBON-TO-RIBBON (RTR) PROCESS. SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SILICON SHEET TASK OF THE LOW COST SILICON SOLAR ARRAY PROJECT Technical Quarterly Report No. 6, 10 Oct. - 31 Dec. 1977

R. W. Gurtler, A. Baghdadi, R. Legge, B. Sopori, and R. J. Ellis 31 Dec. 1977 106 p Prepared for JPL (Contracts NAS7-100; JPL-954376) (DOE/JPL-954376-78/1; Rept-2256/8) Avail: NTIS HC A06/MF A01 CSCL 10A

The Ribbon-to-Ribbon (RTR) approach to silicon ribbon growth is investigated. An existing RTR apparatus is to be upgraded to its full capabilities and operated routinely to investigate and optimize the effects of various growth parameters on growth results. A new RTR apparatus was constructed to incorporate increased capabilities and improvements over the first apparatus and to be capable of continuous growth. New high power lasers were implemented and this led to major improvements in growth velocity -- 4 inch/min growth has been demonstrated. A major step in demonstration of the full feasibility of the RTR process is reported in the demonstration of RTR growth from CVD polyribbon rather than sliced polyribbon ingots. Average solar cell efficiencies of greater than 9% and a best cell efficiency of 11.7% are reported. Processing was shown to provide a substantial improvement in material minority carrier diffusion length. An economic analysis is reported which treats both the polyribbon fabrication and RTR processes. Author

N78-24636*# Springborn Labs., Inc., Enfield, Conn.
INVESTIGATION OF TEST METHODS, MATERIAL PROPERTIES, AND PROCESSES FOR SOLAR CELL ENCAPSULANTS. ENCAPSULATION TASK OF THE LOW-COST SILICON SOLAR ARRAY PROJECT Quarterly Progress Report, 12 Aug. - 12 Nov. 1977

Nov. 1977 46 p Sponsored in part by ERDA Prepared for JPL (Contracts NAS7-100; JPL-954527; JPL Proj. 6072.1) (NASA-CR-157149; ERDA/JPL-954527-77/4) Avail: NTIS HC A03/MF A01 CSCL 10A

During this quarter, flat-plate solar collector systems were considered and six basic construction elements were identified: outer coatings, superstrates, pottants, substrates, undercoats, and adhesives. Materials surveys were then initiated to discover either generic classes or/and specific products to function as each construction element. Cost data included in the surveys permit ready evaluation of each material. Silicones, fluorocarbons, glass, and acrylic polymers have the highest inherent weatherability of materials studied to date. Only acrylics, however, combine low costs, environmental resistance, and potential processability. This class will receive particular emphasis. Author

N78-24637*# Dow Corning Corp., Midland, Mich. Solid State Research and Development Lab.
SOLAR SILICON VIA THE DOW CORNING PROCESS Quarterly Report

L. P. Hunt, V. D. Dosaj, and J. R. McCormick Jan. 1978 17 p refs Sponsored in part by DOE Prepared for JPL (Contracts NAS7-100; JPL-954559) (NASA-CR-157065; DOE/JPL-954559-78/1; QR-6) Avail: NTIS HC A09/MF A01 CSCL 10A

Carbon, as a reductant for quartz, must be made available so as to have suitable reactivity in conjunction with high purity, especially with respect to boron and phosphorus. A detailed experimental plan was developed to do this. Different sources of carbon were selected to be subjected to various purification

methods and reactivity-enhancement processes. A developmental scale arc furnace was installed to perform quartz-carbon reactivity testing. Author

N78-24639*# Solarex Corp., Rockville, Md.
SILICON SOLAR CELLS WITH A TOTAL POWER CAPACITY OF 30 KILOWATTS Final Technical Report
 31 Oct. 1977 17 p Revised Sponsored by NASA Prepared for JPL
 (Contract JPL-954577)
 (NASA-CR-157066) Avail: NTIS HC A02/MF A01 CSCL 10A

The bulk of the contract effort was carried out in the following two phases: Phase 1 -- module design, Pre-production module fabrication, inspection and test. Phase 2 -- Production, test and delivery. Effort during the first two months of the contract concentrated on design of a solar module to meet specification. Basic module design resulting from this effort is as follows: (1) frame design; (2) cell pan design; (3) cell interconnection; (4) encapsulation; (5) electrical performance. Author

N78-24640*# Westinghouse Electric Corp., Trafford, Pa. Power Circuit Breaker Div.
LOW COST SILICON SOLAR ARRAY PROJECT SILICON MATERIALS TASK Quarterly Technical Report, Jul. - Sep. 1977
 Sep. 1977 35 p refs Sponsored in part by DOE Prepared for JPL
 (Contracts NAS7-100; JPL-954589)
 (NASA-CR-157092; ERDA/JPL-954589-77/3) Avail: NTIS HC A03/MF A01 CSCL 10A

A program was established to develop a high temperature silicon production process using existing electric arc heater technology. Silicon tetrachloride and a reductant will be injected into an arc heated mixture of hydrogen and argon. Under these high temperature conditions, a very rapid reaction is expected to occur and proceed essentially to completion, yielding silicon and gaseous sodium chloride. Techniques for high temperature separation and collection of the molten silicon will be developed using standard engineering approaches, and the salt vapor will later be electrolytically separated into its elemental constituents for recycle. Preliminary technical evaluations and economic projections indicate not only that this process appears to be feasible, but that it also has the advantages of rapid, high capacity production of good quality molten silicon at a nominal cost. Author

N78-24642*# Solarex Corp., Rockville, Md.
ENERGY REQUIREMENT FOR THE PRODUCTION OF SILICON SOLAR ARRAYS Quarterly Report, 21 Jun. - 20 Sep. 1977
 Joseph Lindmayer, Manfred Wihl, and Alan Scheinine Oct. 1977 73 p refs Sponsored in part by ERDA Prepared for JPL
 (Contracts NAS7-100; JPL-954606)
 (NASA-CR-157074; SX/111/3; ERDA/JPL-954606-77/3; QR-3) Avail: NTIS HC A04/MF A01 CSCL 10A

Refinement techniques are assessed in terms of their energy demands. It is found that all of them are potentially acceptable alternatives to the conventional silane process. Refinement technologies reviewed include: (1) pure silicon via the metallic reduction of silicon tetrahalides; (2) synthesis of silane for solar grade silicon by means of catalytic redistribution of chlorosilanes; (3) refined silicon via a silicon fluoride polymer transport process; and (4) purified silicon from upgraded conventional arc furnace processes. It is shown that the current development of these refinement processes would yield payback times in the range of 0.2 to 1.2 years if a 12.5% efficient cell could be achieved. Compared to the conventional process which is characterized by a payback time of 3.2 years these technologies appear to be endowed with the potential to provide the silicon necessary for energy demands. Author

N78-24643*# Solarex Corp., Rockville, Md.
ENERGY REQUIREMENT FOR THE PRODUCTION OF SILICON SOLAR ARRAYS Final Report, 21 Sep. - 20 Dec. 1977

Joseph Lindmayer, Manfred Wihl, Alan Scheinine, Thomas Rosenfield, Charles Y. Wrigley, Andrew Morrison, Jack Anderson, Anthony Clifford, and Wendell Lafky Dec. 1977 146 p refs Sponsored in part by DOE Prepared for JPL
 (Contracts NAS7-100; JPL-954606)
 (NASA-CR-157071; SX/111/4; ERDA/JPL-954606-77/4) Avail: NTIS HC A07/MF A01 CSCL 10A

The results of a study to investigate the feasibility of manufacturing photovoltaic solar array modules by the use of energy obtained from similar or identical photovoltaic sources are presented. The primary objective of this investigation was the characterization of the energy requirements of current and developing technologies which comprise the photovoltaic field. For cross-checking the energies of prevailing technologies data were also used and the wide-range assessment of alternative technologies included different refinement methods, various ways of producing light sheets, semicrystalline cells, etc. Energy data are utilized to model the behavior of a future solar breeder plant under various operational conditions. Author

N78-24645*# Synal Corp., Sunnyvale, Calif.
SOLAR THERMOELECTRIC GENERATORS Final Report
 29 Jul. 1977 96 p Prepared for JPL
 (Contract JPL-954637)
 (NASA-CR-157097) Avail: NTIS HC A05/MF A01 CSCL 10A

The methods, the findings and the conclusions of a study for the design of a Solar Thermoelectric Generator (STG) intended for use as a power source for a spacecraft orbiting the planet Mercury are discussed. Several state-of-the-art thermoelectric technologies in the intended application were considered. The design of various STG configurations based on the thermoelectric technology selected from among the various technologies was examined in detail and a recommended STG design was derived. The performance characteristics of the selected STG technology and associated design were studied in detail as a function of the orbital characteristics of the STG in Mercury and throughout the orbit of Mercury around the sun. Author

N78-24649*# Optical Coating Lab., Inc., City of Industry, Calif. Photoelectronics Div.
HIGH EFFICIENCY, LONG LIFE TERRESTRIAL SOLAR PANEL Quarterly Report, 1 Sep. - 30 Nov. 1977
 T. Chao, S. Khemthong, R. Ling, and S. Olah 30 Nov. 1977 26 p Sponsored in part DOE Prepared for JPL
 (Contracts NAS7-100; JPL-954831)
 (NASA-CR-157060; DOE/JPL-954831-77/12; QR-1) Avail: NTIS HC A03/MF A01 CSCL 10A

The design of a high efficiency, long life terrestrial module was completed. It utilized 256 rectangular, high efficiency solar cells to achieve high packing density and electrical output. Tooling for the fabrication of solar cells was in house and evaluation of the cell performance was begun. Based on the power output analysis, the goal of a 13% efficiency module was achievable. Author

N78-24650*# Spectrolab, Inc., Sylmar, Calif.
ARRAY AUTOMATED ASSEMBLY, PHASE 2 Quarterly Report
 William E. Taylor Feb. 1978 65 p refs Sponsored by NASA and DOE Prepared for JPL
 (Contract JPL-954853)
 (NASA-CR-157057; DOE/JPL-954853-78/1) Avail: NTIS HC A04/MF A01 CSCL 10A

An analysis was made of cost tradeoffs for shaping modified square wafers from cylindrical crystals. Tests were conducted of the effectiveness of texture etching for removal of surface damage on sawed wafers. A single step texturing etch appeared adequate for removal of surface damage on wafers cut with multiple blade reciprocating slurry saws. Author

N78-24653*# Texas Instruments, Inc., Dallas.
AUTOMATED ARRAY ASSEMBLY, PHASE 2 Quarterly Technical Progress Report

Bernard G. Carbajal Jan. 1978 29 p Sponsored in part by DOE Prepared for JPL (Contracts NAS7-100; JPL-954881) (NASA-CR-157134; TI-03-77-56; DOE/JPL-954881-78-1; QTPR-4) Avail: NTIS HC A03/MF A01 CSCL 10A

This contract includes solar cell module process development activities in the areas of surface preparation, plasma processing, diffusion, cell processing and module fabrication. In addition, a High Efficiency Cell Development Activity is included. The overall goal is to advance solar cell module process technology to meet the 1986 goal of a production capacity of 500 megawatts per year at a cost of less than \$500 per kilowatt. This contract will focus on the process element developments stated above and will propose an overall module process. During this quarter, effort was concentrated on wafer etching for saw damage removal, establishing a standard phosphorous diffusion process and a baseline solar cell process as a test bed, designing a large area square cell including test sites, analyzing module layouts for optimum packing efficiency and fabricating the first Tandem Junction Cells (TJC) for this contract. A TJC with backside contacts gave 15.1% efficiency at AM1. Author

N78-24654* Solarex Corp., Rockville, Md.
DEVELOPMENT OF AN IMPROVED HIGH EFFICIENCY THIN SILICON SOLAR CELL Quarterly Report
Joseph Lindmayer et al Jan. 1978 17 p Prepared for JPL (Contracts NAS7-100; JPL-954883) (NASA-CR-157058; Sx/115/1Q) Avail: NTIS HC A02/MF A01 CSCL 10A

Efforts were concerned with optimizing techniques for thinning silicon slices in NaOH etches, initial investigations of surface texturing, variation of furnace treatments to improve cell efficiency, initial efforts on optimization of gridline and cell sizes and Pilot Line fabrication of quantities of 2 cm x 2 cm 50 micron thick cells. Author

N78-24656* Simat, Helliesen and Eichner, Inc., Newton Center, Mass.

LSSA LARGE AREA SILICON SHEET TASK: CONTINUOUS LIQUID FEED CZOCHRALSKI GROWTH Quarterly Report, Oct. - Dec. 1977

Walter Torbet Jan. 1978 15 p Sponsored in part by DOE Prepared for JPL (Contracts NAS7-100; JPL-954886) (NASA-CR-157135; DOE/JPL-954886-78/1; Rept-0140-0080) Avail: NTIS HC A02/MF A01 CSCL 10A

The development of a Czochralski furnace that permits the growing of silicon crystals with a continuous liquid replenishment of the molten silicon of the growth crucible is described. Author

N78-24659* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ENERGY CONVERSION ALTERNATIVES STUDY (ECAS): Summary Report

Sep. 1977 101 p refs Sponsored in part by NSF (Contract E(49-18)-1751)

(NASA-TM-73871; E-8596) Avail: NTIS HC A06/MF A01 CSCL 10A

ECAS compared various advanced energy conversion systems that can use coal or coal-derived fuels for baseload electric power generation. It was conducted in two phases. Phase 1 consisted of parametric studies. From these results, 11 concepts were selected for further study in Phase 2. For each of the Phase 2 systems and a common set of ground rules, performance, cost, environmental intrusion, and natural resource requirements were estimated. In addition, the contractors defined the state of the associated technology, identified the advances required, prepared preliminary research and development plans, and assessed other factors that would affect the implementation of each type of powerplant. The systems studied in Phase 2 include steam systems with atmospheric- and pressurized-fluidized-bed boilers; combined cycle gas turbine/steam systems with integrated gasifiers or fired by a semiclean, coal derived fuel; a potassium/steam system with a pressurized-fluidized-bed boiler; a closed-cycle gas turbine/organic system with a high-temperature, atmospheric-

fluidized-bed furnace; a direct-coal-fired, open-cycle magnetohydrodynamic/steam system; and a molten-carbonate fuel cell/steam system with an integrated gasifier. The sensitivity of the results to changes in the ground rules and the impact of uncertainties in capital cost estimates were also examined.

Author

N78-24660* National Aeronautics and Space Administration, Washington, D. C.

PATENT APPLICATION. VARIABLE-VOLUME ENGINE

Stephane Convers May 1978 12 p Transl. into ENGLISH from French Patent no. 77-35813, 9 Nov. 1977 8 p Transl. by SCITRAN, Santa Barbara, Calif. (Contract NASw-2791)

(NASA-TM-75094) Avail: NTIS HC A02/MF A01 CSCL 10A

A description is given of an engine using the expansion-contraction of bodies subjected to controlled thermal variations and making use of free natural heat sources. Author

N78-24661* Committee on Energy and Natural Resources (U. S. Senate).

PETROLEUM INDUSTRY INVOLVEMENT IN ALTERNATIVE SOURCES OF ENERGY

Washington GPO 1977 395 p refs Rept. for Subcomm. on Energy Res. and Development of the Comm. on Energy and Natural Resources, 95th Congr., 1st Sess., Sep. 1977 (GPO-93-800; Publ-95-54) Avail: Subcomm. on Energy Res. and Development

Information from the public record about the nonpetroleum resource holdings and research and development activities of the nation's oil companies is presented. Resources considered are coal, oil shale, geothermal, and uranium. Author

N78-24662* Committee on Energy and Natural Resources (U. S. Senate).

SOLAR ENERGY

Washington GPO 1977 406 p refs Joint hearing before the Subcomm. on Energy Production and Supply and the Subcomm. on Energy Res. and Development of the Comm. on Energy and Natural Resources and the Select Comm. on Small Business, 95th Congr., 1st Sess., 1 Jun. 1977 (GPO-94-910; Publ-95-65) Avail: Subcomm. on Energy Production and Supply

Testimony was presented to provide important perspectives on solar energy, particularly as related to small businesses. Means of encouraging optimum commercial development of all the alternative energy industries were discussed. Discussion centered around the opportunities and problems facing small businesses in the emerging alternative energy industries. Institutional and economic barriers to commercialization and dissemination of alternative energy products and services were outlined and the role of government in promoting commercial development was discussed. P.R.A.

N78-24665* Boston Univ., Mass. Dept. of Chemistry.
PHOTOISOMERIZATION OF BIS 9-ANTHRYL METHANE AND OTHER LINKED ANTHRACENES: THE ROLE OF EXCIMERS AND BIRADICALS IN PHOTODIMERIZATION Technical Report, 1 Nov. 1976 - 31 Dec. 1977

William R. Bergmark, Guilford Jones, II, Thomas E. Reinhardt, and Arthur M. Halpern 1 Mar. 1978 43 p refs (Contract N00014-76-C-0442)

(AD-A051336; TR-7) Avail: NTIS HC A03/MF A01 CSCL 07/3

A series of linked anthracenes capable of storing photon energy through endoergic valence photo-isomerization have been studied. Photophysical and photochemical characteristics of the systems have been completely characterized by measurement of fluorescence quantum yields and lifetimes, and efficiencies for forward and reverse isomerization. The release of energy stored in photoisomers has been measured using kinetic and calorimetric techniques. From emission and lifetime data the respective roles of excimers and biradicals in anthracene photodimerization have been defined. Author (GRA)

N78-24667# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPUTER PROGRAM FOR DESIGN AND PERFORMANCE ANALYSIS OF NAVIGATION AID POWER SYSTEMS PROGRAM DOCUMENTATION. VOLUME 2: USER'S MANUAL Final Report

G. Goltz and H. Weiner Jul. 1977 102 p
 (Contract MIPR-Z-70099-5-50352)
 (AD-A047356; JPL-5040-27-Vol-2-Change-1;
 USCG-D-11-77-Vol-2; CGR/DC-18/76-Vol-2) Avail: NTIS
 HC A06/MF A01 CSCL 09/2

A computer program has been developed for designing and analyzing the performance of solar array/battery power systems for the U.S. Coast Guard Navigational Aids. This program is called the Design Synthesis/Performance Analysis (DSPA) Computer Program. The basic function of the Design Synthesis portion of the DSPA program is to evaluate functional and economic criteria to provide specifications for viable solar array/battery power systems. The basic function of the Performance Analysis portion of the DSPA program is to simulate the operation of solar array/battery power systems under specific loads and environmental conditions. This document provides all the information necessary to access the DSPA programs, to input required data and to generate appropriate Design Synthesis or Performance Analysis Output. GRA

N78-24669# Thermo Electron Corp., Waltham, Mass.
THERMODYNAMIC ANALYSIS OF A TIN-STEAMED LMMHD SYSTEM Final Technical Report

29 Jul. 1977 60 p ref
 (Contract N00014-77-C-0523)
 (AD-A052395; TE5471-10-78) Avail: NTIS HC A04/MF A01
 CSCL 10/2

In this report, we evaluate the thermodynamic analyses and data of a tin-steam liquid metal magnetohydrodynamic power system proposed by Argonne National Laboratory, Argonne, Illinois, to the Office of Naval Research, Washington, D.C. Our evaluations consisted of: (1) an analysis of the ideal or limiting performance of the proposed system; (2) a comparison of the results obtained by means of a computer model developed by Argonne with those obtained by simplified hand calculations by Thermo Electron Corporation; (3) an analysis of the sensitivities of the computer results to the values of key but uncertain input parameters; (4) an analysis of the major efficiency losses in the system; and (5) a comparison of the proposed system with one that does not use magnetohydrodynamics but does require effective steam heat management (reheat and feedwater heating). Author (GRA)

N78-24672# Energy Research and Development Administration, Albuquerque, N. Mex.

SOLAR TOTAL ENERGY SYSTEM, LARGE SCALE EXPERIMENT, SHENANDOAH, GEORGIA. VOLUME 2. SECTION 3: FACILITY CONCEPT DESIGN Final Technical Progress Report

17 Oct. 1977 193 p refs Prepared in cooperation with Stearns-Roger Corp., Denver, Colo. and McDonnell Douglas Corp., St. Louis, Mo.
 (Contract EG-77-C-04-3987)

(ALO/3987-1/2-Vol-2) Avail: NTIS HC A09/MF A01

A large scale experiment to design, construct, test, evaluate, and operate a solar total energy system (STES) for the purpose of obtaining experience with large scale hardware systems and to establish engineering capability for subsequent demonstration projects is described. The solar total energy system is sized to supply 1.720 MW thermal power and 383.6 kW electrical power. The STES is sized for the extended knitwear plant of 3902 M2 (42,000 sq-ft) which will eventually employ 300 people. Conceptual design requirements of the facility are presented. Facility concept design, system concept design, performance analysis, operation plan, component and subsystem development, procurement plan, cost estimating and scheduling, and technical and management plans are among the topics discussed. ERA

N78-24673# Energy Research and Development Administration, Albuquerque, N. Mex.

SOLAR TOTAL ENERGY SYSTEM, LARGE SCALE EXPERIMENT, SHENANDOAH, GEORGIA. VOLUME 3 Final Technical Progress Report

17 Oct. 1977 124 p Prepared in cooperation with Stearns-Roger Corp., Denver, Colo. and McDonnell Douglas Corp., St. Louis, Mo.

(Contract EG-77-C-04-3987)

(ALO/3987-1/3-Vol-3) Avail: NTIS HC A06/MF A01
 For abstract, see N78-24672.

N78-24674# Thermo Electron Corp., Waltham, Mass.
ERDA/NASA ADVANCED THERMIONIC TECHNOLOGY PROGRAM Progress Report

May 1977 24 p refs
 (Contracts NAS3-20302; EY-76-C-02-3056)

(NASA-CR-157117; PR-23; TE-4217/4220-140-77;
 COO-3056-25) Avail: NTIS HC A02/MF A01 CSCL 10A

Research progress is outlined in the areas of surface studies (basic experiments and direct beam chamber), plasma studies (converter theory and advanced mode conversion experiments), component development (low-temperature and high-temperature converter experiments), and component hardware (hot shell development). ERA

N78-24675# Battelle Columbus Labs., Ohio.
AGGLOMERATING BURNER GASIFICATION PROCESS: DESIGN, INSTALLATION, AND OPERATION OF A 25-TON-A-DAY PROCESS DEVELOPMENT UNIT Monthly Progress Report

8 Sep. 1977 18 p
 (Contract EX-76-C-01-1513)

(FE-1513-64) Avail: NTIS HC A02/MF A01

Extensive solids circulation tests were completed and a correlation relating solids circulation rate to pressure loss in the vertical riser was developed. Efforts to complete an integrated gasification run were retarded by failure of a section of steel pipe in the solids transfer line and failure of portions of the combustor distributor plate. Fabrication of the erosion test rig was completed and made ready for hot-gas calibration. Activity on the turbine engineering study is presented. ERA

N78-24676# Brookhaven National Lab., Upton, N. Y.
SOME RATE AND MODELING STUDIES ON THE USE OF IRON-TITANIUM HYDRIDE AS AN ENERGY STORAGE MEDIUM FOR ELECTRIC UTILITY COMPANIES

Gerald Strickland and Wen-Shi Yu 26 Apr. 1977 62 p refs
 (Contract EY-76-C-02-0016)

(BNL-50667) Avail: NTIS HC A04/MF A01

Dynamic tests and modeling studies were made on the chemical energy storage portion of an electrical energy conversion and storage system proposed for leveling the load of an electric utility company. The concept utilizes off-peak power to produce hydrogen by electrolyzing water, storing the hydrogen as iron-titanium hydride, FeTiH/sub x/, and subsequently, releasing the hydrogen to a fuel cell where the reaction with air generates electrical power. ERA

N78-24677# Institute of Gas Technology, Chicago, Ill.
OPTIMIZATION STUDY OF OTEC DELIVERY SYSTEMS BASED ON CHEMICAL-ENERGY CARRIERS Final Report

Alex J. Konopka, Abu Talib, Bernard Yudow, and Nicholas Biederman Dec. 1976 331 p refs Sponsored in part by DoE

(Contract NSF C-1008; Grant NSF AER-75-00033)

(ERDA/NSF/00033-76/TI) Avail: NTIS HC A15/MF A01

The technoeconomic feasibility of chemical energy carriers was studied. The chemical energy carriers analyzed were hydrogen, as a gas and as a liquid, and liquid ammonia. Designs of systems for producing and transporting chemical energy to shore were completed. Estimates of the cost at which chemical energy would be available from an onshore terminal were prepared. A technical and economic evaluation of conversion delivered ammonia to

ammonium nitrate and urea was completed and a general analysis of chemical energy reconverted into electricity onshore was also made. The information for the major project tasks--production, transmission, terminaling, and conversion back to electricity--is given. ERA

N78-24678# Los Alamos Scientific Lab., N. Mex.

GAS STIMULATION STUDIES AT LASL

W. J. Carter, B. W. Olinger, N. E. Vanderborgh, and T. E. Springer 1977 27 p refs Presented at the 3d Ann. ERDA Symp. on Enhanced Oil and Gas Recovery, Tulsa, Okla., 30 Aug. - 1 Sep. 1977

(Contract W-7405-eng-36)

(LA-UR-77-1937; Conf-770836-5)

Avail: NTIS

HC A03/MF A01

Hugoniot, dynamic spall strengths, wave profiles on shock and release, and ultrasonic elastic constants were determined as functions of material density and bedding orientation for Devonian shales. These data form the basis of predictive explosive stimulation technology. Weapons-developed shaped charges using heavy metal liners are investigated for downhole use in order to produce a horizontal manifold system leading to a central borehole. Applications of the paths produced by these devices include intersection of the natural fracture patterns, explosive or chemical emplacement, or producing hydrofractures displaced from the borehole. Laser pyrolysis studies showed that pulsed laser heating results in a rapid deposition of precise quantities of thermal energy into selected shale volumes. Such laser-induced pyrolysis forms the basis for a rapid assay technique which can be used at the wellhead or as a downhole logging tool. Finally a computational technique using a hybrid (analog and digital) computer is being developed with the ultimate objective of simulating proposed extraction technologies to establish optimum economic stimulation methods. ERA

N78-24679# Pittsburgh and Midway Coal Mining Co., Merrian, Kans.

SOLVENT REFINED COAL (SRC) PROCESS Monthly Report

Sep. 1977 15 p

(Contract EX-76-C-01-0496)

(FE-496-138) Avail: NTIS HC A02/MF A01

The progress of the SRC project for the month of July 1977 is reported. A blend of Kentucky 9 and 14 coal was processed and a material balance run was completed. ERA

N78-24680# Pittsburgh Univ., Pa.

MEASUREMENT OF THE FLOW PROPERTIES AND CAPILLARY PRESSURE RELATIONSHIPS OF CERTAIN COALS PERTAINING TO UNDERGROUND COAL GASIFICATION Quarterly Report, Mar. - May 1977

P. F. Fulton and A. A. Reznik Jun. 1977 40 p

(Contract EY-76-S-02-4129)

(COO-4129-3) Avail: NTIS HC A03/MF A01

Measurement of the absolute permeability to gas, porosity, and effective and relative permeability to gas of the Pittsburgh bituminous coal and the Hanna, Wyoming subbituminous coal was extended. The same measurements were made on several samples from the Gillette, Wyoming subbituminous coal. Shrinkage of both coals with drying was also measured. The gas relative permeability curves of the coals are compared and the difference is striking. The rate of increase in permeability to gas past the critical gas saturation is significantly greater as the rank of the coal decreases. Similarly values of absolute permeability, shrinkage, and porosity are inverse functions of rank. The critical gas saturation does not appear to be a function of rank. ERA

N78-24681# Union Carbide Corp., Tonawanda, N.Y.

OCEAN THERMAL POWER PLANTS HEAT EXCHANGERS Final Report

A. M. Czikk, C. F. Fails, G. W. Fenner, D. L. McLaughlin, and R. Zawierucha 21 May 1976 150 p refs

(Contract EX-76-C-01-2448)

(ERDA/NSF/43441-76/1) Avail: NTIS HC A07/MF A01

The cycle considered herein is a closed Rankine system, in which a working fluid (ammonia or propane) is evaporated and condensed in heat exchange with the seawater streams. The cost-performance characteristics of OTEC heat exchangers were studied. Corrosion, biofouling, and material selection were discussed in great detail. In order to decrease the exchanger cost, the use of heat transfer enhancement were studied, including a nucleation promoter for the evaporator, a surface tension motivated condensate film-thinner for the condenser, and boundary layer turbulence promoters for the seawater flows. The heat exchangers can only be optimized as part of the entire plant, as a system, in order to properly apportion temperature differences between the evaporator, condenser, and turbine, and to make optimum choice of the internal power consumptions. An optimization program was written and used to obtain the optimum systems designs. ERA

N78-24683# Battelle Pacific Northwest Labs., Richland, Wash.
CHARACTERIZATION OF SUBSTANCES IN PRODUCTS, EFFLUENTS AND WASTES FROM SYNTHETIC FUEL DEVELOPMENT PROCESSES Quarterly Report, 1976

J. S. Fruchter, M. R. Petersen, and P. W. Ryan Jan. 1977 15 p

(Contract EY-76-C-06-1830)

(BNWL-2224; QR-4) Avail: NTIS HC A02/MF A01

Constituents occurring in products, effluents, and emissions from the technology processes that warrant consideration in the development of control measures were identified and quantified. ERA

N78-24684# Brookhaven National Lab., Upton, N. Y.

SYNTHESIS AND PROPERTIES OF USEFUL METAL HYDRIDES. A REVIEW OF RECENT WORK AT BROOKHAVEN NATIONAL LABORATORY

J. J. Reilly Aug. 1977 32 p refs Presented at Intern. Symp. on Hydrides for Energy Storage, Geilo, Norway, 14 Aug. 1977 (Contract EY-76-C-02-0016)

(BNL-23047; Conf-770823-3) Avail: NTIS HC A03/MF A01

The reaction of hydrogen with intermetallic compounds was investigated. Alloy systems of interest for hydrogen storage discussed include: Mg-Cu, Mg-Ni, Fe-Ti, and Ti-Cu. The properties of their corresponding hydrides are reviewed. ERA

N78-24685# Sandia Labs., Albuquerque, N. Mex.

PHYSICS UNDERLYING IMPROVED EFFICIENCY OF HIGH-LOW-JUNCTION EMITTER SILICON SOLAR CELLS

J. G. Fossum, F. A. Lindholm (Florida Univ., Gainesville), and C. T. Sah (Illinois Univ., Urbana) 1977 4 p refs Presented at IEEE Intern. Electron Devices Meeting, Wash., D. C., 5 Dec. 1977

(Contract EY-76-C-04-0789)

(SAND-77-1610C; Conf-771201-6)

Avail: NTIS

HC A02/MF A01

The physical behavior of a HLE solar cell, that yields substantial increases in the open-circuit voltage and in the power-conversion efficiency of p-n junction silicon solar cells, is described. The structure differs from the conventional cell structure (n+-n-p) in that it contains a high-low (H-L) junction in the emitter (n+-p). For cells having low base resistivities (approximately 0.1 ohm cm), efficiency improvements of about 15 percent at AM1 and about 40 percent at 50 suns can be expected. The improvement at 50 suns results in an efficiency of about 20 percent at 27 C. ERA

N78-24686# Sandia Labs., Albuquerque, N. Mex.

MODAL ANALYSIS OF THE FIRST PRODUCTION DESIGN HELIOSTAT USED AT THE SOLAR THERMAL TEST FACILITY (STTF)

John R. Janczy Sep. 1977 122 p refs

(Contract EY-76-C-04-0789)

(SAND-77-1393) Avail: NTIS HC A06/MF A01

Dynamic modal characteristics of a heliostat to be used at a solar thermal test facility are studied. Two studies were conducted of the yoke and one on the facet assembly. During the course of the test, power spectra density studies were performed using wind-loading and transport environmental data.

The modal (frequency, damping and stiffness) data are presented. The data obtained through the various studies compared favorably. The data indicates a possible structural modification, and this modification is discussed. ERA

N78-24888# Aerospace Engineering Office, Zurich (Switzerland). **STUDY OF TEST METHODS FOR LARGE FLEXIBLE SOLAR ARRAYS (VELSA) Final Report**

C. R. Vincent, K. J. Zimmermann, and H.-R. Luessi Paris ESA Jul. 1977 276 p refs Prepared jointly with Pilatus Aircraft Ltd.

(Contract ESTEC-2990/76-NL-HP(SC))
(ESA-CRIP) 1016) Avail: NTIS HC A13/MF A01

Methods and means to predict and verify the dynamic on-orbit characteristics of large flexible solar arrays are discussed. The actual status is given by surveys of available computer programs, recent correlation work, test facilities, and test methods. Required verification tests are listed and, in the outline of particular tests, the gravity effects are checked. Analytical methods investigated for the prediction of the dynamic characteristics take into account material and geometrical nonlinearities as well as thermal transient loads. Algorithms for the correlation of the mathematical model to test results are discussed. Based on cost estimates, feasibility of tests and analytical aspects, suitable verification programs are elaborated for both stowed and deployed configurations. Considering test priorities, a reduced cost program is set up in parallel. The accuracy in the prediction of the solar array dynamic characteristics is mainly improved by a logic sequence of tests starting at component level and following various assembly stages as well as by the correlation of the mathematical model.

Author (ESA)

N78-24889# National Technical Information Service, Springfield, Va.

PETROLEUM EXPLORATION, PRODUCTION, AND RECOVERY METHODS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Feb. 1978

Audrey S. Hundemann Mar. 1978 189 p Supersedes NTIS/PS-77/0231; NTIS/PS-75/254
(NTIS/PS-78/0277; NTIS/PS-77/0231; NTIS/PS-75/254)
Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 08G

Various methods of oil recovery such as water flooding, gas flooding, steam flooding, and thermal recovery methods are discussed in this bibliography of Federally-funded research. Also included are methods used in prospecting for oil and predicting oil recovery; production processes and costs; and mining and petroleum laws of various countries. Offshore drilling and recovery are not included. GRA

N78-24890# Resources for the Future, Inc., Washington, D. C. **THE ENERGY/REAL GROSS DOMESTIC PRODUCT RATIO: AN ANALYSIS OF CHANGES DURING THE 1966-1970 PERIOD IN RELATION TO LONG-RUN TRENDS**

Jack Alterman Oct. 1977 92 p refs
(PB-277235; BEA/SP-77/30) Avail: NTIS HC A05/MF A01 CSCL 10A

The factors underlying the 1966-1970 reversal in the long term decline in the BTU/GDP ratio were analyzed. In attempting to place the 1966-1970 reversal in a longer term perspective, it was found that there had been a slowdown in the secular rate of decline in the ratio since 1929, culminating in the most recent period, between 1966 and 1975, when there was a net increase in the ratio. As a result, the study was broadened to include an analysis of some of the factors underlying the reduction in the long term rate of decline in the BTU/GDP ratio and the connection, if any, between the 1966-1970 reversal and the slowdown in the secular rate. Author

N78-24894# Energy Research and Development Administration, Washington, D. C. **OIL SHALE, FY 1977**

J. D. Powderly and R. Franklin Jun. 1977 56 p
(EDP/F-01(77)) Avail: NTIS HC A04/MF A01

The environmental, health, safety, and socioeconomic issues concerning the development of the program were identified and examined, and the requirements and actions needed to resolve

these issues, and a time phased action plan for the evaluation and mitigation of environmental impacts is presented. The plan addressed the oil shale energy system including mining, crushing and sizing, fracturing, in situ and surface retorting, product recovery and upgrading, transportation, and end use. ERA

N78-24695# Oak Ridge National Lab., Tenn. **KINETIC MODEL FOR PREDICTING THE COMPOSITION OF CHLORINATED WATER DISCHARGED FROM POWER PLANT COOLING SYSTEMS**

Milton H. Lietzke 1977 13 p refs Presented at the Conf. on Water Chlorination: Environ. Impact and Health Effects, Gatlinburg, Tenn., 31 Oct. 1977

(Contract W-7405-eng-26)
(CONF-771070-1) Avail: NTIS HC A02/MF A01

The results of applying a kinetic model to the chlorination data on the once-through cooling system at the Quad Cities Nuclear Station provide a validation of the model. The two examples given demonstrate that the model may be applied to either once-through cooling systems or to cooling systems involving cooling towers. ERA

N78-24696# Oak Ridge National Lab., Tenn. **ENVIRONMENTAL HEALTH, AND CONTROL ASPECTS OF COAL CONVERSION. AN INFORMATION OVERVIEW, VOLUME 1**

H. M. Braunstein, ed., E. D. Copenhaver, ed., and H. A. Pfuderer, ed. Apr. 1977 538 p refs

(Contract W-7406-eng-26)
(ORNL-EIS-94-Vol-1) Avail: NTIS HC A23/MF A01

Topics include: coal, its origin, classification, and physical and chemical properties; coal conversion processes; process effluents (quantities and control technologies), and the analysis of coal and coal products (including wastes). ERA

N78-24697# Oak Ridge National Lab., Tenn. **ENVIRONMENTAL HEALTH, AND CONTROL ASPECTS OF COAL CONVERSION: AN INFORMATION OVERVIEW, VOLUME 2**

H. M. Braunstein, ed., E. D. Copenhaver, ed., and H. A. Pfuderer, ed. Apr. 1977 797 p refs

(Contract W-7405-eng-26)
(ORNL-EIS-95-Vol-2) Avail: NTIS HC A99/MF A01

The five chapters from this second volume entered individually into EDB, ERA and EPA deal with the environmental behavior of possible pollutants (polycyclic aromatic hydrocarbons, sulfur dioxide, nitrogen oxides, trace elements, etc.) from coal conversion plants and the possible biological effects of these pollutants on microbes, plants, animals and man (including occupational diseases). The results presented are very detailed, but made reasonably accessible by the incorporation of appendices giving IUPAC names and structural formulae of common polycyclic aromatic hydrocarbons and a chemical index. ERA

N78-24731# Sandia Labs., Albuquerque, N. Mex. **MECHANICAL PROPERTIES OF OIL SHALE OF IMPORTANCE TO IN-SITU RUBBLIZATION**

K. W. Schuler and R. A. Schmidt 1977 16 p Presented at Amer. Nucl. Soc. Topical Meeting on Energy and Mineral Recovery Research, Golden, Colo., 12 Apr. 1977

(Contract EY-76-C-04-0789)
(SAND-77-0499C; Conf-770440) Avail: NTIS HC A02/MF A01

Current proposals for true in-situ processing of oil shale employ deeply buried explosive charges to produce the desired rubblization. At short times after the explosion, the dynamic behavior of the material is of interest and can be studied in shockwave experiments. At intermediate times the divergence of the flow field requires a multidimensional specification of the material behavior which appears to be best determined from triaxial test data. At late times the possible formation of tensile stresses requires knowledge of the fracture mechanics and tensile behavior of the shale. This report presents a summary of techniques and results of triaxial compression, extension and fracture toughness tests on two grades of oil shale. Results indicate that oil shale differs significantly from most rocks and suggest

N78-24790

that models originally developed for composite materials may be appropriate for describing the mechanical behavior of oil shale. ERA

N78-24790# National Inst. for Occupational Safety and Health, Cincinnati, Ohio.

OCCUPATIONAL EXPOSURE TO REFINED PETROLEUM SOLVENTS. CRITERIA FOR A RECOMMENDED STANDARD

Jul. 1977 256 p refs

(Contract CDC-99-74-31)

(DHEW/Pub/NIOSH-77/192) Avail: NTIS MF A01; HC SOD

The National Institute for Occupational Safety and Health recommends standards to protect employees from exposure to petroleum ether, rubber solvent, varnish makers' and painters' naphtha, mineral spirits, Stoddard solvents and kerosene in the workplace. The standards are designed to protect the health and provide for the safety of employees for up to a 10 hour work shift, 40 hour workweek, over a working life. Compliance with all sections of the standards should prevent adverse effects of these chemicals on the health of employees and provide for their safety. Techniques recommended are valid, reproducible, and available to industry and government agencies. Sufficient technology exists to permit compliance with the recommended standards. Although the environmental limits for the workplace are considered to be safe levels based on current information, the employer should regard these as the upper boundary of exposure and every effort should be made to keep the exposure as low as is technically feasible. Author

N78-24920# Argonne National Lab., Ill.

ALTERNATIVE FUEL CYCLE OPTIONS: PERFORMANCE CHARACTERISTICS AND IMPACT ON NUCLEAR POWER GROWTH POTENTIAL

Y. I. Chang, C. E. Till, R. R. Rudolph, J. R. Deen, and M. J. King Sep. 1977 43 p refs

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

(ANL-77-70) Avail: NTIS HC A03/MF A01

The fuel utilization characteristics for LWR, SSCR, CANDU and LMFBR reactor concepts are quantified for various fuel cycle options, including once-through cycles, thorium cycles, and denatured cycles. The implications of various alternative reactor deployment strategies on the long-term nuclear power growth potential are then quantified in terms of the maximum nuclear capacity that can be achieved and the growth pattern over time, subject to the constraint of a fixed uranium-resource base. The overall objective was to shed light on any large differences in the long-term potential that exists between various alternative reactor/fuel cycle deployment strategies. ERA

N78-24923# Nuclear Regulatory Commission, Washington, D. C. Office of Management Information and Program Control.

REPORT TO CONGRESS ON ABNORMAL OCCURRENCES JULY - SEPTEMBER 1977

Nov. 1977 22 p

(PB-278534; Nureg-0090-9) Avail: NTIS HC A02/MF A01 CSDL 18H

An abnormal occurrence is identified as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety. It is determined that during this period there were no abnormal occurrences neither at the 65 nuclear power plants licensed to operate nor at fuel cycle facilities. There was one abnormal occurrence at other licensed facilities, which involved the loss and recovery of a radioactive source and probable preexposure. GRA

N78-24974# Barry (Theodore) and Associates, Los Angeles, Calif.

SAMICS SUPPORT STUDY. VOLUME 1: COST ACCOUNT CATALOG Final Report

Sep. 1977 94 p refs Sponsored in part by ERDA Prepared for JPL

(Contracts NAS7-100: JPL-954800)

(NASA-CR-157131; ERDA/JPL-954800-77/2.1) Avail: NTIS HC A04/MF A01 CSDL 05A

The Jet Propulsion Laboratory (JPL) is examining the feasibility of a new industry to produce photovoltaic solar energy collectors similar to those used on spacecraft. To do this, a standardized costing procedure was developed. The Solar Array Manufacturing Industry Costing Standards (SAMICS) support study supplies the following information: (1) SAMICS critique; (2) Standard data base--cost account structure, expense item costs, inflation rates, indirect requirements relationships, and standard financial parameter values; (3) Facilities capital cost estimating relationships; (4) Conceptual plant designs; (5) Construction lead times; (6) Production start-up times; (7) Manufacturing price estimates. Author

N78-25000# Committee on Interstate and Foreign Commerce (U. S. House).

NATIONAL ENERGY ACT, PART 4

Washington GPO 1977 918 p refs Hearings on H.R. 6831, H.R. 687, H.R. 1562, H.R. 2088, H.R. 2818, H.R. 3317, H.R. 3664, H.R. 6660, and all similar and identical bills before Subcomm. on Energy and Power of the Comm. on Interstate and Foreign Commerce, 95th Congr., 1st Sess., 25-27 May 1977

(GPO-96-231) Avail: Subcomm. on Energy and Power

The topic of discussion for this hearing was the use of coal conversion to supplement the nation's energy needs. Included in the testimonies is the emphasis placed on coal conversion as it relates to economics, public health and environmental impact. G.Y.

N78-25001# Committee on Interstate and Foreign Commerce (U. S. House).

NATIONAL ENERGY ACT, PART 5

Washington GPO 1977 505 p refs Hearings on H.R. 6831, H.R. 687, H.R. 1562, H.R. 2088, H.R. 2818, H.R. 3317, H.R. 3664, H.R. 6660, and all similar and identical bills before the Subcomm. on Energy and Power of the Comm. on Interstate and Foreign Commerce, 95th Congr., 1st Sess., 1 Jun. 1977 (GPO-98-577) Avail: Subcomm. on Energy and Power

Evaluation of the President's proposed National Energy Act on a broad and long term view are reported. Through economic analysis the overall goals and impacts of the President's plan are evaluated and recommendations are set forth. A collection of data are presented to give a better understanding to the proposed plan and recommendations. G.Y.

N78-25002# Committee on Finance (U. S. Senate).

THE FUEL EFFICIENCY INCENTIVE TAX PROPOSAL: ITS IMPACT UPON THE FUTURE OF THE US PASSENGER AUTOMOBILE INDUSTRY

Washington GPO 1977 302 p refs Rept. on Investigation No. 332-86 under Section 332 of the Tariff Act of 1930 to the Comm. on Finance, 95th Congr., 1st Sess., Jul. 1977

(GPO-93-188) Avail: SOD HC

The impact of the fuel inefficiency tax and the fuel efficiency rebate (sections 1201-1204 of the proposed National Energy Act) on consumption and sales of U.S. and foreign automobiles, on employment in the U.S. automobile industry, and on U.S. consumers of passenger automobiles is assessed. This analysis, which is for the period 1978 through 1985, is based on three different assumptions: (1) the U.S. market under existing laws and regulations; (2) the U.S. market with the implementation of both the tax and the rebate; and (3) the U.S. market with the implementation of the fuel efficiency tax only. Author

N78-25003# ECON, Inc., Princeton, N. J.

POLITICAL AND LEGAL IMPLICATIONS OF DEVELOPING AND OPERATING A SATELLITE POWER SYSTEM Final Report

George A. Hazelrigg, Jr. 15 Aug. 1977 234 p refs Sponsored by NASA Prepared for JPL

(Contract JPL-954652)

(NASA-CR-157077; ECON-77-195-1)

Avail: NTIS

HC A11/MF A01 CSCL 05D

A number of political and legal implications of developing and operating a satellite power system (SPS) are identified and studied in this report. These include the vulnerability of SPS to actions of adversaries, communications impacts, the legality of an SPS in orbit including on-orbit military protection, alleviation of political concerns about deployment and operation of SPS, programmatic planning for SPS and the interaction of SPS with federal regulatory agencies and major departments. In comparing SPS to terrestrial power stations, it is seen that the political problems are neither clearly larger nor clearly smaller--they are clearly different and they are international in nature. If SPS is to become a reality these problems must be dealt with. Five major issues are identified. These must be resolved in order to obtain international acceptance of SPS. However, this study has found no insurmountable obstacles that would clearly prohibit the deployment, operation and protection of an SPS fleet.

Author.

N78-25006# Committee on Science and Technology (U. S. House).

THE 1978 ERDA AUTHORIZATION; THE CLINCH RIVER BREEDER REACTOR PROGRAM, VOLUME 4

Washington GPO 1977 1129 p refs. Hearings before Subcomm. on Fossil and Nuclear Energy Res., Development and Demonstration of the Comm. on Sci. and Technol., 95th Congr., 1st Sess., 7-10 Jun. 1977

(GPO-92-462) Avail.: Subcomm. on Fossil and Nuclear Energy Res., Development and Demonstration

Testimony was given on different technical alternatives for the breeder reactor research and development program. Particular emphasis was given to the Clinch River breeder reactor project. The minimum criterion of acceptability for the commercialization of an energy supply alternative was discussed. The plutonium breeder and its associated fuel cycle was not felt by many to meet the minimum criterion of acceptability and alternative energy sources were discussed such as the denatured uranium-thorium fuel cycle.

Author

N78-25012# National Aeronautics and Space Administration, Washington, D. C.

WASTE HEAT UTILIZATION IN INDUSTRIAL PROCESSES
M. Weichsel and W. Heitmann Apr. 1978 35 p refs Transl. into ENGLISH from Tech. Mitt. (West Ger.), v. 70, no. 5, May 1977 p 259-272 Transl. by Sci. Transl. Serv., Santa Barbara, Calif.

(Contract NASw-2791)

(NASA-TM-75210) Avail.: NTIS HC A03/MF A01 CSCL 10B

A survey is given of new developments in heat exchangers and heat pumps. With respect to practical applications, internal criteria for plant operation are discussed. Possibilities of government support are pointed out. Waste heat steam generators and waste heat aggregates for hot water generation or in some cases for steam superheating are used. The possibilities of utilization can be classified according to the economic improvements and according to their process applications, for example, gascooling. Examples are presented for a large variety of applications.

Author

N78-25047# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

STUDIES OF ADVANCED TRANSPORT AIRCRAFT

A. I. Nagel May 1978 35 p refs Presented at CTOL Transport Technol. Conf., Hampton, Va., 28 Feb. - 3 Mar. 1978. Published in NASA-CP-2036

(NASA-TM-78697; L-12276) Avail.: NTIS HC A03/MF A01 CSCL 01C

Concepts for possible future airplanes are studied that include all-wing distributed-load airplanes, multi-body airplanes, a long-range laminar flow control airplane, a nuclear powered airplane designed for towing conventionally powered airplanes during long range cruise, and an aerial transportation system comprised of continuously flying liner airplanes operated in

conjunction with short range feeder airplanes. Results indicate that each of these concepts has the potential for important performance and economic advantages, provided certain suggested research tasks are successfully accomplished. Indicated research areas include all-wing airplane aerodynamics, aerial rendezvous, nuclear aircraft engines, air-cushion landing systems, and laminar flow control, as well as the basic research discipline areas of aerodynamics, structures, propulsion, avionics, and computer applications.

Author

N78-25096# Maxwell Labs., Inc., Woburn, Mass. Utility Products Div.

INDUCTOR NETWORK DEVELOPMENT FOR AIRCRAFT HIGH POWER SUPPLIES Final Report, Jan. 1974 - Feb. 1977

J. Tenko, R. L. Bryan, S. Ghoshroy, L. M. Lontai, and O. K. Sonju Apr. 1977 248 p

(Contract F33615-74-C-20; AF Proj. 3145)

(AD-A052750; AFAPL-TR-77-15)

Avail.: NTIS

HC A11/MF A01 CSCL 10/2

This report presents the results of a study program undertaken to perform a comparative analysis of several approaches to the generation of high electrical power by storing tens to hundreds of kilojoules of energy in a compact, superconducting inductive system with efficient extraction in short bursts at high repetition rates. The critical factors for the comparison were the weight, volume, dissipation and reliability of the system and components for various operating regimes characterized by pulse power, repetition rate and pulse shape. Research and development work hitherto undertaken in the U.S. and abroad indicate the engineering feasibility of operating inductive storage systems storing ten to perhaps one hundred kilojoules of energy with extraction rates of tens of pulses per second at pulse durations of the order of a few hundred microseconds with state-of-the-art technology. The major effort of this study was directed towards developing analytical tools to predict the performance of superconducting coils at repetition rates of 100 - 1000 pps with pulse discharge times of 20 - 40 microseconds and to evaluate the relative merits of different circuit configurations for storage and extraction of energy at high average power (3 - 10 MW). At frequencies of a few hundred pulses per second, it appears that inductive storage has a distinct advantage over capacitive storage at power levels of the order 1 - 10 MW.

GRA

N78-25225# Cities Service Oil Co., Tulsa, Okla.

EL DORADO MICELLAR-POLYMER DEMONSTRATION PROJECT REPORT Annual Report, Jun. 1976 - Aug. 1977

G. W. Rosenwald, ed., R. J. Miller, ed., and J. Vairogs, ed. Feb. 1978 296 p

(Contract EY-76-C-02-4100)

(BERC/TPR-77/12; AR-3) Avail.: NTIS HC A13/MF A01

The El Dorado Demonstration Project is designed to allow a side-by-side comparison of two distinct micellar-polymer processes in the same field so that the reservoir conditions for the two floods are as nearly alike as possible. Selection of sulfonates and polymers for both patterns was completed. Salinity changes in produced fluids and in observation well samples have shown that breakthrough of preflush (or preflush) has occurred at some wells in both patterns. Observation well sampling and logging data showed that preflush arrived earlier at the observation wells in the north pattern than the south pattern. Injectivities of the micellar system designed for the south pattern and components of that system were tested in three monitoring wells. Similarly, extensive injectivity testing of the surfactant and polymer slugs designed for the north pattern was conducted using two monitoring wells.

ERA

N78-25226# Gary Operating Co., Englewood, Colo.

BELL CREEK FIELD MICELLAR-POLYMER PILOT DEMONSTRATION Annual Report, Jul. 1976 - Sep. 1977

Arnold Goldberg 1978 168 p refs

(Contract EY-77-C-02-4207)

(BERC/TPR-77/13; COO-4207-15)

Avail.: NTIS

HC A08/MF A01

A pilot demonstration is being conducted to determine whether micellar-polymer flooding is an economically feasible technique for enhanced oil recovery from the Muddy Sand Unit, A Reservoir of the Bell Creek Field, Powder River and Carter Counties, Montana. During the first year of this project extensive reservoir studies, site and pattern selection, design and selection of an optimal micellar-polymer system, water flood history matching and preliminary process simulations by numerical models, and development of pilot injection and production wells were completed. The major effort during the first contract year was the design for the Bell Creek pilot of two optimal micellar-polymer processes - one oil external and one water-external; and the concomitant development of a selection methodology by which to decide upon the more suitable process by means of a standard set of laboratory experiments and numerical simulations. This effort was completed. ERA

N78-25233*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. APPLICATIONS OF AEROSPACE TECHNOLOGY TO PETROLEUM EXTRACTION AND RESERVOIR ENGINEERING

Leonard D. Jaffe, Lloyd H. Back, C. Martin Berdahl, Earl E. Collins, Jr., Paul G. Gordon, John Houseman, Marshall F. Humphrey, George C. Hsu, John D. Ham, Jack E. Marte et al 30 Oct. 1977 343 p refs

(Contract NAS7-100)

(NASA-CR-157167; JPL-Pub-78-22)

Avail: NTIS

HC A15/MF A01 CSCL 21D

Through contacts with the petroleum industry, the petroleum service industry, universities and government agencies, important petroleum extraction problems were identified. For each problem, areas of aerospace technology that might aid in its solution were also identified, where possible. Some of the problems were selected for further consideration. Work on these problems led to the formulation of specific concepts as candidate for development. Each concept is addressed to the solution of specific extraction problems and makes use of specific areas of aerospace technology. Author

N78-25235*# Gordian Associates, Inc., New York. COMPUTER MODEL FOR REFINERY OPERATIONS WITH EMPHASIS ON JET FUEL PRODUCTION. VOLUME 3: DETAILED SYSTEMS AND PROGRAMMING DOCUMENTATION Final Report

Daniel N. Dunbar and Barry G. Tunnah 27 Jun. 1978 53 p (Contract NAS3-20620)

(NASA-CR-135335; Rept-1099-1-Vol-3)

Avail: NTIS

HC A04/MF A01 CSCL 21D

The FORTRAN computing program predicts flow streams and material, energy, and economic balances of a typical petroleum refinery, with particular emphasis on production of aviation turbine fuels of varying end point and hydrogen content specifications. The program has a provision for shale oil and coal oil in addition to petroleum crudes. A case study feature permits dependent cases to be run for parametric or optimization studies by input of only the variables which are changed from the base case. Author

N78-25237*# National Aeronautics and Space Administration, Pasadena Office, Calif. SURFACTANT-ASSISTED LIQUEFACTION OF PARTICULATE CARBONACEOUS SUBSTANCES Patent Application

George C. Hsu, inventor (to NASA) (JPL) Filed 7 Oct. 1976 20 p (Contract NAS7-100)

(NASA-Case-NPO-13904-1; US-Patent-Appl-SN-730468) Avail: NTIS HC A02/MF A01 CSCL 21D

Enhanced and improved quality yields are achieved in coal liquefaction by adding to the coal slurry in solvent a small amount of an oil soluble organic surfactant capable of dispersing the asphaltene particles. The liquefaction system described includes a slurring means having a stirrer in which is formed a slurry of surfactant, particulate coal or other carbonaceous substance and solvent. The slurry is converted in the liquefaction reactor under

the influence of heat and high pressure hydrogen to a gaseous hydrocarbon product and to a product slurry which is then separated into a light and heavy oil product, solvent, and coal residue by process steps which include extraction, filtration, and distillation. The effects of surfactant on coal conversion, product distribution, conversion rate and filtration time are demonstrated. NASA

N78-25239# Exxon Research and Engineering Co., Linden, N. J. Government Research Lab. EVALUATION OF METHODS TO PRODUCE AVIATION TURBINE FUELS FROM SYNTHETIC CRUDE OILS; PHASE 3, VOLUME 3 Final Report, 24 Apr. 1976 - 30 Apr. 1977

William F. Taylor, J. L. Kaufman, E. C. Brown, A. R. Cunningham, and C. A. Smith Jun. 1977 88 p refs (Contract F33615-74-C-2036; AF Proj. 3048)

(AD-A053106; EXXON/GRU.3PEA.77-Vol-3; AFAPL-TR-75-10-Vol-3) Avail: NTIS HC A05/MF A01 CSCL 21/4

An engineering planning study was made of the effect of processing shale oil in a refinery processing both shale oil and petroleum to a full product slate including jet fuel. This study was part of an overall program whose object was to investigate the feasibility of producing aviation turbine fuels from synthetic crude oils. In this Phase 3 engineering planning study the results and conclusions of the Phase 1 state-of-the-art assessment and Phase 2 pilot plant experimental study were further investigated. The Exxon RESCUE Linear Program for Refinery Planning was used to provide a framework for the analysis. The study which involved a number of arbitrary but well-defined assumptions, was done in the context of a grass roots refinery processing shale oil and petroleum in segregated operations. Shale oil processing was restricted to distillation and hydrotreating of the kerosene and gas oil fractions, whereas petroleum processing involved a full spectrum of refinery processes with a relatively high level of conversion of heavier fractions to lighter fractions to meet a high motor gasoline demand. GRA

N78-25240# Exxon Research and Engineering Co., Linden, N. J. Government Research Lab. ALTERNATE FUELS NITROGEN CHEMISTRY Final Technical Report, 19 Oct. 1976 - 20 Oct 1977

John W. Frankenfeld and William F. Taylor Nov. 1977 62 p refs (Contract N00019-76-C-0675)

(AD-A053299; EXXON/GRUS.1KWC.77) Avail: NTIS

HC A04/MF A01 CSCL 21/4

An investigation of the effects of nitrogen compounds on sediment formation was initiated. Several different nitrogen compounds were studied, including 2,5-dimethylpyrrole, indole, carbazole and a number of aromatic and aliphatic amines. The diluent employed was purified n-decane. All of the compounds caused darkening of the fuel although appreciable amounts of sediment were formed only with the pyrrole derivatives. The sediment formation was found to be strongly catalyzed by light and by organic acids. Some phenols retarded the sedimentation. A start was made toward characterizing the sediment obtained from 2,5-dimethylpyrrole. It appeared to be a low molecular weight oligomer of partially oxidized pyrrole units. Author (GRA)

N78-25241# California Univ., Livermore. Lawrence Livermore Lab. ALTERNATIVE FUELS UTILIZATION PROGRAM

C. J. Anderson 7 Dec. 1977 73 p refs (Contract W-7405-eng-48)

(UCID-17645) Avail: NTIS HC A04/MF A01

The goals, scope, and objectives of the Department of Energy's plan for government participation in alternative fuels research and development are discussed. Because the transportation and transportation energy systems in the U.S. consist mainly of privately-owned companies that provide goods and services to individuals and because the market system is regulated by the government, decision making processes and decisions that link alternative fuels R&D should be responsive to the nation's predominantly private energy system. This plan anticipates the failure of the market to achieve a timely commercialization of alternative fuels for transportation. ERA

N78-25242# American Energy Research Co., McLean, Va.
SOURCES OF ALCOHOL FUELS FOR VEHICLE FLEET TESTS

W. J. Barr and F. A. Parker 31 Aug. 1977 88 p refs
 (Contract EG-77-X-01-2693)
 (CONS/2693-1) Avail: NTIS HC A05/MF A01

Twenty-five coal gasification projects were reviewed for the purpose of determining if they offered an opportunity to provide a source of methanol for a fleet vehicle test program. All were concerned with the gasification of coal to produce a low, medium, or high Btu gas or a liquid fuel. The analysis revealed that only four programs offered a reasonable opportunity for completion of a commercial scale gasification plant and full operation in the foreseeable future. Further, all four, elected to use the Lurgi gasification technology together with the Lurgi Rectisol gas cleanup process incorporating methanol as the absorbing medium. Consequently all four projects are candidates for supplying the 150 ton needed for a fleet vehicle test program. ERA

N78-25243# Exxon Research and Engineering Co., Linden, N. J.
 Government Research Labs.

PRODUCTION ECONOMICS FOR HYDROGEN, AMMONIA AND METHANOL DURING THE 1980-2000 PERIOD

H. G. Corneli, Fred J. Heinzelmann, and Edward W. S. Nicholson
 Apr. 1977 178 p refs Prepared for BNL
 (Contracts EY-76-C-02-0016; BNL-368150-S)
 (BNL-50663) Avail: NTIS HC A09/MF A01

Refinery hydrogen, ammonia, and methanol, the principal industrial hydrogen products, are now manufactured mainly by catalytic steam reforming of natural gas or some alternative light-hydrocarbon feed stock. Anticipated increases in the prices of hydrocarbons are expected to exceed those for coal, thus gradually increasing the incentive to use coal gasification as a source of industrial hydrogen during the 1980 to 2000 period. Although the investment in industrial hydrogen plants will exceed those for reforming by a factor of 2 or more, coal gasification will provide lower production costs (including 20%/y before tax return) for methanol manufacture in the early 1980's and for ammonia 5 years or so later. However, high costs for transporting coal to major refining centers will make it difficult to justify coal gasification for refinery hydrogen production during the 1980 to 2000 period. ERA

N78-25244# Rockwell International Corp., Canoga Park, Calif.
 Rocketdyne Div.

HYDROGASIFIER DEVELOPMENT FOR THE HYDRANE PROCESS Quarterly Report, Mar. - May 1977

J. A. Gray and K. M. Sprouse Jun. 1977 116 p refs
 (Contract EF-77-C-01-2518)
 (FE-2518-4) Avail: NTIS HC A06/MF A01

Short residence, hydrolysis of coal experiments in entrained flow reactors are reviewed. Fifty percent carbon conversion was attained with lignite at a temperature of 1600 to 1800 F, a residence time of about 1 second, and a hydrogen pressure of at least 1000 psi; with bituminous coal, 50 percent carbon conversion, was attained at 1500 F, a residence time of 0.6 second and a hydrogen pressure of 1000 psi. Small differences in the results (2 to 5 percent carbon conversion) are likely due to variations in the heat up rate and in the conditions of contacting the coal and hydrogen. Product yields are mainly methane and light hydrocarbon liquids with relative amounts of each depending on the temperature. Individual experimental results are reported and certain theoretical results related to scaling laws of chemical reactors used for this purpose are developed. ERA

N78-25245# Energy Research and Development Administration,
 Washington, D. C.

ALTERNATIVE FUELS DEMONSTRATION PROGRAM, VOLUME 1 OF 2 Final Environmental Impact Statement

Sep. 1977 780 p refs
 (ERDA-1547-Vol-1) Avail: NTIS HC A99/MF A01

While processes for converting coal, oil shale and other domestic resources into synthetic fuels have been known for many years, they have not been applied on a commercial scale in the U.S. because, in the past, the synthetic products were not competitive in cost with petroleum and natural gas. In order

to remedy this situation, a program to accelerate alternative fuels production was proposed. An environmental statement examines impacts of the program on a plant-by-plant basis and in the aggregate. To examine aggregate impacts, four options for total program implementation were analyzed. The statement deals with the potential environmental impacts that could occur as the result of implementing the Alternative Fuels Demonstration Program under each of these strategies. The statement also uses a building block approach to assess the potential environmental impacts of a synthetic fuels industry, which allows for assessing the impacts related to any combination of production levels, technological mixes, and buildup rates. ERA

N78-25248# Dynatech R/D Co., Cambridge, Mass.

FUEL GAS PRODUCTION FROM ANIMAL WASTE, PHASE 1 Quarterly Progress Report, 1 Jun. - 1 Sep. 1977

E. Ashare, R. L. Wentworth, D. L. Wise, and D. C. Augenstein
 28 Sep. 1977 16 p
 (Contract EY-76-C-02-2991)
 (COO-2991-23; Rept-1665; QPR-4) Avail: NTIS
 HC A02/MF A01

During this quarter, a quarterly review meeting with ERDA contractors was held. The agenda is included in the appendix. Site visits were made to various ERDA contractors. A preliminary engineering report on digester gas scrubbing was submitted to ERDA. ERA

N78-25249# General Electric Co., Wilmington, Mass. Aircraft
 Equipment Div.

SPE WATER ELECTROLYSIS TECHNOLOGY DEVELOPMENT FOR LARGE SCALE HYDROGEN PRODUCTION Progress Report, 1 Jan. - 31 Mar. 1977

25 Apr. 1977 42 p
 (Contract EY-76-C-02-2675)
 (COO-2675-6; PR-6) Avail: NTIS HC A03/MF A01

The following topics are discussed: Low cost current collector development; high temperature operation; catalytic electrode development; low cost polymer development; evaluation of the effect of hydrogen enrichment on older gas pipelines; cell and SPE optimization; cell assembly design; stack assembly design; manufacturing process development; and system analysis and definition. ERA

N78-25250# Institute of Gas Technology, Chicago, Ill.

STATUS OF STEAM-IRON PILOT PLANT OPERATIONS

Paul B. Tarman 1977 12 p Presented at the 9th Syn. Pipeline Gas Symp., Chicago, 31 Oct. - 2 Nov. 1977
 (Contract EX-76-C-01-2435)
 (CONF-771092) Avail: NTIS HC A02/MF A01

Start-up operations of a pilot plant designed to produce 1.1 million SCF of hydrogen per day began in October 1976. Operations during the first year are summarized. Pilot plant operations were initially directed towards separate startup of the three main systems; the slurry vaporizer, the producer reactor, and the steam-iron reactor. Once these systems were operable on an individual basis, efforts were then concentrated on combined operation of all three systems. Four slurry vaporization tests, six solids circulation tests in the steam-iron reactor, and five char feed and gasification tests were conducted in the producer reactor. The last three tests were directed towards combined operation of the entire system. ERA

N78-25251# Mobil Research and Development Corp., Princeton, N. J.

RESEARCH GUIDANCE STUDIES TO ASSESS GASOLINE FROM COAL BY METHANOL-TO-GASOLINE AND SASOL-TYPE FISCHER-TROPSCH TECHNOLOGIES Monthly Report, Nov. 1977

Max Schreiner Dec. 1977 10 p
 (Contract EF-77-C-01-2447)
 (FE-2447-12) Avail: NTIS HC A02/MF A01

The results of an economic comparative evaluation of the methanol-to-gasoline and Fischer-Tropsch syntheses are reported. It was concluded that the methanol conversion technology is superior to the F-T technology. The thermal energy loss converting

the methanol to gasoline is not excessive. The fluid-bed process is somewhat better than its fixed-bed process. The results of the evaluation are tabulated. Author (ERA)

N78-25252# Natural Dynamics, Des Moines, Iowa.
FAST PRODUCTION OF METHANE BY ANAEROBIC DIGESTION Progress Report, 7 Nov. - 6 Dec. 1977

C. D. Finney, R. S. Evans, II, and K. A. Finney Dec. 1977 32 p

(Contract EY-76-C-02-2900)

(COO-2900-11) Avail: NTIS HC A03/MF A01

Pressure data at 62.5 C were taken for three digesters operating at 50 rpm pulsed to 350 rpm for 15 seconds every five minutes; 50 rpm pulsed to 350 rpm for 45 seconds every five minutes; and 50 rpm pulsed to 350 rpm for 135 seconds every five minutes. Kinetic data in the form of reducing sugars, soluble COD, volatile acids, and methane concentrations for digesters operating at 58.0, 62.5, and 66.0 C are analyzed using first order rate expressions. A table of rate coefficients is presented. ERA

N78-25253# Gordian Associates, Inc., New York.
SMALL REFINER BIAS ANALYSIS Final Report

Jan. 1978 218 p refs

(Contract EM-77-C-01-8758)

(HCP/B70258-01) Avail: NTIS HC A10/MF A01

The small refiner bias program, part of the entitlements program, was intended to help maintain the competitive viability of small and independent refiners. The bias program provides for issuance of additional entitlements to small refiners on a sliding scale basis as a function of company size. The impact of differences in refinery size, refinery type, and type of crude run, by means of engineering and economics analysis of a wide range of possible refinery operations was studied. Estimates were made of refinery investment costs, operating costs, product realizations, and operating margins before and after capital charges. The appropriate government policy toward small and independent refiners is discussed. Author (ERA)

N78-25254# Institute of Gas Technology, Chicago, Ill.
DEVELOPMENT OF THE STEAM-IRON PROCESS FOR HYDROGEN PRODUCTION Quarterly Report, 1 Jan. - 31 Mar. 1977

Nov. 1977 71 p refs Sponsored in part by the Am. Gas Assoc., Inc., Arlington, Va.

(Contract EX-76-C-01-2435; Proj. 9010)

(FE-2435-12; QR-3) Avail: NTIS HC A04/MF A01

Controlled operation of the producer and the steam iron reactor was achieved. A second ore circulation test was completed in the steam iron reactor, and a char feed test was conducted in the producer reactor. Char water slurries, containing solids concentrations up to 30 wt percent solids, were pumped through the slurry heater and vaporized without difficulty for 36 hrs. Some modifications were made in the lift line expansion joint and the 145 degree elbow in the solids transfer line of the steam iron reactor to improve their performance. The objective of Task 4 is to develop improved solids, with high chemical reactivity, high attrition resistance, and no tendency to agglomerate, for use in the steam iron reactor. Fifteen reactivity tests and 10 attrition tests were conducted. The reactivity of iron-chromia 5 was found to be about twice as high as that of siderite. ERA

N78-25335# Los Alamos Scientific Lab., N. Mex.
DEVELOPMENT OF A LOW COST, 10 kV CAPACITOR

E. L. Kemp, G. P. Boicourt, and K. J. Bickford 1977 4 p refs Presented at 7th Symp. on Fusion Res. Proj., Knoxville, Tenn., 25-28 Oct. 1977

(Contract W-7405-eng-36)

(LA-UR-77-2408; Conf-771029-32)

Avail: NTIS

HC A02/MF A01

The cost of an energy storage capacitor is largely determined by the quantity of material in it. Labor cost is typically less than 25 percent of the total cost. A 170 F, 10 kV capacitor has been developed which presently sells for less than four cents per joule. The 10-kV rating was chosen because this is the

optimum voltage for minimum cost. A development specifications was written to evaluate only a single parameter such as paper thickness and a small number of capacitors were purchased and tested to destruction in a standardized 85 kJ test bank. The capacitors were then dissected to determine cause of failure. Over six designs have been evaluated. Recently a new dielectric sandwich and a new impregnant have been evaluated with encouraging results. The details of the various designs, the test conditions and the test results are presented. ERA

N78-25337# United Technologies Research Center, East Hartford, Conn.

VENTURE ANALYSIS CASE STUDY OF COMBINED GAS AND STEAM POWER SYSTEMS FOR THE GENERATION OF UTILITY ELECTRIC POWER Technical Progress Report, 16 Oct. - 15 Nov. 1977

W. R. Davison 1 Dec. 1977 17 p refs

(Contract EX-77-C-01-2483)

(APAE-2483-5; TPR-5; R77-952907-5) Avail: NTIS HC A02/MF A01

A logical and consistent framework of venture analysis which could be used by government personnel to analyze a wide variety of business related programs was defined. The use of the methodology was demonstrated in analyzing the potential commercialization of the gas turbine as part of combined gas and steam (COGAS) systems for the generation of utility electric power in the period through 2000. The study was conducted in three phases: simulation of the venture from the specific standpoint of the private sector gas turbine manufacturers; identification and quantification of the social benefits which would accompany the commercialization of COGAS systems; and estimation of government assistance and incentives required to assure the commercial development of the system. Extension of the diffusion analysis model to multicompetitor situations was undertaken and calculations of initial deterministic venture returns as well as estimates of the sensitivity of the results to variations in the individual input parameters were made. Author

N78-25340# Johnson (Bernard), Inc., Houston, Tex.
REPORT ON EMERGENCY ELECTRICAL POWER SUPPLY SYSTEMS FOR NUCLEAR FUEL CYCLE AND REACTOR FACILITIES SECURITY SYSTEMS

1977 70 p

(Contract W-7405-eng-26)

(Y/Sub-77-14263/1) Avail: NTIS HC A04/MF A01

Basic considerations for establishing system requirements for emergency electric power systems for physical security and special nuclear materials accountability operations are presented. Methods of supplying emergency power that are available at present and methods predicted to be available in the future are discussed. The characteristics of capacity, cost, safety, reliability and environmental and physical facility considerations of emergency electric power techniques are presented. Considerations for the development of a system concept and the preparation of a detailed system design are included. ERA

N78-25342# Stanford Univ., Calif. Edward L. Ginzton Library.

SUPERCONDUCTING POWER TRANSMISSION LINE MATERIALS RESEARCH AND CONDUCTOR DEVELOPMENT Final Report

T. H. Geballe and M. R. Beasley Jul. 1977 96 p refs

(Contract EY-76-S-03-0326)

(SAN/0326-1) Avail: NTIS HC A05/MF A01

The feasibility of transferring the conductor technology developed on tubes to more practical tape conductors was investigated and studies aimed at improving the basic understanding of the important superconducting properties crucial to superconducting power transmission line (SPTL) applications were continued. The major objectives were: to produce one to three meter long tapes of multi-layered prototype Nb₃Sn tape conductors based on the results obtained earlier on tubular

conductors. Also to measure the electrical characteristics of these conductors at 4.2 K; to study the dynamics of the flux penetration process in superconductors at low fields; to study and attempt to improve the stability of SPTL conductors; to investigate codeposited third element depositions using electron beam coevaporation as an alternative to layering to achieve growth morphologies conducive to strong flux pinning; and to complete dielectric studies. ERA

N78-25376# Battelle Columbus Labs., Ohio.
STUDY OF HEAT TRANSFER THROUGH REFRACTORY LINED GASIFIER VESSEL WALLS Quarterly Progress Report, Jun. - Aug. 1977

J. R. Schorr, Aug. 1977, 48 p refs
 (Contract EX-76-C-01-2210)

(FE-2210-20) Avail: NTIS HC A03/MF A01

The objective of this program is to develop an empirically derived computer model suitable for use by the vessel designer to determine heat flow through multicomponent, refractory-lined gasifier vessel walls, so that the effects of parameters such as lining thickness, density, refractory composition, physical form, metal anchor spacing and configuration, and gas pressure and composition can be predicted. The program includes the design, construction, and operation of test apparatus for evaluating the parameters which influence heat flow through refractory lining materials. ERA

N78-25382# National Technical Information Service, Springfield, Va.

HEAT PIPES, VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1974 - Mar. 1977

William E. Reed, Mar. 1978, 225 p
 (NTIS/PS-78/0303) Copyright. Avail: NTIS
 HC \$28.00/MF \$28.00 CSCL 20D

Research reports covering the thermodynamics, design, fabrication, and applications of heat pipes are cited from worldwide literature. Applications are described in the areas of electronics cooling, spacecraft thermal control, heat exchangers, heating and refrigeration, and waste heat utilization. This updated bibliography contains 216 abstracts, none of which is a new entry to the previous edition. Author

N78-25383# National Technical Information Service, Springfield, Va.

HEAT PIPES, VOLUME 3. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, Apr. 1977 - Mar. 1978

William E. Reed, Mar. 1978, 140 p Supersedes NTIS/PS-77/0276; NTIS/PS-76/0251
 (NTIS/PS-78/0304; NTIS/PS-77/0276; NTIS/PS-76/0251)
 Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 20D

Research reports covering the thermodynamics, design, fabrication, and applications of heat pipes are cited from worldwide literature. Applications are described in the areas of electronics cooling, spacecraft thermal control, heat exchangers, heating and refrigeration, and waste heat utilization. This updated bibliography contains 131 abstracts, all of which are new entries to the previous edition. Author

N78-25384# National Technical Information Service, Springfield, Va.

HEAT PIPES, VOLUME 3. CITATIONS FROM THE NTIS DATA BASE Progress Report, Mar. 1976 - Mar. 1978

William E. Reed, Mar. 1978, 177 p Supersedes NTIS/PS-77/0275; NTIS/PS-76/0249; NTIS/PS-75/317
 (NTIS/PS-78/0302; NTIS/PS-77/0275; NTIS/PS-76/0249; NTIS/PS-75/317) Copyright. Avail: NTIS
 HC \$28.00/MF \$28.00 CSCL 20D

The theory, design, fabrication, testing, and operation of heat pipes are discussed in these federally-sponsored research reports. Applications are described in the areas of heating and air conditioning power generation, electronics cooling, spacecraft, nuclear reactors, cooling engines, and thermodynamics. This updated bibliography contains 170 abstracts, 83 of which are new entries to the previous edition. Author

N78-25434# Transport and Road Research Lab., Crowthorne (England).

ENERGY LOSSES IN HEAVY COMMERCIAL VEHICLES

T. Williams, 1977, 52 p refs
 (PB-277354; TRRL-Suppl-329) Avail: NTIS HC A04/MF A01
 CSCL 13F

This report examines the factors affecting the fuel consumption of heavy commercial vehicles. It covers power loss in the engine, tires, vehicle warm-up, and aerodynamic shaping. GRA

N78-25439# Mechanical Technology, Inc., Latham, N. Y.
DESIGN STUDY FOR HIGH-PRESSURE HIGH-FLOW OXYGEN CENTRIFUGAL COMPRESSOR, PHASE 1 Final Report

D. G. Dominy, Dec. 1976, 258 p refs
 (Contract EX-76-C-01-2366)

(MTI-77TR17) Avail: NTIS HC A12/MF A01

Activities are reported in a program to produce a conceptual design for an oxygen centrifugal compressor which will satisfy the flow rate and pressure requirements for commercial size coal gasification plants. Program results show that the basic engineering technologies for aerothermodynamic and mechanical design together with stress analysis, bearing technology, etc., exist now and has existed for many years for the construction of large flow, high-pressure centrifugal compressors. A fundamental requirement for any compressor flowing hazardous or non-hazardous gas is a good sound mechanical design reflecting the best facets of the mechanical designs art unhindered by cost restrictions. The mechanical design and control system must protect the compressor as much as possible against human error in any form. ERA

N78-25442# Curtiss-Wright Corp., Wood-Ridge, N. J.
HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM. PHASE 1: COMBINED CYCLE ELECTRIC POWER PLANT WITH COAL DERIVED LOW BTU GAS OR COAL-LIQUID FUEL, BOOK 2 Final Report

May 1977, 155 p refs
 (Contract EY-76-C-01-2291)

(FE-2291-18-Bk-2) Avail: NTIS HC A08/MF A01

The overall objective of the ERDA High Temperature Turbine Technology program is to develop a high temperature turbine subsystem capable of operating in an environmentally acceptable manner on a coal-derived low BTU gas or on a coal-derived liquid fuel at inlet temperatures of from 2600 to 3000 F. The Phase 1 objective was to define the systems and the development efforts required during Phase 2 (Technology Testing and Support Studies) and the Phase 3 (Verification Test Program) to bring these systems to technology readiness. Conceptual designs of commercial combined/cycle plants utilizing the coal-fueled high temperature turbine system were part of the Phase 1 effort. Selection of the turbine cooling concept and design definition of the high temperature turbine subsystem were also established. This volume contains information on the preliminary design of the three low-BTU gas combustors; low BTU combustor technology development plan; program plans for Phase 2 and Phase 3; research and technology requirements; and reliability including failure mode analysis. ERA

N78-25443# Department of Energy, Morgantown, W. Va. Energy Research Center.

HIGH PRESSURE ROTARY PISTON COAL FEEDER

John F. Gardner, H. T. Gencsoy (West Va. Univ., Morgantown), and Donald C. Strimbeck, Dec. 1977, 12 p
 (MERC/SP-77/6) Avail: NTIS HC A02/MF A01

A coal feeder with discharge capabilities of 1500 psig and 350 F was designed and described. The feeder consists of a rotating disk in a cylindrical feed chamber containing a reciprocating piston. The piston seals the feed chamber after the coal is dumped into a reactor vessel so that there is no loss of gas from the reactor. These are the only moving parts in the feeder, and their rugged construction should present minimum wear problems. The feeder is designed for 1200 pounds per hour, operating at 30 rpm. The compact design makes it possible to use more than one feeder in parallel to get higher coal feed rates. Higher values of rotational speed could also

increase the feed capacity. The drive requirement of a single unit at 30 rpm is 5.3 horsepower. ERA

N78-25484 World Meteorological Organization, Geneva (Switzerland).

METEOROLOGICAL ASPECTS OF LOCAL AND URBAN AIR POLLUTION WITH SPECIAL CONSIDERATION OF ENERGY PRODUCTION AND CONSUMPTION

J. M. Giovannoni and A. Junod *In its Educ. and Training in Meteorol. Aspects of Atmospheric Pollution and Related Environ. Probl.* 1977 p 157-193 refs

Copyright. HC A17/MF A01; WMO, Geneva, Sw. Fr. 40

Two case studies serving to document points for a syllabus for the training of air pollution meteorologists are presented in addition to general remarks and discussions about topics regarding educational requirements. The case studies present problems of urban air pollution in Lausanne (Switzerland) due to district heating and electricity producing thermal plants, and the dispersion of fluorine from an aluminum plant in rural Martigny (Switzerland). ERA

N78-25510# Gary Operating Co., Englewood, Colo.
PILOT DEMONSTRATION-ENHANCED OIL RECOVERY BY MICELLAR-POLYMER WATERFLOODING BELL CREEK FIELD Monthly Technical Progress Report, Aug. 1977

10 Sep. 1977 22 p refs
(Contract EX-76-C-01-2237)

(COO-4207-14; MTPR-14) Avail: NTIS HC A02/MF A01

This fourteenth Monthly Technical Progress Report describes tasks for: Micellar-polymer systems selection and evaluation; site development; pilot performance predictions, and fluid distribution facilities. The major activity at this time is Phase 2, Task 1, the Micellar-polymer systems selection as between two competing designs being developed. ERA

N78-25511# Tulsa Univ., Okla.
PULSE TEST ANALYSIS OF VERTICALLY FRACTURED WELLS M.S. Thesis. Final Report, 1 Feb. 1976 - 30 Jun. 1977

R. Raghaven 1977 214 p refs
(Contract EY-76-S-21-8036)

(ORO-8036-5) Avail: NTIS HC A10/MF A01

Generalized correlations are presented whereby an engineer may easily analyze and/or design pulse tests in fractured wells from pulse tests. The results of the study can be used to obtain the compass orientation of a vertical fracture as well as the degree of reservoir anisotropy by pulse tests provided the formation permeability and fracture half-length are known. These two parameters may be easily obtained from a pressure test at the fractured well by type curve matching. This pressure test may be conducted subsequent to the pulse test or during the pulse test. If the formation permeability is known, then the results may be used to determine fracture half-length and compass orientation. Procedures to obtain the desired results are discussed in an example. The results can also be used to design pulse tests. Conditions necessary to insure that the response obtained is maximum are described. ERA

N78-25512# Brandywine Associates, Bellport, N. Y.
LAND USE CONFIGURATIONS AND THE UTILIZATION OF DISTRIBUTED ENERGY TECHNOLOGY Final Report

30 Sep. 1977 64 p refs
(Contract W-7405-eng-48)

(UCRL-13773) Avail: NTIS HC A04/MF A01

The feasibility of future development is considered in which energy systems utilizing distributed technologies are employed to meet state energy demands. Distributed technologies were defined as favoring the use of renewable, small scale energy support systems. Land use was viewed both as a factor which limits the use of such systems and as providing a set of institutional mechanisms for aiding their utilization. Land use was treated in the context of development on a community and regional scale to take place over a period of approximately 50 years. ERA

N78-25513# Booz-Allen and Hamilton, Inc., Bethesda, Md.
Development Research Div.

INTERACTION OF LAND-USE PATTERNS AND RESIDENTIAL ENERGY CONSERVATION

25 May 1977 212 p refs Sponsored in part by DOE and FEA

(TID-28058) Avail: NTIS HC A10/MF A01

The purpose of this report to evaluate the relationships between land-use patterns, energy consumption, and public land use policies is studied. The major objectives of the research program are to: (1) provide empirical data on energy consumption for various configurations of single- and multi-family residential units in relation to their location within an urban area; (2) evaluate the potential short term public land use policy options and their subsequent savings in energy consumption; and (3) identify and prioritize future data and research needs in the fields of land use and energy consumption relationships within urbanized areas. Primary energy consumption data were collected for 4 neighborhoods each in the SMSA's of Tucson, Washington, D.C., and Chicago. ERA

N78-25514# Gruy Federal, Inc., Arlington, Va.
OIL AND GAS REPLACEMENT COST: DEVELOPMENT AND PRODUCTION. VOLUME 1: DISCUSSION OF METHODOLOGY, EXHIBITS, AND PROJECTIONS Final Report

5 Aug. 1977 101 p

(Contract FEA-CR-05-60813-00)

(TID-28043/1) Avail: NTIS HC A06/MF A01

The development and production costs by region and well depth interval were projected for the benchmark years 1980, 1985, and 1990. The identification and collection of reliable and consistent historical series disaggregate to these levels are considered essential to the generation of accurate and viable forecasts of replacement costs for oil and gas production systems. Twenty-four geographical regions were specified and six depth classes. A clear delineation is drawn between the cost of drilling and completing development wells and the cost of operating producing wells. Development well costs are projected on a cost per foot basis. Operating costs of producing wells are projected on a cost per month basis. ERA

N78-25515# Gruy Federal, Inc., Arlington, Va.
OIL AND GAS REPLACEMENT COST: DEVELOPMENT AND PRODUCTION. VOLUME 2: EXHIBITS Final Report

5 Aug. 1977 294 p

(Contract FEA-CR-05-60813-00)

(TID-28043/2) Avail: NTIS HC A13/MF A01

Data tables are presented relative to the replacement cost of petroleum and natural gas in the USA for the benchmark years 1980, 1985, and 1990. ERA

N78-25518# Indiana Univ., Bloomington.
CARBONACEOUS SHALES OF INDIANA AS SOURCES OF ENERGY, PETROCHEMICALS, AND CERAMIC MATERIALS Quarterly Technical Progress Report, Oct. - Dec. 1977

1977 11 p

(Contract EY-76-C-05-5204)

(TID-28179) Avail: NTIS HC A02/MF A01

Activities during the report period include selection of drill site locations and compilation of three west-to-east cross sections of the New Albany shale equivalents in the Michigan basin. Work is also reported on isopach maps of lithologic units in the New Albany shale interval. ERA

N78-25519# City of Long Beach, Calif.
PILOT DEMONSTRATION OF ENHANCED OIL RECOVERY BY MICELLAR POLYMER WATERFLOODING, PHASE B Quarterly Report, 1977

James E. Wade and H. L. Staub 24 Oct. 1977 16 p

(Contract EF-77-C-03-1395)

(SAN/1395-14; QR-3) Avail: NTIS HC A02/MF A01

A field test to demonstrate an improved oil recovery process which will displace economic quantities of otherwise non-recoverable viscous oil from the Wilmington oil field, as well as to determine its suitability for application to other sites is

presented. Favorable preliminary results on core-flood tests were obtained using a sulfonate formulated from Wilmington crude oil. ERA

N78-25526# National Academy of Sciences - National Research Council, Washington, D. C. Commission on Natural Resources. **OCS OIL AND GAS: AN ASSESSMENT OF THE DEPARTMENT OF THE INTERIOR ENVIRONMENTAL STUDIES PROGRAM**

18 Feb. 1978 119 p refs
(Contract DI-AA550-CT6-30)
(PB-277493) Avail: NTIS HC A06/MF A01 CSCL 08G
The concepts, procedures, and results of the Department of Interior Environmental Studies Program were examined in order to provide an evaluation and some recommendations that the Department could use as a basis for improvement of the program. The program and the actual or potential use of the results. GRA

N78-25527* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SOLAR CELL COLLECTOR Patent
John C. Evans, Jr., inventor (to NASA) Issued 4 Apr. 1978
5 p Filed 22 Feb. 1977 Supersedes N77-17564 (15 - 08, p 1052)

(NASA-Case-LEW-12552-1; US-Patent-4,082,569;
US-Patent-Appl-SN-770869; US-Patent-Class-136-89CC;
US-Patent-Class-357-30; US-Patent-Class-357-65;
US-Patent-Class-357-67; US-Patent-Class-29-572;
US-Patent-Class-427-75; US-Patent-Class-427-261) Avail: US Patent Office CSCL 10A

A method is provided for the fabrication of a photovoltaic device which possesses an efficient collector system for the conduction of the current generated by incident photons to the external circuitry of the device.

Official Gazette of the U.S. Patent Office

N78-25529* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

METHOD FOR PRODUCING SOLAR ENERGY PANELS BY AUTOMATION Patent

John C. Evans, Jr., inventor (to NASA) Issued 18 Apr. 1978
11 p Filed 25 Apr. 1977 Supersedes N77-22615 (15 - 13, p 1744)

(NASA-Case-LEW-12541-1; US-Patent-4,084,985;
US-Patent-Appl-SN-790637; US-Patent-Class-136-89P;
US-Patent-Class-29-572; US-Patent-Class-136-89H;
US-Patent-Class-136-89CC; US-Patent-Class-156-633) Avail: US Patent Office CSCL 10A

A solar cell panel was fabricated by photoetching a pattern of collector grid systems with appropriate interconnections and bus bar tabs into a glass or plastic sheet. These regions were then filled with a first, thin conductive metal film followed by a layer of a mixed metal oxide, such as InAsO or InSnO. The multiplicity of solar cells were bonded between the protective sheet at the sites of the collector grid systems and a back electrode substrate by conductive metal filled epoxy to complete the fabrication of an integrated solar panel.

Official Gazette of the U.S. Patent Office

N78-25530* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INORGANIC-ORGANIC SEPARATORS FOR ALKALINE BATTERIES Patent

Dean W. Sheibley, inventor (to NASA) Issued 18 Apr. 1978
4 p Filed 7 Sep. 1976 Supersedes N76-31674 (14 - 22, p 2890)

(NASA-Case-LEW-12649-1; US-Patent-4,085,241;
US-Patent-Appl-SN-720521; US-Patent-Class-427-385B;
US-Patent-Class-427-385C; US-Patent-Class-429-254) Avail: US Patent Office CSCL 10C

A flexible separator is reported for use between the electrodes of Ni-Cd and Ni-Zn batteries using alkaline electrolytes. The

separator was made by coating a porous substrate with a battery separator composition. The coating material included a rubber-based resin copolymer, a plasticizer and inorganic and organic fillers which comprised 55% by volume or less of the coating as finally dried. One or more of the filler materials, whether organic or inorganic, is preferably active with the alkaline electrolyte to produce pores in the separator coating. The plasticizer was an organic material which is hydrolyzed by the alkaline electrolyte to improve conductivity of the separator coating. Official Gazette of the U.S. Patent Office

N78-25532*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **PROCEEDINGS OF THE DOE CHEMICAL ENERGY STORAGE AND HYDROGEN ENERGY SYSTEMS CONTRACTS REVIEW**

James H. Kelley 15 Feb. 1978 296 p refs Meeting held at Hunt Valley, Md., 16-17 Nov. 1977
(Contracts NAS7-100; EC-77-A-31-1035)
(NASA-CR-157164; JPL-Pub-78-1) Avail: NTIS HC A13/MF A01 CSCL 10C

The background and objectives of thirty-nine hydrogen-related tasks were discussed, the status of the studies or technical effort is shown, and state projected solutions for resolving the identified problems are projected. Author

N78-25533*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **COAL DESULFURIZATION BY LOW TEMPERATURE CHLORINOLYSIS, PHASE 1 Final Report, 6 Jul. - 6 Nov. 1977**

John J. Kalvinskis, George C. Hsu, John B. Ernest, Duane F. Andress, and Donald R. Feller 23 Nov. 1977 105 p refs Sponsored in part by DOE

(Contract NAS7-100)
(NASA-CR-157172; JPL-Pub-78-8) Avail: NTIS HC A06/MF A01 CSCL 21D

The reported activity covers laboratory scale experiments on twelve bituminous, sub-bituminous and lignite coals, and preliminary design and specifications for bench-scale and mini-pilot plant equipment. Author

N78-25535*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **PROCESS HEAT IN CALIFORNIA: APPLICATIONS AND POTENTIAL FOR SOLAR ENERGY IN THE INDUSTRIAL, AGRICULTURAL AND COMMERCIAL SECTORS**

Rosalyn H. Barbieri, Ralph E. Bartera, E. S. Davis, George E. Hlavka, Donna S. Pivrotto, and Gilbert Yanow Mar. 1978 105 p refs Sponsored in part by Calif. Energy Resources Conservation and Develop. Comm.

(Contract NAS7-100)
(NASA-CR-157169; JPL-Pub-78-33) Avail: NTIS HC A06/MF A01 CSCL 10A

A summary of the results of a survey of potential applications of solar energy for supplying process heat requirements in the industrial, agricultural, and commercial sectors of California is presented. Technical, economic, and institutional characteristics of the three sectors are examined. Specific applications for solar energy are then discussed. Finally, implications for California energy policy are discussed along with recommendations for possible actions by the State of California. Author

N78-25536*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **POTENTIAL FOR COGENERATION OF HEAT AND ELECTRICITY IN CALIFORNIA INDUSTRY, PHASE 1 Final Report**

H. S. Davis, R. M. Gurfield, V. C. Moretti, and M. L. Slonski 1 May 1978 179 p Sponsored in part by Calif. Energy Resources Conserv. and Develop. Comm.

(Contract NAS7-100)
(NASA-CR-157168; JPL-Pub-78-42) Avail: NTIS HC A09/MF A01 CSCL 10B

Information collected during an industrial survey of 12 selected plants was organized into four categories: technical, economic,

N78-25537

environmental, and institutional. The technical aspects of industrial cogeneration are examined on a site-specific basis. The site-specific economics, environmental constraints, and institutional barriers that impact industrial cogeneration will be further investigated. Author

N78-25537*# General Electric Co., Philadelphia, Pa. Space Div.

PROTOTYPE SOLAR HEATING AND COMBINED HEATING AND COOLING SYSTEMS Quarterly Report, Jul. - Sep. 1976

1 Oct. 1976 116 p Prepared for DoE
(Contract NAS8-32092)
(NASA-CR-150686) Avail: NTIS HC A06/MF A01 CSCL 10A

Eight prototype solar heating and combined heating and cooling systems are considered. This effort includes development, manufacture, test, installation, maintenance, problem resolution, and performance evaluation. Author

N78-25538*# General Electric Co., Philadelphia, Pa. Space Div.

PROTOTYPE SOLAR HEATING AND COMBINED HEATING AND COOLING SYSTEMS Quarterly Report, Oct. - Dec. 1976

1 Jan. 1977 118 p Prepared for DoE
(Contract NAS8-32092)
(NASA-CR-150687) Avail: NTIS HC A06/MF A01 CSCL 10A
For abstract, see N78-25537.

N78-25539*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

HARDWARE PROBLEMS ENCOUNTERED IN SOLAR HEATING AND COOLING SYSTEMS

Mitchell Cash May 1978 42 p Prepared for DoE
(NASA-TM-78172) Avail: NTIS HC A03/MF A01 CSCL 10A

Numerous problems in the design, production, installation, and operation of solar energy systems are discussed. Described are hardware problems, which range from simple to obscure and complex, and their resolution. Author

N78-25540*# General Electric Co., Philadelphia, Pa. Space Div.

PROTOTYPE SOLAR HEATING AND COMBINED HEATING AND COOLING SYSTEMS Quarterly Report, Jan. - Mar. 1977

1 Apr. 1977 188 p Prepared for DoE
(Contract NAS8-32092)
(NASA-CR-150691; QR-3) Avail: NTIS HC A09/MF A01 CSCL 10A

System analysis activities were directed toward refining the heating system parameters. Trade studies were performed to support hardware selections for all systems and for the heating only operational test sites in particular. The heating system qualification tests were supported by predicting qualification test component performance prior to conducting the test. Author

N78-25541*# General Electric Co., Philadelphia, Pa. Space Div.

PROTOTYPE SOLAR HEATING AND COMBINED HEATING AND COOLING SYSTEMS Quarterly Report, Apr. - Jun. 1977

1 Jul. 1977 75 p Prepared for DoE
(Contract NAS8-32092)
(NASA-CR-150692; QR-4) Avail: NTIS HC A04/MF A01 CSCL 10A

Eight prototype solar heating and combined heating and cooling systems are being developed. The effort includes development, manufacture, test, installation, maintenance, problem resolution, and performance evaluation. Author

N78-25542*# General Electric Co., Philadelphia, Pa. Space Div.

PROTOTYPE SOLAR HEATING AND COMBINED HEATING AND COOLING SYSTEMS Quarterly Report, Jul. 1977 - Sep. 1977

3 Oct. 1977 69 p Prepared for DoE
(Contract NAS8-32092)

(NASA-CR-150693; QR-5) Avail: NTIS HC A04/MF A01 CSCL 10A

Schedules and technical progress in the development of eight prototype solar heating and combined solar heating and cooling systems are reported. Particular emphasis is given to the analysis and preliminary design for the cooling subsystem, and the setup and testing of a horizontal thermal energy storage tank configuration and collector shroud evaluation. Author

N78-25543*# General Electric Co., Philadelphia, Pa. Space Div.

PROTOTYPE SOLAR HEATING AND COMBINED HEATING AND COOLING SYSTEMS Quarterly Report, Oct. - Dec. 1977

6 Jan. 1978 41 p Prepared for DoE
(Contract NAS8-32092)
(NASA-CR-150694; QR-6) Avail: NTIS HC A03/MF A01 CSCL 10A

Designs were completed, hardware was received, and hardware was shipped to two sites. A change was made in the heat pump working fluid. Problem investigation of shroud coatings for the collector received emphasis. Author

N78-25545*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

PROGRESS ON COAL-DERIVED FUELS FOR AVIATION SYSTEMS

Robert D. Witcofski May 1978 27 p refs Presented at CTOL Transport Technol. Conf., Hampton, Va., 28 Feb. - 3 Mar. 1978. Published in NASA-CR-2036
(NASA-CR-78696; L-12275) Avail: NTIS HC A03/MF A01 CSCL 21D

Synthetic aviation kerosene (Syn. Jet-A), liquid methane (LCH₄), and liquid hydrogen (LH₂) appear to be the most promising coal-derived fuels. Liquid hydrogen aircraft configurations, their fuel systems, and their ground requirements at the airport are identified. These aircraft appear viable, particularly for long haul use, where aircraft fueled with coal derived LH₂ would consume 9 percent less coal resources than would aircraft fueled with coal derived Syn. Jet-A. Distribution of hydrogen from the point of manufacture to airports may pose problems. Synthetic JET-A would appear to cause fewer concerns to the air transportation industry. Of the three candidate fuels, LCH₄ is the most energy efficient to produce, and an aircraft fueled with coal-derived LCH₄ may provide both the most efficient utilization of coal resources and the least expensive ticket as well. Author

N78-25546*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

DESIGN AND OPERATION OF A SOLAR HEATING AND COOLING SYSTEM FOR A RESIDENTIAL SIZE BUILDING J. W. Littles, W. R. Humphries, and J. C. Cody May 1978 35 p Prepared for DOE

(NASA-TM-78169) Avail: NTIS HC A03/MF A01 CSCL 10A

The first year of operation of solar house is discussed. Selected design information, together with a brief system description is included. The house was equipped with an integrated solar heating and cooling system which uses fully automated state-of-the-art. Evaluation of the data indicate that the solar house heating and cooling system is capable of supplying nearly 100 percent of the thermal energy required for heating and approximately 50 percent of the thermal energy required to operate the absorption cycle air conditioner. Author

N78-25547*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.

INDOOR TEST FOR THERMAL PERFORMANCE EVALUATION ON LIFE SCIENCES ENGINEERING (AIR) SOLAR COLLECTOR

Feb. 1978 33 p Sponsored by DOE Prepared for IBM Fed. Systems Div., Huntsville, Ala.
(Contract NAS8-32036)

(NASA-CR-150665; WYLE-TR-531-18) Avail: NTIS

HC A03/MF A01 CSCL 10A

The test procedure used and the results obtained from an evaluation test program conducted to obtain thermal performance data on a life sciences double-glazed air solar collector under simulated conditions is discussed. These tests were made using the Marshall Space Flight Center's solar simulator. A time constant test and incident angle modifier test were also conducted to determine the transient effect and the incident angle effect on the collector. These results and the results of the collector load test are also discussed. Author

N78-25548* Solar Engineering and Equipment Co., Metairie, La.

DESIGN DATA BROCHURE: SOLAR HOT AIR HEATER

May 1978 30 p Prepared for DOE

(Contract NAS8-32347)

(NASA-CR-150697) Avail: NTIS HC A03/MF A01 CSCL 10A

The design, installation, performance, and application of a solar hot air heater for residential, commercial and industrial use is reported. The system has been installed at the Concho Indian School in El Reno, Oklahoma. Author

N78-25549* Houston Chemical Co., Pittsburgh, Pa.

PRELIMINARY DESIGN PACKAGE FOR NONCORROSIVE FLUID SUBSYSTEM, SOLAR HEATING AND COOLING

May 1978 24 p Prepared for DOE

(Contract NAS8-32255)

(NASA-CR-150698) Avail: NTIS HC A02/MF A01 CSCL 10A

The preliminary evaluation includes drawings for subsystem definition, rationale for special handling, installation and maintenance tools, and an outline for hazard analysis, along with development and testing plans. Author

N78-25550* Owens-Illinois, Inc., Toledo, Ohio.

DEVELOPMENT OF PROTOTYPE AIR/LIQUID SOLAR COLLECTOR SUBSYSTEM Quarterly Report, 1 Feb. - 30 Apr. 1978

May 1978 7 p Prepared for DOE

(Contract NAS8-32259)

(NASA-CR-150703; QR-6) Avail: NTIS HC A02/MF A01 CSCL 10A

Testing of the evacuated tubular air collector in conjunction with air/liquid heat exchange and liquid storage elements was completed. Test results, emphasize matching of heat exchanger and collector characteristics with specific attention to the dynamic response of each of the elements. Author

N78-25551* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PHOTON DEGRADATION EFFECTS IN TERRESTRIAL SOLAR CELLS

V. G. Weizer, H. W. Brandhorst, Jr., J. D. Broder, R. E. Hart, and S. H. Lamneck 1978 14 p refs Presented at the 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by IEEE

(Contract E(49-26)-1022)

(NASA-TM-78924; DOE/NASA/1022-78/35; E-9684) Avail: NTIS HC A02/MF A01 CSCL 10A

Reduction in cell output was observed in $N(+)/P$ cells upon exposure to illumination or upon the application of a sufficiently high forward bias. Conversely, an enhancement in output was observed when $P(+)/N$ cells were illuminated. Investigations performed on $N(+)/P$ cells indicated that a recombination center located at $E_{sub} c - 0.37$ eV in the forbidden band was responsible for the loss in output. The center was electrically inactive in its ground state but was activated either by raising the minority carrier quasi-Fermi level sufficiently close to the latent center energy level in the band gap, or by direct excitation of electrons from the valence band to the latent center level. The center was identified as a complex of a lattice defect and a silver atom or cluster of atoms. Author

N78-25552* IBM Federal Systems Div., Huntsville, Ala.

DESIGN DATA BROCHURE: SIMS PROTOTYPE SYSTEM 3

30 May 1978 43 p Prepared for DOE

(Contract NAS8-32036)

(NASA-CR-150707; IBM-78W-0005)

Avail: NTIS

HC A03/MF A01 CSCL 10A

A closed hydronic solar system is reported for space and hot water heating. Design, performance, and hardware specifications are presented sufficient for architectural engineers and contractors to procure, install, operate, and maintain a similar solar application. Author

N78-25553* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SOLAR CELL SYSTEM HAVING ALTERNATING CURRENT OUTPUT Patent Application

J. C. Evans, Jr., inventor (to NASA) Filed 9 Jun. 1978 11 p

(NASA-Case-LEW-12806-1; US-Patent-Appl-SN-915050) Avail:

NTIS HC A02/MF A01 CSCL 10A

A P-N junction solar cell modified by fabricating an integrated circuit inverter on the back of the cell to produce a device capable of generating an alternating current output was developed. In another embodiment, integrated circuit power conditioning electronics is incorporated in a module containing a solar cell power supply. NASA

N78-25557* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

STAINLESS STEEL PANEL FOR SELECTIVE ABSORPTION OF SOLAR ENERGY AND THE METHOD OF PRODUCING SAID PANEL Patent Application

Marion L. Roberts, Max H. Sharpe, and Albert C. Krupnick, inventors (to NASA) Filed 30 May 1978 23 p

(NASA-Case-MFS-23518-3; US-Patent-Appl-SN-910793) Avail:

NTIS HC A02/MF A01 CSCL 10A

A composite panel is reported that contains a coated metal substrate which absorbs solar energy selectively. The panel consisted either of an aluminum substrate with zinc and nickel layers and an outer coating of nickel oxide, or a copper substrate with nickel and nickel oxide layers. NASA

N78-25559* National Aeronautics and Space Administration, Pasadena Office, Calif.

LOW COST SOLAR ENERGY COLLECTION SYSTEM Patent Application

Charles G. Miller (JPL) and James B. Stephens, inventors (to NASA) (JPL) Filed 15 May 1978 23 p

(Contract NAS7-100)

(NASA-Case-NPO-13579-4; US-Patent-Appl-SN-906297) Avail:

NTIS HC A02/MF A01 CSCL 10A

A fixed, linear, ground based primary reflector was designed for use in a tracking solar energy collection system. The primary reflector was constructed at ground level by slip forming in concrete or stabilized dirt a trough with a segmented one dimensional circular cross section profile. This profile was covered with an inexpensive light-reflective material. The axis of the primary reflector was optimally aligned with respect to the sun path in the area. NASA

N78-25560* National Aeronautics and Space Administration, Pasadena Office, Calif.

A SOLAR ARRAY STRIP AND A METHOD FOR FORMING THE SAME Patent Application

Robert L. Mueller (JPL) and Robert K. Yasui, inventors (to NASA) (JPL) Filed 29 Mar. 1978 15 p

(Contract NAS7-100)

(NASA-Case-NPO-13652-3; US-Patent-Appl-SN-891358) Avail:

NTIS HC A02/MF A01 CSCL 10A

A method is provided for forming a flexible solar array strip adapted for storage in a helically wound roll. The method is applicable to automated production techniques where a continuous solar arrays strip may be used economically in converting solar flux to electrical energy. NASA

N78-25562# UOP, Inc. Des Plaines, Ill.

OPTIMIZATION OF PtDOPE KOCITE: ELECTRODES IN H3PO4 FUEL CELLS Interim Progress Report, 30 Mar. - 30 Dec. 1977

L. B. Welsh and R. W. Leyerle Jan. 1978 47 p refs
(Contract DAAG53-76-C-0014; DA Proj. 1G7-62708-AH-67)
(AD-A053300; IPR-4) Avail: NTIS HC A03/MF A02 CSCI 10/2

The use of Kocite(Trade Name) electrocatalysts as low-cost air and/or fuel electrocatalysts in phosphoric acid electrolyte fuel cells is being optimized with respect to some of the electrocatalyst and electrode structure parameters. Kocite electrocatalysts are made from Kocite materials, which are composite structures consisting of pyropolymers chemically bonded to refractory substrates. Fuel cell electrodes are fabricated from these electrocatalysts and normally tested as anodes or cathodes in model fuel cells with standard platinum-black counter electrodes. GRA

N78-25564# Oak Ridge National Lab., Tenn.

CENTRAL HEATING: PACKAGE BOILERS

Ebrahim Farahan May 1977 87 p refs Prepared for Argonne Natl. Lab., Ill.
(Contract W-31-109-eng-38)

(ANL/CES/TE-77-6) Avail: NTIS HC A05/MF A01

Performance and cost data for electrical and fossil-fired package boilers currently available from manufacturers are provided. Performance characteristics investigated include: unit efficiency, rated capacity, and average expected lifetime of units. Costs are tabulated for equipment and installation of various package boilers. The information supplied in this report will simplify the process of selecting package boilers required for industrial, commercial, and residential applications. ERA

N78-25565# Boeing Co., Seattle, Wash.

CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM PILOT PLANT PRELIMINARY DESIGN REPORT. VOLUME 3: COLLECTOR SUBSYSTEM

29 Apr. 1977 202 p refs

(Contract EY-76-C-03-1111)

(SAN/1111-8/2) Avail: NTIS HC A10/MF A01

A preliminary design of the collector (heliostat) subsystem for a 10 MW/sub e/ Solar Pilot Plant is presented. The collector subsystem concept, operating with a central receiver installation, is shown. In this concept, circular membrane reflectors formed with aluminized polyester film, direct sunlight to the central receiver. Transparent air-support Tedlar enclosures protect the lightweight reflectors from the environment. Reflectors are individually aimed with a 2 axis gimbal, driven by digital-controlled stepper motors. Minicomputers, located at the central control facility, provide signals to the stepper motors. Field geometry, performance, and cost analyses have resulted in specification of 1650 heliostats, to provide 42 MW/sub th/ to a cylindrical receiver at solar noon on the equinox. Overall efficiency of the heliostat field is 54.5 percent at the design point. Components, materials, and large scale hardware were developed and tested. ERA

N78-25566# Aerodyne Research, Inc., Bedford, Mass.

CHARACTERIZATION OF OPEN-CYCLE COAL-FIRED MHD GENERATORS, REVISION A Quarterly Technical Summary Report No. 4, 1 Apr. - 30 Jun. 1977

C. E. Kolb, V. Yousefian, J. Wormhoudt, M. Martinez-Sanchez, and J. L. Kerrebrock 15 Jul. 1977 90 p refs

(Contract EX-76-C-01-2478)

(FE-2478-4-Rev-A) Avail: NTIS HC A05/MF A01

Research progress on the effects of slags on the electron and alkali seed chemistry in a high temperature coal combustion system such as direct-fired MHD generators is reported. Problems studied include the formation of negative ions due to electron attachment processes in combustion flow, the role slag condensation may play in determining the electron density through recombination which adversely affects conductivity in the core flow, and the interaction of alkali seed with particles formed by slag condensation in the generator channel. Models will describe

the appropriate fluid mechanical conditions expected in direct fired MHD channels and will permit the calculation, through the appropriate chemical equilibrium or chemical kinetic equations, of the changes in negative ion, alkali and slag conditions as the fluid conditions change. A one-dimensional model of the fluid and MHD processes in the channel core flow has been completed. ERA

N78-25568# Argonne National Lab., Ill.

ANALYSIS OF A HIGH-TEMPERATURE COAL COMBUSTOR ACCORDING TO A ONE-DIMENSIONAL FLOW MODEL

P. M. Chung and R. S. Smith Oct. 1977 133 p refs

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

(ANL/MHD-77-2) Avail: NTIS HC A07/MF A01

A steady state, one-dimensional analysis for a high temperature coal combustor is presented. An existing solution of solid fuel ignition is employed to describe the ignition of the coal particles. A one-dimensional flow model with radiative heat loss is then constructed to describe the subsequent vaporization of ash and devolatilization, combustion, and gasification of the coal. Combustion is considered to take place either at a flame sheet in the diffusion layer surrounding each particle or at the particle surface. The combustion products are considered to be redistributed in the main gas stream of the combustor according to simplified chemical equilibrium criteria. A simplified devolatilization rate law is formulated, which incorporates in a tractable manner the various competing reactions within the coal particle. Data are presented for the variation of temperatures and mass fractions with position in the combustor and for the influence of various parameters on combustor performance. ERA

N78-25569# Acurex Corp., Mountain View, Calif. Aerotherm Div.

APPLICATION OF SOLAR ENERGY TO THE SUPPLY OF INDUSTRIAL PROCESS HOT WATER: PRELIMINARY DESIGN AND PERFORMANCE REPORT. VOLUME 1: TECHNICAL REPORT

14 Oct. 1976 167 p refs

(Contracts EY-76-C-03-1218; E(04-3)-1218)

(SAN/1218-3-Vol-1; TR-76-219-Vol-1)

Avail: NTIS

HC A08/MF A01

The design and performance of a solar hot water system for can washing are presented. The collector field is located on the roof of the finished products warehouse. Detail drawings and descriptions of the collector field, installation, piping, controls, data acquisition equipment, and roof structure are included. Furthermore, a program schedule with equipment and manpower costs for successfully completing Phase 2 of this contract is included. Also included is an organization chart of the Phase 2 program personnel. ERA

N78-25570# RAND Corp., Santa Monica, Calif.

NOBLE-GAS CLOSED-CYCLE SYSTEM OF MAGNETOHYDRODYNAMIC POWER GENERATION

R. Y. Pri and R. W. Hess Aug. 1977 94 p refs

(Contract EX-76-C-01-2261)

(R-2128-ERDA) Avail: NTIS HC A05/MF A01

The critical components of the closed cycle system, like those of the open cycle system, are the coal combustor, heat exchanger, MHD generator, seed recovery system, and power conditioning equipment. Although the components may be common, the technologies pacing the development of the two systems differ substantially. The current concept for the design of a closed cycle system calls for a regenerative heat exchanger in which the same refractory surface will come in contact with both the combustion gases and the working fluid. The heat exchanger must be designed to ensure a low enough level of contamination carry over and leakage to maintain the noble gas loop. The same type of heat exchanger used as the air preheater in an open cycle system presumably could tolerate greater leakage and contamination. ERA

N78-25571# Energy Research and Development Administration, Washington, D. C.

REPORT ON ERDA WORKSHOP WITH SOUTHEASTERN STATES AND CITIES ON IMPROVING COORDINATION IN ENERGY RD AND D ESPECIALLY FOR SOLAR PROGRAMS

1977 30 p Workshop held in Knoxville, Tenn., 7-8 Jul. 1977 (TID-27778) Avail: NTIS HC A03/MF A01

Issues and problems were identified and recommendations were made regarding ways to facilitate ERDA/State/City coordination and communication especially with regard to ERDA's solar energy RD and D program. Major recommendations resulting from the workshop are summarized. ERA

N78-25572# Seattle Dept. of Lighting, Wash.

OFFICE OF CONSERVATION Quarterly Report, Jul. - Sep. 1977

1977 161 p refs

(Contract EC-77-G-01-5097)

(TID-27998; QR-3) Avail: NTIS HC A08/MF A01

Progress in Seattle City Light's energy conservation program is reported. This program promoted electric power conservation in the industrial, commercial, and residential sector by performing energy audits on buildings, conducting energy conservation seminars, recommending educational and legislative programs for energy conservation, facilitating the purchase and certification of home insulation, providing educational displays, and sponsoring conservation research. It is claimed that electric power consumption for this area was reduced from projected consumption figures by 80 MW. ERA

N78-25573# Mechanical Technology, Inc., Latham, N. Y.

DESIGN, DEVELOP. AND MANUFACTURE PROCESS GAS LUBRICATED HOT RECYCLE GAS CIRCULATORS Final Technical Report

D. G. Dominy and J. D. Hurley Oct. 1976 150 p

(Contract EY-76-C-02-0004)

(COO-0004-1; MTI-77TR5) Avail: NTIS HC A07/MF A01

In the SYNTHANE coal gasification process raw product gas of approximately 35 mole % methane is passed through a methanator which increases the methane content (and heating value) to approximately 86 mole % methane. In order to limit the temperature rise of the reaction, high BTU methane process gas is diluted with raw product gas. A pressure increase is necessary to force the mixed gases back into the methanator. In addition, varying recycle ratios affect the total flow of the gas stream necessitating a compressor or other device to operate at varying flow capacities. The present hot gas recycle methanator system utilized an eductor to mix and raise the pressure of the product gas. This method has limitations. For commercial use a compressor is essential. ERA

N78-25575# Argonne National Lab., Ill.

LABORATORY SUPPORT FOR IN SITU GASIFICATION REACTION KINETICS Quarterly Report, Jan. - Mar. 1977

J. Fischer, J. E. Young, J. E. Johnson, D. C. Bowyer, and A. A. Jonke Jun. 1977 20 p refs

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

(ANL/CEN/FE-77-2) Avail: NTIS HC A02/MF A01

Support studies for the national endeavor on in-situ coal gasification are reported. The objective is to determine the reaction-controlling variables and reaction kinetics for gasification of chars resulting when coal is pyrolyzed in underground gasification. The reactions to be studied include steam-char, CO₂-char, H₂-char, and the water-gas shift reaction. Kinetic data related to the reaction of steam with Wyodak subbituminous coal are presented. The temperature dependence of the reaction, the apparent reaction order with respect to steam, and inhibitory effects of hydrogen are discussed. ERA

N78-25576# Oak Ridge National Lab., Tenn.

COAL-FIRED ALKALI METAL POWER SYSTEM DESIGN STUDY Quarterly Progress Report, 1 Apr. - 30 Jun. 1977

Garland Samuels Aug. 1977 32 p refs

(Contract W-7405-eng-26)

(ORNL-TM-6000; QPR-3) Avail: NTIS HC A03/MF A01

The report given is the third of a series of quarterly progress reports for the Coal-Fired Alkali Metal Power System Design Study. The effort during this quarter was devoted to the design and analysis of an atmospheric pressure fluidized bed furnace-boiler system for either cesium or potassium. The tasks receiving the most attention during this period were the selection and analysis of the basic plant arrangement, the design of the furnace-alkali metal boiler, and the analysis of the alkali metal condenser-steam boiler. ERA

N78-25578# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Chemistry.

IMPROVED CATHODES FOR PHOSPHORIC ACID FUEL CELLS Final Report

Ernest B. Yeager, P. Bindra, N. Doddapaneni, J. C. Huang, R. K. Sen, and J. Zagal Jun. 1977 91 p refs

(EPRI Proj. 634-1)

(EPRI-EM-505) Avail: NTIS HC A05/MF A01

Oxygen reduction was examined on a number of electrode surfaces with both rotating disk and gas fed electrodes. Particular emphasis was placed on transition metal monomeric and polymeric phthalocyanines. The iron and cobalt complexes have substantial activity for O₂ reduction but are still well short of that for Pt and have long-term stability problems in 85% H₃PO₄. The objectives of the project were broadened to include the identification and optimization of the factors which control O₂ reduction on platinum in phosphoric acid. Kinetic studies on Pt in purified 85% H₃PO₄ indicate O₂ reduction via two parallel mechanisms with the non-peroxide pathway predominant over the peroxide pathway. ERA

N78-25579# Chevron Research Co., Richmond, Calif.

CATALYTIC HYDROPROCESSING OF SHALE OIL TO PRODUCE DISTILLATE FUELS

R. F. Sullivan and B. E. Stangeland 1977 42 p refs Presented at the 174th Natl. Am. Chem. Soc. Symp., Chicago, 28 Aug. - 2 Sep. 1977

(Contract EX-76-C-01-2315)

(CONF-770814-9) Avail: NTIS HC A03/MF A01

Results are presented of a study to demonstrate the feasibility of converting whole shale oil to a synthetic crude resembling a typical petroleum distillate. The synthetic crude thus produced can then be processed, in conventional petroleum-refining facilities, to transportation fuels such as high octane gasoline, diesel, and jet fuel. It is shown that whole shale oil can be catalytically hydrodenitrified with the resulting synthetic crude resembling a petroleum distillate that can be fractionated and further processed. Shale oil contains about 0.6% sulfur. Sulfur is more easily removed by hydrofining than is nitrogen. Oxygen contained in the shale oil is also reduced to low levels during hydrodenitrification. The shale oil contains appreciable quantities of iron and arsenic which are removed by a guard bed placed upstream from the hydrofining catalyst. The naphthas from the shale oil hydrofiner can readily be upgraded to high octane gasoline by catalytic reforming. The middle distillate fraction may require some additional hydrofining to produce salable diesel or jet fuel. ERA

N78-25581# International Institute for Applied Systems Analysis, Laxenburg (Austria).

SYSTEMS ASPECTS OF LARGE-SCALE SOLAR ENERGY CONVERSION

J. M. Weingart May 1977 36 p refs Presented at the Intern. Symp. on New Trends in Systems Anal., Versailles, France, 13-17 Dec. 1976

(IIASA-RM-77-23; Conf-761246-1) Avail: NTIS (US Sales Only) HC A03/MF A01; DOE Depository Libraries

The initial stage of solar energy development would include local low temperature applications for heating purposes, and the embedding of small amounts of solar electric generation capacity in the existing electric grids. Regional interconnections of solar electric power generation would be followed by increasing

production of solar fuels in locations with favorable insolation, and by long-distance transport of these fuels. Much more needs to be known about the behavior of very large integrated solar energy conversion systems. Market penetration calculations indicate that it takes roughly five decades for a major source of energy to be developed and used on a truly significant scale. It therefore would be necessary to initiate large-scale deployment of solar energy perhaps 50 years or more before fossil resources are finally depleted. ERA

N78-25582# Energy Research and Development Administration, Washington, D. C. Office of the Assistant Administrator to Fossil Energy.

FOSSIL ENERGY PROGRAM REPORT. Progress Report, Jul. 1975 - Oct. 1976
Sep. 1977 650 p
(ERDA-77-70) Avail: NTIS HC A99/MF A01

A review is given with respect to objectives, importance, and accomplishments US ERDA's research programs in coal liquefaction, coal gasification (high- and low-Btu gas), advanced power systems, combustion, materials research, process research, component research, magnetohydrodynamics (open- and closed-cycle systems), enhanced recovery of petroleum and natural gas, in-situ oil shale technology, commercial applications, and various program planning and analysis projects. ERA

N78-25583# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.

SOLAR PILOT PLANT, PHASE 1, PRELIMINARY DESIGN REPORT. VOLUME 2, BOOK 2: CENTRAL RECEIVER OPTICAL MODEL USERS MANUAL, CDRL ITEM 2

1 May 1977 228 p
(Contract EY-76-C-03-1109)
(SAN/1109-8/3-Vol-2-Bk-2) Avail: NTIS HC A11/MF A01

A FORTRAN computer program (HELIAKI) which simulates the optical/thermal performance of a central receiver solar heat to electricity is described. The power retained by the cavity receiver at any point in time or the energy into the receiver over a year's time is calculated using a Monte Carlo ray trace technique to solve the multiple integral equations. An artist's concept of this plant is shown. ERA

N78-25584# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.

SOLAR PILOT PLANT, PHASE 1, PRELIMINARY DESIGN REPORT. VOLUME 2, BOOK 3: DYNAMIC SIMULATION MODEL AND COMPUTER PROGRAM DESCRIPTIONS, CDRL ITEM 2

1 May 1977 358 p refs
(Contract EY-76-C-03-1109)
(SAN/1109-8/4-Vol-2-Bk-3) Avail: NTIS HC A16/MF A01

The mathematical models and computer program comprising the solar power plant (SPP) dynamic simulation are described. The SPP dynamic simulation is a computerized model representing the time-varying performance characteristics of the SPP. A master control/instrumentation system is utilized to coordinate the various plant operations. The master controller reacts to plant operator demands and control settings to effect the desired output response. The SPP dynamic simulation computer program is written in FORTRAN language. Various input options (e.g., insolation values, load demands, initial pressures/temperatures/flows) are permitted. Plant performance may be monitored via computer printout or computer generated plots. The detailed pilot plant dynamic model, the basis for this simulation, and the utilization of this simulation to obtain analytical plant performance results are described. ERA

N78-25585# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.

SOLAR PILOT PLANT, PHASE 1, PRELIMINARY DESIGN REPORT. VOLUME 3: COLLECTOR SUBSYSTEM, CDRL ITEM 2

1 May 1977 571 p
(Contract EY-76-C-03-1109)
(SAN/1109-8/5-Vol-3) Avail: NTIS HC A24/MF A01

A low profile, multifaceted heliostat designed to provide high reflectivity and accurate angular and spatial positioning of the redirected solar energy under all conditions of wind load and mirror attitude within the design operational envelope is described. The heliostats are arranged in a circular field around a cavity receiver on a tower halfway south of the field center. A calibration array mounted on the receiver tower provides capability to measure individual heliostat beam location and energy periodically. This information and weather data from the collector field are transmitted to a computerized control subsystem that addresses the individual heliostat to correct pointing errors and determine when the mirrors need cleaning. Results of the SRE heliostat test program are presented. ERA

N78-25586# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.

SOLAR PILOT PLANT, PHASE 1, PRELIMINARY DESIGN REPORT. VOLUME 8: ELECTRICAL POWER GENERATION; MASTER CONTROL SUBSYSTEMS; BALANCE OF PLANT CDRL ITEM 2

1 May 1977 373 p
(Contract EY-76-C-03-1109)
(SAN/1109-8/8-Vol-6) Avail: NTIS HC A16/MF A01

The relationship of the electrical power generation subsystem to the rest of the plant, the design methodology and evolution, the interface integration and control, and the operation and maintenance procedures were described. ERA

N78-25587# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

INDUSTRIAL APPLICATIONS OF SOLAR TOTAL ENERGY. VOLUME 1: SUMMARY Final Report

Apr. 1977 37 p
(Contract EY-76-C-03-1132)
(SAN/1132-2/1-Vol-1) Avail: NTIS HC A03/MF A01

A summary of the program to define solar energy systems that are technically and economically feasible that can satisfy all or part of selected industry demands and to determine the market potential of such systems is given. The primary emphasis was placed on the application of total energy systems where the industrial process heat, electrical demands, and space heating and cooling are satisfied at maximum possible efficiency. Industrial energy usage was first determined, leading to a survey of those which were energy-intensive. Concurrently with the industry survey, subsystem methodologies were established in the areas of insolation data retrieval, collector performance and sizing, thermal storage, energy conversion, and heat transport. In excess of 40, first-level designs were generated allowing a preliminary ranking and selection of industries for the conceptual design phase. Volumes 2, 3, 4 and 5 of this report contain detailed results. ERA

N78-25588# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

INDUSTRIAL APPLICATIONS OF SOLAR TOTAL ENERGY. VOLUME 2: TECHNICAL Final Report

Apr. 1977 240 p refs
(Contract EY-76-C-03-1132)
(SAN/1132-2/2-Vol-2) Avail: NTIS HC A11/MF A01

For abstract, see N78-25587.

N78-25589# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

INDUSTRIAL APPLICATIONS OF SOLAR TOTAL ENERGY. VOLUME 3: MARKET PENETRATION Final Report

Apr. 1977 179 p
(Contract EY-76-C-03-1132)
(SAN/1132-2/3-Vol-3) Avail: NTIS HC A09/MF A01

An integrated economic/market penetration model was developed to simulate the impact of the various quantifiable parameters on the economic viability and market penetration potential of specific solar total energy systems. The two basic types of solar total-energy-system configurations considered in this analysis are: (1) central receiver systems and (2) distributed concentrating systems. Conceptual-system designs have been developed for each of the systems and in each of the five

candidate-industry applications. The conceptual designs developed for each industry were used as reference baselines to determine economic viability of specific applications. The five industries that were selected are: (1) meat packing industry; (2) fluid milk industry; (3) sugar beet industry; (4) asphalt material industry; and (5) concrete block. ERA

N78-25590# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
INDUSTRIAL APPLICATIONS OF SOLAR TOTAL ENERGY. VOLUME 5: CATALOG OF CONCEPTUAL DESIGNS Final Report
 Apr. 1977 100 p
 (Contract EY-76-C-03-1132)
 (SAN/1132-2/5-Vol-5) Avail: NTIS HC A05/MF A01

Conceptual designs for five industries have been completed (meat packing, fluid milk, sugar beets, asphalt materials, and concrete block). Each industry was evaluated at a primary location corresponding to the location of an actual industry whose demand was used in sizing the Solar Total Energy Station (STES). Three alternate locations were selected for each industry. In all, 12 locations were analyzed. Six of the locations were assessed for more than one industry. Two different types of collector fields were sized and their performance analyzed for each industry/location. The collector types were central receiver and two-axis tracking distributed collectors. One industry, meat packing, was also analyzed using one-axis tracking distributed collectors as well. All of the designs are hybrid in nature, that is, they use auxiliary energy supplied by fossil-fueled heaters during times of reduced insolation. Component summaries including major subsystem descriptions and operating parameters are included. ERA

N78-25592# California Univ., Livermore. Lawrence Livermore Lab.
FIBER COMPOSITE FLYWHEEL PROGRAM Quarterly Progress Report, Jul. - Sep. 1977
 J. A. Rinde 2 Dec. 1977 8 p
 (Contract W-7405-eng-48)
 (UCRL-50033-77-3) Avail: NTIS HC A02/MF A01

Fiber composite flywheels are planned for use in energy storage systems because they have strength-to-density ratios, enabling them to store large amounts of kinetic energy per unit mass. Research progress is reported in the areas of stress rupture, composite properties, and composites with flexible matrices. ERA

N78-25593# Argonne National Lab., Ill.
HIGH-PERFORMANCE BATTERIES FOR STATIONARY ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION Progress Report, Apr. - Jun. 1977
 Oct. 1977 77 p refs
 (Contract W-31-109-eng-38)
 (ANL-77-68) Avail: NTIS HC A05/MF A01

Research, development, and management activities of the program on lithium aluminum/metal sulfide batteries are described. The cells are of a vertically oriented, prismatic design with a central positive electrode of FeS or FeS₂, two facing negative electrodes of lithium - aluminum alloy, and an electrolyte of molten LiCl - KCl. The concepts receiving major attention are carbon-bonded positive electrodes, scaled-up designs of stationary energy storage cells, additives to extend electrode lifetime, alternative electrode separators, and pellet-grid electrodes. Materials development efforts included the development of a lightweight electrical feedthrough; studies of various current-collector designs; investigation of powder separators; wettability and corrosion tests of materials for cell components; and postoperative examinations of cells. Voltametric studies were conducted to investigate the reversibility of the FeS₂ electrode. The use of calcium and magnesium alloys for the negative electrode in advanced battery systems were investigated. ERA

N78-25595# Brookhaven National Lab., Upton, N. Y. Energy Technology Assessment Group.

ENERGY MODELING AND DATA SUPPORT FOR THE ELECTRIC POWER RESEARCH INSTITUTE Annual Report
 H. Ablock, M. Beller, E. A. Cheriavsky, A. Hermelee, L. L. Juang, and W. Marchuse Jul. 1977 75 p refs
 (Contract EY-76-C-02-0016; EPRI Proj. RP442-1)
 (BNL-50696) Avail: NTIS HC A04/MF A01

Reference energy systems were formulated for the base year 1972 and projections developed for the years 1980, 1985, and 2000 for the area serviced by the New York power pool. In addition, Brookhaven, EPRI, and the Tennessee Valley Authority entered into a cooperative effort to develop demand projections for the area serviced by TVA. The RES and associated data provided a baseline against which TVA evaluated the effect of substituting alternate technologies and policies for one another. Development of the dynamic energy systems optimization model is continuing, with effort this year directed toward better representation of the electrical sector within the model. The model was reformulated such that the year was divided into three seasons and two daily divisions, thus allowing the model to choose whether a summer or winter peak occur and to better depict the yearly time dependence of demands. ERA

N78-25596# Economics Research Group Ltd., Toronto (Ontario).
DYNAMIC MODELS OF THE INDUSTRIAL DEMAND FOR ENERGY Interim Report

Ernst R. Berndt, Melvyn A. Fuss, and Leonard Waverman Nov. 1977 147 p refs Prepared for EPRI, Palo Alto, Calif.
 (EPRI Proj. 683-1)
 (EPRI-EA-580) Avail: NTIS HC A07/MF A01

Econometric approaches to modeling the demand for electricity, petroleum, coal, and natural gas by the manufacturing sector of the U.S. economy are investigated. Aspects of the research are incorporation of dynamic effects as well as an introduction of the impact of technological change on energy usage. An analysis of the effects of an investment tax credit on both the long-run demand for energy and the adjustment path to the new long-run equilibrium demand was made. Several models were considered that were utilized in an analysis of endogenous technical change. The most promising model for future research was one which incorporated knowledge as a quasi-fixed factor within the cost of adjustment framework. ERA

N78-25598# Electric Power Research Inst., Palo Alto, Calif.
FORECASTING AND MODELING TIME-OF-DAY AND SEASONAL ELECTRICITY DEMANDS

Anthony Lawrence Dec. 1977 465 p refs Presented at the Workshop on Methodologies for Forecasting Time-of-Day and Seasonal Elec. Loads, Aspen, Colo., 30 Mar. - 1 Apr. 1977
 (EPRI-EA-578-SR; Conf-770391) Avail: NTIS HC A20/MF A01

The papers presented are divided into three main categories: econometric papers that deal with modeling and forecasting an individual households' demand for electricity with time-of-day pricing; econometric and statistical time-series papers that deal with forecasting the peak load of utility systems; and papers that provide insights into previous experience with peak-load pricing, benefit/cost analysis, model specification, and experimental design related to load forecasting and load control. ERA

N78-25599# Blalock (S. D., Jr.), Kingsport, Tenn.
HEAT EXTRACTION SYSTEM OF THE PERM THERMAL ELECTRIC POWER PLANT

1977 11 p Transl. into ENGLISH of "The Design and Operation of Heat Extraction Systems of Thermoelectric Power Plants and Nuclear Power Plants", Joint Sov.-Am. Coord. Comm. Theme 08.0203 Inst. of the Min. of Energy of the USSR, Uralsk Affiliate, Moscow, 1977 p 1-13 Sponsored by DOE Prepared for ORNL

(ORNL-TR-4492) Avail: NTIS HC A02/MF A01

The basic equipment of the 4800 MW Perm coal-fired power plant in the Ural region, U.S.S.R., its water supply source, the once through cooling system, measures taken to prevent thermal pollution in the water reservoir and damage to fish at the water supply intake point, and the ash and cinder removal system at the plant are discussed. ERA

N78-25600# Battelle Columbus Labs., Ohio.
AGGLOMERATING BURNER GASIFICATION PROCESS: DESIGN, INSTALLATION, AND OPERATION OF A 25-TON-A-DAY PROCESS DEVELOPMENT UNIT. Monthly Progress Report, Dec. 1977

B. C. Kim, comp. 9 Jan. 1978 9 p
 (Contract EX-76-C-01-1513)

(FE-1513-69; PR-59) Avail: NTIS HC A02/MF A01

Progress on the operation of the 25 ton per day coal gasification PDU to study the Agglomerating Burner Gasification Process is summarized. Also reported is work on the process engineering task and the activity on the turbine engineering study. One run was made with subbituminous coal. For the first time solids circulation was maintained at a sufficient rate to provide adequate heat to the gasifier from combustion of coal in the combustor. The system pressure during much of the run was 90 psig with one period of operation at the design pressure of 100 psig. This run was terminated prematurely because an asbestos gasket in the bottom head of the gasifier failed resulting in a leak that could not be repaired safely. A draft report on the process engineering and economic task is currently undergoing internal technical review. Fabrication of the erosion test rig is complete and ready for installation at the appropriate time. ERA

N78-25601# Foster Wheeler Corp., Livingston, N.J.
DEVELOPMENT WORK FOR AN ADVANCED COAL GASIFICATION SYSTEM FOR ELECTRIC POWER GENERATION FROM COAL DIRECTED TOWARD A COMMERCIAL GASIFICATION GENERATING PLANT, PHASE 2. VOLUME 12: COLD-FLOW MODEL TESTING OF A TWO-STAGE ENTRAINED-FLOW SLAGGING COAL GASIFIER

Dec. 1977 182 p
 (Contracts EX-76-C-01-1521; Contract E(49-18)-1521)
 (FE-1521-31) Avail: NTIS HC A09/MF A01

Qualitative information regarding the operating characteristics of the two-stage entrained-flow coal gasifier is presented, using a series of cold flow tests in a scale model of the proposed prototype gasifier. Common, unreacting substances were used to simulate the flow of anticipated components in the prototype, with air representing product gas, granulated cork representing both coal and char feeds, and glycerine simulating the flow of slag in the lower stage of the gasifier. The flow rates for these substances were determined by matching numerical values of various dimensionless groups in the model to those expected in the prototype. Aspects of the flow patterns in both stages were examined, including possible problem areas concerned primarily with refractory erosion, slag drainage, and particulate agglomeration. ERA

N78-25602# Foster Wheeler Corp., Livingston, N.J.
DEVELOPMENT WORK FOR AN ADVANCED COAL GASIFICATION SYSTEM FOR ELECTRIC POWER GENERATION FROM COAL DIRECTED TOWARD A COMMERCIAL GASIFICATION GENERATING PLANT, PHASE 2. VOLUME 14: SYSTEM ANALYSIS

Dec. 1977 151 p refs
 (Contract EX-76-C-01-1521)

(FE-1521-33) Avail: NTIS HC A08/MF A01

A detailed computer model was developed for the system simulation of an integrated coal gasification combined-cycle pilot plant using an air-blown, two-stage, entrained flow, slagging gasifier. The pilot plant system is described by a system of partial differential and algebraic equations governing the energy, material, and momentum balance of the pilot plant. An implicit finite-difference scheme was used to discretize the partial differential equations in both the time and space domain. The resulting set of non-linear algebraic equations was solved by the method of successive iteration. Model developments of various subsystems and components are given in detail. Both steady-state and transient studies were carried out with the computer code in order to investigate pilot plant performance characteristics as well as component interface under various operation conditions. Specifically, steady-state, full and part-load operations were studied. ERA

N78-25603# National Bureau of Standards, Washington, D. C.
Inst. for Materials Research.

MATERIALS RESEARCH FOR CLEAN UTILIZATION OF COAL Quarterly Progress Report, Jan. - Mar. 1977

S. J. Schneider Nov. 1977 69 p refs
 (Contract EA-77-A-01-6010-002)

(FE-6010-11) Avail: NTIS HC A04/MF A01

Coal gasification processes require the handling and containment of corrosive gases and liquids at high temperature and pressures, and also the handling of flowing coal particles in this environment. These severe environments cause materials failures which inhibit successful and long-time operation of the gasification systems. The project entails investigations on the wear, corrosion, chemical degradation, fracture, and deformation processes which lead to the breakdown of metals and ceramics currently being utilized in pilot plants. A system was initiated to abstract and compile all significant operating incidents from coal conversion plants. ERA

N78-25605# Oak Ridge National Lab., Tenn.
COAL TECHNOLOGY PROGRAM Progress Report, Oct. 1977

Dec. 1977 48 p refs
 (Contract W-7405-eng-26)

(ORNL-TM-6137) Avail: NTIS HC A03/MF A01

Blocks of Pittsburgh seam bituminous coal were pyrolyzed under reducing gas in the project in support of in situ gasification. Higher heating rates appear to reduce swelling of the block during pyrolysis, and higher final pyrolysis temperature results in lower boiling tars. Three pressurized residue carbonization tests were completed at 1100 F and 400 psi of methane with three feed materials. Modifications to experimental techniques were made to allow the heat treatment of tension specimens and simulated heat treatment of thick plate sections. Exposure of heat exchanger tubes in the Fluidyne Corporation atmospheric fluidized bed has reached a maximum of 1500 hr. Tube samples were recovered. In the gas-fired potassium boiler project, three preliminary runs of short duration were made in which the boiler was filled with potassium and heated up to or near the boiling temperature with the main burner. Operating problems that were encountered in these runs were resolved. ERA

N78-25606# Argonne National Lab., Ill.
NONDESTRUCTIVE EVALUATION NEEDS FOR COAL LIQUEFACTION

D. S. Kupperman Sep. 1977 47 p refs
 (Contract W-31-109-eng-38)

(ANL-77-61) Avail: NTIS HC A03/MF A01

Nondestructive evaluation was highly rated in importance as a way to help alleviate problems in coal-conversion systems. The primary problems were associated with highly erosive and corrosive slurries being transferred throughout the coal-conversion process. Applicable NDE techniques for both preservice and in-service inspection include high-temperature ultrasonics, acoustic emission, radiography, acoustic holography, and ultrasonic spectroscopy. ERA

N78-25607# Oklahoma State Univ., Stillwater. Dept. of Chemistry.

MASS SPECTROMETRIC ANALYTICAL SERVICES AND RESEARCH ACTIVITIES TO SUPPORT COAL-LIQUID CHARACTERIZATION RESEARCH Annual Progress and Quarterly Report, 9 Mar. - 8 Jun. 1977

S. E. Scheppele Sep. 1977 47 p refs

(Contract EY-76-S-02-0020)

(COO-0020-8) Avail: NTIS HC A03/MF A01

Ion-source temperature markedly affects the sensitivity for field ionization of saturated hydrocarbons relative to sensitivity for FI of aromatic hydrocarbons. Using relative FI sensitivities determined for a number of organic compounds over a range of temperatures, excellent analytical data were obtained for a test mixture. Field-ionization mass spectrometry constitutes an ideal technique for group-type analysis of saturated hydrocarbons, and mixtures of saturated and aromatic hydrocarbons providing FI/MS are obtained with adequate resolution. Implementation of computer-assisted data reduction, correlation, and interpretation focused on converting mass spectral ion abundance data for a given gel-permeation chromatography (GPC) fraction into quantitative distributions and conversion of the data for the various fractions into distributions for the total sample. High-resolution 70-eV electron-impact mass spectra were recorded for 56 fractions obtained from separation of a tar sand sample on photographic plates. ERA

N78-25608# Mobil Research and Development Corp., Paulsboro, N. J. Process Research and Technical Service Div.

UPGRADING OF COAL LIQUIDS FOR USE AS POWER GENERATION FUELS Annual Report, Feb. 1976 - Jan. 1977

T. R. Stein, J. G. Bendoraitis, A. V. Cabal, R. B. Callen, M. J. Dabkowski, R. H. Heck, H. R. Ireland, and C. A. Simpson Oct. 1977 146 p refs

(EPRI-AF-444) Avail: NTIS HC A07/MF A01

The hydroprocessing of coal liquids (derived from the H-Coal and SRC processes) in fixed bed pilot units using commercially available catalysts is described. Distillate coal liquids were upgraded to the quality levels of existing petroleum-derived turbine fuels. Hydrogen consumption and processing severity depends upon the hydrogen and nitrogen contents of the feed. Product quality (e.g., heteroatom and aromatic content) was quantified in terms of process conditions by a kinetic reaction model. The distillate coal liquids were compatible with petroleum-derived fuels. Hydroprocessing of the non-distillable SRC product/process solvent (SRC) blends removed up to 90 wt.% of the heteroatoms and converted large quantities of the SRC to lower boiling, less aromatic material suitable as turbine fuel. Severe hydroprocessing is required to significantly improve the compatibility of SRC with heavy petroleum fuel. ERA

N78-25609# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.

OPTIMIZATION OF PYROLYTIC CONVERSION OF COAL TO CLEAN FUEL Quarterly Report, Jan. - Mar. 1977

H. L. Friedman, M. J. Antal, Jr., T. J. Ohlemiller, R. L. Derham, and M. Summerfield 15 Apr. 1977 24 p refs

(Contract EX-76-C-01-2253)

(FE-2253-5) Avail: NTIS HC A02/MF A01

Computer programs were perfected to obtain kinetic parameters from thermogravimetry of coals heated at several linear rates of temperature rise, and were applied to Wyodak coal with success. Program development is underway to model the fixed bed coal pyrolysis reactor, and to combine thermogravimetry and differential scanning calorimetry for better understanding of the mechanism of pyrolysis and to get more accurate kinetic equations and parameters. Experimental activities included the following: the chemical data systems pyrolysis/gas chromatography/peak identifier system was studied further to select the specific method of its application to this research. Four coals were pyrolyzed under identical conditions and gas chromatography curves were obtained and were compared. Calibration samples are currently being run and are being compared with results of pyrolysis. ERA

N78-25610# Brookhaven National Lab., Upton, N. Y. Process Sciences Div.

REGENERATIVE PROCESS FOR DESULFURIZATION OF HIGH TEMPERATURE COMBUSTION AND FUEL GASES Quarterly Progress Report, 1 Apr. - 30 Jun. 1977

M. Steinberg and R. T. Yang 1977 28 p refs

(Contract EY-76-C-02-0016)

(BNL-50706; QPR-5) Avail: NTIS HC A03/MF A01

The sulfation rate of reagent-grade monocalcium silicate is of the same order of magnitude as that of limestone and higher than that of reagent-grade calcium oxide. Construction of a micro-pilot rotary kiln for regeneration of lime from the sulfated lime was completed. Design and construction of a micro-combustor used to test the regenerated lime are underway. Studies on sulfation of lime continue. The catalysis by Fe₂O₃ and/or coal ash was established and its mechanisms were studied. A process flow diagram for producing commercial strength sulfuric acid from regenerator off-gas was prepared. A preliminary comparison between a once-through sorbent system and the combined regenerative/H₂SO₄ system indicates that the net energy outputs (useful) of the two systems are approximately the same. The quantity of solid wastes generated by the once-through system is about 2.5 times the quantity generated by the combined system. ERA

N78-25611# Bituminous Coal Research, Inc., Monroeville, Pa. **GAS GENERATOR RESEARCH AND DEVELOPMENT, BI-GAS PROCESS** Interim Report, 1 Jul. 1976 - 30 Jun. 1977

Aug. 1977 344 p refs Prepared in cooperation with Phillips Petroleum Co., Homer City, Pa.

(Contracts EX-76-C-01-1207; EF-77-C-01-1207)

(FE-1207-33; BCR-L-828) Avail: NTIS HC A15/MF A01

Work continued on the evaluation of fluidized-bed methanation catalysts at both the bench-scale and PEDU-scale levels. In addition, assistance was given in planning, acquisition, and assessment of the BI-GAS pilot plant operation data. Bench-scale studies included four standard life tests and one extended life test to evaluate experimental fluidized-bed methanation catalysts. ERA

N78-25612# Arizona State Univ., Tempe. **SOLAR ENERGY CONVERSION: AN ANALYSIS OF IMPACTS ON DESERT ECOSYSTEMS** Progress Report, 1 Jun. - 31 Dec. 1977

Duncan T. Patten Sep. 1977 44 p refs

(Contract EC-77-S-02-4339)

(COO-4339-1) Avail: NTIS HC A03/MF A01

Some of the important potential ecological impacts that might occur when solar collector arrays are constructed and maintained in the desert Southwest are discussed. These impacts are categorized under major environmental consequences of solar collector development, that is, shading wind deflection and site destruction, and soil disturbance. Under these major categories secondary impacts are developed to show the significance of altering desert ecosystems with solar conversion systems. Some of the secondary impacts which include abiotic changes in radiation, temperature, heat flux, soil moisture and erosion, and biotic changes such as increased plant productivity and species diversity are discussed as to their short and long term significance in the desert system. A brief description of the solar collector simulator array being constructed in the desert to test many of the concepts developed during the early part of Phase 1 of this project is presented. ERA

N78-25613# Atomics International, Canoga Park, Calif. **COMMERCIAL APPLICATIONS OF SOLAR TOTAL ENERGY SYSTEMS** Quarterly Progress Report, 1 Nov. 1976 - 31 Jan. 1977

Sep. 1977 156 p refs

(Contracts EY-76-C-03-1210; E(04-3)-1210)

(AI-ERDA-13203; QPR-3) Avail: NTIS HC A08/MF A01

The application of Solar Total Energy System (STES) to the commercial sector stores is discussed. Candidate solar-thermal and solar-photovoltaic concepts are considered for providing on-site electrical power generation as well as thermal energy

for both heating and cooling applications. The solar-thermal concepts include the use of solar concentrators (distributed or central-receiver) for collection of the thermal energy for conversion to electricity by means of a Rankine-cycle or Brayton-cycle power conversion system. Recoverable waste heat from the power generation process is utilized to help meet the building thermal energy demand. Evaluation methodology is identified to allow ranking and/or selection of the most cost effective concept for commercial building applications. ERA

N78-25614# Bechtel Corp., San Francisco, Calif.
BATTERY STORAGE PERFORMANCE REQUIREMENTS FOR TERRESTRIAL SOLAR PHOTOVOLTAIC POWER SYSTEMS
 Final Report

Aug. 1977 306 p refs Prepared for ANL, Argonne, Ill.
 (Contract W-31-109-eng-38)
 (ANL/OEPM-77-3) Avail: NTIS HC A14/MF A01

A broad spectrum of terrestrial photovoltaic applications was evaluated by considering the types of loads served and the characteristics of system components. Low, intermediate, and high power systems, such as used in a single residence, a multiple residence, a shopping center or a central station power plant were studied. A computer program was developed to assist in determining battery voltages and currents during operation of the photovoltaic systems. Modeling was limited to single-crystal silicon solar cells and the characteristics of a Li-Al/FeS battery. Battery requirements for this application are generally no more severe than for other battery applications and, in some respects (e.g., energy density), may be less severe. Specific conclusions and recommendations are presented. System requirements and battery capabilities are summarized in tabular form. ERA

N78-25615# George Washington Univ., Washington, D. C. Behavioral Studies Group.
ANALYSIS OF POLICY OPTIONS FOR ACCELERATING COMMERCIALIZATION OF SOLAR HEATING AND COOLING SYSTEMS

Roger Bezdek, Joseph Margolin, Thomas Sparrow, George Sponsler, Allan Miller, Fred Meeker, Arthur Ezra, Robert Spongberg, Elliot Roseman, and Marion Misch Apr. 1977 475 p refs

(TID-27597; HCP/M2534-02) Avail: NTIS HC A20/MF A01

Feasible policy options designed to accelerate the commercialization of solar heating and cooling (SHAC) systems are described and analyzed. Both qualitative and quantitative estimates of the costs/benefits of different policy options were made. The critical problem of interfacing dispersed SHAC systems with the public utilities was analyzed. A comprehensive discussion of the legal, regulatory, and institutional problems confronting the rapid commercialization of SHAC systems is presented. The complex problems involved in building codes, standards, and warranties are discussed. Marketing, manpower, consumer, and environmental issues are analyzed. ERA

N78-25617# Michigan Technological Univ., Houghton.
ENERGY AND PROTEIN PRODUCTION FROM PULP MILL WASTES Progress Report, 15 Sep. - 15 Dec. 1977
 M. F. Jurgensen and J. T. Patton 15 Dec. 1977 9 p
 (Contract EY-76-C-02-2983)

(COO-2983-6) Avail: NTIS HC A02/MF A01

The conversion of the protein production experiments from batch to continuous operation, and the identification of growth stimulants to increase methane yield were studied. Yeast production ranging from 0.5 to 5.0 grams of dry yeast per liter were obtained in batch cultures. Highest yields were consistently attained on SSL (spent sulfite liquor). Continuous fermentation studies using three hour ozonated SSL confirmed the characteristic yields demonstrated in previous batch tests. Contamination, which occurred at residence times less than two days, appeared to decrease protein production rate and yield. Vitamins and minerals, fatty acids, and low molecular weight alcohols were investigated as possible stimulants for methane production. ERA

N78-25618# General Electric Co., Philadelphia, Pa. Space Div.

SOLAR TOTAL ENERGY; LARGE SCALE EXPERIMENT. NO. 2, PHASE 2: CONCEPTUAL DESIGN Final Report
 12 Jan. 1978 593 p

(Contract ENG-77-C-04-3985)

(TID-27995; DOC-78SDS4200)

Avail: NTIS

HC A25/MF A01

The selected system incorporates a distributed collector/central generation system using parabolic dish collectors. A steam Rankine cycle power conversion system with extraction turbine/backpressure and condensing was selected. Therminol 66 will be the baseline heat transfer fluid for the solar collector field and thermal energy storage system (a rock and trickle oil system). Two-tank pressurized water storage will be used for low-temperature storage. A site requirements analysis is presented including site description, insolation methodology, and load analysis. A life-cycle cost analysis, energy displacement analysis, legal compliance study, health and safety analysis, environmental assessment, and utilities interface study are included. The overall project plan including schedules and costs is presented. ERA

N78-25619# Resource Planning Associates, Inc., Washington, D. C.

INSTITUTIONAL APPLICATIONS OF SOLAR TOTAL ENERGY SYSTEMS Quarterly Progress Report

Jul. 1977 177 p refs

(Contract EG-77-C-04-3786)

(ALO/3786-1; QPR-1) Avail: NTIS HC A09/MF A01

The meteorology followed to develop a data base for assessing market potential in the eight institutional subsectors is described. The subsectors are: elementary and high schools, colleges, and universities, hospitals, military installations, public administration buildings, post offices, airports, and prisons. The market characteristics to be studied in detail are defined, and the methodology to be followed in assessing the relative economic performance of representative STE systems is given. ERA

N78-25620# Sandia Labs., Albuquerque, N. Mex.
PRELIMINARY ECONOMIC ANALYSIS OF SOLAR IRRIGATION SYSTEMS (SIS) FOR SELECTED LOCATIONS

L. L. Lukens, A. M. Perino, and S. G. Vandevender Nov. 1977 52 p

(Contract EY-76-C-04-0789)

(SAND-77-1403) Avail: NTIS HC A04/MF A01

The economic feasibility was determined by comparing the life cycle cost (LCC) of the solar system to the LCC of conventional systems. The systems analyzed were point studies and do not represent either worst case or best case conditions. Therefore, general conclusions should not be drawn on the results presented here. The results show that for these cases, economic feasibility is dependent on utilization of the SIS for production of energy in addition to that required to water crops. ERA

N78-25621# Clemson Univ., S.C. College of Engineering.
FEASIBILITY EVALUATION: SOLAR HEATED TEXTILE PROCESS WATER Semiannual Progress Report, Jul. 1975 - Feb. 1976

J. C. Hester Dec. 1977 26 p

(Contract EY-76-S-09-0885)

(SRO-0885-75/1) Avail: NTIS HC A03/MF A01

The technical and economic feasibility of the use of solar energy for heating waters in the textile industry and to develop a plan for efforts beyond this feasibility study phase are reported. Specific objectives include (1) determine the industry requirements for heated process water, (2) assess particular schemes and their economic impact, (3) study the total cost environment for solar water heating in this industry, and (4) recommend future experiments. Major progress was made in terms of collaboration with textile firms, user needs, and dissemination of results. Software for facilitating the design of potential systems has reached an intermediate stage of development. The cost environment was probed and is being systematically documented. Long-term economic impact programs are in the advanced stage of development. Areas of future effort are prescribed. ERA

N78-25623# Oak Ridge National Lab., Tenn.

EXPERIMENTAL STUDY OF HEAT TRANSFER ENHANCEMENT FOR AMMONIA CONDENSING ON VERTICAL FLUTED TUBES

S. K. Combs Jan. 1978 128 p. refs

(Contract W-7405-eng-26)

(ORNL-5356) Avail: NTIS HC A07/MF A01

Experiments were run to determine heat transfer performance of single vertical tubes with ammonia condensing on the outside. The four test tubes (aluminum) were of 1 in. nominal diameter and 4 ft length with 0 (smooth), 24, 48, and 60 external flutes. Test parameter ranges are given. The condensing heat transfer coefficients are reported as composite coefficients that include the resistance of both the condensing side and the tube wall. All parameters were based on total condensing surface area. The data show that, for a given heat flux, a fluted tube can increase condensing coefficients by up to 7.2 times smooth tube values. ERA

N78-25624# Institute of Gas Technology, Chicago, Ill.

APPLICATION ANALYSIS OF SOLAR TOTAL ENERGY TO THE RESIDENTIAL SECTOR Quarterly Technical Status Report, 1 Apr. - 30 Jun. 1977

T. Whaley, B. Yudow, N. Malik, and L. Korobkin Aug. 1977 207 p. refs

(Contract EG-77-C-04-3787)

(TID-28103) Avail: NTIS HC A10/MF A01

A solar total energy system (STES) is defined as an energy system designed to maximize the efficient use of collected solar energy by supplying both the low grade (low temperature thermal) and high grade (electrical and/or mechanical) energy needs of selected applications. ERDA's Solar Total Energy Program is concerned primarily with those solar total energy systems that use heat engine or photovoltaic devices to produce electricity (and/or mechanical work) and apply the residual thermal energy from the conversion process to some useful purpose. ERA

N78-25625# Resource Planning Associates, Inc., Washington, D. C.

INSTITUTIONAL APPLICATIONS OF SOLAR TOTAL ENERGY SYSTEMS Quarterly Report

Oct. 1977 86 p. refs Prepared in cooperation with Intertechnology Corp., Warrenton, Va.

(Contract EG-77-C-04-3786)

(TID-22782; QR-2) Avail: NTIS HC A05/MF A01

The applicability of solar energy (STE) systems is being analyzed in the industrial, commercial, residential, and institutional building sectors. The applications analysis is being conducted in the institutional sector, which has been defined to include eight subsectors: hospitals, primary and secondary schools, colleges, and universities, public-administration buildings, military installations, prisons, post offices, and airports. The three major components of the study are: (1) a market assessment, (2) the development of conceptual designs, and (3) an examination of federal policies aimed at speeding the commercialization of STE systems. ERA

N78-25627# Argonne National Lab., Ill.

PERFORMANCE AND TESTING OF A STATIONARY CONCENTRATING COLLECTOR

R. L. Cole, J. W. Allen, N. M. Levitz, W. R. McIntire, and W. W. Schertz 1977 11 p. Presented at the Concentration Solar Collector Conf., Atlanta, 26-28 Sep. 1977

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

(CONF-770953-7) Avail: NTIS HC A02/MF A01

The development of nonimaging solar collectors for heating and cooling applications is reported. A totally stationary concentrating collector has been designed, built, and tested. The collectors employ compound parabolic concentrators coupled to tubular evacuated receivers. Performance of the collector is substantially better than flat plate collectors, and the collectors are suitable for powering mechanically driven air conditioning systems as well as conventional absorption cycle machines. ERA

N78-25628# Argonne National Lab., Ill. Chemical Engineering Div.

CPC THERMAL COLLECTOR TEST PLAN

Kent A. Reed 1977 5 p. refs Presented at the Concentrating Solar Collector Conf., Atlanta, 26-28 Sep. 1977

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

(CONF-770953-6) Avail: NTIS HC A02/MF A01

A comprehensive set of test procedures were developed for establishing the performance of compound parabolic and concentrating thermal collectors with large angular fields of view. The procedures range from separate thermal and optical tests, to overall performance tests. A calorimetric ratio technique was designed to determine the heat output of a collector without knowledge of the heat transfer fluid's mass flow rate and heat capacity. Special attention was paid to the problem of defining and measuring the incident solar flux with respect to which the collector efficiency was calculated. ERA

N78-25629# Argonne National Lab., Ill. Chemical Engineering Div.

CONCEPTUAL DESIGN OF A 5x CPC FOR SOLAR TOTAL ENERGY SYSTEMS

R. L. Cole, W. W. Schertz, and W. P. Teagan (Little, Arthur D., Inc., Cambridge, Mass.) 1977 13 p. refs Presented at the Concentrating Solar Collector Conf., Atlanta, 26-28 Sep. 1977

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

(CONF-770953-5) Avail: NTIS HC A02/MF A01

The results of a conceptual design of a nontracking collector for a solar total energy system are described. A cycle turbine, generator, controls, thermal storage, and air conditioning equipment were installed and tested. The thermal energy for the facility is to be provided by a large concentrating collector field. A portion of the area is installed as E-W oriented linear parabolic troughs. Three additional concepts for the remaining area were selected: a fixed mirror-moving receiver system; fixed receiver-moving reflector slats; and a two-axis tracking parabolic dish. All four systems use diurnal tracking and have the reflecting surfaces exposed to the elements. ERA

N78-25630# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.

SOLAR TOTAL ENERGY: LARGE SCALE EXPERIMENT. PHASE 2: FORT HOOD, TEXAS Final Technical Progress Report

J. J. Buggy Sep. 1977 500 p. refs

(Contract EG-77-C-04-3988)

(TID-18040) Avail: NTIS HC A21/MF A01

Descriptions of the application, the selected Conceptual Design, and the performance of the system, as well as documentation of the major supporting studies that led to selection of the concept are presented. The approach consisted basically of a detailed definition of the specific design requirements which included a description of the interface connections with the existing Ft. Hood Building Complex. Equipment availability which could satisfy, in a practical way, the general system configuration requirements was evaluated. Real equipment designs or design alternates were then selected to form the basis for the concept design analysis, selections and sizing. Power conversion system concepts were developed that provided the design summer day and winter day thermal requirements. These concepts included both single and dual turbine systems, and in the case of dual turbine systems, both series and parallel arrangements were investigated. A complete site description, environmental impact study, and life-cycle cost analysis are included. ERA

N78-25631# Sandia Labs., Albuquerque, N. Mex.

VERTICAL AXIS WIND TURBINE TIE-DOWN DESIGN WITH AN EXAMPLE

R. C. Reuter, Jr. Dec. 1977 35 p. refs

(Contract EY-76-C-04-0789)

(SAND-77-1919) Avail: NTIS HC A07/MF A01

Design of cable tie-down systems for vertical axis wind turbines (VAWT) is discussed and guidelines are furnished. Topics such as the number, size and material of the cables, cable elevation angle, tensioning, and thermoelastic effects are discussed in detail. The tiedown system of an existing 17 meter VAWT is used throughout as a numerical example. ERA

N78-25632# Sandia Labs., Albuquerque, N. Mex. Aerodynamics Div.

FREE-AIR PERFORMANCE TESTS OF A 5-METRE-DIAMETER DARRIEUS TURBINE

R. E. Sheldahl and B. E. Blackwell Dec. 1977 36 p refs

(Contract EY-76-C-04-0789)

(SAND-77-1063) Avail: NTIS HC A03/MF A01

The results of these tests and some of the problems associated with free air testing of wind turbines are presented. The performance data obtained follow the general trend of data obtained in extensive wind tunnel tests of a 2 meter diameter turbine. However, the power coefficient data are slightly lower than anticipated. The reasons for this discrepancy are explored along with comparisons between experimental data and a computerized aerodynamic prediction model. ERA

N78-25633# California Univ., Berkeley. Lawrence Berkeley Lab.

STUDY OF BRINE TREATMENT Final Report

Sidney L. Phillips, Ashwani K. Mathur, and Raymond E. Doebler Nov. 1977 253 p refs

(Contract W-7405-eng-48; Proj. 791-1)

(EPRI-ER-476; LBL-6371) Avail: NTIS HC A12/MF A01

Information pertinent to the treatment of geothermal brines was collected by literature search and then evaluated and summarized for use by the electric and geothermal industries. The information was screened from the geothermal, oil and gas, wastewater disposal, and boiler water treatment industries. The current state of knowledge and methodology concerning the treatment of geothermal brines to control scaling and corrosion in geothermal electric power production was assessed. Currently, geothermal scale in pipes and wells is removed by physical or chemical methods. There is a growing effort on developing methods to control scale formation for both fresh and spent brines, including pH adjustment and application of an electrical potential for fresh fluids, and coagulation to treat spent fluids. Current methods of corrosion control center around planned replacement of piping and other plant components, with efforts focused primarily on development of materials with improved corrosion resistance. ERA

N78-25634# California Univ., Livermore. Lawrence Livermore Lab.

PRELIMINARY TESTS USING A LASER PARTICLE-SIZE ANALYZER ON GEOTHERMAL BRINE

J. Grens 18 Nov. 1977 18 p refs

(Contract W-7405-eng-48)

(UCID-17637) Avail: NTIS HC A02/MF A01

A laser light-scattering particle-size analyzer was used for a two-day period under limited field conditions to observe the occurrence and growth of particles in geothermal brines. Tests were conducted under conditions where both pH and rate of cooling to room temperature strongly influence the size and nature of the particulate population, with a low (4.5) pH and rapid quenching favoring slow growth rates. A method for estimating particulate mass in time periods shorter than 6 h from quenching is presented. Some implications for sampling and solids analysis are discussed. ERA

N78-25635# California Univ., Livermore. Lawrence Livermore Lab.

POTENTIAL GROWTH OF ELECTRIC POWER PRODUCTION FROM IMPERIAL VALLEY GEOTHERMAL RESOURCES

D. L. Ermak Sep. 1977 33 p refs

(Contract W-7405-eng-48)

(UCRL-52252) Avail: NTIS HC A03/MF A01

The growth of geothermal electric power operations in Imperial Valley, California is projected over the next 40 years. With commercial power forecasts to become available in the 1980's, the scenario considers three subsequent growth rates: 40, 100, and 250 MW per year. These growth rates, along with estimates of the total resource size, result in a maximum level of electric power production ranging from 1000 to 8000 MW to be attained in the 2010 to 2020 time period. Power plant siting constraints are developed and used to make siting patterns for the 400 through 8000 MW level of power production. Two

geothermal technologies are included in the scenario: flashed steam systems that produce cooling water from the geothermal steam condensate and emit noncondensable gases to the atmosphere; and high pressure, confined flow systems that inject the geothermal fluid back into the ground. ERA

N78-25636# California Univ., Livermore. Lawrence Livermore Lab.

REMOVAL OF SILICA FROM SPENT GEOTHERMAL BRINE

Richard W. Ryon and John H. Hill Dec. 1977 8 p refs

(Contract W-7405-eng-48)

(UCID-17702) Avail: NTIS HC A02/MF A01

Preliminary survey experiments conducted at the LLL Salton Sea Geothermal Test Site in April and May, 1977 are reported. The addition of caustic to raise the brine pH to approximately 6 precipitated silica and other materials. The addition of flocculating agents, such as ferric hydroxide, aids settling and filtration. Small-scale pilot plant studies are recommended. ERA

N78-25637# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.

RESOURCE, TECHNOLOGY, AND ENVIRONMENT AT THE GEYSERS

Oleh Weres, Karen Tsao, and Byron Wood Jun. 1977 348 p refs

(Contract W-7405-eng-48)

(LBL-5231) Avail: NTIS HC A15/MF A01

A general review, description, and history of geothermal development at the geysers is presented. Particular emphasis is placed on environmental impacts of development of the area. The discussion is presented under the following chapter titles: introduction; energy, enthalpy and the First Law; vapor-producing geothermal reservoirs-review and models; geothermal; entropy and the Second Law; power plants-basics; H₂S emissions; hydrogen sulfide-possible health effects and odor; other emissions; power plant hydrogen sulfide abatement; hot water based geothermal development; phytotoxicity of geothermal emissions; appendices; and bibliography. ERA

N78-25639# Babcock and Wilcox Co., Alliance, Ohio. EVALUATION OF DEVOLATILIZATION CONCEPT Final Report

R. K. Bhada, R. H. Boll, A. J. Kubasco, and W. L. Sage Dec. 1977 209 p refs

(EPRI Proj. 523-1)

(EPRI-AF-608) Avail: NTIS HC A10/MF A01

The concept of increasing gas heating value from an air-blown entrained gasifier by feeding some or all of the coal to a devolatilizer vessel downstream of the gasifier was evaluated. A pilot plant was constructed consisting of a one foot diameter gasifier and an eight inch I.D. by eight feet high devolatilizer. A total of forty-three test runs were conducted using an eastern bituminous coal as well as a western subbituminous coal. Three modes of operation were employed; all coal feed to the gasifier, all coal feed to the devolatilizer, and a 50 to 50 split between the two. The results of the analysis of the pilot plant data are presented. ERA

N78-25640# Argonne National Lab., Ill. INSTRUMENTATION AND PROCESS CONTROL FOR FOSSIL DEMONSTRATION PLANTS Quarterly Technical Progress Report, Apr. - Jun. 1977

E. F. Bennett, C. E. Cohn, S. A. Cox, L. R. Dates, R. W. Doering, D. Duffey, E. F. Groh, C. L. Herzenberg, L. W. Kirsch, W. W. Managan et al Jul. 1977 97 p refs

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

(ANL/FE-49622-9) Avail: NTIS HC A05/MF A01

Work was performed on updating the study of the state-of-the-art of instrumentation for fossil demonstration plants (FDP), development of mass-flow and other on-line instruments for FDP, process control analysis for FDP, and organization of a symposium on instrumentation and control for FDP. A solid gas flow test facility under construction for instrument development, testing, evaluation, and calibration is described. The development work for several mass-flow and other on-line instruments is described:

acoustic flowmeter, capacitive density flowmeter, neutron activation flowmeter and composition analysis system, gamma ray correlation flowmeter, optical flowmeter, and capacitive liquid interface level meter. ERA

N78-25641# Daystar Corp., Burlington, Mass.
SOLAR ENERGY IN HIGH-RISE BUILDINGS

Oct. 1977 86 p refs

(Contract EA-77-X-01-1963)

(DSE/1963-1) Avail: NTIS HC A05/MF A01

An 88 collector solar domestic hot water system was installed during the summer of 1976 on a subsidized elderly housing project in Brookline, Massachusetts. No government funding or support of any kind was associated with this installation which is believed to be the largest multi-family high-rise (16 stories) solar domestic hot water system in the USA. This case study report of the project was prepared as a guide for similar programs. A summary of the events which occurred in the proposal and approval phase of the project is included in addition to interviews with individuals who were involved in the decision-making process. Also included are a copy of the proposal used in selling the project, photographs of the completed system, and other support materials developed and utilized in marketing this project. ERA

N78-25642# Sandia Labs., Livermore, Calif.
ANALYSIS OF THE THERMAL FATIGUE INDUCED BY DNB OSCILLATIONS IN THE MDAC ROCKETDYNE PILOT AND COMMERCIAL PLANT SOLAR RECEIVER DESIGNS

J. F. Jones, Jr. and D. L. Siebers Dec. 1977 49 p refs

(Contract EY-76-C-04-0789)

(SAND-77-8283) Avail: NTIS HC A03/MF A01

A theoretical investigation is presented of the high cycle fatigue damage that may result from temperature oscillations in the boiler tube wall around the location of the point of departure from nucleate boiling (DNB) in a receiver subsystem for the pilot and commercial solar power plants. The problem was analyzed using the SAHARA and HEATMESH heat transfer codes and the GNATS structural analysis code. The results of the structural analysis show that fatigue damage due to DNB oscillations will not be a substantial problem in the pilot plant, but may cause a significant reduction in the life of the commercial receiver. It was found, however, that the results are highly dependent on the nature of the internal flow characteristics. ERA

N78-25643# Institute of Gas Technology, Chicago, Ill.
APPLICATION ANALYSIS OF SOLAR TOTAL ENERGY TO THE RESIDENTIAL SECTOR Quarterly Technical Status Report, 1 Oct. - 31 Dec. 1977

T. Whaley, B. Yudow, N. Malik (GKC), M. Gamze (GKC), B. Foster, T. Goff, J. Wurm, D. Deyoe (S. Cal. Gas), and G. Smith (Honeywell) Jan. 1978 287 p refs

(Contract EG-77-C-04-3787; IGT Proj. 8987)

(TID-28104) Avail: NTIS HC A13/MF A01

The application of solar total energy to appropriate segments of the residential sector, the market penetration potential for STE systems, and criteria for selecting suitable demonstration sites throughout the United States are presented. Concentration of single-family houses, townhouses, lowrise apartments, and high-rise apartments were projected to the 1980-1990 time frame for eleven regions of the country. The performance of both a low temperature system and a high-temperature system was analyzed by a computer program that simulates hourly performance of the conceptual STES designs. ERA

N78-25644# Energy Research and Development Administration, Albuquerque, N. Mex.

SOLAR TOTAL ENERGY SYSTEM: LARGE SCALE EXPERIMENT, SHENANDOAH, GEORGIA. VOLUME 1. SECTION 1: CONCLUSIONS AND RECOMMENDATIONS. SECTION 2: SYSTEMS REQUIREMENTS

17 Oct. 1977 153 p

(Contract EG-77-C-04-3987)

(ALO/3987-1/1-Vol-1) Avail: NTIS HC A08/MF A01

Baseline design recommendations, facility requirements, solar system, schedules and costs are described for a large scale

solar total energy experiment designed to provide both thermal and electrical power to a knitwear factory employing 300 people. The systems requirements analysis covers loads, energy displacement, local laws and ordinances, life cycle costs, health and safety, environmental and reliability assessments, and utility interface. ERA

N78-25645# California Univ., Livermore. Lawrence Livermore Lab.

MECHANICAL ENGINEERING DEPARTMENT Quarterly Report, Jul. - Sep. 1977

R. G. Stone, ed., M. B. Bathgate, ed., D. N. Cornish, D. W. Deis, A. R. Harvey, D. G. Hirzedl, J. E. Johnston, R. L. Leber, R. L. Nelson, J. P. Zbasnik et al 30 Sep. 1977 34 p refs

(Contract W-7405-eng-48)

(UCRL-50016-77-3) Avail: NTIS HC A03/MF A01

The initial efforts were directed toward developing optical and heat transfer codes to model the inflated cylindrical concentrator performances. These codes gave detailed information on how geometry, optical and thermal properties, and ambient conditions affect collector performance. It was found that surface properties of the receiver tube are critical. The annular gap size between the receiver tube and the surrounding plastic jacket was investigated. Results indicate that manually reorienting the collector tilt once a week in the north-south plane gives 90% of the obtainable by active tracking in the north-south plane each day. ERA

N78-25646# California Univ., Berkeley. Lawrence Berkeley Lab.

ANAEROBIC FERMENTATION OF SIMULATED IN-SITU OIL SHALE RETORT WATER

E. A. Ossio, J. P. Fox, J. F. Thomas, and R. E. Poulson (DOE, Laramie, Wyo.) Nov. 1977 13 p refs Presented at the Meeting of the Am. Chem. Soc., Anaheim, Calif., 22-23 Mar. 1978

(Contract W-7405-eng-48)

(LBL-6855; Conf-780305-6) Avail: NTIS HC A02/MF A01

The feasibility of removing soluble organics from oil shale retort water by anaerobic digestion with methane production was experimentally investigated. The following conclusions were made. The retort water studied had to be pretreated to remove toxic and add deficient constituents before it could be successfully treated with the anaerobic fermentation process. Pretreatment included pH adjustment to 7, ammonia reduction, and nutrient addition. A digested sludge from a conventional municipal sewage treatment plant was successfully acclimated to the retort water studied. A major fraction of the organics in the retort water studied was stabilized by conversion to CH₄ and CO₂ using the anaerobic fermentation process. ERA

N78-25647# Oak Ridge National Lab., Tenn. Chemical Technology Div.

EVALUATION OF IN SITU COAL GASIFICATION PROCESSES ON A REGIONAL BASIS

W. C. Ulrich Dec. 1977 61 p refs

(Contract W-7405-eng-26)

(ORNL-5279) Avail: NTIS HC A04/MF A01

A comparison was made of four candidate in situ coal gasification processes on the basis of a qualitative assessment of their technical merits and their suitability for application to various resource types and configurations in the continental United States. Three seam thickness, two seam dips, and seam depths to 3000 ft were considered. The United States was divided into four regions, and a predominant or representative coal type was selected within each region for purpose of displaying each candidate process to its best advantage. Russian experience, where it applies to the regional conditions under consideration, is described. Current techniques for linking wells drilled into coal seams are either slow, erratic, and/or costly. Therefore, to reduce the time and expense of in situ gasification, it is necessary to develop reliable, rapid linking techniques for the different coal types, various resource configurations, and diverse geological conditions. Author.

N78-25648# Combustion Engineering, Inc., Windsor, Conn. Power Systems Group.

SAMPLING AND ANALYSIS REQUIREMENTS FOR LOW-BTU GASIFICATION OF COAL FOR ELECTRIC POWER GENERATION Final Report, Feb. 1975 - Aug. 1976

David M. Farrell Apr. 1977 142 p refs
(Contract EX-76-C-01-1545)

(FE-1545-38) Avail: NTIS HC A07/MF A01

Process analytical instrumentation requirements were identified for a 5 ton per hour, low Btu, atmospheric pressure, entrained bed, coal gasification process development unit (PDU). Special process instruments (primarily used for gas analysis and not usually encountered in boiler design applications) which are needed to satisfy measurement requirements were selected from instrument operating characteristics/features to provide reliable and straightforward measurement. Both in situ and extractive type instruments were selected for purchase. The necessary extractive sampling network was defined. Application of the instruments selected for the PDU to a commercial scale gasification plant was examined. It was concluded that with only few modifications, the same of similar instruments used on the PDU, can be used on commercial scale plants. ERA

N78-25649# Dow Chemical Co., Midland, Mich. Hydrocarbons and Energy Research Dept.

ENERGY FROM IN SITU PROCESSING OF ANTRIM OIL SHALE Quarterly Technical Progress Report, Jul. - Sep. 1977

J. P. Humphrey 18 Oct. 1977 39 p
(Contract EX-76-C-01-2346)

(FE-2346-16; DOW/SRPR-16) Avail: NTIS HC A03/MF A01

The first in situ extraction trial has been completed using an electrical heater to initiate combustion. Evidence of oxidation was obtained by analysis of gases from the production well. An attempt to induce horizontal fractures, was halted when vertical fractures were induced by the pressure applied to seal off a zone with a packer. Shale characterization work and resource inventory activity are well underway. ERA

N78-25650# Energy Research and Development Administration, Pittsburgh, Pa. Energy Research Center.

RESEARCH IN COAL-BASED MAGNETOHYDRODYNAMICS Quarterly Technical Progress Report, Apr. - Jun. 1977

D. Bienstock 1977 20 p refs

(TID-27893) Avail: NTIS HC A02/MF A01

Runs were made in the nominal 5 megawatt pressurized MHD coal gasifier-combustor pilot plant including the first operation on coal. Several facility system improvements were made as a result of the first coal run. Testing of a scroll-type cyclone combustor was completed. Three additional tests using pittsburg seam coal were conducted with the original side-entry cyclone combustor. A third cyclone configuration, featuring top entry of fuel and air, was installed in the atmospheric pressure facility. Work was completed on a technical and economic evaluation of the PERC scheme for sulfur elimination from coal-fired MHD power plant. Program SCOOP (Staged Combustor Operation Optimizer Program) was run in routine support for about five computer hours. Implementation of the numerically stable linear programming code analyzes coals for enthalpy of formation in routine SCOOP runs. A cyclone combustor code was reviewed and coupled to a multiphase equilibrium code BUSTION. ERA

N78-25651# Argonne National Lab., Ill.

EXPERIMENTAL TWO-PHASE LIQUID-METAL MAGNETOHYDRODYNAMIC GENERATOR PROGRAM Annual Report, Aug. 1975 - Sep. 1976

M. Petrick, G. Fabris, E. S. Pierson, D. A. Carl, A. K. Fischer, and C. E. Johnson Sep. 1977 101 p refs
(Contract W-31-109-eng-38)

(ANL-MHD-77-3) Avail: NTIS HC A06/MF A01

The revised ambient-temperature NaK-nitrogen facility is described. The maximum liquid flow rate and generator inlet pressure are 10.9 kg/s (200 gpm) and 1.48 MPa/sub a/ absolute (200 psig), respectively, compared with the previous values of 6kg/s (110 gpm) and 0.72 MPa absolute (90 psig). Satisfactory loop operation was obtained, and new experiments with the second diverging-channel generator were completed. The principal

experimental results were a higher power density for the same generator operating conditions, and an apparent tendency for the efficiency to improve more with increasing quality at higher velocities than lower velocities. An evaluation of an annular generator geometry is presented. The advantages and disadvantages of the geometry are described, the equations developed, and solutions obtained for three cases-constant velocity and no armature reactions, laminar flow with no armature reaction, and armature reaction with constant velocity. ERA

N78-25652# Dow Chemical Co., Midland, Mich. Hydrocarbons and Energy Research Dept.

ENERGY FROM IN SITU PROCESSING OF ANTRIM OIL SHALE Monthly Technical Progress Report, Nov. 1977

John P. Humphrey 19 Dec. 1977 14 p

(Contract EX-76-C-01-2346)

(FE-2346-19; DOW/SRPR-19) Avail: NTIS HC A02/MF A01

Reported are in situ fracturing and assessment, in situ extraction trials; shale characterization and resource evaluating; and environmental, public, policy, and legal assessment. ERA

N78-25653# Sandia Labs., Albuquerque, N. Mex.

OIL SHALE PROGRAMS Quarterly Report, Apr. - Jun. 1977

R. R. Boade, ed. Oct. 1977 64 p refs
(Contract EY-76-C-04-0789)

(SAND-77-1497; QR-6) Avail: NTIS HC A04/MF A01

The operating characteristics of an oxygen probe (to monitor oxygen concentration in the effluent gases of a retort) were enhanced by improvements in the sensing electrodes and seals of the unit. Three hydrofractures were formed for the rubblization experiment scheduled for later this year. The dependence of the fracture properties of oil shale on rate of deformation was examined through an analysis in which theoretical predictions were compared with experimental observations. Author

N78-25655# New England Federal Regional Council. Energy Resource Development Task Force.

POTENTIAL OF WOOD AS AN ENERGY RESOURCE IN NEW ENGLAND

Joseph M. Pecoraro, Robert Chase, Peter Fairbank, and Richard Meister Sep. 1977 100 p refs

(TID-28131) Avail: NTIS HC A05/MF A01

Topics discussed include: the benefits of utilizing the forest as an energy resource; the availability of commercial forest land; the harvesting and transportation of timber for wood energy projects; and institutional problems associated with developing the forest as an energy resource in New England. ERA

N78-25657# National Technical Information Service, Springfield, Va.

TOTAL ENERGY SYSTEMS FOR BUILDINGS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1984 - Mar. 1978

Audrey S. Hundemann, ed. Mar. 1978 74 p Supersedes NTIS/PS-77/0273; NTIS/PS-76/0275 (NTIS/PS-78/0306; NTIS/PS-77/0273; NTIS/PS-76/0275) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10B

Technology and economics associated with total energy systems are discussed in these Federally-funded research citations. These systems employ a primary source of energy, such as oil, natural gas, or solar heat to provide comprehensive energy requirements in the form of light, heating, cooling, air conditioning, drying, process heat, and power for an industrial plant or for a commercial or public building. Included are schemes for electricity generation, waste heat recovery, and direct drive of mechanical equipment coupled to a prime mover. Abstracts primarily pertain to Modular Integrated Utility Systems (MIUS) technology as applied to residential complexes; a few abstracts deal with MIUS technology for military facilities and commercial buildings. Topic areas cover social costs, energy conservation potential, and the use of solar energy in total energy systems.

GRA

N78-25658# National Technical Information Service, Springfield, Va.

TOTAL ENERGY SYSTEMS FOR BUILDINGS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Mar. 1978

Audrey S. Hundemann, ed. Mar. 1978 157 p Supersedes NTIS/PS-77-0272; NTIS/PS-76/0274 (NTIS/PS-78/0305; NTIS/PS-77/0272; NTIS/PS-76/0274) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10B For abstract, see N78-25657.

N78-25659# National Technical Information Service, Springfield, Va.

PETROLEUM RECOVERY. VOLUME 2: RESERVOIR ENGINEERING AND RECOVERY METHODS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1976 - Mar. 1977

Audrey S. Hundemann Mar. 1978 184 p (NTIS/PS-78/0278) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 08G

Thermal recovery methods and well stimulation using waterflooding, steam injection, gas injection, and fluid injection techniques are discussed. Topic areas cover fire flooding, caustic water flooding, miscible displacement, microemulsion flooding, polymer flooding, carbon dioxide miscible flooding, control of water mobility using polymers, and heat loss calculations. Reservoir modeling and simulation studies and studies pertaining to well logging, core analysis, and well perforation are included. A few abstracts discuss techniques of determining residual oil saturation, predicting oil recoverability, and monitoring the degree of flooding. (This updated bibliography contains 177 abstracts, none of which are new entries to the previous edition.)

GRA

N78-25660# National Technical Information Service, Springfield, Va.

PETROLEUM RECOVERY. VOLUME 3: RESERVOIR ENGINEERING AND RECOVERY METHODS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, Apr. 1977 - Feb. 1978

Audrey S. Hundemann Mar. 1978 218 p Supersedes NTIS/PS-77/0233 (NTIS/PS-78/0279; NTIS/PS-77/0233) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 08G

For abstract, see N78-25659.

N78-25661# National Technical Information Service, Springfield, Va.

WASTE HEAT UTILIZATION. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Mar. 1978

Audrey S. Hundemann Mar. 1978 258 p Supersedes NTIS/PS-77/0283; NTIS/PS-76/0276; NTIS/PS-75/215; COM-74-11138; COM-73-11582 (NTIS/PS-78/0294; NTIS/PS-77/0283; NTIS/PS-76/0276; NTIS/PS-75/215; COM-74-11138; COM-73-11582) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10A

Federally-funded research on techniques of recovering waste heat from power plants, buildings, industrial processes, and waste disposal is covered. Studies of waste heat boilers and the use of waste heat for irrigation, sewage treatment, odor control, desalination, heating, and aquaculture are included. GRA

N78-25662# National Technical Information Service, Springfield, Va.

WASTE HEAT UTILIZATION. VOLUME 3. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1977 - Mar. 1978

Audrey S. Hundemann Mar. 1978 160 p Supersedes NTIS/PS-77/0284; NTIS/PS-76/0278 (NTIS/PS-78/0296; NTIS/PS-77/0284; NTIS/PS-76-0278) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10A

Worldwide research of waste heat from industrial process plants, electric power plants, buildings, and incineration of wastes is covered. Emphasis is on energy conservation in industrial plants. Studies of waste heat boilers and the use of waste heat for irrigation, sewage treatment, odor control, desalination, and heating are included. GRA

N78-25663# National Technical Information Service, Springfield, Va.

WASTE HEAT UTILIZATION. VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1975-1976

Audrey S. Hundemann Mar. 1978 187 p (NTIS/PS-78/0295) Copyright. Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10A

For abstract, see N78-25662.

N78-25671# New Hampshire Univ., Durham. **INVESTIGATION OF THE MECHANISM OF FLY-ASH FORMATION IN COAL-FIRED UTILITY BOILERS Quarterly Report, 1 May 1977 - 31 Jul. 1977**

G. D. Ulrich 24 Aug. 1977 10 p refs

(Contract EX-76-C-01-2205)

(FE-2205-8) Avail: NTIS HC A02/MF A01

A probe was developed and chemical analysis techniques were established for quantitative fly-ash analysis. The program for computing condensed-phase equilibria is ready for use in a theoretical analysis. A model for submicron fly-ash formation and growth was developed. ERA

N78-25674# Radian Corp., Austin, Tex. **ASSESSMENT, SELECTION, AND DEVELOPMENT OF PROCEDURES FOR DETERMINING THE ENVIRONMENTAL ACCEPTABILITY OF SYNTHETIC FUEL PLANTS BASED ON COAL, APPENDIX 2**

R. G. Oldham and R. G. Wetherold May 1977 495 p refs Revised

(Contract EX-76-C-01-1795; Contract E(49-18)-1795)

(FF-1795-3-Pt-2-Rev) Avail: NTIS HC A21/MF A01

Process engineering analyses were conducted on five processes considered representative of the emerging technologies: Koppers-Totzek, Lurgi, Solvent Refined Coal, Synthane, and Synthoil. A detailed analysis was performed on a generalized coal handling facility which was common to all of the above processes. The process engineering analyses were conducted from a mass and energy balance orientation. All process streams, including effluent streams, were fully characterized as to temperature, pressure, phase, bulk composition and flow rate. Possible paths of pollutants were followed through the selected processes. All gaseous, liquid and solid effluents were identified, with special emphasis being placed on the EPA criteria pollutants and trace organics and inorganics contained in these streams. A sampling approach generally applicable to all coal conversion processes was developed. ERA

N78-25678# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.

ENERGY/ENVIRONMENT 2. PROCEEDING OF 2ND

NATIONAL CONFERENCE ON THE INTERAGENCY R AND D PROGRAM

Richard Laska, ed. and Kathleen Dixon, ed. Nov. 1977 515 p
 refs Proc. held at Washington, D. C., 6-7 Jun. 1977
 (Contract EPA-68-01-2934)
 (PB-277917; EPA-600/9-77-025) Avail: NTIS
 HC A22/MF A01 CSCL 13B

The proceedings from the Second National Conference on the Interagency Energy/Environment R&D Program are reported. All papers presented at the conference along with discussion from question and answer periods are included in the text. This volume is part of the Energy/Environment R&D Decision Series. The series presents the key issues and findings of the Federal Interagency Energy/Environment Research and Development Program in a format conducive to efficient information transfer. Planned and coordinated by the Environmental Protection Agency (EPA), research projects supported by the program range from the analysis of health and environmental effects of energy systems to the development of environmental control technologies. The works in this series reflect the full range of program concerns.

GRA

N78-25701# National Technical Information Service, Springfield, Va.

POLLUTION AND ENVIRONMENTAL ASPECTS OF FUEL CONVERSION. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Mar. 1978

Audrey S. Hundemann Apr. 1978 218 p. Supersedes
 NTIS/PS-77/0212; NTIS/PS-76/0222 and NTIS/PS-75/371
 (NTIS/PS-78/0314; NTIS/PS-77/0212; NTIS/PS-76/0222;
 NTIS/PS-75/371) Avail: NTIS HC \$28.00/MF \$28.00 CSCL
 07A

Abstracts dealing with environmental impacts related to fossil fuel conversion processes (primarily coal gasification) are presented. A few citations concerning environmental considerations pertaining to future energy growth are included. GRA

N78-25719# Mound Lab., Miamisburg, Ohio. GEOCHEMICAL CHARACTERIZATION OF DEVONIAN GAS SHALE

Ronald E. Zielinski 1977 24 p refs Presented at the Eastern Gas Shale Program Conf., Morgantown, W. Va., 17 Oct. 1977
 (Contract EY-76-C-04-0053)
 (MLM-2467(OP); Conf-771038-4) Avail: NTIS
 HC A02/MF A01

Detailed geochemical analyses are being used to provide an accurate assessment of the oil and gas resources present in the Devonian shales in the Appalachian and Illinois Basins. The suite of geochemical analyses is designed to evaluate the organic richness, the hydrocarbon potential, the type of organic matter and the thermal maturity of the organic matter. Laboratory techniques such as pyrolysis gas chromatography and mass balance thermal extraction were also employed to measure thermally derived oil and gas yields from the Devonian shales. Stable carbon isotope geochemistry has also been initiated. The first phase of this study involved the determination of stable carbon isotope values for shale core samples. ERA

N78-25720# Mound Lab., Miamisburg, Ohio. PHYSIOCHEMICAL CHARACTERIZATION OF DEVONIAN GAS SHALE

R. E. Zielinski, A. Attalla, E. Stacy, B. D. Craft, and R. L. Wise 1977 24 p refs Presented at the Eastern Gas Shale Program Conf., Morgantown, W. Va., 17 Oct. 1977
 (Contract EY-76-C-04-0053)
 (MLM-2466(OP); Conf-771038-3) Avail: NTIS
 HC A02/MF A01

Several physicochemical analyses are being performed to better characterize the Devonian gas shales located in the Appalachian and Illinois Basins. The results of these analyses are being integrated with the geochemical analyses to present an accurate characterization of the Devonian shales and to accurately assess their resource potential. These studies are also providing data that are being used to evaluate the physical behavior of the shales. ERA

N78-25722# California Univ., Livermore. Lawrence Livermore Lab.

HYDROGEOCHEMICAL AND STREAM-SEDIMENT SURVEY OF THE NATIONAL RESOURCE EVALUATION (NURE) PROGRAM: WESTERN UNITED STATES Quarterly Progress Report, Apr. - Jun. 1977

20 Sep. 1977 16 p
 (Contract W-7405-eng-48)
 (UCID-16911-77-2) Avail: NTIS HC A02/MF A01

Field work was completed for two reconnaissance sampling projects in southern Nevada and California and a reconnaissance sampling project in western Utah and eastern Nevada was started. Sampling was also completed for two orientation study areas in Arizona and planning and site selections finalized for two reconnaissance sampling projects in Nevada. The Great Basin groundwater sampling program continued on schedule. Although the instrumental neutron-activation analysis facility operated in automatic mode, hardware, and software development are continuing to increase reliability and facilitate automatic data processing. Procedures and equipment for generation precision map overlays and digitizing map data are nearly complete. ERA

N78-25742# Texas A&M Univ., College Station. Dept. of Oceanography.

DEVELOPMENT AND COORDINATION OF A PROGRAM OF ENERGY-RELATED OCEANOGRAPHIC RESEARCH AND THE CONTINENTAL SHELVES OF THE GULF OF MEXICO Progress Report, 1 Jan. 1976 - 30 Sep. 1977

T. K. Treadwell 1977 7 p
 (Contracts EY-76-S-05-5017; E(40-1)-5017)
 (ORO-5017-3) Avail: NTIS HC A02/MF A01

A workshop was organized to obtain inputs from scientists most familiar with the scientific problems in the Gulf shelf area. The results of this workshop are briefly summarized. Initial efforts at organization of the program are reported. ERA

N78-25920# Department of Energy, Washington, D. C. Div. of Magnetic Fusion Energy.

TOKAMAK IMPURITY REPORT

Dec. 1977 136 p refs
 (DOE/ET-0001) Avail: NTIS HC A07/MF A01

In May 1976, a meeting of Tokamak physicists was held in order to discuss what is known about impurities in Tokamaks, what one should be able to learn from planned experiments, and what issues remain unaddressed by present or future programs. Background and perspective for discussion as well as detailed information on impurities in Tokamaks is given. Attention was focused on impurities, the effects of neutral beam heating on impurity generation and the effects of impurities on neutral beam penetration and heating are presented. ERA

N78-25923# Argonne National Lab., Ill. PLASMA DRIVING SYSTEM REQUIREMENTS FOR COMMERCIAL TOKAMAK FUSION REACTORS

J. N. Brooks 1977 8 p refs Presented at the 7th Symp. on Fusion Res. Proj., Knoxville, Tenn., 25 Oct. 1977
 (Contract W-31-109-eng-38)
 (CONF-771029-191) Avail: NTIS HC A02/MF A01

Results for a single reactor configuration together with several design concepts for the driving system are summarized. Both the reactor configuration and the driving system concepts are natural extensions from the EPR. Thus, the new results can be compared with the previous EPR results to obtain a consistent picture of how the driving system requirements will evolve--for one particular design configuration. ERA

N78-25930# Argonne National Lab., Ill. THERMAL HYDRAULIC ANALYSES OF TWO FUSION REACTOR FIRST WALL/BLANKET CONCEPTS

B. Misra and V. A. Maroni 1977 8 p refs Presented at the 7th Symp. on Eng. Probl. of Fusion Res., Knoxville, Tenn., 25-28 Oct. 1977
 (Contract W-31-109-eng-38)
 (CONF-771029-178) Avail: NTIS HC A02/MF A01

Two liquid lithium blanket concepts for Tokamak-type reactors are discussed and compared. In one concept, lithium is circulated through 60 cm deep cylindrical modules oriented so that the module axis is parallel to the reactor minor radius. In the other, helium carrying channels oriented parallel to the first wall are used to cool a 60 cm thick stagnant lithium blanket. Paralleling studies were carried out wherein the thermal and structural properties of the construction materials were based on those projected for either solution-annealed 316 stainless steel or vanadium-base alloys. The effects of limitations on allowable peak structural temperature, material strength, thermal stress, coolant inlet temperature, and pumping power/thermal power ratio were evaluated. Consequences to thermal hydraulic performance resulting from the presence of or absence of a divertor were also investigated. ERA

N78-25938# Illinois Univ., Urbana. Fusion Studies Lab.
EXPLORATORY STUDIES OF HIGH-EFFICIENCY ADVANCE FUEL FUSION REACTORS Annual Report, Feb. 1977
Nov. 1977 175 p refs Prepared in cooperation with BNL and California Univ., Lawrence Livermore Lab.
(EPRI Proj. 645)
(EPRI-ER-581) Avail: NTIS HC A08/MF A01

The potential advantages and feasibility of using deuterium and D-He-3 fusion fuels rather than D-T are examined. The present report describes the first part of the study which was concerned with the use of Tokamak reactors to burn such fuels on the expectation that, due to the emphasis on such systems in the national R and D program, they will form the basis for the first generation of fusion power plants. Parameters are presented for three classes of reactors: D-D plants designed for He-3 generations as well as electrical production; D-He-3 Tokamak that would serve as satellites to the generators by burning He-3 in smaller, relatively clean plants suitable for near-urban siting; and self-contained catalyzed-D Tokamaks that burn T and He-3 from D-D fusion in-situ. The size scaling for these plants is, in descending order, D-D generators, catalyzed-D plants, and D-He-3 satellites. This flexibility in size and fuel allows a wide variation in characteristics that could well be vital to the full utilization of fusion power. ERA

N78-25939# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
ECONOMIC IMPACT OF USING REFRACTORY METALS FOR FUSION REACTORS, PHASE 1
J. W. Davis Oct. 1977 44 p refs
(Contract EG-77-C-02-4247)
(COO-4247-1) Avail: NTIS HC A03/MF A01

The following topics were considered: (1) TOCOMO computer code, (2) selection of a baseline reactor configuration, (3) selection of a power conversion system, (4) selection of refractory metals, (5) use of refractory metals in the first wall and blanket, (6) use of refractory metals in the primary coolant loop, and (7) the economic consequence of using an advanced conversion cycle. ERA

N78-25982# George Washington Univ., Washington, D. C.
LEGAL-INSTITUTIONAL ARRANGEMENTS FACILITATING OFFSHORE WIND ENERGY CONVERSION SYSTEMS (WECS) UTILIZATION Final Report
Louis H. Mayo Sep. 1977 103 p refs Sponsored by DOE
(Grant NSF APR-75-19137)
(DOE/NSF/19137-77/3) Avail: NTIS HC A06/MF A01

Concern for the continuing sufficiency of energy supplies in the U.S. has tended to direct increasing attention to unconventional sources of supply, including wind energy. Some of the more striking proposals for the utilization of wind energy relate to offshore configurations. The legal-institutional arrangements for facilitating the utilization of offshore wind energy conversion systems were examined by positioning three program alternatives and analyzing the institutional support required for the implementation of each. Author

N78-25983# George Washington Univ., Washington, D. C.
Program of Policy Studies in Science and Technology.
LEGAL-INSTITUTIONAL IMPLICATIONS OF WIND ENERGY CONVERSION SYSTEMS (WECS) Final Report
Sep. 1977 332 p refs Sponsored in part by DOE
(Grant NSF APR-75-19137)

(NSF/RA-770204) Avail: NTIS HC A15/MF A01

Because of the interplay between technical, economic, social, and legal factors, some information about wind systems, their likely applications, and the problems raised thereby is presented. The most significant legal obstacles to the utilization of land-based WECS are described. The features of the existing legal structure which may facilitate the implementation of such systems are discussed. The ways in which the legal situation varies with particular applications, and which applications pose the greatest and fewest legal difficulties are summarized. A separate section is devoted to the complex subject of offshore wind systems. ERA

N78-26007# North Dakota State Univ., Fargo. Dept. of Civil Engineering.

ULTRAFILTRATION AND HYPERFILTRATION OF PHENOLIC COMPOUNDS IN COAL GASIFICATION WASTEWATER STREAMS

Stanley L. Klemetson and Monte D. Scharbow [1977] 14 p refs Presented at the Intern. Conf. on Advan. Treat. and Reclamation of Wastewater Sponsored in part by DOE

(Grant NSF ENG-75-10251)

Avail: NTIS HC A02/MF A01

The treatment of phenolic compounds from coal gasification plants using ultrafiltration and hyperfiltration is presented. Dynamically formed hydrous zirconium (IV) oxide membranes on several types of supports were the focus of the investigation. The pH variations of 6.5 to 11, pressure variations of 250 to 1000 psig (1724 to 6895 kPa), and concentration variations of 1 to 400 mg/l were examined. Phenol reductions greater than 95 percent were obtained with several membranes, and flux rates were greater than 100 gpd/sq ft (4.08 cu m/day/sq m). Author

N78-26036# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Advanced Energy Storage Systems.

DEVELOPMENT SCHEDULES FOR VEHICLE ENERGY STORAGE SYSTEMS

1977 25 p refs

(Contract EY-76-C-02-2708-012)

(TID-28030) Avail: NTIS HC A02/MF A01

The development of advanced energy storage systems for electric and hybrid electric powered vehicles is discussed. A minimum of one year for flywheels and two years for batteries will be necessary to translate most laboratory concepts into production prototype designs with a minimum of testing to establish confidence in the anticipated performance. ERA

N78-26038# Oak Ridge National Lab., Tenn.

SOLID WASTE UTILIZATION: PYROLYSIS

William J. Boegly, Jr., William R. Mixon, Clark Dean (Hamilton Std. Div., United Aircraft Corp., Windsor Locks, Conn.), and Daniel J. Lidas (Hamilton Std. Div., United Aircraft Corp., Windsor Locks, Conn.) Aug. 1977 77 p refs Prepared for Argonne Natl. Lab., Ill.

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

(ANL/CES/TE-77-15) Avail: NTIS HC A05/MF A01

The use of pyrolysis is considered as a method of producing energy from municipal solid waste. The energy can be in the form of a gas, oil, chars, or steam. Pyrolysis, the decomposition of organic matter in the absence of oxygen (or in an oxygen-deficient atmosphere), is used to convert organic matter to other products or fuels. This process is also described as destructive distillation. Four processes are described in detail: the Landgard System (Monsanto Environ-Chem Systems, Inc.); the Occidental Research Corporation Process. Also included is a listing of other pyrolysis processes currently under development for which detailed information was not available. ERA

N78-26039# Little (Arthur D.), Inc., Cambridge, Mass.
STUDY OF FUTURE HEAT ENGINE VEHICLE SYSTEMS
Final Report

D. A. Hurter Jul. 1977 31 p Prepared for California Univ., Lawrence Livermore Lab.
 (Contract W-7405-eng-48)

(UCRL-13781) Avail: NTIS HC A03/MF A01

The vehicles considered are all extensions of present heat engine technology. Data are given on the change in fuel economy, incremental change in consumer cost, and total vehicle weight by vehicle size for each of the time periods. The most likely technical improvements and the timing for their introduction are indicated. Fuel economy is possible with relatively low technical risk until the years 1990-2000. ERA

N78-26098*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COLD-AIR PERFORMANCE OF THE COMPRESSOR-DRIVE TURBINE OF THE DEPARTMENT OF ENERGY BASELINE AUTOMOBILE GAS-TURBINE ENGINE Final Report

Richard J. Roelke and Kerry L. McLallin Jul. 1978 24 p refs (Contract EC-77-A-31-1011)

(NASA-TM-78894; E-9480; DOE/NASA/1011-78/25) Avail: NTIS HC A02/MF A01 CSCL 01A

The aerodynamic performance of the compressor-drive turbine of the DOE baseline gas-turbine engine was determined over a range of pressure ratios and speeds. In addition, static pressures were measured in the diffusing transition duct located immediately downstream of the turbine. Results are presented in terms of mass flow, torque, specific work, and efficiency for the turbine and in terms of pressure recovery and effectiveness for the transition duct. Author

N78-26146*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

LIQUID-COOLING TECHNOLOGY FOR GAS TURBINES REVIEW AND STATUS

G. James VanFossen, Jr. (Army Res. and Technol. Labs.) and Francis S. Stepka Aug. 1978 14 p refs Proposed for presentation at the 13th Intersoc. Energy Conversion Eng. Conf., San Diego, Calif., 20-25 Aug. 1978; sponsored by the SAE, ACS, AIAA, ASME, IEEE, AIChE, and ANS

(NASA-TM-78906; AVRADCOM-TR-78-26(PL); E-9517-1) Avail: NTIS HC A02/MF A01 CSCL 21E

A review of research related to liquid cooling of gas turbines was conducted and an assessment of the state of the art was made. Various methods of liquid cooling turbines were reviewed. Examples and results with test and demonstrator turbines utilizing these methods along with the advantages and disadvantages of the various methods are discussed. B.B.

N78-26154*# General Research Corp., McLean, Va.
SOLAR SAIL-SOLAR ELECTRIC TECHNOLOGY READINESS AND TRANSFER ASSESSMENT Final Report

Ramon L. Chase Aug. 1977 62 p

(Contract NASw-2973)

(NASA-CR-157239; Rept-709-01-CR; WGRC-77-4764) Avail: NTIS HC A04/MF A01 CSCL 22A

A method of conducting a technology readiness assessment was developed. It uses existing OAST technology readiness and risk criteria to define a technology readiness factor that considers both the required gain in technology readiness level to achieved technology readiness plus the degree of effort associated with achieving the gain. The results indicate that Solar Electric Propulsion is preferred based on technology readiness criteria. Both Solar Sail and Solar Electric Propulsion have a high level of transfer potential for future NASA missions, and each has considerable technology spillover for non-NASA applications. Author

N78-26190# Georgetown Univ., Washington, D.C.

INDUSTRIAL APPLICATION OF FLUIDIZED-BED COMBUSTION Quarterly Technical Progress Report, Jul. - Sep. 1977

Oct. 1977 15 p

(Contract EX-76-C-01-2461)

(FE-2461-5) Avail: NTIS HC A02/MF A01

Progress is reported in the design of a prototype plant and atmospheric fluidized bed boiler for burning high sulfur coals in an environmentally acceptable manner in an urban institutional complex. The boiler, to be located on the Georgetown University campus, will have the capacity to generate 100,000 pounds per hour of saturated steam. Data from the prototype operation will be used in the design and construction of commercially warranted industrial size fluidized bed boiler units. A.R.H.

N78-26217# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.

DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS Quarterly Report, 1 Apr. - 30 Jun. 1977

J. W. Sadler, W. E. Young, L. H. Codoff, J. A. Dillmore, E. L. Kochka, J. A. Kuszyk, J. Lempert, B. R. Rossing, S. J. Schneider, and A. B. Turner Jul. 1977 106 p refs

(Contract EX-76-C-01-2248)

(FE-2248-15) Avail: NTIS HC A06/MF A01

Ceramic MHD electrodes for both clean fuel and coal fired environments were designed, fabricated, and evaluated. The tests verified design prediction of material temperatures and heat fluxes. Both the test facility and test section demonstrated their suitability as test vehicles for long duration testing of generator materials and designs. A number of designs reflecting various electrode to copper cooling block attachment techniques were examined. These techniques involved the use of a compliant material (metal or organic) to reduce mechanical stresses in the ceramic electrode structures. Laboratory screening tests indicate that both MgCr2O4 and MO2Si are resistant to slag corrosion and can be seriously considered as anode materials for semi-hot slagging wall operation (T/sub wall/ = 900 to 1500 C). ERA

N78-26223*# National Aeronautics and Space Administration, Washington, D. C.

AVIATION FUELS BEYOND THE 1980'S

Willson H. Hunter (NASA Senior Sci. Representative, Canberra, Australia) 1978 17 p refs Presented at the Symp. on Aviation Fuel in the 1980's, Melbourne, 26-27 Jun. 1978; sponsored by the Inst. of Engr. Australia and the Australian Inst. of Petrol. (NASA-TM-79510) Avail: Issuing Activity CSCL 21D

The competitive use and effect of coal-derived synthetic JET-A and cryogenic liquid methane (LCH4) and liquid hydrogen (LH2) fuels on the design, mass and operation of large subsonic, supersonic and hypersonic transport aircraft are analyzed. Overall energy and cost efficiency comparisons are presented from studies of JET-A and LH2 fuels usage in subsonic and supersonic transports. The probable concerns of the public and the aviation industry over the use of the coal-derived fuels are discussed. The possibility that space-flight-vehicle-derived technology may be applied to special purpose passenger transports is considered. The likelihood that petroleum-derived fuels similar to JET-A will continue in major use in aviation for the foreseeable future is predicted. Author

N78-26226# Department of Energy, Bartlesville, Okla. Energy Research Center.

EXPERIMENTS WITH NOVEL FUELS FOR DIESEL ENGINES

W. F. Marshall Feb. 1978 7 p

(BERC/TPR-77/8) Avail: NTIS HC A02/MF A01

Engine tests were conducted with two fuels that would be considered as novel for use in diesel engines. The fuels, methanol and a water/diesel fuel emulsion, were used because of their potential for reductions in exhaust emissions. The test results showed that these fuels yield no advantages over standard diesel fuel with respect to emissions of unburned hydrocarbons and oxides of nitrogen. Although smoke and carbon monoxide emissions were reduced with the use of the water/fuel emulsion, the same effect could also be achieved via engine adjustment. ERA

N78-26226# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

IMPACT OF ALTERNATE FUELS ON REFRACTORIES AND REFRACTORY INSULATIONS

May 1977 67 p refs Sem. held in Washington, D.C., 21 Sep. 1976

(Contract W-7405-eng-26)

(ORNL-TM-5895-Add; Conf-7609156)

Avail: NTIS

HC A04/MF A01

Topics covered in the seminar include: assessment of the impact of alternate fuels on refractories and refractory insulations; alternate fuel experience in refractory manufacturing; slagging of refractories by ash from alternate fuels; and substitution of coal for natural gas in face brick production. A panel discussion following the formal presentations is summarized. Author (ERA)

N78-26227# Department of Energy, Washington, D. C. Div. of Environmental Control Technology.

APPROACH TO LIQUEFIED NATURAL GAS (LNG) SAFETY AND ENVIRONMENTAL CONTROL RESEARCH

Feb. 1978 464 p refs

(Contracts EY-76-C-08-1830; EE-77-C-02-4234;

EE-77-C-02-4204; W-7405-eng-48; EY-76-C-08-0020)

(DOE/EV-0002) Avail: NTIS HC A20/MF A01

LNG safety and control information is presented for use by industry, regulatory bodies, and the general public. To achieve verified predictive capabilities and verified control methods, activities in six technical elements were identified: vapor generation and dispersion; fire and radiation hazards; flame propagation; release prevention and control; instrumentation and technique development; and scale effects experiments. ERA

N78-26232# Babcock and Wilcox Co., Alliance, Ohio. Research Center.

CHARACTERISTICS OF SOLVENT REFINED COAL: DUAL REGISTER BURNER TESTS Final Report

W. L. Sage, W. Downs, and P. L. Cioffi Jan. 1978 118 p refs

(EPRI Proj. 1235-5)

(EPRI-FP-628) Avail: NTIS HC A06/MF A01

Retrofitting requirements for pulverizers and for a dual register burner were identified. Changes made to the pulverizer included lessening of the grinding pressure, slowing of the grinding elements, changing of the feeder controls, and operating with cold primary air. The dual register burner was equipped with a water cooled coal nozzle, and eddy circulations were minimized in the vicinity of the burner front. These changes were necessary to prevent agglomeration and melting of the solvent refined coal in the equipment. ERA

N78-26237# General Motors Research Labs., Warren, Mich. **A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 1.1: MODEL 3 GROUND POWER UNITS DESIGN, CONSTRUCTION AND TESTING. GOVERNMENT CONTRACT REPORTS**

Apr. 1978 184 p

(GMR-2690-Pt.1.1) Avail: NTIS HC A09/MF A01

Numerous progress reports concerning the performance of the Stirling ground power unit are presented. Acceptance tests results are included as well as an instruction manual and a listing of parts.

N78-26245# General Motors Research Labs., Warren, Mich. **STIRLING ENGINE GROUND POWER UNIT Quarterly Progress Report, 1 May - 31 Jul. 1965**

F. Earl Heffner In its A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 12 p

(Contract DA-44-009-AMC-250(TI))

(GMR-2690-Sect-1.108; QPR-8)

Avail: NTIS

HC A09/MF A01

Progress toward the construction of two Stirling ground units to be delivered to the U.S. Army is reviewed. The major elements of the manual starting system for the GPU 3's were built and tested to show their complete feasibility. The final requirements for the crankcase were established by extensive governor and prototype engine generator testing. B.B.

N78-26247# General Motors Research Labs., Warren, Mich. **STIRLING ENGINE GROUND POWER UNIT MODEL GPU 3 ACCEPTANCE TEST REPORT**

F. Earl Heffner In its A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 19 p

(GMR-2690-Sect-1.110) Avail: NTIS HC A09/MF A01

A discussion of the acceptance tests conducted prior to the delivery of the Stirling engines, is presented and certain required graphic plots of data from those tests are included. B.B.

N78-26249# General Motors Research Labs., Warren, Mich. **US ARMY ENGINEER RESEARCH AND DEVELOPMENT LABORATORIES FIVE HUNDRED HOUR ENGINEERING EVALUATION OF THE STIRLING GPU 2-1**

F. Earl Heffner In its A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.1: Model 3 Ground Power Units Design, Construct. and Testing. Govt. Contract Rept. Apr. 1978 24 p

(GMR-2690-Sect-1.112) Avail: NTIS HC A09/MF A01

The performance of the Stirling ground power unit during the Army 500 hour engineering evaluation is discussed, and the results of a post-test inspection are presented. B.B.

N78-26250# General Motors Research Labs., Warren, Mich. **A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 1.2: MODEL 3 GROUND POWER UNITS DESIGN, CONSTRUCTION, AND TESTING, GENERAL MOTORS RESEARCH STUDIES**

Apr. 1978 266 p refs

(GMR-2690-Pt.1.2) Avail: NTIS HC A12/MF A01

The design, production, and performance of a prototype Stirling engine ground power unit are described, as well as uniform test procedures and component reliability.

N78-26251# General Motors Research Labs., Warren, Mich. **EFFECT OF DIESEL FUEL ON STIRLING ENGINE GROUND POWER UNIT COMPONENTS**

Richard R. Toepel In its A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing; Gen. Motors Res. Studies Apr. 1978 9 p refs

(GMR-2690-Sect-1.201) Avail: NTIS HC A12/MF A01

The effects of several types of diesel fuel on nitrile, neoprene, and vitron compounds as related to component of the Stirling engine ground power unit are compared. Results of fuel analysis and elastomer immersion tests are presented. Recommendations are made for elastomer specifications. A.R.H.

N78-26252# General Motors Research Labs., Warren, Mich. **MANUAL CRANKING TESTS OF THE STIRLING ENGINE GROUND POWER UNIT**

Richard R. Toepel In its A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing; Gen. Motors Res. Studies Apr. 1978 14 p

(GMR-2690-Sect-1.202) Avail: NTIS HC A12/MF A01

Starting tests were conducted on the Stirling engine ground power unit (GPU 2-2) to determine the input energy requirements over a range of engine working pressures and to judge the suitability of several manual cranking systems for use on the GPU-3. The manual systems tested were (1) spring, (2) dead-weight, and (3) hand-type. The spring cranking tests were conducted at various package moment of inertias from 125 to 500 lb-sq in. The dead-weight and hand-type tests were conducted at an inertia value of 500 lb-sq in. Input energy requirements were found to vary directly with engine working pressure and to be independent of engine inertia. The hand-type starts using a cable and pulley arrangement were found to provide an excess of input energy over the minimum requirements; therefore, this system was recommended for use on the GPU-3. Author

N78-26253# General Motors Research Labs., Warren, Mich.
THE GPU-3 STIRLING ENGINE GROUND POWER UNIT IGNITION SYSTEM

Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 9 p

(GMR-2690-Sect-1.203) Avail: NTIS HC A12/MF A01

The ignition system for the GPU-3 Stirling ground power unit requires compatibility with the manual starting requirements of the package, as well as less input power than previous systems because of necessary limits on total accessory input power for the manual method of starting. A system was developed consisting of a permanent magnet ac generator and an ac input exciter unit coupled to an ignitor plug. Tests were conducted on purchased sets of alternators and exciters to determine spark rate and alternator input torque.

A.R.H.

N78-26254# General Motors Research Labs., Warren, Mich.
COMBUSTOR DEVELOPMENT FOR STIRLING GROUND POWER UNITS, GPU-2 AND GPU-3

Robert E. Sullivan *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 53 p ref

(GMR-2690-Sect-1.204) Avail: NTIS HC A12/MF A01

The design and development of continuous combustion systems for the GPU-2 and GPU-3 Stirling engine ground power units are described. Durability aspects of the GPU-2 burner and modifications to appreciably extend the endurance life of the combustion parts are discussed as well as the GPU-3 burner configuration which evolved as a result of the GPU-2 burner experience. The improved GPU-3 burner demonstrated good durability for operating time in excess of 1000 hours, reliable ignition, and smokeless operation during engine warm up. Combustion systems deviating in design and operating principles from conventional gas turbine practice were assessed such as burners having alternate wall cooling techniques and novel internal flow schemes. The merits and limitations of these configurations are reported.

A.R.H.

N78-26256# General Motors Research Labs., Warren, Mich.
PRELIMINARY PERFORMANCE TESTS OF A GPU-3 STIRLING ENGINE ON HYDROGEN, HELIUM, AND NITROGEN

James E. Bennethum *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 14 p

(GMR-2690-Sect-1.206) Avail: NTIS HC A12/MF A01

The GPU-3 Stirling thermal engine was found to have poor performance when helium was used as the working gas. Preliminary tests indicate that the problem involves low heater tube wall temperatures and additional friction losses resulting from the operation of the rulon piston rings in the helium filled cylinder. Several deviations from the predictions generated by the Stirling engine analysis program were found and more testing is required after the addition of more instrumentation on the engine cylinder and the installation of a heater manifold and external preheater to obtain more accurate measurements.

A.R.H.

N78-26257# General Motors Research Labs., Warren, Mich.
STIR-LEC 2 STIRLING ENGINE PERFORMANCE

Richard R. Toepel *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 5 p ref

(GMR-2690-Sect-1.207) Avail: NTIS HC A12/MF A01

Prior to its installation in the Stir-Lec hybrid vehicle, a Stirling engine weighing 57 pounds less than the original one was dynamometer tested to establish its performance. Three speed levels, four pressure levels, and three water temperature levels

were run in a factorial plan so that 12 runs of a possible 36 combinations were made. Results of the 12 runs are tabulated for horsepower output, fuel consumption, and compression space temperature. Complete calculations for the 36 combinations are included.

A.R.H.

N78-26258# General Motors Research Labs., Warren, Mich.
METHOD OF TESTS AND INSTRUCTIONS (GENERATOR SETS, STIRLING ENGINE DRIVE)

Raymond M. Cole *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 1.2: Model 3 Ground Power Units Design, Construct., and Testing, Gen. Motors Res. Studies Apr. 1978 37 p

(GMR-2690-Sect-1.208) Avail: NTIS HC A12/MF A01

Military tests for gasoline or diesel engines (MIL-STD-1400) and for engine driven gasoline sets (MIL-STD-705A) were adapted for use in the uniform testing of Stirling engines. Qualification tests presented include: initial inspection; check test and run in; initial performance; ideal idle to full-load characteristics; actual idle to full load characteristics; maximum power; governor stability and transient response; governor droop characteristics; endurance tests; final performance; and final inspection. Because the ground power unit does not represent a production prototype, environmental testing procedures were not included.

A.R.H.

N78-26262# General Motors Research Labs., Warren, Mich.
A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 2: STIRLING CYCLE ANALYSIS AND ENGINE DESIGN STUDIES

Apr. 1978 315 p refs

(GMR-2690-Pt-2) Avail: NTIS HC A14/MF A01

Computerized design studies on Stirling cycle thermal engines for automotive applications are reported.

N78-26285# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE HEATER TUBE FAILURES

John N. Johnson *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 9 p

(GMR-2690-Sect-3.101) Avail: NTIS HC A10/MF A01

The cause of leaks which had developed in the austenitic stainless steel heater tubes during operation was determined. It is concluded that: (1) the tube leaks were due to intergranular cracking of the tube wall, apparently resulting from a combination of high thermal stresses and grain boundary oxidation; (2) the severe grain boundary attack was associated with carbide precipitation and attendant depletion of chromium in the grain boundaries, producing localized regions of reduced oxidation resistance; and (3) appreciable intergranular oxidation was noted on the I.D., as well as the O.D., of the tubes, indicative of contamination of the hydrogen working gas. Use of a stabilized grade of stainless steel to reduce the incidence of intergranular oxidation is recommended. However, in view of the apparent high thermal stresses imposed on the tubes during operation, a material of greater high temperature strength than 310 stainless steel, such as N-155, is recommended for this application.

J.M.S.

N78-26286# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE HEATER TUBE FAILURE

John N. Johnson *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 16 p

(GMR-2690-Sect-3.102) Avail: NTIS HC A10/MF A01

Failure of a Stirling engine heater-cylinder assembly was examined. Failure occurred after 265 hours of operation under various conditions. Metallographic examination and electron probe microanalyses indicated the failure to be associated with extreme oxidation and carburization of the tube walls. The abnormal oxidation was attributed to the presence of copper on the tubes. A proprietary high temperature anti-seize compound used in

assembly of the engine was judged to be the source of the copper. Carburizing exhaust gases produced at low air-fuel ratios and the presence of 'hot spots' on the tubes due to the abnormally heavy oxide scale was believed to be the cause of the carburization of the tubes. Copper was also detected in deposits obtained from three other heaters, not yet failed. J.M.S.

N78-26289# General Motors Research Labs., Warren, Mich.
EXAMINATION OF STIRLING ENGINE REGENERATOR SCREENS

J. E. Hunter and S. W. Iwankovitch *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 9 p refs

(GMR-2690-Sect-3.105) Avail: NTIS HC A10/MF A01

Stacked 304 stainless steel screens, which comprise the heat exchanger surface of one type of Stirling engine regenerator, were found to be subject to local deterioration at the inlet tubes to the regenerator. The screens were examined to determine the cause for failure. Metallurgical examination indicated the inlet sides of the top screens were severely oxidized. Electron probe analysis confirmed this observation. Commercial dry hydrogen used as the working fluid, which may contain as much as 0.5 percent oxygen, is considered to be the most probable source of oxygen in the system. Use of purified hydrogen to eliminate oxidation of the screens and other parts is recommended. Use of nickel MetNet regenerators in the present atmosphere should also eliminate the regenerator oxidation. J.M.S.

N78-26294# General Motors Research Labs., Warren, Mich.
EVALUATION OF STRESSES IN TUBES WITH EXTERNAL HEAT FLUX AND INTERNAL PRESSURIZATION

Wallace R. Wade *In its* A Collection of Stirling Engine Reports from General Motors' Research, 1958 to 1970. Part 3: Stirling Engine Materials and Stresses, 3.1 Stirling Engine Materials, 3.2 Stirling Engine Stresses Apr. 1978 19 p

(GMR-2690-Sect-3.204) Avail: NTIS HC A10/MF A01

A method is presented for calculating severe stress levels in a heater tube subjected to loads experienced in a Stirling thermal engine. Specific calculations are presented for typical tubes subjected to conditions similar to those of current and possible future interest. The calculations indicate that heater tubes used in engines of current interest are within the safe operating range when the short time yield strength is used as a criterion. For extended periods of operation, creep considerations alter this conclusion. It was concluded that use of similar tubes in higher output engines may not be satisfactory. J.M.S.

N78-26318# General Motors Research Labs., Warren, Mich.
A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 6: REGENERATORS

Apr. 1978 130 p refs

(GMR-2690-Pt-6) Avail: NTIS HC A06/MF A01

The Stirling Thermal Engine regenerator cost reduction program is outlined.

N78-26319# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM OUTLINE

John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 5 p

(GMR-2690-Sect-6.001) Avail: NTIS HC A06/MF A01

The procedure to be followed in evaluating potential regenerator matrix materials is outlined. The objective is to determine the cost of alternative materials and the effect that lower cost materials will have upon engine performance. L.S.

N78-26320# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM REPORT 1: WIRE CLOTH MATRIX MATERIALS

John C. Steiner *In its* A Collection of Stirling Eng. Rept. from

Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 10 p

(GMR-2690-Sect-6.002) Avail: NTIS HC A06/MF A01

Costs of wire cloth regenerator matrix materials for volume production are presented along with the predicted Stirling Engine performance with the wire cloth materials. The costs of the ideal material were estimated to be 15 to 20 percent of the allowable cost of the entire engine and the Divisions desired an order of magnitude reduction of this cost to 0.90 dollars per engine horsepower. Some cost reduction is possible with wire cloth of other than ideal configuration and this was studied. Results of this wire cloth analysis are described. L.S.

N78-26321# General Motors Research Labs., Warren, Mich.
STIRLING ENGINE REGENERATOR PERFORMANCE ANALYSIS

James R. Mondt *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 25 p refs

(GMR-2690-Sect-6.003) Avail: NTIS HC A06/MF A01

The packed wire regenerator for the Stirling engine was developed for best engine performance. The high cost of this regenerator prompted a study of alternate regenerator core materials which could provide equivalent engine performance but at a significant cost reduction relative to the packed screen. An investigation was undertaken of regenerator core materials that have been considered for the vehicular gas turbine regenerator: GMR surface, CERCOR ceramic, and sphere bed. A steady-state model simulation was made of the thermodynamic behavior of the packed screen regenerator for a 10 horsepower Stirling engine. This was used as a baseline for comparison of alternate core material candidates. The results of the study indicate a regenerator core, which will provide equivalent engine performance, can be fabricated from the GMR surface, CERCOR ceramic or ceramic sphere bed at a cost of approximately 50 cents per horsepower. Cost estimates were based on medium volume production rates, hence, there is the potential of further cost reduction. L.S.

N78-26322# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM. REPORT 2: JUNE 1966 STATUS

John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 23 p refs

(GMR-2690-Sect-6.004) Avail: NTIS HC A06/MF A01

Early cost estimates of Stirling Engines indicated that the regenerators were the part most in need of cost reduction if the engine was to compete successfully on the commercial market. A goal to reduce the regenerator costs by an order of magnitude to 0.90 dollars per engine horsepower was set for the Regenerator Cost Reduction Program. Sample test regenerators were made from materials which would cost as little as 0.15 dollars per engine horsepower. The Cost Reduction Program consists of a thorough cost analysis and experimental evaluation of the fluid friction and heat transfer characteristics of the candidate materials. Regenerator geometry optimization, engine optimization and manufacturing technique are studied to accommodate the characteristics of the different materials. If 1.32 dollars per engine horsepower wire cloth is used in a properly designed engine in place of the present optimum 11.70 dollars per engine horsepower wire cloth, 98 per cent of the present power and 95.1 per cent of the present maximum efficiency can be attained. L.S.

N78-26323# General Motors Research Labs., Warren, Mich.
STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM. REPORT 3: MANUFACTURING THE ELECTRO-MOTIVE DIVISION 48/BV12C STIRLING ENGINE REGENERATORS

John C. Steiner and Robert Diepenhorst *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 17 p refs

(GMR-2690-Sect-6.005) Avail: NTIS HC A06/MF A01

The manufacturing procedure includes special wire cloth specifications which must be closely followed for ease in

production. Wire cloth configuration measuring methods are described for use in the production of wire cloth regenerators and the results of tests performed on the EMD regenerators are reported. The wire cloth punch mechanism which is described could be automated for large volume production. L.S.

N78-26324# General Motors Research Labs., Warren, Mich. **STIRLING THERMAL ENGINE REGENERATOR COST REDUCTION PROGRAM. REPORT 4: MET NET FLUID FRICTION HEAT TRANSFER TEST RESULTS, ENGINE TEST FOR FOUR REGENERATION MATERIALS**

John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 6: Regenerators Apr. 1978 45 p refs

(GMR-2690-Sect-6.006) Avail: NTIS HC A06/MF A01

The major effort was concentrated on the testing of the GMR MetNet material developed by the Metallurgical Engineering Department which has a projected cost of 0.15 dollars per engine horsepower. Initial tests of the fluid friction and heat transfer characteristics of the material were completed. Engine tests were performed utilizing the low cost 150 mesh wire cloth and the lowest cost MetNet materials. The structural integrity of MetNet was proven in 100 hours of engine operation with 0.15-0.25 MetNet. The GPU size Stirling engine at full load utilizing 150 mesh wire cloth regenerators produced 100 per cent of the power and 89 per cent of the efficiency of the same engine utilizing the standard 200 mesh wire cloth. The engine using 0.05-0.20 MetNet produced 91 per cent of the power and 89 per cent of the engine efficiency of the engine utilizing standard regenerators. L.S.

N78-26326# General Motors Research Labs., Warren, Mich. **A COLLECTION OF STIRLING ENGINE REPORTS FROM GENERAL MOTORS' RESEARCH, 1958 TO 1970. PART 7: THERMAL ENERGY STORAGE AND PUBLICATION LIST, 7.1 THERMAL ENERGY STORAGE, 7.2 LIST OF GENERAL MOTORS STIRLING ENGINE PUBLICATIONS**

Apr. 1978 243 p refs

(GMR-2690-Pt-7) Avail: NTIS HC A11/MF A01

Various aspects of thermal energy storage were studied for use in the Stirling cycle engine. Lithium hydroxide heat storage system; heat transfer and pressure drop across ground power unit heater; brazed test assembly exposed to molten LiOH; nickel tanks; and energy transfer rates from solidifying lithium fluoride to a plain tube heater were evaluated. The results from these tests are presented. For individual titles, see N78-26327 through N78-26337.

N78-26329# General Motors Research Labs., Warren, Mich. **THERMAL ENERGY STORAGE FOR ROAD VEHICLE PROPULSION**

Worth H. Percival *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. Lists, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 23 p

(GMR-2690-Sect-7.103) Avail: NTIS HC A11/MF A01

Small systems are shown to be at a considerable disadvantage compared to large systems. The problem of heat loss and insulation is described, and methods of transferring heat from the storage unit to the engine are explained. Various properties and heat capacity of 10 solid heat storage substances are compared to lithium fluoride. Three compounds are then compared for a specific application to a small vehicle, and boron carbide is recommended. A small two passenger vehicle is briefly described, along with some theoretical performance. A particular Stirling engine and its ancillaries are explained, along with several transmission types. The weight of the power system is estimated and compared to an electric battery system. Author

N78-26330# General Motors Research Labs., Warren, Mich. **THERMAL ENERGY STORAGE STIRLING ENGINE POWER PLANTS 1: CALCULATED HEAT TRANSFER AND PRESSURE DROP ACROSS GROUND POWER UNIT HEATER ASSEMBLIES**

John C. Steiner *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy

Storage, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 24 p refs

(GMR-2690-Sect-7.104) Avail: NTIS HC A11/MF A01

A power plant basically consisting of a thermal energy storage tank, an existing ground power unit-size Stirling engine and a gas circulating system for transporting energy from the thermal energy storage tank to the engine is considered. The external heat transfer to the engine heater and attendant circulating gas pumping losses are analytically studied. Results show that the pumping losses would be appreciable for the existing heater design, and several new plain tube configurations are proposed to reduce these losses. The most significant reduction in pumping losses would be realized with a heater design of the same number of tubes and spacing as the existing design, but with a 133 percent increase in heater height. The new heater configurations show decreases in the heater outlet gas temperatures at which the circulation blower must operate. Author

N78-26332# General Motors Research Labs., Warren, Mich. **ANALYSIS OF THE FAILURE OF THE NICKEL TANK USED FOR LITHIUM THERMAL ENERGY STORAGE FOR THE CALVAIR AUTOMOBILE**

John C. Bierlein *In its* A collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 34 p ref

(GMR-2690-Sect-7.106) Avail: NTIS HC A11/MF A01

This nickel thermal energy storage tank for use with lithium hydroxide was designed for use in the Calvair automobile. The failure of this tank was caused by several factors. The relative importance of each of these factors is discussed. Author

N78-26333# General Motors Research Labs., Warren, Mich. **ENERGY STORAGE SYSTEMS COMPLEMENT THE STIRLING ENGINE**

In its A Collection of Stirling Eng. Rept. from Gen. Motors Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 3 p

(GMR-2690-Sect-7.107) Avail: NTIS HC A11/MF A01

The heat energy converter of the Stirling engine is described, along with the Calvair automobile (converted '64 Corvair with a Stirling engine). The energy storage capacity of various sources and the output available during energy conversion are shown in tabular form, using watt-hours per pound and watt-hours per cubic inch as measurement. J.A.M.

N78-26334# General Motors Research Labs., Warren, Mich. **THERMAL ENERGY STORAGE--STIRLING ENGINE POWER PLANTS 2. CALCULATED ENERGY TRANSFER RATES FROM SOLIDIFYING LITHIUM FLUORIDE TO A PLAIN-TUBE HEATER**

A. Cocanower *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 49 p refs

(GMR-2690-Sect-7.108) Avail: NTIS HC A11/MF A01

An idealized model of the system was set up and the calculated results indicate that energy could be transferred at a rate sufficient to produce an engine output of 10 horsepower for 10 hours or 20 horsepower for 7 hours. The accuracy of the results is limited to the validity of the idealized model as well as to the certainty of the data, such as the thermal conductivity of lithium fluoride and the heat transfer film coefficients. Author

N78-26335# General Motors Research Labs., Warren, Mich. **METALLURGICAL STUDIES OF HIGH TEMPERATURE ALLOY CAPSULES AFTER LONG TIME CYCLIC CORROSION TESTS AS CONTAINERS FOR LITHIUM FLUORIDE**

Erwin R. Cprek *In its* A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 23 p

(GMP-2690-Sect-7.109) Avail: NTIS HC A11/MF A01

Corrosion resistance and effect of the purity of the lithium fluoride on the rate of attack were of primary interest in evaluating the materials. Results of the examination showed no significant corrosion attack on any of the five alloys represented. The use of ultrahigh purity lithium fluoride did not appear to be justified as a means of controlling corrosion attack. Author

N78-26336# General Motors Research Labs., Warren, Mich.
PERFORMANCE EVALUATION OF A STIRLING CYCLE HEAT PUMP

John H. Lienesch In its A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List, 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 17 p

(GMR-2690-Sect-7.110) Avail: NTIS HC A11/MF A01

Interest in Stirling-powered underwater vehicles has focussed on thermal energy storage systems. Using the engine itself as a heat pump by motoring it in the reverse direction was proposed. Data taken on a ten-horsepower dynamometer engine indicate that such a system is feasible. The effect of speed, temperature, and pressure on heat pump performance is shown in the form of performance maps at various steady state operating conditions. J.A.M.

N78-26337# General Motors Research Labs., Warren, Mich.
THERMAL ENERGY STORAGE-STIRLING ENGINE POWER-PLANTS FOR ROAD VEHICLES

James N. Mattavi In its A Collection of Stirling Eng. Rept. from Gen. Motors' Res., 1958 to 1970. Pt. 7: Thermal Energy Storage and Publ. List; 7.1 Thermal Energy Storage, 7.2 List of Gen. Motors Stirling Eng. Publ. Apr. 1978 23 p refs

(GMR-2690-Sect-7.111) Avail: NTIS HC A11/MF A01

The performance of thermal energy storage-Stirling engine powerplants is predicted for six types of road vehicles; these include a family car, commuter car, utility car, delivery van, city taxi, and city bus. Vehicle requirements were taken from study programs on low pollution potential, propulsion systems for urban vehicles. Data on TES-Stirling engine powerplants for the same study guidelines are provided. J.A.M.

N78-26380# National Bureau of Standards, Washington, D. C.
 Inst. for Materials Research.

DEVELOPMENT, TESTING, AND EVALUATION OF MHD-MATERIALS Quarterly Report, July - Sep. 1977

H. P. Frederikse, T. Negas, and S. J. Schneider 30 Sep. 1977 76 p refs

(Contract EA-77-A-01-6010-035)

(FE/6010-9) Avail: NTIS HC A05/MF A01

During this quarter preparations went forward for the testing of an electrode/insulator assembly in the U-02 facility under auspices of the US-USSR cooperative program on MHD power generation (Phase 3). Samples of various electrode materials to be used in this test were received for determination of their electrical conductivity. Some 60 materials were analyzed by X-ray diffraction with regard to crystallinity and phase composition. Further progress was made on the seed-slag interaction problem by mapping major sections of the phase diagram for the system $K_2O-CaO-Al_2O_3-SiO_2$. Characterization of six electrodes tested in the MIT rig was completed. Samples of chrome-magnesia, tested for 30 hrs in a seed environment, were examined by means of X-ray diffraction and Scanning Electron Microscopy. A list was compiled of references to property data for some 20 stainless steels and alloys which show promise for use in downstream components of MHD systems. ERA

N78-26390# National Aeronautics and Space Administration.
 Lewis Research Center, Cleveland, Ohio.

LITHIUM AND POTASSIUM HEAT PIPES FOR THERMIONIC CONVERTERS

Gabor Miskolczy (Thermo Electron Corp., Waltham, Mass.) and Erich Kroeger 1978 7 p refs Proposed for presentation at the 13th Intersociety Energy Conversion Engr. Conf., San Diego, Calif., 20-25 Aug. 1978; sponsored by SAE, ACS, AIAA, ASME, IEEE, AIChE, and ANS

(Contract NAS3-20270)

(NASA-TM-78946; E-9695) Avail: NTIS HC A02/MF A01 CSCL 20D

A prototypic heat pipe system for an out-of-core thermionic reactor was built and tested. The emitter of the concentric thermionic converter consists of the condenser of a tungsten heat pipe utilizing a lithium working fluid. The evaporator section of the emitter heat pipe is radiation heated to simulate the thermal input from the nuclear reactor. The emitter heat pipe thermal transport is matched to the thermionic converter input requirement. The collector heat pipe of niobium, 1% zirconium alloy uses potassium as the working fluid. The thermionic collector is coupled to the heat pipe by a tapered conical joint designed to minimize the temperature drop. The collector heat flux matches the design requirements of the thermionic converter. Author

N78-26398# Fluidyne Engineering Corp., Minneapolis, Minn.
SUPPORT TESTING AND DESIGN STUDY EVALUATION OF REGENERATIVE AIR HEATERS Progress Report, Jan. - Mar. 1977

Apr. 1977 51 p refs

(Contract EX-76-C-01-2254)

(FE-2254-5) Avail: NTIS HC A04/MF A01

Progress on the ceramic heater development program for coal-fired MHD generators is summarized. Tasks include: (1) analytical studies of full scale heaters to evaluate fullscale directly and indirectly fired regenerative air heaters suitable for use in a combined MHD-steam power plant; (2) engineering design of heater test module to design a directly-fired air heater test module suitable for construction and testing under realistic, dynamic conditions expected in an MHD power generation system; (3) design support tests to provide a basis for the analytical and design studies of (1) and (2), and to provide design, operational, and material data based on model experiments to optimize the geometry of bed components and to provide techniques to control seed and slag deposit buildup in the bed and connecting ducts; (4) liaison with materials testing and development activities to ensure maximum transfer and utilization of current materials testing and development technology. ERA

N78-26402# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.

DESIGN METHOD FOR HEAT LOSS CALCULATION FOR IN-GROUND HEAT STORAGE TANKS

F. C. Hooper and C. R. Attwater Jul. 1977 6 p ref Presented at the Conf. on Heat Transfer in Solar Energy Systems, Atlanta, 27 Nov. - 2 Dec. 1977; sponsored by ASME

(Contract EY-76-C-02-2939)

(COO-2939-3) Avail: NTIS HC A02/MF A01

A method for calculating the temperature and heat losses for large, partially buried heat storage tanks over a seasonal heat storage cycle is presented. A lumped parameter approach was used, based on three indices evaluated for particular configurations from much more detailed computations. The method appears to offer good accuracy and design convenience in predicting the transient responses of large storages associated with annual heat storage solar heating systems. ERA

N78-26442# National Aeronautics and Space Administration.
 Lewis Research Center, Cleveland, Ohio.

DESIGN APPROACHES TO MORE ENERGY EFFICIENT ENGINES

Neal T. Saunders, Raymond S. Colladay, and Lawrence E. Macioce Jul. 1978 13 p refs Presented at the 14th Propulsion Conf., Las Vegas, Nev., 25-27 Jul. 1978; cosponsored by AIAA and SAE

(NASA-TM-78893) Avail: NTIS HC A02/MF A01 CSCL 10B

The status of NASA's Energy Efficient Engine Project, a comparative government-industry effort aimed at advancing the

technology base for the next generation of large turbofan engines for civil aircraft transports is summarized. Results of recently completed studies are reviewed. These studies involved selection of engine cycles and configurations that offer potential for at least 12% lower fuel consumption than current engines and also are economically attractive and environmentally acceptable. Emphasis is on the advancements required in component technologies and systems design concepts to permit future development of these more energy efficient engines. G.Y.

N78-26450# Hanford Engineering Development Lab., Richland, Wash.

TRIBOLOGY: RESEARCH AND DEVELOPMENT NEEDS IN ADVANCED ENERGY TECHNOLOGY

Roger N. Johnson 1977 30 p refs Presented at the ERDA Workshop on Tribology in Energy Technol. Revised (Contract EY-76-C-14-2170) (HEDL-SA-1191-Rev; Conf-770237-1) Avail: NTIS HC A03/MF A01

Poorly controlled wear and friction affects energy conservation, material conservation, and the reliability and safety of mechanical systems, and is estimated to cost U.S. industries \$16 billion/yr. The National Friction, Wear, and Self-Welding Program and its accomplishments are described. The program includes studies of wear and friction problems in high temperature and unusual environments, e.g., as experienced by LMFBR components, and common to much technology involving energy conversion using fossil fuel, geothermal, nuclear, and solar resources. Program activities for tribology information handling and wear and friction testing are discussed. Author (ERA)

N78-26457# Massachusetts Inst. of Tech., Cambridge. Energy Lab.

ISSUES IN FEDERALLY SUPPORTED RESEARCH ON ADVANCED AUTOMOTIVE POWER SYSTEMS Final Report. 1 Jan. - 31 Dec. 1977

Lawrence H. Linden, Subramanyam Kumar, and Paul B. Samuelson Dec. 1977 198 p refs (Grant NSF PRA-76-81015) (PB-278124/3; MIT-EL-77-019; NSF/PRA-7681015/1/8) Avail: NTIS HC A09/MF A01 CSCL 21E

Policy issues related to Federal support for R, D, and D on advanced automotive power systems are examined: (1) whether there is any reasonable justification for the Federal Government to support work in this general area at all, (2) what work should be supported on the automotive gas turbine, and (3) strategic choices to be made in the advanced automotive power systems R and D program. Incentives for privately supported research were examined along with impact of emissions and fuel economy regulation. A set of calculations for the value of the automotive gas turbine engine is presented from the social and private viewpoints and the impact on industry behavior during the introduction phase. Author

N78-26524# Oak Ridge National Lab., Tenn.
NATIONWIDE ASSESSMENT OF WATER QUANTITY IMPACTS OF THE NATIONAL ENERGY PLAN. VOLUME 1: SUMMARY AND CONCLUSIONS

Jerome E. Dobson, Alf D. Shepherd, Ronald G. Palmer (Los Alamos Sci. Lab. N. Mex.), and Shen-yann Chiu Dec. 1977 69 p refs (Contract W-7405-eng-26) (ORNL/TM-6098-Vol-1; ORNL/OEPA-3-Vol-1) Avail: NTIS HC A04/MF A01

The water requirements of steam electric generating plants, coal liquefaction and gasification facilities, and coal extraction activities projected for 1985 are calculated, and impacts associated with the National Energy Plan (NEP) Initiative are compared with those of a Base Case Scenario for the conterminous United States. It can be concluded that there is no appreciable difference in water quantity impacts at the Water Resources Council aggregated subarea level. Consumption as a percentage of the

surface supply never varies by more than one percent between the two scenarios except for the Trinity Basin of Texas, and most of the differences are reductions from the base case to the NEP. However, for either case there will be a considerable increase in water use for energy between 1975 and 1985, and water availability may constrain development in several basins of the western United States. Even in the humid eastern United States localized water problems may occur on certain small tributaries. ERA

N78-26525# Department of Energy, Bartlesville, Okla. Bartlesville Energy Research Center.

REVIEW OF PETROLEUM OIL SATURATION AND ITS DETERMINATION

E. C. Donaldson and Michael E. Crocker Dec. 1977 48 p refs (BERC/RI-77/15) Avail: NTIS HC A03/MF A01

The influence of the wettability of the rock-oil-water system on the microscopic structure of oil saturation is discussed from a background of experimental work conducted at BERC as well as a review of the literature. The general conclusion is that the wetting phase occupies the small pores and coats the surface of the larger pores. A summary of the gross distribution of oil saturation that remains at the end of waterfloods using various well patterns is presented and the methods of laboratory analysis of cores obtained from oilfields are discussed. Core analysis is capable of measuring the distribution of oil saturation in a reservoir, but it is too costly and time-consuming to be applied to a complete field; therefore, its results are complemented by well logs to achieve an economical evaluation of oil saturation. In addition, brief explanations of the procedures and utility of various well logging techniques are presented. ERA

N78-26529# Cameron Engineers, Inc., Denver, Colo.

OIL SHALE RESEARCH OVERVIEW

Charles O. Hook May 1977 79 p (Contract EPA-68-01-4337) (PB-278159/9; EPA-908/4-77-007) Avail: NTIS HC A05/MF A01 CSCL 081

A compilation is given of some federally sponsored oil shale research, both current and recently completed. A breakdown of funding levels and number of projects in the areas of (1) general environmental research, (2) water research, (3) atmospheric research, (4) land and revegetation research, (5) health effects research, and (6) miscellaneous oil shale research is shown. GRA

N78-26541*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LOW-COST SILICON SOLAR ARRAY PROJECT ENVIRONMENTAL HAIL MODEL FOR ASSESSING RISK TO SOLAR COLLECTORS

Charles Gonzalez 6 Dec. 1977 54 p refs Sponsored by DOE (Contract NAS7-100) (NASA-CR-157225; JPL-5101-45) Avail: NTIS HC A04/MF A01 CSCL 10A

The probability of solar arrays being struck by hailstones of various sizes as a function of geographic location and service life was assessed. The study complements parallel studies of solar array sensitivity to hail damage, the final objective being an estimate of the most cost effective level for solar array hail protection. Author

N78-26542*# National Aeronautics and Space Administration. Lewis Research Center; Cleveland, Ohio.

TRANSIENT RESPONSE TO THREE-PHASE FAULTS ON A WIND TURBINE GENERATOR Ph.D. Thesis - Toledo Univ.

Leonard J. Gilbert Jun. 1978 146 p refs (NASA-TM-78902; E-9638) Avail: NTIS HC A07/MF A01 CSCL 10A

In order to obtain a measure of its responses to short circuits a large horizontal axis wind turbine generator was modeled and its performance was simulated on a digital computer. Simulation of short circuit faults on the synchronous alternator of a wind turbine generator, without resort to the classical

assumptions generally made for that analysis, indicates that maximum clearing times for the system tied to an infinite bus are longer than the typical clearing times for equivalent capacity conventional machines. Also, maximum clearing times are independent of tower shadow and wind shear. Variation of circuit conditions produce the modifications in the transient response predicted by analysis. P.R.A.

N78-26543* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

STATUS OF WRAPAROUND CONTACT SOLAR CELLS AND ARRAYS

Cosmo R. Baraona and L. E. Young 1978 10 p refs Proposed for presentation at the 13th Intersociety Energy Conversion Engr. Conf., San Diego, Calif., 20-25 Aug. 1978; sponsored by SAE, ACS, AIAA, ASME, IEEE, AICHE, and ANS (NASA-TM-78911; E-9646) Avail: NTIS HC A02/MF A01 CSCL 10A

Solar cells with wraparound contacts provide the following advantages in array assembly: (1) eliminate the need for discretely formed, damage susceptible series tabs; (2) eliminate the n gap problem by allowing the use of uniform covers over the entire cell surface; (3) allow a higher packing factor by reducing the additional series spacing formerly required for forming, and routing the series tab; and (4) allow the cell bonding to the interconnect system to be a single-side function wherein series contacts can be made at the same time parallel contacts are made. Author

N78-26547* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

VARIATION OF SOLAR CELL SENSITIVITY AND SOLAR RADIATION ON TILTED SURFACES

Thomas M. Klucher 1978 10 p refs Presented at the 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by IEEE

(Contract E(49-26)-1022)

(NASA-TM-78921; DOE/NASA/1022-78/32; E-9661) Avail: NTIS HC A02/MF A01 CSCL 10A

The validity is studied that one of various insolation models used to compute solar radiation incident on tilted surfaces from global data measured on horizontal surfaces. The variation of solar cell sensitivity to solar radiation is determined over a wide range of atmospheric condition. A new model was formulated that reduced the deviations between measured and predicted insolation to less than 3 percent. Evaluation of solar cell sensitivity data indicates small change (2-3 percent) in sensitivity from winter to summer for tilted cells. The feasibility of using such global data as a means for calibrating terrestrial solar cells is discussed. G.G.

N78-26549* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

DOE LERC PHOTOVOLTAIC SYSTEMS TEST FACILITY

Ronald C. Cull and Americo F. Forestieri 1978 10 p refs Presented at the 13th Photovoltaic Specialists Conf., 5-8 Jun. 1978; sponsored by IEEE

(Contract E(49-26)-1022)

(NASA-TM-78923; DOE/NASA/1022-78/34; E-9663) Avail: NTIS HC A02/MF A01 CSCL 10A

The facility was designed and built and is being operated as a national facility to serve the needs of the entire DOE National Photovoltaic Program. The object of the facility is to provide a place where photovoltaic systems may be assembled, and electrically configured, without specific physical configuration, for operation and testing to evaluate their performance and characteristics. The facility as a breadboard system allows investigation of operational characteristics and checkout of components, subsystems and systems before they are mounted in field experiments or demonstrations. The facility as currently configured consist of 10 kW of solar arrays built from modules, two inverter test stations, a battery storage system, interface with local load and the utility grid, and instrumentation and control necessary to make a flexible operating facility. Expansion to 30 kW is planned for 1978. Test results and operating experience are summarized to show the variety of work that can be done with this facility. G.Y.

N78-26550* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

IMPACT OF BALANCE OF SYSTEM (BOS) COSTS ON PHOTOVOLTAIC POWER SYSTEMS

Gerald F. Hein, James P. Cusick, and William A. Poley 1978 8 p Presented at the 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by IEEE (Contract E(49-26)-1022)

(NASA-TM-78939; DOE/NASA/1022-78/40; E-9685) Avail: NTIS HC A02/MF A01 CSCL 10A

The Department of Energy has developed a program to effect a large reduction in the price of photovoltaic modules, with significant progress already achieved toward the 1986 goal of 50 cents/watt (1975 dollars). Remaining elements of a P/V power system (structure, battery storage, regulation, control, and wiring) are also significant cost items. The costs of these remaining elements are commonly referred to as Balance-of-System (BOS) costs. The BOS costs are less well defined and documented than module costs. The Lewis Research Center (LeRC) in 1976/77 and with two village power experiments that will be installed in 1978. The costs were divided into five categories and analyzed. A regression analysis was performed to determine correlations of BOS Costs per peak watt, with power size for these photovoltaic systems. The statistical relationship may be used for flat-plate, DC systems ranging from 100 to 4,000 peak watts. A survey of suppliers was conducted for comparison with the predicted BOS cost relationship. Author

N78-26551* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

BASELINE TESTS OF THE KORDESH HYBRID PASSENGER VEHICLE

Richard F. Soltis, John M. Bozek, Robert J. Denington, and Miles O. Dustin Jun. 1978 69 p

(Contract EC-77-A-31-1011)

(NASA-TM-73769; CONS-1011-14; E-9604) Avail: NTIS HC A04/MF A01 CSCL 10A

Performance test results are presented for a four-passenger Austin A40 sedan that was converted to a heat-engine-alternator and battery-powered hybrid. It is propelled by a conventional, gasoline-fueled, heat-engine-driven alternator and a traction pack powering a series-wound, 10 hp direct-current electric drive motor. The 16 hp gasoline engine drives the 7 kilowatt alternator, which provides electrical power to the drive motor or to the 96 volt traction battery through a rectifier. The propulsion battery consists of eight 12 volt batteries connected in series. The electric motor is coupled to a four-speed standard transmission, which drives the rear wheels. Power to the motor is controlled by a three-step foot throttle, which actuates relays that control armature current and field excitation. Conventional hydraulic brakes are used. G.G.

N78-26552* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

DESIGN AND OPERATING EXPERIENCE ON THE US DEPARTMENT OF ENERGY EXPERIMENTAL MOD-0 100-kW WIND TURBINE

John C. Glasgow and Arthur G. Birchenough 1978 17 p refs Proposed for presentation at the 13th Intersoc. Energy Conversion Eng. Conf., San Diego, Calif., 20-25 Aug. 1978

(Contract E(49-26)-1028)

(NASA-TM-78915; E-9652; DOE/NASA/1028-78/18) Avail: NTIS HC A02/MF A01 CSCL 10A

The experimental wind turbine was designed and fabricated to assess technology requirements and engineering problems of large wind turbines. The machine has demonstrated successful operation in all of its design modes and served as a prototype developmental test bed for the Mod-0A operational wind turbines which are currently used on utility networks. The mechanical and control system are described as they evolved in operational tests and some of the experience with various systems in the downwind rotor configurations are elaborated. G.G.

N78-26553* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

DOE/NASA MOD-0A WIND TURBINE PERFORMANCE

T. R. Richards and H. E. Neustadter 1978 8 p refs Proposed for presentation at the 13th Intersoc. Energy Conversion Eng. Conf., San Diego, Calif., 20-25 Aug. 1978 (Contract E(49-26)-1004)

(NASA-TM-78916; E-9654; DOE/NASA/1004-78/13) Avail: NTIS HC A02/MF A01 CSCL 10A

Design and operation of a large wind turbine at Clayton, New Mexico is reported. This is the first of three identical 200 kW wind turbines to be operated on electric utility networks. A comparison between its predicted and measured power versus wind speed performance is presented. G.G.

N78-26554* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

DESCRIPTION AND STATUS OF NASA-LERC/DOE PHOTOVOLTAIC APPLICATIONS SYSTEMS.

Anthony F. Ratajczak 1978 10 p refs Presented at the 13th Photovoltaic Specialists Conf., Washington, D. C., 5-8 Jun. 1978; sponsored by IEEE

(Contract E(49-26)-1022)

(NASA-TM-78936; E-9679; DOE/NASA/1022-78/38) Avail: NTIS HC A02/MF A01 CSCL 10A

Designed, fabricated and installed were 16 geographically dispersed photovoltaic systems. These systems are powering a refrigerator, highway warning sign, forest lookout towers, remote weather stations, a water chiller at a visitor center, and insect survey traps. Each of these systems is described in terms of load requirements, solar array and battery size, and instrumentation and controls. Operational experience is described and present status is given for each system. The P/V power systems have proven to be highly reliable with almost no problems with modules and very few problems overall. Author

N78-26556* General Electric Co., Philadelphia, Pa. Space Div.

SOLAR HEATING AND COOLING SYSTEM DESIGN AND DEVELOPMENT Quarterly Summary, Jan. - Mar. 1978

Apr. 1978 33 p Prepared for DOE

(Contract NAS8-32092)

(NASA-CR-150705) Avail: NTIS HC A03/MF A01 CSCL 10A

The progress made in the manufacture, test, evaluation, installation, problem resolution, performance evaluation, and development of eight prototype solar heating and combined heating and cooling systems is described. M.V.

N78-26557* Northrup, Inc., Hutchins, Tex.

DEVELOPMENT AND FABRICATION OF A CONCENTRATING SOLAR COLLECTOR SUBSYSTEM Quarterly Report, 1 Jan. - 31 Mar. 1977

Apr. 1977 37 p Prepared for DOE

(Contract NAS8-32251)

(NASA-CR-150712; QR-2) Avail: NTIS HC A03/MF A01 CSCL 10A

The progress of work on the evacuated receiver, lens design, lens die fabrication, and improvements on components, production techniques, and performance testing is discussed. M.V.

N78-26558* Northrup, Inc., Hutchins, Tex.

DEVELOPMENT AND FABRICATION OF A CONCENTRATING SOLAR COLLECTOR SUBSYSTEM Quarterly Report, 1 Apr. 1977 - 30 Sept. 1977

(Contract NAS8-32251)

(NASA-CR-150713; QR-3; QR-4) Avail: NTIS HC A12/MF A01 CSCL 10A

The finalization of designs, fabrication of the new lens, receiver, and tracking box and a review of the contract status are presented. Author

N78-26559* Northrup, Inc., Hutchins, Tex.

CONCENTRATING SOLAR COLLECTOR SUBSYSTEM: PRELIMINARY DESIGN PACKAGE Quarterly Report, 1 Oct. - 31 Dec. 1976

20 Jan. 1977 109 p Prepared for DOE

(Contract NAS8-32251)

(NASA-CR-150714; Rept-10046-4; QR-1) Avail: NTIS

HC A06/MF A01 CSCL 10A

Preliminary design data are presented for a concentrating solar collector including an attitude controller. Provided are schedules, technical status, all documents required for preliminary design, and other program activities. G.G.

N78-26563# Sandia Labs., Livermore, Calif.

EFFECTIVENESS OF SPECTRALLY SELECTIVE SURFACES FOR EXPOSED, HIGH-TEMPERATURE SOLAR ABSORBERS

M. Abrams Jan. 1978 30 p refs

(Contract EY-76-C-04-0789)

(SAND-77-8300) Avail: NTIS HC A03/MF A01

A theoretical heat transfer analysis of spectrally selective absorbers shows that spectral selectivity offers the greatest benefits for conditions of high absorber temperature and/or low values of solar irradiation. By using a two-band model of the selective absorber, the cutoff wavelength which maximizes absorber efficiency was found to depend on just two parameters: the absorber temperature, and the level of solar irradiation. The emittance of the infrared band has a greater effect upon efficiency than the absorbance of the solar band when a critical dimensionless parameter exceeds unity. The analysis was undertaken for application to central receivers for solar tower focus power plants. ERA

N78-26564# Sandia Labs., Albuquerque, N. Mex.

LASER RAY TRACE AND BI-DIRECTIONAL REFLECTOMETRY MEASUREMENTS OF VARIOUS SOLAR CONCENTRATORS Presented at the Concentrating Solar Collector Conf., Atlanta, 26 Sep. 1977

R. B. Pettit and B. L. Butler 1977 19 p refs

(Contract EY-76-C-04-0789)

(SAND-77-1466C; Conf-770953-4)

Avail: NTIS HC A02/MF A01

In order to characterize the optical quality of reflecting parabolic solar concentrators, low measurement techniques were developed. Laser ray trace measurements were used to determine the focal length and focused beam size of the parabolic structures, while bidirectional reflectometry was developed to measure the specular reflectance properties of mirror materials. The overall optical quality of a concentrator is calculated by combining results from these two measurements. Model parabolic structures were fabricated by commercial suppliers from a variety of materials, including forest products, metals, ceramics and plastics. ERA

N78-26565# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.

OPTIMIZATION OF COATINGS FOR FLAT PLATE SOLAR COLLECTORS, PHASE 2 Final Report, 28 Jun. 1976 - 27 Jun. 1977

R. J. H. Lin and P. B. Zimmer Jul. 1977 133 p refs

(Contract EY-76-C-02-2930)

(COO-2930-12) Avail: NTIS HC A07/MF A01

Optical coatings that would enhance the economic feasibility of flat plate solar collectors were investigated. Etched and dipcoated antireflection (AR) coatings and selective absorbing plated and paint coatings that are low cost and optically efficient were investigated. A selective paint coating was developed with solar absorptance of 0.92 and room temperature emittance of 0.10. It was made through the optimization of coating thickness, pigment volume concentration, and pigment particle size. Accelerated humidity and outdoor exposure tests were conducted for black chrome, black-nickel and black iron coatings. The black chrome coating is most durable and its life was estimated to be greater than 30 years. ERA

N78-26567# Los Alamos Scientific Lab., N. Mex.

IMPACTS OF THE NATIONAL ENERGY PROGRAMME ON SOLAR ECONOMICS

S. Ben-David, S. Noll, F. Roach, and W. Schulze 1978 70 p Presented at the Intern. Solar Energy Congr. New Delhi, 16 Jan. 1978

(Contract W-7405-eng-36)

(LA-UR-78-131; Conf-780114-2)

Avail: NTIS

HC A04/MF A01

The National Energy Plan (NEP) sets as a goal the use of solar energy in two and a half million homes in 1985. A key provision of the NEP (as well as congressional alternatives) provides for the subsidization of solar equipment. The extent to which these subsidies (income tax credits) might offset the impact of continued energy-price control is examined. Regional prices and available of conventional energy sources (oil, gas, and electricity) were compiled to obtain a current and consistent set of energy prices by state and energy type. Projections of conventional fuel price increase (or decreases) are made under both the NEP scenario and a projected scenario where all wellhead price controls are removed on natural gas and crude oil production. The economic feasibility (life cycle cost basis) of solar energy for residential space heating and domestic hot water is examined on a state-by-state basis. ERA

N78-26568# George Washington Univ., Washington, D. C. School of Engineering and Applied Science.

SUMMARY OF PROCEEDINGS OF SOLAR HEATING AND COOLING COMMERCIALIZATION WORKSHOP

R. H. Bezdek, A. B. Cambel, and C. R. Hauer May 1977 48 p Workshop held at Washington, D.C., 4-5 May 1977

(Contract EG-77-C-01-4017)

(DSE/4017-1) Avail: NTIS HC A03/MF A01

The present state of commercialization of solar heating and cooling was examined and suggestions were obtained from the various parties of interest on how the existing commercialization process might be improved. The discussions were limited to the existing government program and near term program changes which could increase the growth rate of solar energy heating and cooling. A four session workshop was conducted in which the following general areas were covered: (1) the industrial perspective; (2) legal issues; (3) the utility interface; and (4) institutional considerations. ERA

N78-26570# Charles River Associates, Inc., Cambridge, Mass. **METHODOLOGY FOR PREDICTING THE DEMAND FOR NEW ELECTRICITY USING GOODS Final Report**

Dec. 1977 81 p refs

(EPRI Proj. 488-1)

(EPRI-EA-593) Avail: NTIS HC A05/MF A01

A model was exposit to analyze conventional demand functions. The potential and requirements for applying this model to the market for home-temperature-conditioning alternatives are considered to predict the future demand for heat pumps with specified characteristics. The applicability of the model to studying the demand for heat pumps is discussed, and the specifics of such a study are illustrated. ERA

N78-26571# Argonne National Lab., Ill. Chemical Engineering Div.

ADVANCED FUEL CELL DEVELOPMENT Progress Report, Jul. - Sep. 1977

J. P. Ackerman, K. Kinoshita, J. W. Sim, R. Swaroop, and P. A. Nelson Nov. 1977 27 p refs

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

(ANL-77-79) Avail: NTIS HC A03/MF A01

Fuel cell research and development activities are presented. Work was aimed at understanding and improving the performance of fuel cells having molten alkali-carbonate mixtures as electrolytes; the fuel cells operate at temperatures near 923 K. Effort was directed toward development of methods for fabricating and evaluating electrolyte structures for these cells and optimizing their design. Cell performance, life, and cost are the criteria of optimization. A clear relationship was established between electrolyte structure and cell performance, and the effectiveness of a wet-seal protection technique was demonstrated for more than 2600 h. A method for testing of electrolyte specimens for thermal expansion and high-temperature static creep was developed. Results for the first few samples are given, and a tentative preliminary correlation with conventional creep behavior is proposed. ERA

N78-26572# National Academy of Sciences - National Research Council, Washington, D. C. Ad Hoc Panel on Liquefaction of Coal.

ASSESSMENT OF TECHNOLOGY FOR THE LIQUEFACTION OF COAL: SUMMARY

Dec. 1977 45 p

(Contract EX-76-C-01-1216)

(FE-1216-2) Avail: NTIS HC A03/MF A01

Scale-up of the most promising solvent extraction process and the most promising direct catalytic coal-oil-slurry hydrogenation process (H-Coal) is carried forward expeditiously at a scale of 250 to 600 tons per day. ERA

N78-26573# Department of Energy, Washington, D. C.

FOSSIL ENERGY DEMONSTRATION PLANTS

Nov. 1977 16 p

(TID-28182) Avail: NTIS HC A02/MF A01

The conversion of domestic coal resources into environmentally and socially acceptable substitutes for oil and natural gas is considered. In processing fossil fuels, the plant size needed for acceptable economics is very large. Capital requirements are, therefore, large and the time from conceptual design to capacity operation and process evaluation is long. The need for demonstration plant as an intermediate step between the pilot plant and the commercial plant is outlined. The program encourages private industry to become industrial partners who direct project and share the risks and costs of demonstrating unproven but potentially viable fossil energy conversion and utilization technologies. The industrial partner directs all design, construction and operation. Demonstration plant projects in the program areas of fuel gas and pipeline gas are described. ERA

N78-26574# Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy and Composites Lab.

THERMODYNAMIC PHASE STABILITY DIAGRAMS FOR THE ANALYSIS OF CORROSION REACTIONS IN COAL GASIFICATION/COMBUSTION ATMOSPHERES

P. L. Hemmings and Roger A. Perkins Dec. 1977 110 p refs (EPRI Proj. 716-1)

(EPRI-FP-539) Avail: NTIS HC A06/MF A01

An understanding of corrosion chemistry in complex environments is needed for the effective use of metals and alloys in coal gasification/combustion systems. High-temperature corrosion reactions were analyzed from a thermodynamic equilibrium point of view. The equilibrium pressure of sulfur, oxygen, nitrogen and carbon in the gas will determine which condensed phases can stand in equilibrium with the gas. Reaction paths can be charted to determine how other phases can exist beneath the surface scale. The use of thermodynamic phase-stability diagrams for this purpose is discussed. The diagrams show which phases can exist at a given temperature for a given element (Fe, Ni, Co, etc.) in a mixture of two different oxidants (CO₂S and N₂). The derivation and use of these diagrams to interpret behavior in coal gasification/combustion atmospheres is discussed. ERA

N78-26575# California Univ., Livermore. Lawrence Livermore Lab.

LLL GAS STIMULATION PROGRAM Quarterly Progress Report, Jul. - Sep. 1977

M. E. Hanson, R. J. Shaffer, G. D. Anderson, H. C. Heard, D. O. Emerson, C. Knutson (Geoenergy Corp.), and B. C. Haimson (Wisconsin Univ., Madison) 28 Oct. 1977 40 p refs

(Contract W-7405-eng-48)

(UCRL-50036-77-3) Avail: NTIS HC A03/MF A01

Two theoretical models that simulate, respectively, the local and distance effects of the hydraulic fracturing process were formulated. Application and analysis have indicated that for a penetrating fluid the stress intensity factor tends to decrease as the pore pressure increases. Laboratory fracturing experiments the hydraulic fluid pressure necessary to initiate a crack is relatively insensitive to the applied load on the block. The sensitivity of the principal stress magnitudes on the fracture orientation was also tested. A rock geometry and mechanics study of the Western tight gas sands was also completed. ERA

N78-26576# General Atomic Co., San Diego, Calif.
PREDICTION OF THERMOELECTRIC BATTERY POWER AND VOLTAGE FOR A 15 YEAR LIFETIME MB-75 mW (B) BATTERY

E. J. Steeger and J. C. Bass Nov. 1977 16 p ref
 (Contract EY-76-C-03-0167-060; Proj. 3246)
 (GA-A-14718) Avail: NTIS HC A02/MF A01

In order to predict the power output of a radioisotope-powered thermoelectric generator (RTG) at sometime in the future, it is necessary to make corrections for both isotope decay and for module degradation. The laws governing isotope decay are well known, however, their application to a RTG can be complicated by other phenomena which occurs within the generator. Results of an empirical approach to the problem are presented. ERA

N78-26578# National Academy of Sciences - National Research Council, Washington, D. C. Commission on Sociotechnical Systems.

ASSESSMENT OF ADVANCED TECHNOLOGY FOR DIRECT COMBUSTION OF COAL

Dec. 1977 100 p refs
 (Contracts EX-76-C-01-1216; E(49-18)-1216)
 (HCP/T1216-0001) Avail: NTIS HC A05/MF A01

Methods were assessed for burning high-sulfur coal that would permit existing sulfur dioxide, nitrogen oxides, and particulate emission limits to be met without a substantial increase in capital investment or in operating costs and that would improve the thermal efficiency of the electric-power generation process. Fluidized-bed combustion of coal has the potential for controlling gaseous emissions more economically than existing methods. Of all the alternative processes considered, the most promising for first-stage development is atmospheric pressure fluidized-bed combustion using a minimum amount of excess air and a carbon burnup cell to complete combustion. Fluidized-bed combustion may be available for industrial boilers and total energy systems in the early 1980s. The larger, more complex units needed for electric-power generation require additional demonstration. ERA

N78-26580# California Univ., Livermore. Lawrence Livermore Lab.

SUMMARY OF THE METAL-AIR FUEL CELL RESEARCH PROGRAM

J. F. Cooper 8 Sep. 1977 13 p refs
 (Contract W-7405-eng-48)
 (UCID-17591) Avail: NTIS HC A02/MF A01

An analysis was conducted to determine whether a full performance, economical electric vehicle can be developed using a mechanically rechargeable metal -- air battery as a power source. State of the art and projected performance, energy conversion efficiency, estimates of cost of ownership and operation, considerations of market entry, and current research areas are discussed. Li, Al, and Ca seem to hold the greatest promise. ERA

N78-26581# Mississippi State Univ., Mississippi State. Energy Research Center.

TESTING AND EVALUATION OF MHD MATERIALS AND SUBSTRUCTURES Quarterly Technical Progress Report, Jan. - Mar. 1977

Oct. 1977 56 p refs
 (Contract EX-76-C-01-2246)
 (FE-2246-3-Rev-A) Avail: NTIS HC A04/MF A01

The equilibrium chemical composition and constituent phases of the gas stream were determined as a function of temperature. These calculations allow determination of the initial stream preparation conditions of the MSU test stand at 1.1 atm that will match the operating conditions of the baseline MHD plant. The longitudinal variation of the total wall heat flux, gas temperature, gas velocity, metal surface temperature on both the gas side and water side, and slag thickness were determined for various cases of slag coated and bare wall conditions using the developed thermal model of the metallic materials component test stand and annular boiler. P.R.A.

N78-26583# Los Alamos Scientific Lab., N. Mex.
STATUS OF EUROPEAN THERMOCHEMICAL HYDROGEN PROGRAMS

M. G. Bowman 16 Nov. 1977 5 p Presented at the DOE Ann. Chem. Energy Storage and Hydrogen Energy Systems Contract Rev. Meeting, Washington, D.C., 16-17 Nov. 1977
 (Contract W-7405-eng-36)
 (LA-UR-77-2985; Conf-771131-3) Avail: NTIS HC A02/MF A01

Visits were made to European Laboratories engaged in thermochemical hydrogen research. The visits to the listed laboratories were primarily to learn the scope of the different programs and the general areas of information expected to be made available under the International Energy Agency Implementing Agreement on the Production of Hydrogen from Water. From observations made during the visits, the following conclusions were reached: (1) It is clear that Europeans are directing their efforts towards relatively short term development of better methods for the production and utilization of hydrogen. (2) The European effort on thermochemical hydrogen research and development is significantly greater than the total of U.S. programs. (3) It will be advantageous for the United States to cooperate in information exchange activities under the I.E.A. The description of the different visits is given in the format of a trip report. ERA

N78-26584# Oak Ridge National Lab., Tenn.
VALUE OF ENERGY STORAGE FOR DIRECT-REPLACEMENT SOLAR THERMAL POWER PLANTS

T. D. Anderson, Stephen I. Kaplan, and John V. Wilson 1978 29 p refs Presented at the Appl. Workshop: Thermal Storage Integrated into Solar Power Plants, SERI, Golden, Colo., 14-15 Feb. 1978
 (Contract W-7405-eng-26)
 (CONF-780216-2) Avail: NTIS HC A03/MF A01

The general objective of the study was to develop information on energy storage requirements for solar thermal power plants as an aid to planning and implementing the research and development work. The specific objectives of the study are to derive cost targets for energy storage systems over a range of applications of direct-replacement solar-thermal power plants and to determine the amount of energy storage required for a given cost of storage. The utility applications considered are base-load (100% demand factor) and intermediate-load (50% and 25% demand factor). Locations examined are Inyokern, Chicago, and Philadelphia. The locations selected are intended to provide a representative sampling of U.S. conditions with respect to both solar resources and utility system load patterns. Backup capacity, economic tradeoffs, demand factors, and economic analysis are discussed. It is concluded that the energy storage R and D program should focus on storage systems of relatively low capacity, i.e., less than 6 kW/hr/kW. ERA

N78-26585# Oak Ridge National Lab., Tenn. Environmental Sciences Div.

ENERGY FROM BIOMASS: AN OVERVIEW OF ENVIRONMENTAL ASPECTS

R. D. Roop 1978 15 p refs Presented at Technol. for Energy Conserv., Albuquerque, N. Mex., 23 Jan. 1978
 (Contract W-7405-eng-48)
 (CONF-780109-3) Avail: NTIS HC A02/MF A01

Recent literature regarding energy from biomass is reviewed in order to delineate environmental issues and suggest research needed for assessment of this energy option. Potential sources of biomass for conversion to energy include agricultural and forestry residues, municipal and industrial wastes, biomass plantations, and freshwater and marine grown plant material. The impacts of using wastes and of growing biomass for fuel are summarized. ERA

N78-26586# Oregon Univ., Eugene. Solar Energy Center.
COMMUNITY LEADERS WORKSHOP ON SOLAR ENERGY ASSESSMENT Final Report

C. Venolia, ed. Aug. 1977 45 p Workshop held in Eugene, Ore., 20 Aug. 1977
 (Contract EY-76-S-06-2230-005)
 (RLO/2230/T5-1) Avail: NTIS HC A03/MF A01

A summary of activities and discussions and general format of a solar energy conference at Eugene, Oregon, to involve local groups in the assessment of environmental and social issues relating to solar energy development are presented. The topics of the three workshops were (1) solar heating and cooling, (2) fuels from biomass, and (3) agricultural and industrial heat. ERA

N78-26588# Sandia Labs., Livermore, Calif. Systems Studies Div.

STAEAC: SOLAR THERMAL ELECTRIC ANNUAL ENERGY CALCULATOR DOCUMENTATION

J. B. Woodard and G. I. Miller Jan. 1978 78 p refs

(Contract EY-76-C-04-0789)

(SAND-77-8278) Avail: NTIS HC A05/MF A01

The Solar Thermal Electric Annual Energy Calculator (STAEAC) is a computer model which estimates the annual performance of a solar thermal electric power plant. Written in FORTRAN 4 for the CDC 6600, STAEAC is a quasi-steady state model with a constant (but user-variable) time step. Factors such as energy losses and delays incurred in start-up, effects of ambient weather conditions on plant operation and efficiency, effects of hold time and charge and discharge rates on deliverable energy in storage, subsystem maximum and minimum power limits, and auxiliary power requirements are taken into account in the computation of the annual electrical output of the plant. Default parameters may be easily modified through the use of NAMELIST inputs. ERA

N78-26591# Carnegie-Mellon Univ., Pittsburgh, Pa.
DYNAMIC MODELS OF FALLING FILM EVAPORATORS FOR OCEAN THERMAL ENERGY CONVERSION PLANTS

S. A. Heteyi and Charles P. Neuman Jun. 1977 52 p refs

(Contract EY-76-S-02-2641)

(COO-2641-3) Avail: NTIS HC A04/MF A01

The pertinent physical laws of heat transfer and mass balance are applied to develop lumped parameter, dynamic and steady state models for shell and tube evaporators incorporating falling films. The dynamic evaporator model is specified by three ordinary differential equations and one algebraic equation with two time delays. It is shown that, in the steady state, this dynamic model reduces to the steady state evaporator model previously developed. It is demonstrated that the dynamic evaporator model is stable for perturbations around an equilibrium operating point. The dynamic evaporator model is being incorporated with the component models developed earlier to assemble a simulation model of the power cycle of an OTEC PLANT. The power cycle model will be simulated on the digital computer to ensure that the component models adequately characterize experimentally observed data. ERA

N78-26592# Electric Power Research Inst., Palo Alto, Calif. Fossil Fuel and Advanced Systems Div.

PERSPECTIVES ON UTILITY CENTRAL STATION PHOTOVOLTAIC APPLICATIONS

E. A. DeMeo and P. B. Bos Jan. 1978 54 p refs

(EPRI-ER-589-SR) Avail: NTIS HC A04/MF A01

Nominal cost and performance goals are developed for solar photovoltaic conversion devices intended for large-scale electric utility applications. The objective is to provide an improved basis for establishing research and development priorities for photovoltaic devices and conversion concepts. Comparisons are made among a number of generic power plant conceptual designs, with the aid of an array design parameter that is defined to include array-area-related costs, overall power plant efficiency, and average available insolation. The analysis indicates that flat plate approaches without concentration or tracking have good prospects for commercial viability if device conversion efficiencies near 10 percent can be combined with installed device costs under \$20/sq m \$2/sq ft and device lifetimes in excess of 20 years. Thin-film approaches have potential for achieving these cost and performance goals because of low material content and potentially low fabrication costs. ERA

N78-26594# Houston Univ., Tex. Solar Energy Lab.
LIQUID METAL COOLED SOLAR CENTRAL RECEIVER

FEASIBILITY STUDY AND HELIOSTAT FIELD ANALYSIS. PART 1: LIQUID SODIUM COOLED CENTRAL RECEIVER SYSTEM CONCEPTUAL DESIGN Final Report. 15 Jun. 1976 - 15 Jun. 1977

Lorin L. Vant-Hull, Gerry Coleman (McDonnell Douglas Astronautics Co.), Tom Springer (Atomics Intern.), and Jerry Friefeld (Rocketdyne) Oct. 1977 162 p ref

(Contract EG-76-G-03-1426)

(ORO/5178-78-1) Avail: NTIS HC A08/MF A01

A conceptual design for a 100 MWe Solar Tower System employing liquid sodium as a heat transfer fluid and as a storage medium is generated. This design intentionally parallels the current commercial baseline design for a water/steam transfer fluid in order to enhance comparisons between the two approaches and to maximize the application of the limited funds in this study to the unique features of the liquid sodium system. Heat transfer at the receiver and the steam generator were considered in detail. Components for the liquid sodium loop currently under test on development were identified for a 10 MWe pilot plant and a 100 MWe demonstration plant. Economic comparisons with the MDAC water/steam receiver are favorable. ERA

N78-26595# Los Alamos Scientific Lab., N. Mex.

PROSPECTS FOR SOLAR ENERGY: THE IMPACT OF THE NATIONAL ENERGY PLAN

F. Roach, Scott Noll (New Mexico Univ., Albuquerque), Shaul Ben-David (New Mexico Univ., Albuquerque), Larry Bickle (L. W. Bickle and Assoc., Consulting Engineers, Albuquerque, New Mexico), and William Schulze (Univ. of Southern California, Los Angeles) Dec. 1977 53 p ref

(Contract W-7405-eng-36)

(LA-7064-MS) Avail: NTIS HC A04/MF A01

The National Energy Plan (NEP) set as a goal, the use of solar energy in two and a half million homes in 1985. A key provision of the NEP provides for the subsidization of solar equipment. The extent to which these subsidies might offset the impact of continued energy price control is examined. Regional prices and availability of conventional energy sources were compiled to obtain a current and consistent set of energy prices by state and energy type. Projections of conventional fuel price increases are made under both the NEP scenario and a projected scenario where all wellhead price controls are removed on natural gas and crude oil production. Solar system costs are developed for each state by fraction of Btu heating load provided. The total number of homes, projected energy savings, and sensitivity to heating loads, alternative energy costs and prices are included in the analysis. ERA

N78-26596# Avco-Everett Research Lab., Everett, Mass.

MHD GENERATOR COMPONENT DEVELOPMENT Quarterly Report, Jan. - Mar. 1977

Apr. 1977 89 p refs

(Contract EF-77-C-01-2519)

(FE-2519-1) Avail: NTIS HC A05/MF A01

Radial flow disk experiments were performed at peak magnetic fields in the 4 to 4.5 tesla range. Maximum output power was in the 8 MW range with a corresponding enthalpy extraction of 7 per cent. The working fluid consisted of a mixture of N₂, CO₂, and H₂. A comparison of measured and calculated plasma conductivities and MHD channel characteristics is presented. Channel calculations predict accurately the Hall effect. Results of other experimental tasks are also presented. P.R.A.

N78-26597# Brookhaven National Lab., Upton, N. Y.

FUEL CELLS: APPLIED RESEARCH FUEL CELL MATERIALS AND ELECTROCATALYSIS Annual Report, Jan. - Dec. 1976

S. Srinivasan and H. S. Isaacs Sep. 1977 32 p refs

(Contract EY-76-C-02-0016)

(BNL-50852) Avail: NTIS HC A03/MF A01

Research is described on electrocatalysis of fuel cell reactions including the topics (1) mixed oxides as oxygen electrodes, (2) electrolyte effects on the oxygen reduction reaction, (3) anion effects on the oxygen reduction reaction, and (4) selection and evaluation of electrocatalysts for oxygen reduction in KHCO₃/K₂CO₃ buffered electrolytes. Phosphoric acid fuel cell studies

include inhibition of sintering of fuel cell catalyst particles; electrochemical methods for surface regeneration and temperature effects on the oxygen reduction reaction a platinum in phosphoric acid electrolyte. Research on the characterization of overpotentials of solid electrolyte fuel cells and selection and evaluation of interconnector materials for solid electrolyte fuelcells is summarized. Author (ERA)

N78-26598# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.

MIXED STRATEGIES FOR ENERGY CONSERVATION AND ALTERNATIVE ENERGY UTILIZATION (SOLAR) IN BUILDINGS, VOLUME 1. EXECUTIVE SUMMARY Final Report Jun. 1977 62 p

(Contract EY-76-C-03-1234)

(SAN/1234-1/1) Avail: NTIS HC A04/MF A01

Information is presented on the cost effectiveness of a strategy for reducing energy consumption in buildings by combining energy conservation techniques, such as improved building design and thermal insulation with solar heating and cooling systems. It is concluded, from computer simulation studies used to determine building loads and the interaction of the solar system, that energy conservation is the most cost effective way to save energy in all buildings at any location, and that solar systems are currently not cost effective. ERA

N78-26599# National Science Council, Dublin (Ireland). Energy Group.

ANALYSIS OF THE IMPACT OF HEAT PUMP TECHNOLOGY ON THE IRISH ENERGY SYSTEM TO THE YEAR 2000. ENERGY CASE STUDY SERIES: NO. 2

J. Brady Sep. 1977 103 p refs Presented at the Energy Workshop of the Natl. Sci. Council of Ireland, Dublin, 13 Sep. 1977

(CONF-770956-2) Avail: NTIS HC A06/MF A01

The methodology involved the measurement of the potential impact against a base reference energy system for various heat pump strategies. A short analysis of the implementation rates and their effect on technology impact was also carried out. ERA

N78-26601# Oak Ridge National Lab., Tenn.

MOLTEN CARBONATE FUEL CELL RESEARCH AT ORNL. 2: THEORETICAL AND EXPERIMENTAL TRANSPORT STUDIES, THERMOCHEMISTRY, AND ELECTRON MICROSCOPY

J. Braunstein, H. R. Bronstein, S. Cantor, D. E. Heatherly, L. D. Hulett, R. L. Shermann, C. E. Vallet, and G. Watts Dec. 1977 22 p refs

(Contract W-7405-eng-26)

(ORNL/TM-6168/V2) Avail: NTIS HC A02/MF A01

Theoretical and modeling studies of mass transport in molten Li₂CO₃-K₂CO₃ mixtures were extended for the prediction of possible composition gradients. A parametric representation was developed that incorporates the effects of current density, electrode separation, initial composition, effective Li/K mobility ratio and effective interdiffusion coefficient. Electrolysis experiments designed to test the model and simulate mass transport in an operating fuel cell are being carried out by analysis of emf-time relaxation curves measured after electrolysis. Direct analysis of composition profiles in electrolyte tiles is being developed by means of scanning electron microscopy with energy dispersive X-ray fluorescence. Differential scanning calorimetry was applied to the thermochemistry of the carbonate electrolyte and lithium aluminate matrix. ERA

N78-26604# Sandia Labs., Albuquerque, N. Mex.

NUMERICAL CODES FOR MHD FLOWS Quarterly Technical Progress Report, Jan. - Mar. 1977

K. J. Touryan, F. G. Blottner, A. J. Russo, and J. G. Taylor Nov. 1977 42 p

(Contract EY-76-C-04-0789)

(SAND-77-1658) Avail: NTIS HC A03/MF A01

A previously developed code for an inviscid perfect gas was adapted to the calculation of the flow from the combustion chamber through the MHD channel. Verification of the quasi-two-

dimensional approximation was obtained. Using an electrodynamic code which calculates current and potential fields in an expanding section of MHD channel, routines for iteratively interchanging data with the two-dimensional fluid code were developed. The equations modelling slag vapor condensation in a coal combustion MHD generator were simplified to provide a more tractable problem for initial study. Results of other progress are also reported. P.R.A.

N78-26608# Alabama Univ., Huntsville. Kenneth E. Johnson Environmental and Energy Center.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM CONTRACTOR'S REVIEW. SUMMARY AND ANALYSIS OF WORKSHOP AND PANEL SESSIONS

D. L. Christensen Dec. 1977 43 p Conf. held at New Orleans, 5-7 Dec. 1977

(Contract EC-78-C-01-4131)

(CONF-771229-Summ) Avail: NTIS HC A03/MF A01

The Workshop Summary contains the results and summaries of the five workshops and panel session held on the final day of the program. The workshops reflected much of the interests and concerns of the various attendees and generally represent a summary of the overall program. The workshops included: (1) design concepts, philosophy and techniques; (2) installation, construction and hardware procurement; (3) operational and performance factors; (4) economic, environmental, societal and institutional issues; and (5) overview of National Demonstration Program. ERA

N78-26609# Boeing Engineering and Construction, Seattle, Wash.

CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM: COLLECTOR SUBSYSTEM Final Report

15 Aug. 1977 154 p refs

(Contract EY-76-C-03-1111)

(SAN/1111-76-7) Avail: NTIS HC A08/MF A01

Three heliostats and a drive and control assembly were fabricated and tested to provide design data and verification of the preliminary design. In addition, an extensive evaluation program was conducted on the key plastic materials used in the protective enclosure and reflector. Performance and environmental exposure tests on large scale heliostats were conducted over an eight month period at a desert test site in northeast Oregon to determine optical performance, demonstrate operation of the drive and control assembly in the various operational modes, and verify survivability of hardware in the environment. Plastic materials evaluation tests included measurement of mechanical and optical properties, creep, chemical exposure, cleanability, accelerated simulated sunlight, and actual desert sunshine exposure tests. ERA

N78-26610# Tennessee Univ., Knoxville.

IN SITU CONVERSION OF COAL Final Report, 1 Jun. 1976 - 30 Nov. 1977

John W. Larsen Oct. 1977 16 p refs

(Contract EY-76-S-02-0066)

(COO-0066-2) Avail: NTIS HC A02/MF A01

Intermolecular hydride transfer from a variety of compounds to carbonium ions was reviewed. The reaction developed uses BF₃H₂O as the acid and Et₃SiH as the hydride donor. The organic compound to be reduced is protonated by the BF₃H₂O to give a carbonium ion which then hydride abstracts from the Et₃SiH. ERA

N78-26611# California Univ., Livermore. Lawrence Livermore Lab.

ENERGY AND RESOURCE PLANNING GROUP. Annual Report, FY 1977

William J. Ramsey, ed. 27 Oct. 1977 31 p refs

(Contract W-7405-eng-48)

(UCRL-50029-77) Avail: NTIS HC A03/MF A01

A major effort was devoted to transportation planning and analysis; system analysis, conceptual design studies, and planning support to the Transportation Energy Conservation Division of DOE. Also, a multilaboratory study of energy-storage power systems for automobiles was directed for DOE and results

published. The results show while some of the energy storage power vehicles can provide performance comparable to that of conventional internal combustion engine vehicles, they would be heavier and more expensive. The value of regenerative braking for vehicles in recovering kinetic energy was assessed. Such braking would have the most benefit in vehicles already equipped with energy storage systems and whose deriving cycle involves many stops and starts. A conceptual design study on a possible transition electric vehicle was completed. Such a vehicle would be battery/flywheel powered, with a small internal combustion engine for range extension. ERA

N78-26612# Stanford Univ., Calif. Dept. of Operations Research.

ETA-MACRO: A MODEL OF ENERGY-ECONOMY INTERACTIONS

Alan S. Manne Dec. 1977 82 p refs Sponsored by EPRI (EPRI-EA-592) Avail: NTIS HC A05/MF A01

A market economy is simulated through a dynamic nuclear optimization process. To describe the production relationship within this economy, two dynamic submodels are incorporated: ETA, a process analysis for energy technology assessment; and a macroeconomic growth model providing for substitution between capital, labor, and energy inputs. The focus is on one specific policy option--banning the introduction of additional civilian nuclear power plants in the U.S. Under base-case assumptions, it turned out that a no nuclear policy would have negligible macroeconomic effects prior to the year 2000, but that it could lead to an annual loss of the order of \$100 billions by the year 2010. ERA

N78-26613# Oak Ridge National Lab., Tenn.

POWER PLANT REJECT HEAT UTILIZATION: AN ASSESSMENT OF THE POTENTIAL FOR WIDE-SCALE IMPLEMENTATION

M. Olszewski Dec. 1977 51 p refs

(Contract W-7405-eng-26)

(ORNL/TM-5841) Avail: NTIS HC A04/MF A01

Economic and heat utilization merits of plant reject heat utilization systems were assessed in an effort to indicate those technologies that show the greatest potential for wide-scale implementation in the power generating industry. It was assumed that these systems replaced the cooling tower as the primary condenser cooling water heat dissipation system. Implementation potential and user incentive considerations were used in assessing the technologies. Assessment of the implementation potential included economic, marketing, and power plant performance criteria. The user incentive assessment essentially viewed the use of reject heat from the user's perspective. The overall assessment indicated that extensive pond aquaculture offered the greatest potential for wide-scale implementation. ERA

N78-26616# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

A PROJECT TO REDUCE THE IMPACT OF ENERGY SHORTAGES AND COST INCREASES ON INDUSTRIAL PRODUCTION IN THE SOUTHEAST. VOLUME 1: PROJECT OVERVIEW Final Report

Feb. 1978 29 p 3 Vol.

(Grant EDA-99-6-09359-1)

(PB-278078/1; EDA-78-056) Avail: NTIS HC A03/MF A01; HC also available in set of 3 reports HC E09, PB-278077-SET CSCL 10A

The goal is to reduce the impact of energy shortages and increased energy costs on employment and industrial expansion by creation and stimulation of industrial energy conservation programs. Project activities and major end items that were produced are described. Project methodology, other benefits of the project, and recommendations for future work of this type are included. GRA

N78-26617# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

A PROJECT TO REDUCE THE IMPACT OF ENERGY SHORTAGES AND COST INCREASES ON INDUSTRIAL

PRODUCTION IN THE SOUTHEAST. VOLUME 2: CASE STUDY AND TECHNICAL ASSISTANCE Final Report

Feb. 1978 246 p 3 Vol.

(Grant EDA-78-057)

(PB-278079/9; EDA-78-057) Avail: NTIS HC A11/MF A01; HC also available in set of 3 reports HC E09, PB-278077-SET CSCL 10A

A compilation is given of case study and technical assistance information catalogued by industry. The volume also includes a compilation by industry of specific energy conservation ideas showing estimated costs and savings. It is designed as a working reference for individuals who would provide technical assistance to industry. It describes the make-up of industries, the technical energy conserving opportunities within the industries, and specific projects undertaken. GRA

N78-26618# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

A PROJECT TO REDUCE THE IMPACT OF ENERGY SHORTAGES AND COST INCREASES ON INDUSTRIAL PRODUCTION IN THE SOUTHEAST. VOLUME 3: TRANSFER PACKAGE Final Report

Feb. 1978 130 p 3 Vol.

(Grant EDA-99-6-09359-1)

(PB-278080/7; EDA-78-058) Avail: NTIS HC A07/MF A01; HC also available in set of 3 reports HC E09, PB-278077-SET CSCL 10A

Information is given to provide a basis for conducting a similar program in other states. Program methodology is described in detail as are methods for selecting participating firms. In addition, training materials for technical workshops are included. GRA

N78-26619# American Mathematical Society, Providence, R.I. **MATHEMATICAL ASPECTS OF PRODUCTION AND DISTRIBUTION OF ENERGY: PROCEEDINGS OF SYMPOSIUM IN APPLIED MATHEMATICS OF THE AMERICAN MATHEMATICAL SOCIETY, VOLUME 21**

Peter D. Lax, ed. 1977 139 p refs Symp. held in San Antonio, 20-21 Jan. 1976

(Contract E(11-1)-2409; Grant NSF MCS-76-10597)

(PB-278350/4; ISBN-0-8218-0121-X) Avail: NTIS HC A07/MF A01 CSCL 10A

The subjects are grouped in two categories: those having to do with the mathematical problems involved in the technology of energy production, and those which have to do with the mathematical problems of estimating the resources of energy and the efficient distribution of available energy. The models for energy production are in the form of fairly complicated systems of partial differential equations whose solutions require techniques of finite difference schemes, finite element methods, and Fourier techniques. The models of energy distribution are large networks; their analysis is based on techniques from statistics, linear programming, dynamic programming, and techniques of optimization. GRA

N78-26620# Oak Ridge Associated Universities, Tenn.

ENVIRONMENTAL EFFECTS OF ENERGY

1976 32 p Proc. of Conf. held at Savannah, 2-3 Dec. 1976 Sponsored in part by EPA

(Contract DI-14-16-008-1237)

(PB-278169/8; FWS/OBS-76/52) Avail: NTIS HC A03/MF A01 CSCL 10A

Ecological effects and environmental transport processes of an EPA program were reviewed. Topics discussed include: energy and ecology; assessment of interagency research and its management implications; dilemmas in environmental effects research and energy development; a framework for assessment; and the Federal inventory of energy related biomedical and environmental research. GRA

N78-26621# Northeastern Legislative Leaders Energy Research Project.

ENERGY POLICY MAKING IN THE NORTHEAST: A DIRECTORY OF STATE PROGRAMS AND INSTITUTIONS Sep. 1977 132 p

(Grant NSF ISP-74-43894)
(PB-277503/9; NSF/RA-770213) Avail: NTIS
HC A07/MF A01 CSDL 10A

An overview is provided of the current energy related duties and programs of governmental institutions in Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont. State legislative institutions were included along with executive bodies. The directory is arranged by states, separated into the two categories of executive and legislative branches. For each agency the following information concerning energy policy making is included: structure; responsibilities (purpose, authority, energy related duties, energy related activities); administration; and publications. GRA

N78-26634# Battelle Pacific Northwest Labs., Richland, Wash.
EFFECT OF LIQUID WASTE DISCHARGES FROM STEAM GENERATING FACILITIES
H. E. McGuire, Jr. Sep. 1977 54 p refs
(Contract EY-76-C-06-1830)
(BNWL-2393) Avail: NTIS HC A04/MF A01

A simplified model for use in approximately determining the effects of these discharges is given. Four basic fuels are used in steam electric power plants: three fossil fuels--coal, natural gas, and oil; and uranium--presently the basic fuel of nuclear power. Coal and uranium are expected to be the major fuels in future years. The following power plant effluents are considered: heat, chlorine, copper, total dissolved solids, suspended solids, pH, oil and grease, iron, zinc, chrome, phosphorus, and trace radionuclides. ERA

N78-26642# Argonne National Lab., Ill.
IMPLICATIONS OF THE 1977 CLEAN AIR ACT AMENDMENTS FOR ENERGY RESEARCH AND DEVELOPMENT
D. B. Garvey, S. L. Kung, D. G. Streets, and G. Leppert 1977 9 p refs Presented at 5th Natl. Conf. on Energy and the Environment, Cincinnati, Ohio, 31 Oct. 1977
(Contract W-31-109-eng-38)
(CONF-7710101-2) Avail: NTIS HC A02/MF A01

The Clean Air Act Amendments of 1977 establish Federal environmental policy governing industrial development in all areas of the country. Some impacts of the legislation on energy development will be to increase the incentives for research on technologies that are inherently less polluting and on improved emission control; to accelerate the rate at which technologies with reduced emissions or with emission control advantages become economical; and to expand the role of conservation measures to reduce energy demand. The legislation will have an impact on the siting and scale of future energy facilities, on control technology requirements, and on the cost-effectiveness and relative attractiveness of various technologies to utilities and other industries. ERA

N78-26644# Chemical Lab. RVO-TNO, Rijswijk (Netherlands).
DISPERSION AND ANALYSIS OF METHANE IN THE ATMOSPHERE
C. J. P. vanBuijtenen, A. Verweij, and H. L. Boter Sep. 1976 24 p refs In DUTCH; ENGLISH summary
(CL-1976-16; TDCK-68902) Avail: NTIS HC A02/MF A01

As part of the project assessing the hazards involved in the transport and handling of liquefied natural gas (LNG-project) the dispersion of methane gas clouds in the atmosphere was studied. Calculations for an instantaneous, continuous, and time-dependent source were made. Starting from Pasquill's method, and taking into account the source dimensions, the amount of gas in the explosive region (5 to 15% v/v) was calculated. For an instantaneous cloud this amount shows a maximum of approximately 50% irrespective of the source length and meteorological conditions. Special attention was paid to the calculation of the safety distance for a quasiinstantaneous spill on the sea. For this case the behavior of the cloud at the source was numerically simulated. For a 25,000 cubic meter spill of LNG this leads to a distance where the average concentration is half the lower flammability limit of approx. 20 km under unfavorable meteorologi-

cal conditions and a 7 km under favorable meteorological conditions. The possibilities of the continuous and discontinuous measurement of methane concentrations were investigated. A device was built to generate 0.5 to 50% concentrations of methane in air. The accuracy of the concentrations was checked with infrared spectroscopy. The performance of a commercially available combustible gas detector to measure the methane concentration continuously and the use of gas chromatography as a discontinuous method were investigated. Author (ESA)

N78-26645# Resources Conservation Co., Renton, Wash.
EFFECTIVE CONTROL OF SECONDARY WATER POLLUTION FROM FLUE GAS DESULFURIZATION SYSTEMS
Final Report, Jul. 1976 - May 1977
Lanny D. Weimer Sep. 1977 70 p refs
(Contract EPA-68-C2-2171)
(PB-278373/6; EPA-600/7-77-106) Avail: NTIS
HC A04/MF A01 CSDL 07A

A vertical-tube, falling-film, vapor-compression evaporator to concentrate waste water from a flue gas desulfurization process is discussed. Tests showed that waste water from the FGD process can be concentrated up to 140 times and with recovery of more than 99% to the waste stream as high quality water. Two series of tests were conducted: one with a 25 gpd bench model evaporator; the other with a 6000 gpd pilot size evaporator. Process conditions were identified and verified for scale free operation. A conceptual design and economic study of a full size treatment facility showed that capital costs will range from \$5110 to \$8706/1000 gpd of waste water processed, depending on system capacity. GRA

N78-26646# TRW, Inc., Redondo Beach, Calif.
ENVIRONMENTAL ASSESSMENT OF HIGH-BTU GASIFICATION
Annual Report, May - Oct. 1977
M. Ghassemi and C. Murray Feb. 1978 87 p refs
(Contract EPA-68-02-2635)
(PB-278175/5; EPA-600/7-78-025) Avail: NTIS
HC A05/MF A01 CSDL 07A

Environmental impacts are assessed that are associated with technologies for converting coal to high-Btu gaseous fuel and to identify control technologies required to reduce or eliminate adverse environmental impacts associated with commercial operation. The program consists of: evaluating existing processes and environmental data; acquiring supplementary data through sampling and analyzing process waste streams; and environmental assessment and process engineering support studies. A modular approach was chosen for analyzing and presenting data on gasification, gas treatment, pollution control, and integrated facilities. Draft gasification data sheets were prepared for some of the processes considered. GRA

N78-26648# Environmental Protection Agency, Research Triangle Park, N.C. Emissions Standards and Engineering Div.
STANDARDS SUPPORT AND ENVIRONMENTAL IMPACT STATEMENT. VOLUME 2: PROMULGATED STANDARDS OF PERFORMANCE FOR PETROLEUM REFINERY SULFUR RECOVERY PLANTS
Jan. 1978 39 p
(PB-278163/1; EPA-450/2-76-016-Vol-2) Avail: NTIS
HC A03/MF A01 CSDL 13B

A national emission standard for sulfur dioxide and reduced sulfur compounds was proposed under authority of section 3 of the Clean Air Act. The intent of the standard was to minimize reduced sulfur and sulfur dioxide emissions from refinery sulfur recovery plants to the level attainable with best available control technology. Twenty-one comment letters were received from the petroleum industry, state and local air pollution control agencies, and other federal agencies. As a result of these comments, changes were made in the promulgated standard. The major change is an exemption from the standard for sulfur recovery plants of 20 long tons per day or less associated with a small petroleum refinery. GRA

N78-26653# Rutgers - The State Univ., New Brunswick, N. J. Water Resources Research Inst.

THE PETROLEUM INDUSTRY IN THE DELAWARE ESTUARY Report of Work Completed, 1974 - 1976

Ruth Patrick Jan. 1977 450 p

(Grant NSF ENV-74-14810-A03)

(PB-277962/7; NSF/RA-770429)

Avail: NTIS

HC A19/MF A01 CSCL 13B

A comprehensive evaluation is presented of all of the sources of petroleum in the Delaware Estuary, including the finding that urban runoff and other unrecorded sources constitute a major part of the total load. Investigations of toxicity of petroleum and its products and derivatives to fish, shellfish, and other organisms has revealed that toxicity to most, but not all, immature organisms is greater than that to adults, that petroleum on sediments is much more toxic to oysters than when it is dissolved in the water column, and that chronic and life cycle studies show very much greater toxicity than the acute bioassay tests which are usually relied upon. The study shows that ultraviolet irradiation of no. 2 fuel oil and Iranian crude greatly increases their toxicity. GRA

N78-26654# Hittman Associates, Inc., Columbia, Md.

ENVIRONMENTAL ASSESSMENT OF COAL LIQUEFACTION Annual Report, Jul. 1976 - Sep. 1977

Ken T. Budden and Werner H. Zieger Feb. 1978 202 p

(Contract EPA-68-02-2162)

(PB-278333/0; EPA-600/7-78-019)

Avail: NTIS

HC A10/MF A01 CSCL 21D

Environmental aspects of 14 of the most prominent coal liquefaction systems, in terms of background, process description, major operations, input and output streams, status, and schedules of system development are given. GRA

N78-26657# Midwest Research Inst., Kansas City, Mo.

EVALUATION OF SULFATE-BEARING WASTE MATERIAL FROM FLUIDIZED BED COMBUSTION OF COALS FOR SOIL STABILIZATION Final Report

J. W. Nebgen, J. G. Edwards, and D. Conway Sep. 1977 70 p refs

(Contracts DOT-FH-11-8515; E(49-18)-2491)

(PB-278031/0; FHWA-RD-77-136)

Avail: NTIS

HC A04/MF A01 CSCL 13B

The effects of spent bed material from the fluidized bed combustion of coal in the physical and strength properties of selected finegrained soils were evaluated. The spent bed material is a mixture of time and calcium sulfate obtained by a process from which pulverized coal is burned in a fluid bed of finely ground calcitic or dolomitic limestone. GRA

N78-26699# New Mexico State Bureau of Mines and Mineral Resources, Socorro.

BIBLIOGRAPHY OF NEW MEXICO GEOLOGY AND MINERAL TECHNOLOGY, 1971-1976

John R. Wright and Judy A. Russell 1977 142 p

(PB-278348/8; BULL-106) Avail: NTIS HC A07/MF A01 CSCL 08G

Items that are generally accessible and contain technical information on geoscience and mineral technology are listed. Papers relating to geographical areas adjoining New Mexico were sometimes included (for example west Texas) particularly where major geologic features straddle the state boundary. Highly generalized articles of only a page or two (for example devoted to the Southwest) were excluded. The few references dated prior to 1971 are included because they were omitted in earlier bibliographies. GRA

N78-26832# Mechanics Research, Inc., McLean, Va.

OCS ANALYTICAL MODEL Final Report, 1 Nov. 1976 - 30 Apr. 1977

Glen Robinson May 1977 224 p refs

(SDC/MRI-2345-017) Avail: NTIS HC A10/MF A01

The status of various U.S. outer continental shelf energy source locations is assessed, offshore wells in the Gulf of Mexico and the Santa Barbara Channel. A logic network was designed to describing the entire offshore development process from geological surveys to the delivery on oil and gas ashore. The completed model will include all present U.S. offshore activities. Weighing factors can then be applied to translate the model for each of the 17 frontier areas now considered worth exploring. ERA

N78-26865# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

STATUS OF PHOTOELECTROCHEMICAL PRODUCTION OF HYDROGEN AND ELECTRICAL ENERGY

Charles E. Byvik and Gilbert H. Walker In Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 244-247 refs

Avail: NTIS HC A13/MF A01 CSCL 10A

The efficiency for conversion of electromagnetic energy to chemical and electrical energy utilizing semiconductor single crystals as photoanodes in electrochemical cells was investigated. Efficiencies as high as 20 percent were achieved for the conversion of 330 nm radiation to chemical energy in the form of hydrogen by the photoelectrolysis of water in a SrTiO₃ based cell. The SrTiO₃ photoanodes were shown to be stable in 9.5 M NaOH solutions for periods up to 48 hours. Efficiencies of 9 percent were measured for the conversion of broadband visible radiation to hydrogen using n-type GaAs crystals as photoanodes. Crystals of GaAs coated with 500 nm of gold, silver, or tin for surface passivation show no significant change in efficiency. By suppressing the production of hydrogen, in a CdSe-based photogalvanic cell, an efficiency of 9 percent was obtained in conversion of 633 nm light to electrical energy. A CdS-based photogalvanic cell produced a conversion efficiency of 5 percent for 500 nm radiation. Author

N78-26869# Illinois Inst. of Tech., Chicago.

GAS CORE REACTORS FOR COAL GASIFICATION

Herbert Weinstein In Princeton Univ. Partially Ionized Plasmas, Including the 3rd Symp. on Uranium Plasmas Sep. 1976 p 269-274 refs

(Grant NSG-7039)

Avail: NTIS HC A13/MF A01 CSCL 10A

The concept of using a gas core reactor to produce hydrogen directly from coal and water is presented. It is shown that the chemical equilibrium of the process is strongly in favor of the production of H₂ and CO in the reactor cavity, indicating a 98% conversion of water and coal at only 1500 K. At lower temperatures in the moderator-reflector cooling channels the equilibrium strongly favors the conversion of CO and additional H₂O to CO₂ and H₂. Furthermore, it is shown the H₂ obtained per pound of carbon has 23% greater heating value than the carbon so that some nuclear energy is also fixed. Finally, a gas core reactor plant floating in the ocean is conceptualized which produces H₂, fresh water and sea salts from coal. Author

N78-26906# Bernische Kraftwerke A. G. (Switzerland).

COMPLETION OF THE FUEL CYCLE IN SMALL COUNTRIES

P. Stoll 1977 7 p refs In ENGLISH and GERMAN Presented at Reactor Conf. of the Ger. Atom Forum and Nucl. Technol. Soc., Mannheim, Ger., 29 Mar. - 1 Apr. 1977

(CONF-770323-5) Avail: NTIS HC A02/MF A01

Problems involving fuel cycle competition for various countries by means of contracts with national reprocessing installations are discussed. Possible solutions are presented as the following: (1) Enlargement of the capabilities of in house fuel element storage basins and intermediate storage; and (2) Construction and operation of central storage for spent fuel elements. Author (ERA)

N78-26933# Argonne National Lab., Ill.
STUDIES ON TWO-PHASE FLOW MIXING PERTAINING TO LIQUID-METAL MAGNETOHYDRODYNAMIC POWER GENERATION

G. Fabris, P. F. Dunn, J. C. F. Chow, and R. Kolp. 1977 11 p refs Presented at 5th Biennial Symp., Rolla, Mo., 2 Oct. 1977 (Contract W-31-109-eng-38)
 (CONF-771098-1) Avail: NTIS HC A02/MF A01

The local flow structure occurring inside two-phase mixers liquid-metal magnetohydrodynamic (LMMHD) mixers and generators was investigated to determine the relation between the characteristics of local two-phase flow structure at high void fractions (approximately 0.6 to approximately 0.9) and LMMHD power generation system efficiency. Evaluations of the fluid mechanical performance of various two-phase LMMHD mixer designs are discussed. The finding from flow visualization studies of the local two-phase flows downstream from various mixer-element configurations are presented in addition to the local measurements performed to characterize these flows. ERA

N78-26962# Colorado School of Mines, Golden. Dept. of Chemical and Petroleum Refining Engineering.

ENTHALPY MEASUREMENT OF COAL-DERIVED LIQUIDS
Quarterly Technical Progress Report, Oct. - Dec. 1977

A. J. Kidnay and V. F. Yesavage 15 Jan. 1978 20 p refs (Contract EX-76-C-01-2035)
 (FE-2035-10) Avail: NTIS HC A02/MF A01

Experimental enthalpy measurements were made on a naphtha sample produced by the SRC-I process. A total of 116 enthalpy determinations were made covering the ranges 160 to 670 F and 30 to 900 psia. A comparison of three correlations for enthalpy with the experimental data for a Synthoil distillate was also made. The predicted enthalpies were considerably in error. ERA

N78-26968# National Field Research Center, Inc., Iowa City, Iowa.

A NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT, BUSINESS AND INDUSTRY, PHASE 1
Final Report

Dec. 1977 73 p refs
 (Grant EPA-T-900591-01-0)
 (PB-277904/9) Avail: NTIS HC A04/MF A01 CSCL 051

Workforce needs for pollution control and abatement in the United States for the five-year period of 1976 through 1981 were assessed. Fields for pollution control --air, noise, pesticides, potable water, radiation, solid waste, and wastewater -- are analyzed, together with energy-related programs currently accentuated by the national effort to solve energy supply problems. Information and data collected from the private industrial sector in the areas of pollution control and abatement are presented. Included are indications of current workforce levels and career potentials as supplied by numerous industrial respondents. GRA

N78-26969# National Field Research Center, Inc., Iowa City, Iowa.

A NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT, NATIONAL LEGISLATION, PHASE 1
Final Report

Dec. 1977 73 p
 (Grant EPA-T-900591-01-0)
 (PB-277905/6) Avail: NTIS HC A05/MF A01 CSCL 051
 For abstract, see N78-26968.

N78-26970# National Field Research Center, Inc., Iowa City, Iowa.

A NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT, NATIONAL ABSTRACT

Dec. 1977 74 p
 (Grant EPA-T-900591-01-0)
 (PB-277906/4) Avail: NTIS HC A04/MF A01 CSCL 051
 For abstract, see N78-26968.

N78-26986# Capital Systems Group, Rockville, Md.
APPLIED SCIENCE AND RESEARCH APPLICATIONS.

RECENT RESEARCH REPORTS, FEBRUARY 1978

Feb. 1978 41 p
 (Grant NSF ISP-75-22472)
 (PB-278530/1: NSF/RA-780002) Avail: NTIS
 HC A03/MF A01 CSCL 05B

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N78-28995*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

AN INVERTER/CONTROLLER SUBSYSTEM OPTIMIZED FOR PHOTOVOLTAIC APPLICATIONS

Roy Pickrell, George O'Sullivan (Abacus Controls, Inc., Somerville, N. J.), and Walter C. Merrill 1978 11 p refs Presented at 13th Photovoltaic Specialists Conf., Washington, D.C., 5-8 Jun. 1978; sponsored by IEEE
 (Contract E(49-26)-1022)
 (NASA-TM-78903; DOE/NASA/1022-78/31; E-9639) Avail: NTIS HC A02/MF A01 CSCL 13F

Conversion of solar array dc power to ac power stimulated the specification, design, and simulation testing of an inverter/controller subsystem tailored to the photovoltaic power source characteristics. Optimization of the inverter/controller design is discussed as part of an overall photovoltaic power system designed for maximum energy extraction from the solar array. The special design requirements for the inverter/controller include: a power system controller (PSC) to control continuously the solar array operating point at the maximum power level based on variable solar insolation and cell temperatures; and an inverter designed for high efficiency at rated load and low losses at light loadings to conserve energy. Author

N78-26998# Pacific Northwest Environmental Research Lab., Corvallis, Ore.

ENERGY CONSUMPTION OF ADVANCED WASTEWATER TREATMENT AT ELY, MINNESOTA

Donald J. Hernandez Jan. 1978 30 p refs
 (PB-278270/4; EPA-600/7-78-001) Avail: NTIS
 HC A03/MF A01 CSCL 13B

The use of energy in an advanced sewage treatment plant was studied from the point of view of plant operation, support services, and indirect use. A process by process analysis of plant operation indicates the energy used in the treatment process is minimal when compared to other usages. GRA

N78-27005# Gordian Associates, Inc., New York.
OVERCOMING INSTITUTIONAL BARRIERS TO SOLID WASTE UTILIZATION AS AN ENERGY SOURCE
Final Report

Nov. 1977 284 p refs
 (Contracts EM-75-C-01-8403; FEA-CO-04-50172-00)
 (HCP/L50172-01) Avail: NTIS HC A13/MF A01

The institutional constraints affecting the demand for the various forms of energy available in municipal solid waste (MSW) such as processed fuel, low-quality pyrolysis gas, and steam were investigated with emphasis on possible barriers to participation by investor-owned utilities. Evaluations included process technology (excepting pyrolysis oil), product characteristics, marketability, price, environmental impacts, and such institutional issues as regulatory constraints and utility attitudes toward risk-sharing in projects to recovery energy from waste. Financial and operating risks in MSW-energy recovery are caused by inflation, the lag in rate relief, high interest rates, lack of sufficient investment capital, reliance on fuel adjustment clauses, and the

likelihood that MSW-energy investment costs will not be allowed in a utility rate base. Technologies for recovering energy from waste are developing rapidly, however, under any current technology, the cost to recover energy remains greater than the price the recovered energy can command in the marketplace.

ERA

N78-27006# Gordian Associates, Inc., New York.
OVERCOMING INSTITUTIONAL BARRIERS TO SOLID WASTE UTILIZATION AS AN ENERGY SOURCE: EXECUTIVE SUMMARY

Nov. 1977 284 p refs
 (Contracts EM-75-C-01-8403; FEA-CO-04-50172-00)
 (HCP/L50172-02) Avail: NTIS HC A02/MF A01

N78-27009# Battelle Columbus Labs., Ohio.
AN AGENDA FOR TECHNOLOGY ASSESSMENT IN THE MATERIALS FIELD. VOLUME 1: PRINCIPAL FINDINGS
 Alexander Christakis, Samuel Globe, Kazuhiko Kawamura, and Doreen F. McGirr 24 Mar. 1978 66 p refs 2 Vol.
 (Grant NSF ERS-77-17735)

(PB-278639/0) Avail: NTIS HC A04/MF A01 CSCL 05A
 The views of materials scientists and materials technologies were synthesized to produce a forecast of materials technologies for the ensuing two decades. From these technologies a list of 21 candidate subjects, which are proposed topics for technology assessment, was developed. The ratings of the candidates subjects were treated statistically to rank them as to urgency. From the rankings as to urgency, the five topics selected as meriting highest priority for full technology assessment are biodegradable plastics; conversion of coal to cleaner fuels; electric power generation and transmission; materials for nuclear systems; and mining ocean nodules.

GRA

N78-27010# Battelle Columbus Labs., Ohio.
AN AGENDA FOR TECHNOLOGY ASSESSMENT IN THE MATERIALS FIELD. VOLUME 2: APPENDICES
 Alexander Christakis, Samuel Globe, Kazuhiko Kawamura, and Doreen F. McGirr 24 Mar. 1978 178 p 2 Vol.
 (Grant NSF ERS-77-17735)
 (PB-278640/8) Avail: NTIS HC A09/MF A01 CSCL 05A
 For abstract, see N78-27009.

N78-27046# National Aeronautics and Space Administration.
 Langley Research Center, Langley Station, Va.
CTOL TRANSPORT TECHNOLOGY, 1978
 Jun. 1978 516 p refs Conf: held at Hampton, Va., 28 Feb.-3 Mar. 1978
 (NASA-CP-2036-Pt-1; L-12178) Avail: NTIS
 HC A22/MF A01 CSCL 02A

Technology generated by NASA and specifically associated with advanced conventional takeoff and landing transport aircraft is reported. Topics covered include: aircraft propulsion; structures and materials; and laminar flow control.

N78-27047# National Aeronautics and Space Administration.
 Washington, D. C.
OVERVIEW OF NASA CTOL PROGRAM
 James J. Kramer In NASA: Langley Res. Center CTOL Transport Technol., 1978 Jun. 1978 p 1-7

Avail: NTIS HC A22/MF A01 CSCL 02A

Technology generated by NASA and specifically oriented toward advanced commercial air transport is reviewed. Results of the Aircraft Energy Efficiency program and of related disciplinary areas are reported. The CTOL research efforts are put into perspective relative to the total NASA aeronautics program.

J.M.S.

N78-27048# National Aeronautics and Space Administration.
 Lewis Research Center, Cleveland, Ohio.
ACEE PROPULSION OVERVIEW
 Donald L. Nored In NASA: Langley Res. Center CTOL Transport Technol., 1978 Jun. 1978 p 9-23 refs

Avail: NTIS HC A22/MF A01 CSCL 21E

Technology for fuel-efficient subsonic CTOL transport aircraft is discussed. The engine, component improvement project, the energy efficient engine project, and the advanced turboprop project are included. The overall goals and objectives of each project are reviewed and the approach and schedule for accomplishing these project goals and objectives are given.

J.M.S.

N78-27053# Pratt and Whitney Aircraft Group, East Hartford, Conn.

ENERGY EFFICIENT ENGINE: PRELIMINARY DESIGN AND INTEGRATION STUDIES

David E. Gray In NASA: Langley Res. Center CTOL Transport Technol., 1978 Jun. 1978 p 89-110

Avail: NTIS HC A22/MF A01 CSCL 21E

A mixed exhaust, direct drive fan turbofan configuration was selected from four candidates. This choice was based on its ability to exceed study goals of 12% lower thrust specific fuel consumption and 5% lower direct operating cost by the 1990's with commercially acceptable technical risk and relative mechanical simplicity. The evaluation leading to configuration selection is discussed. Necessary technology advancements are identified and related to the goals.

J.M.S.

N78-27054# General Electric Co., Fairfield, Conn.
ENERGY EFFICIENT ENGINE PRELIMINARY DESIGN AND INTEGRATION STUDIES

R. P. Johnston and M. C. Hemsworth In NASA: Langley Res. Center CTOL Transport Technol., 1978 Jun. 1978 p 111-138 refs

Avail: NTIS HC A22/MF A01 CSCL 21E

The characteristics and systems benefits of an energy efficient engine (E3) suitable for use on advanced subsonic transport aircraft were determined. Relative to a current CF6-50C engine, the following benefits were estimated: 14.4% reduction in installed cruise specific fuel consumption, and a reduction in direct operating cost of more than 5%. The advanced technology E3 system would also permit: compliance with FAR 36 (1977) noise limits, and compliance with 1981 EPA emission standards.

J.M.S.

N78-27059# National Aeronautics and Space Administration.
 Lewis Research Center, Cleveland, Ohio.
IMPACT OF BROAD-SPECIFICATION FUELS ON FUTURE JET AIRCRAFT

Jack Grobman In NASA: Langley Res. Center CTOL Transport Technol., 1978 Jun. 1978 p 217-233 refs

Avail: NTIS HC A22/MF A01 CSCL 21D

The effects that broad specification fuels have on airframe and engine components were discussed along with the improvements in component technology required to use broad specification fuels without sacrificing performance, reliability, maintainability, or safety.

J.M.S.

N78-27122# National Aeronautics and Space Administration.
 Lewis Research Center, Cleveland, Ohio.
SUPERCRITICAL FUEL INJECTION SYSTEM Patent Application

C. J. Marek and L. P. Cooper, inventors (to NASA) Filed 19 Jun. 1978 10 p

(NASA-Case-LEW-12990-1; US-Patent-Appl-SN-916654) Avail: NTIS HC A02/MF/A01 CSCL 21E

A fuel injection system for gas turbines or the like which includes a pair of high pressure pumps which provide fuel and a carrier fluid such as air at pressures above the critical pressure of the fuel was developed. A supercritical mixing chamber mixes the fuel and carrier fluid and the mixture is sprayed into a combustion chamber for burning therein. The use of fuel and a carrier fluid at supercritical pressures promotes rapid mixing of the fuel in the combustion chamber so as to reduce the formation of pollutants and promote cleaner burning.

NASA

N78-27127*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FUEL CONSERVATIVE AIRCRAFT ENGINE TECHNOLOGY
Donald L. Nored 1978 39 p refs Proposed for presentation at 11th Congr. of the Intern. Council of Aeronautical Sci., Lisbon, Portugal, 10-16 Sep. 1978; sponsored by AIAA
(NASA-TM-78962; E-9719) Avail: NTIS HC A03/MF A01 CSCL 21E

Technology developments for more fuel-efficiency subsonic transport aircraft are reported. Three major propulsion projects were considered: (1) engine component improvement - directed at current engines; (2) energy efficient engine - directed at new turbofan engines; and (3) advanced turboprops - directed at technology for advanced turboprop-powered aircraft. Each project is reviewed and some of the technologies and recent accomplishments are described. G.G.

N78-27174*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF A THERMIONIC CONVERTER MODULE UTILIZING EMITTER AND COLLECTOR HEAT PIPES

Erich Kroeger, James Morris, Gabor Miskolczy (Thermo Electron Corp.), David P. Lieb (Thermo Electron Corp.), and Douglass B. Goodale (Thermo Electron Corp.) Jun. 1978 38 p refs
(Contract NAS3-20270)

(NASA-TM-78941; E-9705) Avail: NTIS HC A03/MF A01 CSCL 10A

A thermionic converter module simulating a configuration for an out-of-core thermionic nuclear reactor was designed, fabricated, and tested. The module consists of three cylindrical thermionic converters. The tungsten emitter of the converter is heated by a tungsten, lithium heat pipe. The emitter heat pipes are immersed in a furnace, insulated by MULTI-FOIL thermal insulation, and heated by tungsten radiation filaments. The performance of each thermionic converter was characterized before assembly into the module. Dynamic voltage, current curves were taken using a 60 Hz sweep and computerized data acquisition over a range of emitter, collector, and cesium-reservoir temperatures. An output power of 215 W was observed at an emitter temperature of 1750 K and a collector temperature of 855 K for a two diode module. With a three diode module, an output power of 270 W was observed at an average emitter temperature of 1800 K and a Collector temperature of 875 K. J.M.S.

N78-27264# Battelle Pacific Northwest Labs., Richland, Wash.
CORROSION OF IRON-BASE ALLOYS VERSUS ALTERNATE MATERIALS IN GEOTHERMAL BRINES Interim Report, period ending Oct. 1977

D. W. Shannon Nov. 1977 37 p refs
(Contract EY-76-C-06-1830)

(PNL-2456) Avail: NTIS HC A03/MF A01

A series of 30 refreshed autoclave tests and one field test were performed to define how various chemical components in geothermal brines affect uniform corrosion of 35 materials. The data indicate uniform corrosion rates of carbon steels are satisfactory for most major components of a geothermal power plant for low salinity neutral to alkaline pH reservoirs, when 20 miles per year corrosion allowances are permitted. While some minor alloy effects were observed among the 10 carbon steels tested, the alloy composition of the carbon steel was a second order effect compared with important brine chemistry variables such as pH, salinity, and temperature. The corrosion rates of carbon steels were found to be largely controlled by the composition and structure of the corrosion product film that formed on the metal. A number of alloys were found in the screening tests that showed negligible corrosion under all conditions tested up to 250 C and 22 percent salinities. Alternate materials to carbon steels are listed. ERA

N78-27279# AiResearch Mfg. Co., Phoenix, Ariz.
CERAMIC TECHNOLOGY READINESS PROGRAM Monthly Technical Progress Report, 28 Nov. 1977 - 1 Jan. 1978

16 Jan. 1978 27 p refs
(Contract EF-77-C-01-2664)

(FE-2664-3; MTPR-3) Avail: NTIS HC A03/MF A01

Evidence of the ability of ceramic components to survive for lifetimes adequate for utility application in an environment of high temperature combustion products from coal derived fuels was provided. Technology readiness for the application of ceramic materials technology to advanced gas turbines operating on coal derived fuel in utility base load and intermediate load service was developed and demonstrated. A supply of basic ceramic powders for use in noncommercial investigations of materials properties, fabrication techniques, and test methods was ensured. ERA

N78-27287# Department of Energy, Bartlesville, Okla. Energy Research Center.

MOTOR GASOLINES, SUMMER 1977

E. M. Shelton Jan. 1978 92 p refs

(BERC/PPS-78/1) Avail: NTIS HC A05/MF A01

Analytical data for 2,725 samples of motor gasoline, from service stations throughout the country, were collected and analyzed. The samples represent the products of 49 companies, large and small, which manufacture and supply gasoline. These data are tabulated by groups according to brands (unlabeled) and grades for 17 marketing areas and districts into which the country is divided. A map shows marketing areas, districts, and sampling locations. Charts indicating the trends of selected properties of motor fuels since 1946 are included. Twelve octane-distribution-percent charts for areas 1, 2, 3, and 4 for unleaded, regular, and premium grades of gasoline are presented. The antiknock (octane) index $[(R + M)/2]$ averages of gasolines sold in this country were 88.5, 89.6 and 95.0 for unleaded, regular, and premium grades of gasolines, respectively. ERA

N78-27289# Mobil Research and Development Corp., Paulsboro, N. J.

DEVELOPMENT STUDIES ON SELECTED CONVERSION OF SYNTHESIS GAS FROM COAL TO HIGH OCTANE GASOLINE

Mar. 1978 37 p refs

(Contract EX-76-C-01-2276)

(FE-2276-20) Avail: NTIS HC A03/MF A01

Aging and regeneration studies of developmental catalysts SG-B-3 and SG-A-4 in the micro reactor units (10 cc catalyst capacity). Hydrogen regeneration of SG-B-3 at 700 F restores catalyst selectivity, however, catalyst activity is not completely restored by this treatment. High temperature oxidative regeneration of catalyst SG-A-4 was successful. Multiple regeneration studies are now being made. Aging data was obtained on five catalysts in the direct conversion of synthesis gas to dimethylether. All catalysts showed significant aging when compared with proven methanol synthesis catalysts. Flow studies with a spent catalyst in the plexiglass model indicate that slugging may occur in the bench-scale fluid unit (150 cc catalyst capacity). Catalysts recovered from the unit show that carbon formation is excessive and probably responsible for the slugging and the uncontrollable higher temperatures observed in the catalyst disengager zone. ERA

N78-27344# Addis Translations International, Portola Valley, Calif.

HIGH-VOLTAGE HIGH-CURRENT BREAKER AND CLOSER FOR POWER SYSTEMS WITH INDUCTIVE STORAGE DEVICES

E. A. Azizov Nov. 1977 6 p Transl. into ENGLISH from report by Inst. Atomnoi Energii (Moscow), IAE-2673, 1976 6 p Prepared for California Univ., Lawrence Livermore Lab. Sponsored by DoE

(UCRL-Trans-11310) Avail: NTIS HC A02/MF A01

A high voltage high current explosive circuit breaker and a high voltage high current mechanical circuit closer were worked out for use in the energy extraction blocks of high power sources and power supply systems of thermonuclear units, based on inductive storage devices with energy storage of 10 to the 7th power to 10 to the 8th power. General views of the circuit breakers were shown and described. ERA

N78-27440# Department of Energy, Washington, D. C.
**HELIUM HEATERS OF THE HELIUM TURBINE UNIT OF
 THE OBERHAUSEN ENERGY SUPPLY**

G. Innocente, H. Wydler, and J. Halzl Jun. 1977 11 p Transl.
 into ENGLISH from VGB Kraftwerkstechn. (Germany), no. 6, Jun.
 1977 p 375-380

(DOE-tr-35). Avail: NTIS HC A02/MF A01

The high working medium temperature and the low pressure loss on the medium side with helium turbine units indicate limiting values with respect to the materials as well as to the manufacture of thick walled collectors. Various aspects of design, manufacture, and assembly were studied. A 50 MW gas turbine supplied by conventionally heated helium is part of the nuclear energy program of the Federal Republic of Germany for development of the high temperature reactor with high capacity helium turbines. A turbine such as this was constructed for the energy supply at Oberhausen. The plant will not only generate current and heat but also offer the opportunity for testing out essential components of the closed circuit as they are installed in a nuclear heated power plant. ERA

N78-27441# AiResearch Mfg. Co., Phoenix, Ariz.
**CLOSED GAS TURBINE HEATER PROGRAM Quarterly
 Technical Progress Report, 4 Jul - 2 Oct. 1977**

R. Stefun and D. Softley 12 Dec. 1977 41 p refs
 (Contract EF-77-C-01-2611)

(TID-28200; QTPR-2) Avail: NTIS HC A03/MF A01

The objective of this program is to advance high-temperature closed gas turbine power conversion systems to a point of technological readiness for use in coal fired public utility power conversion plants. The initial contract addresses two specific problem areas. These are: (1) the identification and analysis of system concepts which offer highest overall plant efficiency consistent with lowest cost of electricity (COE) from coal-pile-to-bus-bar; and (2) the identification and preliminary design of combustor/heat exchanger concepts compatible for use as the cycle gas primary heater for those plant systems. System cycle analyses and parametric studies performed to evaluate entire closed gas turbine utility power plants, with and without Rankine bottoming cycles with emphasis on lowest COE. Two heater systems based on 1550F are closed gas turbine inlet temperature using metallic materials and two based on 1750F and higher using non-metallc materials. ERA

N78-27447# Avco-Everett Research Lab., Everett, Mass.
**DEVELOPMENT PROGRAM FOR MHD POWER GENERA-
 TION. VOLUME 4: SUPERCONDUCTING MAGNET STUDY
 Final Report, 1 Jul. 1975 - 30 Jun. 1976**

A. M. Hatch, R. C. Beals, and A. J. Sofia Apr. 1977 163 p
 (Contract EX 76-C-01-2015)

(FE-2015-16-Vol-4) Avail: NTIS HC A08/MF A01

Methods for making and nondestructively inspecting joints in superconductors of the type applicable to MHD magnets were investigated. Soldering fixtures were made, soldering procedures developed and X-ray and ultra-sonic inspection techniques tried out. A number of sample joints of various designs, including joints bonded with alternate soft-solders and also by cold-welding, were prepared for final testing and evaluation. A special test apparatus was designed and built, suitable for testing joints in liquid helium at currents comparable to those used in MHD magnet windings and with various tension loads up to breaking loads. Joint surface resistivities were determined, sample elongations vs. load were measured and breaking strengths were determined. One sample was subjected to a stress cycling test. The performance of various types of joints was compared and the effects of variations in design and fabrication were evaluated. ERA

N78-27482# Georgia Southwestern Coll., Americus.
**INTRODUCTORY WORKSHOPS ON REMOTE SENSING AS
 RELATED TO GEOLOGICAL PROBLEMS IN GEORGIA Final
 Report**

Barry F. Beck and Jack C. Carter, Principal Investigators Mar.
 1978 23 p refs Workshop held at Americus, Ga., 24-25 May
 1977 ERTS

(Contract NAS8-30884)

(E78-10152; NASA-CR-150710)
 HC A02/MF A01 CSCL 08G

Avail: NTIS

N78-27493# Washington Univ., Seattle. Dept. of Mining,
 Metallurgical, and Ceramic Engineering.

**APPENDIX: COOK INLET COAL: ECONOMICS OF MINING
 AND MARINE SLURRY TRANSPORT Final Report**

Brian David Hennagin 5 Jan. 1978 97 p refs

(Contract D1-BM-GO-264012)

(PB-278756/2; BM-OFR-17(2)-78)

Avail: NTIS

HC A05/MF A01 CSCL 08I

Beluga coal deposits on Cook Inlet, Alaska are described, and mining and transport costs to move the coal to a potential steam-electric plant site in northern Washington as a marine slurry are evaluated. A surface mine site was chosen 15 miles from tidewater. The coal is mined, washed, slurried, and transported by pipeline to tidewater where it is loaded aboard ship as a settled marine slurry. The coal is carried by ship to northern Washington, reslurried and pumped off the ship to dewatering facilities. Costs for mining, washing, preparation, transport, and dewatering are developed per ton of clean coal and final costs per million BTU's. Production rates are evaluated to fuel 1000 and 2000 MW plants with 80% annual output factor. GRA

N78-27497# Boise State Univ. Idaho.
GEOTHERMAL POTENTIAL OF THE WEST BOISE AREA
 L. L. Mink and D. L. Graham Oct. 1977 40 p refs

(Contract EY-76-C-07-1570)

(TREE-1162) Avail: NTIS HC A03/MF A01

Recent investigations in the Boise area shows that hot water is abundant all along the Boise Foothills. Two areas showing good potential for future geothermal development are discussed. These areas are the Dry Creek Valley and the area between Pierce Gulch and Polecat Gulch. Both areas have water temperatures exceeding 37.8 C. In the Boise area it is found that zones of hot water are associated with some type of structural control. The hot water zones associated with the Dry Creek Valley and the Pierce-Polecat area were found to be located at or near the intersection of major linears mapped along the Boise Foothills. By mapping all known fault and linear patterns in the area, it is possible to correlate these zones of weakness with areas of hot water. At the intersection of two or more linears, where fracturing is greatest the majority of geothermal water was located. ERA

N78-27498# City of Long Beach, Calif.
**PILOT DEMONSTRATION OF ENHANCED OIL RECOVERY
 BY MICELLAR POLYMER WATERFLOODING, PHASE B
 Monthly Report, Oct. 1977**

J. E. Wade 10 Nov. 1977 9 p refs

(Contract EF-77-C-03-1395)

(SAN/1395-15) Avail: NTIS HC A02/MF A01

A second stage of the transient test was undertaken. The early pulse tests were complicated by operational difficulties resulting in data that was difficult to interpret. Progress was made on flooding the fresh core material obtained from frozen cores. Preliminary results are very encouraging. Work continued on the facilities for the mini-injectivity test. ERA

N78-27499# Columbia Gas Transmission Corp., Charleston, W.
 Va.
**TERTIARY OIL RECOVERY BY CO2 INJECTION Monthly
 Report, Nov. 1977**

W. D. Conner 1977 23 p refs

(Contract EF-76-C-05-5302)

(ORO-5302-20) Avail: NTIS HC A02/MF A01

Water injection for November was approximately 5530 barrels, which was a slight increase over the 5440 barrels injected during October. Down time of 24 hours was considerably lower than previous months. Mechanically, the project proceeded almost as scheduled except for minor adjustments of the high pressure shutdown switch on the injection pump. Oil production, however,

continued to be disappointing. Total production again declined approximately 200 barrels to 1525. Although it was necessary to service one well, most of the production decline follows the trend of recent months. Total production due to CO2 injection is 8151 barrels. A request was received to allow an environmental assessment team to inspect the project. ERA

N78-27500# Los Alamos Scientific Lab., N. Mex.

MAPPING OFFSHORE OIL LEASES

J. L. Sibert 1978 8 p refs Presented at a Joint Meeting of Am. Congr. on Surveying and Mapping and Am. Soc. for Photogrammetry, Washington, D.C., 26 Feb. 1978 (Contract W-7405-eng-36) (LA-UR-77-2892; Conf-780209-1) Avail: NTIS HC A02/MF A01

A data base query system developed as a tool for regulatory decision making is described. The legal description of each lease, based on the public and survey, is stored in the data base to provide the coordinates necessary for map production. Maps are produced interactively during a query session on a Tektronix 4014 graphics terminal. Hardcopy color maps are obtained by using a color-equipped FR-80 computer output microfilm recorder. The procedure is totally automated and is completely handled from a remote terminal. Several examples of queries and the maps they produce are presented. Other aspects of the data base retrieval system discussed include a network structure based on the CODASYL standard and a query language that allows complex retrievals to be specified in simple english phrases. ERA

N78-27511# Bureau of Mines, Washington, D. C.

ADVANCING COAL MINING TECHNOLOGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION IN FISCAL YEAR

1977 Information Circular, 1 Oct. 1976 - 30 Sep. 1977 1977 18 p (PB-278001/3; BM-IC-8730) Avail: NTIS HC A02/MF A01 CSCL 081

The publication summarizes, for potential contractors and other interested parties, the proposed research, development, and demonstration contract projects programmed by the Bureau of Mines for fiscal year 1977 (October 1, 1976 - September 30, 1977) under its Advancing Coal mining Technology program. The objective of these projects is to provide an ordered and sequenced series of advances toward the overall goal of providing the system technology required to increase the productivity of the coal mining process. GRA

N78-27515* National Aeronautics and Space Administration, Pasadena Office, Calif.

HEXAGON SOLAR POWER PANEL Patent

Irwin Rubin, inventor (to NASA) Issued 16 May 1978 5 p Filed 28 Jul. 1976 (NASA-Case-NPO-12148-1; US-Patent-4,089,705; US-Patent-Appl-SN-709415; US-Patent-Class-136-89P) Avail: US Patent Office CSCL 10A

A solar energy panel support is described upon which silicon cells are arrayed. The cells are wafer thin and of two geometrical types, both of the same area and electrical rating, namely hexagonal cells and hourglass cells. The hourglass cells are composites of half hexagons. A near perfect nesting relationship of the cells achieves a high density packing whereby optimum energy production per panel area is achieved.

Official Gazette of the U.S. Patent Office

N78-27516 Case Western Reserve Univ., Cleveland, Ohio.

A DYNAMIC ENERGY OPTIMIZATION MODEL UNDER UNCERTAINTY Ph.D. Thesis

Reuven Robert Lenary 1978 165 p Avail: Univ. Microfilms Order No. 78-09292

The problem is formulated and solved using a multi-period linear programming model. The model takes into consideration the variability of weather conditions and its effect on the demand for natural gas. Forecasts of future weather conditions are updated several times during the model planning period; also, the optimal

flows of natural gas are determined at the time that the forecasts are updated. The model considers alternatives such as: conservation of natural gas, emergency purchase of gas and gasifying coal to minimize shortages of natural gas. The optimal storage quantities at the beginning of each time period and the consequences of contracting additional storage facilities on the total natural gas shortage are derived by using the model. Dissert. Abstr.

N78-27517 Princeton Univ., N. J.

DYNAMIC MODELS OF HOUSE HEATING BASED ON EQUIVALENT THERMAL PARAMETERS Ph.D. Thesis

Robert Carl Sonderegger 1978 238 p Avail: Univ. Microfilms Order No. 7807500

The house is represented by a single electrical analog, composed of one capacitor and a few resistors, tied together in well determined fashion. The parameters of this model are fitted to recorded time histories of weather and heating load or indoor temperature of the house. The resulting Equivalent Thermal Parameters (ETP's) express a set of unique physical characteristics of the house: an equivalent thermal mass, a set of equivalent conductances (between indoors and outdoors, between indoors and the ground and between indoor room air and massive house structure) and overall efficiencies of furnace and solar heating. The ETP's can be used to establish energy performance standards for a house, useful in comparing houses with different construction. In fact, little knowledge about the house construction is needed to determine the ETP's. Another use for ETP's is the assessment of the overall effect of retrofits on a particular house, by observing the change in ETP's measured before and after the retrofit is implemented. Dissert. Abstr.

N78-27518* Elcam, Inc., Santa Barbara, Calif.

PRELIMINARY DESIGN PACKAGE FOR SUNSPOT DOMESTIC HOT WATER HEATING SYSTEM

Nov. 1976 116 p Prepared for DOE (Contract NAS8-32245) (NASA-CR-150605) Avail: NTIS HC A06/MF A01 CSCL 10A

The design review includes a drawing list, auto-control logic, measurement definitions, and other document pertaining to the solar heated prototype hot water systems and two heat exchangers. The hot water systems consist of the following subsystems: collector, storage, control transport, auxiliary energy, and site data acquisition. Author

N78-27519* AiResearch Mfg. Co., Torrance, Calif.

PRELIMINARY DESIGN PACKAGE FOR SOLAR HEATING AND COOLING SYSTEMS

May 1978 201 p Prepared for DOE (Contract NAS8-32091) (NASA-CR-150674; AiResearch-76-13448) Avail: NTIS HC A10/MF A01 CSCL 10A

Summarized preliminary design information on activities associated with the development, delivery and support of solar heating and cooling systems is given. These systems are for single family dwellings and commercial applications. The heating/cooling system use a reversible vapor compression heat pump that is driven in the cooling mode by a Rankine power loop, and in the heating mode by a variable speed electric motor. The heating/cooling systems differ from the heating-only systems in the arrangement of the heat pump subsystem and the addition of a cooling tower to provide the heat sink for cooling mode operation. LS.

N78-27520* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SELF-RECONFIGURING SOLAR CELL SYSTEM Patent Application

Robert P. Gruber, inventor (to NASA) Filed 19 Jun. 1978 18 p (NASA-Case-LEW-12586-1; US-Patent-Appl-SN-916655) Avail: NTIS HC A02/MF A01 CSCL 10A

An improved solar cell system is reported that utilizes control

Circuits to switch some of its cells so that they can be either in series or in shunt within the array, to match the load for maximum power transfer. Automatic control is provided by a sensor solar cell mounted into the configurable array; its open circuit voltage multiplied by a constant is equal to cell voltage at maximum power point. NASA

N78-27522*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROCEEDINGS OF THE ALTERNATE ENERGY SYSTEMS SEMINAR

30 Mar. 1978 184 p Seminar held at Pasadena, Calif., 30 Mar. 1978; sponsored by DOE. Sponsored in part by DOE (Contract NAS7-100)

(NASA-CR-157255; JPL-Pub-78-45) Avail: NTIS HC A09/MF A01 CSCL 10A

The Alternative Energy Systems Seminar was held on March 30, 1978, and was sponsored jointly by the Southwest District Office of the U.S. Department of Energy and JPL. The seminar was an experiment in information exchange with the aim of presenting, in a single day, status and prospects for a number of advanced energy systems to a diverse, largely nontechnical audience, and to solicit post-seminar responses from that audience as to the seminar's usefulness. The major systems presented are: (1) Solar Photovoltaic; (2) Geothermal; (3) Cogeneration Power; (4) Solar Thermal; (5) Solar Heating and Cooling; (6) Wind Energy; and (7) Systems Considerations.

N78-27523*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLAR PHOTOVOLTAIC SYSTEMS

R. G. Forney *In its Proc.* of the Alternate Energy Systems Seminar 30 Mar. 1978 p 5-42

Avail: NTIS HC A09/MF A01 CSCL 10A

The Department of Energy's photovoltaic program is outlined. The main objective of the program is the development of low cost reliable terrestrial photovoltaic systems. A second objective is to foster widespread use of the system in residential, industrial and commercial application. The system is reviewed by examining each component: silicon solar cell, silicon solar cell modules, advanced development modules and power systems. Cost and applications of the system are discussed. G.Y.

N78-27524*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GEOTHERMAL SYSTEMS

Casey Mohl *In its Proc.* of the Alternate Energy Systems Seminar 30 Mar. 1978 p 43-67

Avail: NTIS HC A09/MF A01 CSCL 10A

Several tasks of JPL related to geothermal energy are discussed. The major task is the procurement and test and evaluation of a helical screw drive (wellhead unit). A general review of geothermal energy systems is given. The presentation focuses attention on geothermal reservoirs in California, with graphs and charts to support the discussion. Included are discussions on cost analysis, systems maintenance, and a comparison of geothermal and conventional heating and cooling systems. G.Y.

N78-27525*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COGENERATION POWER SYSTEMS

Herbert S. Davis *In its Proc.* of the Alternate Energy Systems Seminar 30 Mar. 1978 p 68-96

Avail: NTIS HC A09/MF A01 CSCL 10A

Cogeneration is defined as the combination of electrical generation and process heat for more efficient use of fuel. Comparisons of energy utilization in conventional electric power plants and cogeneration electric power plants are presented. Characteristics of various cogeneration systems are also presented.

Systems are analyzed for use in utility systems and industrial systems. Economic and cost analysis are reviewed. G.Y.

N78-27526*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLAR THERMAL SYSTEMS

Vince C. Truscello *In its Proc.* of the Alternate Energy Systems Seminar 30 Mar. 1978 p 97-125

Avail: NTIS HC A09/MF A01 CSCL 10A

A system is described for producing electricity with the use of conventional machinery, but with the elimination of conventional fuels, through the use of sun energy. The economics of the system is presented by comparing solar thermal units with more conventional systems. Several applications of the solar thermal system are presented. G.Y.

N78-27528*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
WIND ENERGY SYSTEMS

Homer Joe Stewart *In its Proc.* of the Alternate Energy Systems Seminar 30 Mar. 1978 p 150-170

Avail: NTIS HC A09/MF A01 CSCL 10A

A discussion on wind energy systems involved with the DOE wind energy program is presented. Some of the problems associated with wind energy systems are discussed. The cost, efficiency, and structural design of wind energy systems are analyzed. G.Y.

N78-27529*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEM CONSIDERATIONS

M. E. Alper *In its Proc.* of the Alternate Energy Systems Seminar 30 Mar. 1978 p 171-177

Avail: NTIS HC A09/MF A01 CSCL 10A

Closing remarks and a general summary of the Alternative Energy Systems Seminar are presented. It was concluded from the seminar that the DOE programs described were focused on trying to make a commercial market develop for the various systems. The question addressed is how this is going to happen. To address this question, social, economical, political and technical aspects are considered with major emphasis placed on systems engineering to provide low cost efficient systems. G.Y.

N78-27530*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH-POWER, ULTRALOW-MASS SOLAR ARRAYS: FY-77 SOLAR ARRAYS TECHNOLOGY READINESS ASSESSMENT REPORT, VOLUME 1

E. N. Costogoe, L. E. Young (NASA, Marshall Space Flight Center), and H. Brandhorst (NASA, Lewis Res. Center) 15 Jun. 1978 152 p 2 Vol. (Contract NAS7-100)

(NASA-CR-157264; JPL-Pub-78-48-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 10A

The technology readiness of solar array designs for future planetary missions, and particularly for the Halley's comet ion drive space vehicle, is assessed. The effort involves critical component technology for the development of candidate solar array designs, and technology development planning. Results and conclusions are presented in summary form. G.G.

N78-27531*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH-POWER, ULTRALOW-MASS SOLAR ARRAYS: FY-77 SOLAR ARRAYS TECHNOLOGY READINESS ASSESSMENT REPORT, VOLUME 2

E. N. Costogoe, L. E. Young (NASA, Marshall Space Flight Center), and H. Brandhorst (NASA, Lewis Res. Center) 15 Jun. 1978 514 p refs 2 Vol.

(Contract NAS7-100) (NASA-CR-157265; JPL-Pub-78-48-Vol-2) Avail: NTIS HC A23/MF A01 CSCL 10A

Development efforts are reported in detail for: (1) a lightweight solar array system for solar electric propulsion; (2) a high efficiency thin silicon solar cell; (3) conceptual design of 200 W/kg solar arrays; (4) fluorocarbon encapsulation for silicon solar cell array; and (5) technology assessment of concentrator solar arrays. G.G.

N78-27532*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
UTILIZATION OF WASTE HEAT IN TRUCKS FOR INCREASED FUEL ECONOMY

C. J. Leising, G. P. Purohit, S. P. DeGrey, and J. G. Finegold
 1 May 1978 41 p refs Prepared for DoE

(Contract NAS7-100)

(NASA-CR-157292; JPL-Pub-78-39)

Avail: NTIS

HC A03/MF A01 CSCL 10A

Improvements in fuel economy for a broad spectrum of truck engines and waste heat utilization concepts are evaluated and compared. The engines considered are the diesel, spark ignition, gas turbine, and Stirling. The waste heat utilization concepts include preheating, regeneration, turbocharging, turbo-compounding, and Rankine engine compounding. Predictions were based on fuel-air cycle analyses, computer simulation, and engine test data. The results reveal that diesel driving cycle performance can be increased by 20% through increased turbocharging, turbocompounding, and Rankine engine compounding. The Rankine engine compounding provides about three times as much improvement as turbocompounding but also costs about three times as much. Performance for either is approximately doubled if applied to an adiabatic diesel. Author

N78-27533*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A MARKET SURVEY OF GEOTHERMAL WELLHEAD POWER GENERATION SYSTEMS Final Report

Michael W. Leeds Mar. 1978 53 p refs

(Contracts NAS7-100; EG-77-A-36-1021)

(NASA-CR-157262; JPL-Pub-78-29)

Avail: NTIS

HC A04/MF A01 CSCL 10A

The market potential for a portable geothermal wellhead power conversion device is assessed. Major study objectives included identifying the most promising applications for such a system, the potential impediments confronting their industrialization, and the various government actions needed to overcome these impediments. The heart of the study was a series of structured interviews with key decision-making individual in the various disciplines of the geothermal community. In addition, some technical and economic analyses of a candidate system were performed to support the feasibility of the basic concept. L.S.

N78-27536*# Wormser Scientific Corp., Stamford, Conn.
PRELIMINARY DESIGN PACKAGE FOR SOLAR HEATING AND HOT WATER SYSTEM

Jan. 1977 56 p Prepared for DoE

(Contract NAS8-32250)

(NASA-CR-150616) Avail: NTIS HC A04/MF A01 CSCL 10A

The preliminary design review on the development of a multi-family solar heating and domestic hot water prototype system is presented. The report contains the necessary information to evaluate the system. The system consists of the following subsystems: collector, storage, transport, control and Government-furnished site data acquisition. L.S.

N78-27537*# AiResearch Mfg. Co., Torrance, Calif.
PRELIMINARY DESIGN ACTIVITIES FOR SOLAR HEATING AND COOLING SYSTEMS Status Report, 12 Jul. - 1 Sep. 1976

May 1978 222 p refs Prepared for DoE

(Contract NAS8-32091)

(NASA-CR-150673; AiResearch-76-12994) Avail: NTIS HC A10/MF A01 CSCL 10A

Information on the development of solar heating and cooling systems is presented. The major emphasis is placed on program organization, system size definition, site identification, system approaches, heat pump and equipment design, collector procurement, and other preliminary design activities. B.B.

N78-27538*# Little (Arthur D.), Inc., Cambridge, Mass.
EVALUATION OF SOLAR CELLS AND ARRAYS FOR POTENTIAL SOLAR POWER SATELLITE APPLICATIONS Final Report

David W. Almgren, Katinka Csigi, and Arthur D. Gaudet 31 Mar. 1978 81 p

(Contract NAS9-15294)

(NASA-CR-151740) Avail: NTIS HC A05/MF A01 CSCL 10A

Proposed solar array designs and manufacturing methods are evaluated to identify options which show the greatest promise of leading up to the development of a cost-effective SPS solar cell array design. The key program elements which have to be accomplished as part of an SPS solar cell array development program are defined. The issues focussed on are: (1) definition of one or more designs of a candidate SPS solar array module, using results from current system studies; (2) development of the necessary manufacturing requirements for the candidate SPS solar cell arrays and an assessment of the market size, timing, and industry infrastructure needed to produce the arrays for the SPS program; (3) evaluation of current DOE, NASA and DOD photovoltaic programs to determine the impacts of recent advances in solar cell materials, array designs and manufacturing technology on the candidate SPS solar cell arrays; and (4) definition of key program elements for the development of the most promising solar cell arrays for the SPS program. L.S.

N78-27539*# National Aeronautics and Space Administration.
 Lewis Research Center, Cleveland, Ohio.
COST OF PHOTOVOLTAIC ENERGY SYSTEMS AS DETERMINED BY BALANCE-OF-SYSTEM COSTS

Louis Rosenblum Jun. 1978 14 p refs

(NASA-TM-78957; E-9708) Avail: NTIS HC A02/MF A01 CSCL 10B

The effect of the balance-of-system (BOS), i.e., the total system less the modules, on photo-voltaic energy system costs is discussed for multikilowatt, flat-plate systems. Present BOS costs are in the range of 10 to 16 dollars per peak watt (1978 dollars). BOS costs represent approximately 50% of total system cost. The possibility of future BOS cost reduction is examined. It is concluded that, given the nature of BOS costs and the lack of comprehensive national effort focussed on cost reduction, it is unlikely that BOS costs will decline greatly in the next several years. This prognosis is contrasted with the expectations of the Department of Energy National Photovoltaic Program goals and pending legislation in the Congress which require a BOS cost reduction of an order of magnitude or more by the mid-1980s. Author

N78-27544# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
RESEARCH TOWARD IMPROVED FLYWHEEL SUSPENSION AND ENERGY CONVERSION SYSTEMS Final Report

David Eisenhaure Nov. 1977 181 p refs

(Grant NSF AER-75-18813)

(PB-278679/G; R-1108) Avail: NTIS HC A09/MF A01 CSCL 10B

Flywheel and energy conversion studies were directed toward the utilization of flywheel energy storage for utility load-leveling during peak power periods, both at the residential and utility levels, for complementing windmill or photovoltaic systems, and for transportation systems. A set of system requirements which would allow two-way power flow between a high speed flywheel shaft and a 60 Hz line was outlined. Existing conversion system types were studied, indicating that the system requirements could be best met with a new concept. Therefore, a special purpose integrated rotating machine and power switching stage were designed. GRA

N78-27545# Washington Univ., Seattle. Dept. of Mining Metallurgical, and Ceramic Engineering.

FEASIBILITY STUDY OF MINING ALASKA COAL AND TRANSPORTATION BY SLURRY TO THE WEST COAST Final Report

Donald Anderson 5 Jan. 1978 37 p

(Contract DI-BM-GO-264012)

(PB-278755/4; BM-OFR-17(1)-78)

Avail: NTIS

HC A03/MF A01; CSDL 081

The extensive subbituminous coal deposits near Cook Inlet, Alaska, have received considerable attention because of their size, nearness to tidewater, and low sulfur content. As the need for increased electrical power is felt along the west coast, a search is being made for sources of fuel other than petroleum and natural gas. The State of Washington is the only Pacific Coast State with substantial coal resources, but because of geologic setting, much of this resource will be available only at high cost. Reflecting these circumstances, if coal is to be used as a source of electrical energy, it may have to be transported from the Northern Great Plains or Rocky Mountain areas or from more remote sites if they happen to be located at or near tidewater.

GRA

N78-27547# Gould, Inc., Rolling Meadows, Ill. Gould Labs.
STATE-OF-THE-ART LEAD-ACID VEHICLE

26 Aug. 1977 64 p

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

(ANL-K-77-3639-1) Avail: NTIS HC A04/MF A01

A report is given of the state of the art of electric vehicle batteries, what the technology is capable of mass-producing within two years, and what are the research and development tasks that must be undertaken to achieve goals for both the improved state-of-the-art battery and the advanced battery. Energy intensive and life intensive candidate design for electric-vehicle lead-acid batteries are discussed and performance projections are tabulated.

ERA

N78-27548# Little (Arthur D.), Inc., Cambridge, Mass.
**SYSTEM DEFINITION STUDY: PHASE 1 OF INDIVIDUAL
 LOAD CENTER, SOLAR HEATING AND COOLING RESIDENTIAL
 PROJECT Final Report**

James C. Burke, Richard L. Merriam, and John L. Swanson
 Dec. 1977 275 p refs Sponsored by Elec. Power Res. Inst.
 (EPRI Proj. 549-1)

(EPRI-ER-594) Avail: NTIS HC A12/MF A01

A study was carried out to determine preferred systems for residential solar and load management heating, cooling and domestic hot water systems in the Northeast and Southwest regions of the United States. A methodology relating the performance of solar and load management heating and cooling systems to utility power generation, costs of supply and weather characteristics was developed. Preferred systems in the service areas of two utilities were identified. Preliminary designs for five experimental systems in both service areas were developed with the intent of maximizing the acquisition of experimental information on systems compatible with utility operations. The methodology provides a means of determining systems which, on a life cycle cost basis, minimize the total cost of meeting the energy needs for a specific application including investments in generating capacity at the power plant, fuel costs and investments at the point of use for energy conservation. The methodology was tested for 14 additional utilities throughout the United States.

ERA

N78-27549# Exxon Research and Engineering Co., Florham Park, N. J.

**EDS COAL LIQUEFACTION PROCESS DEVELOPMENT,
 PHASE 3 B Monthly Technical Progress Report, 1-31 Dec.
 1977**

Jan. 1978 56 p refs Sponsored in part by the Carter Oil Co., Elec. Power Res. Inst. and Phillips Petrol. Co.

(Contract EF-77-A-01-2893)

(FE-2893-6) Avail: NTIS HC A04/MF A01

The solvent quality study with Wyoming subbituminous coal in the 50 pound-per-day Recycle Coal Liquefaction Unit was completed. The study concentrated on investigation of the effects of increased solvent-to-coal ratio and liquefaction residence time. The liquefaction yield structure used for the updated commercial study design was finalized based on the latest runs at the coal liquefaction pilot plant. Earlier results, which indicated higher start-of-run temperatures were required for a heavier feedstock to reach the same solvent donatable hydrogen level as for

Multi-Pass. Spent Solvent (MPSS), were confirmed. A process variable screening study utilizing Ni/Mo-10 and Co/Mo-20 catalysts and Wyoming spent solvent was completed on the solvent hydrogenation two-train catalyst testing unit. The variables investigated were start-of-run temperatures and space velocities.

ERA

N78-27550# Booz-Allen and Hamilton, Inc., Bethesda, Md.
 Applied Research Div.

**PROJECT ACQUISITION AND EVALUATION PROCESS FOR
 ATMOSPHERIC FLUIDIZED BED COMBUSTION DEMONSTRATION PLANT**

30 Sep. 1977 279 p

(Contract EX-76-C-01-2345)

(FE-2343-1) Avail: NTIS HC A13/MF A01

Fluidized bed technology provided a method of burning coal of all ranks (including high sulfur, high ash, agglomerating, and caking coal) and meeting environmental standards without pretreatment or scrubbing. FBC will have its greatest potential in utilizing pressurized reactors with combined cycle turbine systems but the FBC technology closest to commercial readiness is atmospheric fluidized bed combustion (AFBC) combined with traditional Rankine steam cycles. The current state of the AFBC development program is that numerous bench-scale and process development units are completed or underway; a 30 MWe pilot plant is in the startup and shakedown stage; a component test and integration unit is in the early construction stage; and conceptual designs are being performed for demonstration plants.

ERA

N78-27553# United Technologies Corp., South Windsor, Conn.
ADVANCED TECHNOLOGY FUEL CELL PROGRAM Interim Report

J. M. King, Jr. Nov. 1977 78 p refs

(EPRI-EM-576) Avail: NTIS HC A05/MF A01

Molten carbonate fuel cells, advanced phosphoric acid fuel cells, advanced fuel processors and the use of coal and coal products in central stations or dispersed fuel cell powerplants are under investigation. Molten carbonate fuel cell activities focused on reactant containment, increased endurance, and improved performance. The effort is continuing to demonstrate cell performance and function for extended periods at the cell stack level. An advanced phosphoric acid cell concept, with potential for reduced cost and reduced resistance losses, was demonstrated in a 20-cell stack. The best performing cells achieved expectations, and the concept was successfully demonstrated. Investigations showed that adiabatic steam reforming holds promise for processing No. 2 fuel oil in dispersed fuel cell generators, and subscale testing was conducted to establish acceptable operating conditions.

ERA

N78-27554# Auburn Univ., Ala. Inst. of Water Resources Research.

SUBSURFACE WASTE-HEAT STORAGE: EXPERIMENTAL STUDY Final Report, 15 Nov. 1975 - 30 Jun. 1977

James C. Warman, Fred J. Molz, and Thomas E. Jones Jun. 1977 67 p refs

(Contract EY-76-S-05-5003)

(ORO-5003-1) Avail: NTIS HC A04/MF A01

Electrical power plant and solar heating systems were proposed wherein confined aquifers are used as storage reservoirs for moderate to high temperature water. The Water Resources Research Institute of Auburn University performed an aquifer storage experiment involving warm water (94 F; 36 C). Phase I consisted of the drilling of an exploratory well at the field site near Mobile, Alabama. Phase II involved construction of the central injection well, three observation wells, and performance of preliminary pumping tests. Phase III was devoted to construction of the remainder of the observation well field, performance of final pumping tests, and measurement of aquifer thermal properties; while Phase IV was devoted to a cycle of warm water injection, storage, and recovery. It was concluded that heat storage aquifers must have low natural pore velocities, and much care must be taken not to clog the injection well with solids.

ERA

N78-27556# Institute of Gas Technology, Chicago, Ill.
MOLTEN-SALT THERMAL-ENERGY STORAGE SYSTEMS
 J. F. Dullea and H. C. Maru 1977 12 p ref Presented at the 2d Ann. Thermal Energy Storage Contractors' Inform. Exchange Meeting, Gatlinburg, Tenn., 29 Sep. 1977
 (Contract EY-76-C-02-2888)
 (CONF-770955-3) Avail: NTIS HC A02/MF A01

The goals of the program are to determine the technical feasibility of using inorganic salts as phase-change thermal storage materials (PCM) for high-temperature (> 300 C applications, to develop a mathematical model able to predict the behavior of a PCM in a latent heat, thermal energy storage (TES) system, and to use this information in designing prototype, large scale (100 to 100 kWhr/sub t/) storage systems for further technical and economic evaluation. The first phase of the program, involving selection of a suitable storage material, mathematical modeling, heat transfer analysis, and operation of small scale (< 10 kWhr/sub t/) TES systems, was completed. Results were encouraging, showing good agreement between the mathematical model and the observed performance. Further work on system analysis, performance improvements, and large scale system design is now in progress. ERA

N78-27557# Sandia Labs., Albuquerque, N. Mex.
THERMOCHEMICAL ENERGY STORAGE SYSTEMS: A REVIEW
 R. W. Mar and T. T. Bramlette Feb: 1978 47 p refs
 (Contract EY-76-C-04-0789)
 (SAND-77-8051) Avail: NTIS HC A03/MF A01

The report reviews the characteristics of thermochemical storage systems, analyzes the present state-of-the-art of the relevant technical disciplines, and presents some potential solar storage applications. ERA

N78-27558# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
HYDROGEN-CHLORINE ENERGY STORAGE SYSTEM
 J. McBreen, R. S. Yeo, A. Beaufrere, D. T. Chin, and S. Srinivasan 1977 9 p refs
 (BNL-23670; Conf-771131-4) Avail: NTIS HC A02/MF A01

The electrochemically regenerative hydrogen-chlorine system is being considered for large scale energy storage. It offers many of the advantages of batteries with fluid reactants such as elimination of the problem of electrode morphology changes with cycling and the possibility of independently designing the system for energy and power. Hence, it can be used for both the daily and weekend utility cycles. Recent work includes an extensive heat and mass balance analysis for the system, measurements of Nafion membrane resistivity as a function of HCl concentration and temperatures, and diffusivities and permeation rates of chlorine through Nafion membranes. Results of these studies indicate that an overall electric-to-electric efficiency of 75% or greater can be projected for the system. Author

N78-27559# California Univ., Davis. Dept. of Land, Air, and Water Resources.
ENERGY REQUIREMENTS OF ALTERNATIVES IN WATER SUPPLY, USE, AND CONSERVATION, AND WATER QUALITY CONTROL IN CALIFORNIA Final Report
 Edwin B. Roberts and Robert M. Hagan Sep. 1977 150 p refs
 (Contract W-7405-eng-48)
 (UCRL-13784) Avail: NTIS HC A07/MF A01

Information is presented on: energy requirements associated with water supply and use and waste water treatment; form water supply sources and pumping energy requirements; total energy requirements for irrigation in 1972; and energy requirements associated with irrigation water quality problems in California. Author (ERA)

N78-27560# Department of Energy, Washington, D. C.
ANALYSIS OF THE CURRENT ECONOMIC FEASIBILITY OF SOLAR WATER AND SPACE HEATING
 R. H. Bezdek Jan. 1978 43 p
 (DOE/CS-0023) Avail: NTIS HC A03/MF A01

The current economic feasibility of solar water and space

heating in four representative cities in the U.S. is analyzed. The four representative cities are Boston, Massachusetts; Washington, D.C.; Grand Junction, Colorado; and Los Angeles, California. The feasibility of solar water heating and combined water and space heating is examined separately for single family detached homes and for multi-family apartment buildings. Using actual 1977 regional fuel prices and solar equipment costs, the solar systems are compared against conventional gas, fuel oil, and electric systems. The results are evaluated on the basis of three decision criteria, an identical analysis is then carried out assuming the passage of a solar income tax credit. ERA

N78-27561# Sandia Labs., Albuquerque, N. Mex.
FACTORS AFFECTING MARKET INITIATION OF SOLAR TOTAL ENERGY
 R. W. Harrigan 1978 6 p refs Presented at the Symp. on Energy, Tulsa, Okla., 16 Apr. 1978
 (Contract EY-76-C-04-0789)
 (SAND-78-0148C; Conf-780413-1) Avail: NTIS HC A02/MF A01

An economic methodology is introduced for quickly visualizing the effect of various economic, technical, and programmatic actions on the early commercialization of solar total energy (STE). Process-heat users are identified as primary candidates for earliest market initiation. In addition, while technical factors such as improved power-conversion efficiency and mirror reflectivity do affect time-of-market initiation, programmatic and economic factors such as government-induced mass production of solar collectors and investment tax credits have even greater influence on the market initiation of STE. ERA

N78-27562# Sandia Labs., Albuquerque, N. Mex.
MASTER CONTROL AND DATA SYSTEM FOR THE 5MW SOLAR THERMAL TEST FACILITY
 D. M. Darsey 1978 8 p Presented at the 24th Intern. Instrumentation Symp., Albuquerque, N. Mex., 1 May 1978
 (Contract EY-76-C-04-0789)
 (SAND-78-0205C; Conf-780503-5) Avail: NTIS HC A02/MF A01

The world's largest solar powered research facility, approaching construction completion near Albuquerque, New Mexico, is controlled by a distributed network of minicomputers. The philosophy of the system design and details the system control components, operation and data capabilities are described. ERA

N78-27564# Sandia Corp., Livermore, Calif.
BUCKS: ECONOMIC ANALYSIS MODEL OF SOLAR ELECTRIC POWER PLANTS
 J. M. Brune Jan. 1978 54 p refs
 (Contract EY-76-C-04-0789)
 (SAND-77-8279) Avail: NTIS HC A04/MF A01

A computer model (BUCKS) is designed for economic analysis of solar electric power plants. The model determines the leveled life-cycle revenue per unit output from the plant that will be sufficient to compensate for the fixed and variable costs, pay interest to bondholders, and provide return to stockholders. Cost-scaling relationships for solar-plant subsystems have been developed that allow BUCKS in conjunction with a plant performance model to perform a number of cost/benefit calculations. ERA

N78-27565# California Univ., Berkeley. Sanitary Engineering Research Lab.
SOLAR ENERGY CONVERSION WITH HYDROGEN PRODUCING ALGAE Final Report, 1 Feb. 1978 - 31 Apr. 1977
 J. R. Benemann, P. C. Hallenbeck, J. C. Weissman, L. V. Kochian, P. C. Kostel, and W. J. Oswald Jun. 1977 44 p refs
 (Contract EY-76-S-03-0034-239)
 (SAN/0034-77/1) Avail: NTIS HC A03/MF A01

Biophotolysis--the production of hydrogen and oxygen from water and sunlight by biological catalysts--was demonstrated, for the first time, using nitrogen-starved cultures of the blue-green alga *Anabaena cylindrica*. This system demonstrates all the requirements for development of a practical system of biophotolysis.

sis--high (23 microns moles/mg dry weight) and sustained (3 weeks or longer) hydrogen and oxygen production at a 2:1 ratio with no fundamental limitations in scale-up, stability, or longevity. Present limitations of this system may be classified as biochemical, physiological, engineering. Advances were made in all areas. Operation of an outdoor biophotolysis system demonstrates the basic feasibility of this method of energy conversion. An engineering and economic analysis reveals many aspects of this system which will require further research and development before practical applications will be possible. ERA

N78-27567# Stanford Univ., Calif.
SILICON PHOTOVOLTAIC CELLS IN TPV CONVERSION
 Interim Report

R. N. Bracewell and R. M. Swanson Feb. 1978. 86 p refs (EPRI-ER-633) Avail: NTIS HC A05/MF A01

The feasibility of a solar electric thermophotovoltaic system (TPV) was assessed. A numerical model of TPV conversion was developed both for the purpose of assessing TPV conversion and to facilitate an initial design of TPV photocells. Also, a facility for experimentally evaluating TPV photocells was designed and built. Three runs of TPV cells were fabricated and tested. These achieve efficiencies of 7, 10, and 12% respectively. The cells have negligible resistance loss at currents up to 50 A/cm or 1000 suns. When proper electrical and geometrical parameters for the photovoltaic cell were assumed, the numerical model was found to describe correctly all aspects of the observed behavior of the TPV cells. The model predicts that reduction of parasitic absorption to levels considered achievable will yield TPV cell efficiencies in excess of 30%. ERA

N78-27568# Brookhaven National Lab., Upton, N. Y. Div. of Basic Energy Sciences.

METAL HYDRIDE DEVELOPMENT PROGRAM AT BROOKHAVEN NATIONAL LIBRARY

J. R. Johnson and J. J. Reilly 1977 10 p refs Presented at the DOE Ann. Chem. Energy Storage and Hydrogen Energy System Contract Rev., Baltimore, 16 Nov. 1977 (Contract EY-76-C-02-0016)

(BNL-23574; Conf-771131-2) Avail: NTIS HC A02/MF A01

A progress report which discusses some of the following subjects is presented: The influence of the free energy change and the metal atom mobility upon the reaction of intermetallic compounds with hydrogen; the properties of ferro-titanium alloy hydrides formulated for a specific application (H₂-Cl₂ dual model cell); the effect of cyclic hydriding and dehydriding on FeTi; and the TiCr₂-H system and its properties. ERA

N78-27569# Sandia Labs., Albuquerque, N. Mex.
BRAKE SYSTEM FOR THE 17 METER VERTICAL AXIS WIND TURBINE

C. W. Dodd Feb. 1978 27 p (Contract EY-76-C-04-0789) (SAND-77-1331) Avail: NTIS HC A03/MF A01

The design philosophy and operating procedure of the hydraulic brake system on the 17-meter vertical-axis wind turbine are described. Design details and a functional description of system components are included. ERA

N78-27570# Philips Labs., Briarcliff Manor, New York.
STIRLING TOTAL ENERGY SYSTEMS STUDY Final Report, 15 May 1976 - 13 Jun. 1977

D. Lehrfeld Aug. 1977 190 p refs Sponsored by DOE (HCP/T2947-1) Avail: NTIS HC A09/MF A01

The application of Stirling cycle prime movers to total energy power generation systems was investigated. Electrical, heating, and cooling demand profiles for a typical residential complex, hospital, and office building were studied, and alternative Stirling total energy systems were conceptualized for each site. These were analyzed in detail and contrasted with purchased power systems for these sites to determine fuel energy savings and investment attractiveness. The residential complex and hospital would be excellent candidates for total energy systems; and prime movers in the 1000-kW output range would be required. Consideration was given to the following technological decision areas before arriving at a final design: engine configuration, hot-side heat exchange interface, engine control system, internal gas seals,

and advanced coal combustion technology. The principal advantage of a Stirling prime mover in this application, is that it could utilize low grade liquid fuels and coal. ERA

N78-27572# Resources for the Future, Inc., Washington, D. C.
HOW INDUSTRIAL SOCIETIES USE ENERGY

J. Darmstadter, J. Dunkerley, and J. Alterman Feb. 1978 39 p refs Sponsored by EPRI (EPRI Proj. 384)

(EPRI-EA-707-SY) Avail: NTIS HC A03/MF A01

An attempt is made to find an answer as to why the per capita consumption of primary energy resources are so much higher in the U.S. than in other industrial countries, whose per capita income does not differ appreciably from that of the U.S. Comparative patterns of energy consumption are considered for the U.S., Canada, France, West Germany, Italy, Netherland, UK, Sweden, and Japan. Those components that give rise to variations between countries in the relationship between energy use and national output are identified. As far as possible, the respective contributions of (1) economic structure, and (2) characteristics of energy utilization to the intercountry variations in energy and output are interpreted. Where the data permit, underlying factors--such as relative price differences and demographic features--are woven into the analysis. ERA

N78-27573# Department of Energy, Washington, D. C.
METHODS OF FORECASTING OF SCIENTIFIC AND TECHNICAL PROGRESS IN THE PRODUCTION AND CONSUMPTION OF FUEL AND ENERGY RESOURCES

S. N. Yatrov 1977 47 p refs Transl. into ENGLISH from report from the All-Union Scientific Research Inst. of Complex Fuel and Energy Problems, State Planning Committee of the USSR (Moscow), 1977 47 p (DOE-tr-24) Avail: NTIS HC A03/MF A01

The following subjects are discussed: systems and indices for forecasting the scientific and technical progress in the production and consumption of technical and economic resources; methods and practical experience in forecasting the production and consumption of fuels and energy sources in the U.S.S.R.; and trends in the development of such forecasting methods. Author (ERA)

N78-27575# Mathematica, Inc., Washington, D. C.
ESTIMATING HOUSEHOLD ENERGY EXPENDITURES IN THE PHASE 1 COMPREHENSIVE HUMAN RESOURCES DATA SYSTEM, TASK 2 Final Report

Jill A. King Dec. 1977 57 p refs (Contract EM-74-C-01-8022) (HCP/I60901-01) Avail: NTIS HC A04/MF A01

Results of revising the electricity and piped-gas expenditures imputed to households on the 1974 Comprehensive Human Resources Data Survey (CHRDS) file with equations estimated from the WCMS 1975 Household Energy Survey are presented. The revised expenditures are shown to be superior to the original CHRDS expenditures in many respects. The adjustment factors necessary to calibrate the expenditures with state-by-state control data are generally smaller than those previously required, and more importantly, the variations in expenditures by different characteristics, including income, age of head, race of head, family size, and tenure are much more reasonable than the original expenditures. Without an absolute standard of the true energy expenditures of the U.S. population by which to assess the CHRDS file, however, it is impossible to conclude that the CHRDS revised electricity and piped-gas expenditures reflect accurately the energy expenditures of different subgroups of the population. Author

N78-27576# Institute of Gas Technology, Chicago, Ill.
TRANSMISSION OF ENERGY BY OPEN-LOOP CHEMICAL ENERGY PIPELINE

N. R. Baker 1977 6 p refs Presented at ERDA-Information Exchange Meeting for Thermal Energy Storage Program, Gatlinburg, Tenn., 29 Sep. 1977 (Contract EE-77-C-02-4234) (CONF-770955-4) Avail: NTIS HC A02/MF A01

The technical feasibility and the economic viability of

transmitting and storing energy by an open-loop modification of the reversible chemical energy pipeline system known as EVA/ADAM were evaluated. Topics studied include: (1) the preliminary design of a nuclear (HTGR) and methane-based open-loop system; (2) assessment of the feasibility of using existing natural gas pipelines and storage systems for the synthesis gas; (3) evaluation of energy sources as alternatives to those in the preliminary design; (4) assessment of existing methanation technologies and interchangeability of the synthetic natural gas (SNG) with natural gas; (5) evaluation of the various alternative energy end-uses for heat, SNG, and electricity; and (6) development of two conceptual designs and evaluation of their economics and environmental impacts. ERA

N78-27577# Organization for Economic Co-Operation and Development, Paris (France).

INTERNATIONAL ENERGY TRENDS: MONTHLY SUPPLEMENT ON OIL TRENDS

16 Dec. 1977 30 p refs
(NP-22885) Avail: NTIS (US Sales Only) HC A03/MF A01;
ERDA Depository Libraries

Data on international energy trends are presented in tables and graphs. The data are grouped in sections on consumption of all oil products, consumption by 3 main products, production of crude oil, stock levels of all oil, crude oil imports, average import price for all crude categories, and index of industrial production. ERA

N78-27578# Battelle Pacific Northwest Labs., Richland, Wash.
BRINE CHEMISTRY AND COMBINED HEAT/MASS TRANSFER. VOLUME 2: APPENDIXES

D. W. Shannon Jan. 1978 264 p refs
(Contract EY-76-C-06-1830)
(EPRI-ER-635-Vol-2) Avail: NTIS HC A12/MF A01

Volume II of the two-volume report consists of five appendixes. They are entitled: (1) summary of key input variables for operation of the flashed steam plant computer code; (2) background on component models for fittings and valves; (3) flasher-separator baseline description and performance model; (4) direct contact cascade condenser baseline description and performance; and (5) brine chemistry of geothermal wells listed by resource type. ERA

N78-27579# Exxon Research and Engineering Co., Linden, N. J.
Government Research Lab.

HETEROSTRUCTURE SINGLE CRYSTAL SILICON PHOTO-VOLTAIC CELL TYPE A: SEMICONDUCTOR HETERO-JUNCTION SILICON DEVICES Quarterly Report, 27 Sep. - 31 Dec. 1976

A. K. Ghosh, R. F. Shaw, T. Feng, C. Fishman, S. Merrin (Emdex Corp., Milford, Conn.), and I. Grater (Emdex Corp., Milford, Conn.)
Jan. 1978 39 p refs
(Contract EY-76-C-03-1283)

(TID-27910; QR-1) Avail: NTIS HC A03/MF A01

An account is given of the work that was done on SnO₂/Si Heterostructure solar cells. In the Emdex Innotech cells, a major portion of current losses are due to reflection and shadowing effects due to grids. The SnO₂ thin films act as an antireflection coating but are not comparable in performance to those used in commercial p/n junction solar cells. The shape of the spectral response curve was theoretically calculated by taking into account the reflection losses. In most cases it is not necessary to assume an inversion layer at the surface to account for the decrease in spectral response at short wavelengths. Further for these cells photocurrent suppression was not observed. The diode factor, the reverse saturation current, series and shunt resistances were determined for these cells. The diode factor n determined from dark and light I-V are not the same as one would expect from a normal solar cell. The first batch of newly fabricated SnO₂/Si cells show low efficiency. The problems with these cells and ways to improve its performance are discussed. ERA

N78-27580# Brookhaven National Lab., Upton, N. Y.
ELECTROLYSIS BASED HYDROGEN STORAGE SYSTEM
Semiannual Report, 1 Jan. - 30 Jun. 1977

F. J. Salzano Oct. 1977 39 p refs
(Contract EY-76-C-02-0016)
(BNL-50760) Avail: NTIS HC A03/MF A01

The cost and efficiency of electrolytic hydrogen production and the technique of using metal-hydride hydrogen storage for stationary and transportation applications are discussed. The related work of organizations having subcontracts with BNL is included; and the effort on natural-gas supplementation, systems analysis, and project management of the ERDA Hydrogen Program by BNL are summarized. Hardware development and cell materials testing for both acid and alkaline water electrolyzers are included. Also reported is related work on development of the reversible H₂Cl₂ electrochemical cell which is the key component in an electrical energy storage system proposed for utility use. Progress is reported on solutions to the hydride expansion problem, design of the Hydrogen Technology Advanced Component Test System, design of two hydrogen reservoirs, improved Fe-Ti-based hydrides, and studies on the recovery of storage capacity following poisoning by impurities in the hydrogen. ERA

N78-27581# Hughes Research Labs., Malibu, Calif.
INDIUM PHOSPHIDE/CADMIUM SULFIDE THINFILM TERRESTRIAL SOLAR CELLS Quarterly Report, 1 Jul. - 14 Sep. 1977

K. Zanio and L. Frass Oct. 1977 20 p refs
(Contract EY-76-C-04-3717)
(ALO/3717-1; QR-4) Avail: NTIS HC A02/MF A01

Indium phosphide/cadmium sulfide solar cells with AM2 efficiencies up to 7% were prepared by the deposition of CdS on single crystals of InP. When an intermediate layer of n-type InP was deposited by the planar reactive deposition (PRD) technique, 3% efficiencies were obtained. Reduced efficiencies were obtained when an intermediate layer of p-type Mn-doped InP was used as the light-absorbing layer. Manganese, acting as a deep center at 0.25 eV and introduced in concentrations of about 10 to the 18th power/cubic cm, may act as recombination and tunneling centers, thus limiting the efficiency of the cells. These results suggest that, to improve cell efficiency, either the Mn doping must be reduced or the purity of films must be improved. Methods of improving the purity of the films are suggested. ERA

N78-27582# Brookhaven National Lab., Upton, N. Y.
ROLE OF WIND POWER IN ELECTRIC UTILITIES

H. Davitian Sep. 1977 22 p refs
(Contract EY-76-C-02-0016)
(BNL-50736) Avail: NTIS HC A02/MF A01

Current estimates suggest that the cost of wind generated power is likely to be competitive with conventionally generated power in the near future in regions of the United States with favorable winds and high costs for conventionally generated electricity. This assessment regarding competitiveness includes effects of reduced reliability of wind power compared to conventional sources. Utilities employing wind power are likely to purchase more peaking capacity and less baseload capacity than they would have otherwise to provide the lowest cost reserve power. This reserve power is needed mainly when wind outages coincide with peak loads. The monetary savings associated with this shift contribute substantially to the value of wind energy to a utility. ERA

N78-27583# State Univ. of New York, Albany.
SOLAR ENERGY AND THE HEAT PUMP IN A NORTHERN CLIMATE Final Report

R. Stewart, J. Healey, B. Murphy, and J. Scott Dec. 1977 68 p refs
(EPRI-EA-407) Avail: NTIS HC A04/MF A01

The performance of copper solar panels with a water-to-water heat pump, an air-to-water heat pump, an electric boiler, and two eight thousand gallon storage tanks is reported. The heated building was instrumented to provide data for the time variant electric power demands, the impact of meteorological variables, peak storage capabilities, the efficiency of the solar panels, coefficient of performance of the heat pumps, and heating system performance factor. Computer simulations of the heat budget of the building were prepared and verified. A series of economic

analyses were performed comparing the air source heat pump to the solar assisted water-to-water heat pump and using a base case of electric heating peak shaving. Incremental costs were included but the peak shaving capability was not tested. It is indicated that the air source heat pump has a higher coefficient of performance than the solar assisted water-to-water heat pump. The solar system provides 33% of the heating load during peak winter operating conditions. ERA

N78-27584# George Washington Univ., Washington, D. C.
SOLAR ENERGY INCENTIVES ANALYSIS: PSYCHO-ECONOMIC FACTORS AFFECTING THE DECISION MAKING OF CONSUMERS AND THE TECHNOLOGY DELIVERY SYSTEM

Jan. 1978 52 p

(Contract EX-76-G-01-2534)

(HCP/M2534) Avail: NTIS HC A04/MF A01

The rationale for the study is that economic incentives are necessary, but not sufficient for achieving commercial and residential acceptance. The primary research instrument was 21 Decision Analysis Panel meetings held with groups of Technology Delivery System segment members, and with potential user groups in four regions: the Far West, Southeast, Middle Atlantic and Northeast. Data were analyzed by content and thematic analyses. The major and permanent TDS functions such as financing, manufacturing, distributing, building and installing as well as commercial and private residence consumers are studied. Presented is a broad overview of the behavioral/economic barriers to solar acceptance: a brief review of how these vary within each TDS and consumer segment studies; and a precis of legislative and programmatic recommendations for Federal, state and local government action. ERA

N78-27585# Ford Motor Co., Dearborn, Mich.
FORD/ERDA SODIUM-SULFUR BATTERY DEVELOPMENT, PHASE 2 Progress Report, 1 Nov. - 31 Dec. 1977

A. Topouzian Feb. 1978 28 p

(Contract EY-76-C-02-2566)

(COO-2566-30: PR-30) Avail: NTIS HC A03/MF A01

Progress is reported in the development of a sodium-sulfur battery. Topics covered include: (1) specifications for an electric vehicle battery to meet a duty cycle of 100 miles CVS; (2) system design and component development for a 1-MW load leveling battery; (3) chromium-nickel alloys for use as the sulfur container material; (4) ceramic electrolyte tubing and sealing problems; and (5) results of cell fabrication and testing. ERA

N78-27586# Department of Energy, Washington, D. C.
DOE FACILITIES SOLAR DESIGN HANDBOOK

Jan. 1978 177 p refs

(Contract W-7405-eng-36)

(DOE/AD-0006/1) Avail: NTIS HC A09/MF A01

Design of solar heating systems for commercial and laboratory buildings at Department of Energy Facilities is discussed. Solar energy fundamentals, solar heating and cooling technology, systems, and components are included as well as solar system economics. Quantitative analysis, with generalized design and sizing curves, is presented for solar heating so that collector and other system parameters can be cost-economically sized without a computer simulation. Solar system design considerations and guidelines, as well as guidelines for developing subsystem specifications, are presented. ERA

N78-27587# Energy Research and Development Administration, Washington, D. C. Office of Planning, Analysis, and Evaluation.

MODELS AND METHODOLOGIES FOR ASSESSING THE IMPACT OF ENERGY DEVELOPMENT

Sep. 1977 41 p refs

(Contract EA-77-C-10-0037)

(ERDA-77-91) Avail: NTIS HC A03/MF A01

The most important community service areas impacted are: housing, transportation, solid waste, water supply, waste water treatment, recreation, education, health care, and public safety. This report surveys the major land use, transportation, economic-demographic, and simulation models and methodologies to analyze

their performance vis-a-vis data requirements, model validity and ease of use. GRA

N78-27588# Energy Research and Development Administration, Washington, D. C. Office of Planning, Analysis, and Evaluation.

ASSISTANCE FROM ENERGY DEVELOPERS: A NEGOTIATING GUIDE FOR COMMUNITIES

Sep. 1977 79 p

(Contract EA-77-C-10-0037)

(ERDA-77-90) Avail: NTIS HC A05/MF A01

Public and private policies and actions are considered to increase reliance on more-abundant domestic energy resources such as coal and to develop new technologies to exploit those resources. The focus of this guide is on a general approach and the generic information needed to negotiate for assistance in managing, minimizing, or averting adverse community impacts from energy-development projects. The negotiating process, negotiating leverage, impact and needs assessment, government and developer assistance, and negotiating strategy, are discussed. A case study is made of Mineral City County, USA (fictitious), based on experiences of actual communities where a coal gasification plant is located. ERA

N78-27589# Energy Research and Development Administration, Washington, D. C. Office of Planning, Analysis, and Evaluation.

MANAGING THE SOCIO-ECONOMIC IMPACTS OF ENERGY DEVELOPMENT: A GUIDE FOR THE SMALL COMMUNITY

Sep. 1977 82 p

(Contract EA-77-C-10-0037)

(ERDA-77-79) Avail: NTIS HC A05/MF A01

Employment, personal income, housing, education, transportation, water supply, solid waste collection and disposal, waste water treatment, health care, recreation, and safety are among the factors discussed. Emphasis is given to organizing to most effectively participate in assessing, planning, and managing energy development and how to insure that information is collected and analyzed to reflect local priorities and future planning needs within the small community. ERA

N78-27590# Brookhaven National Lab., Upton, N. Y.
DATA BANK FOR THE GEOGRAPHICAL ALLOCATION OF FUTURE US ENERGY SUPPLY FACILITIES BY COUNTY
 W. A. Sevan and S. R. Bozzo May 1977 32 p refs

(Contract EY-76-C-02-0016)

(BNL-50754) Avail: NTIS HC A03/MF A01

To aid the analysis and evaluation of the biomedical and environmental effects of future energy systems, a county level data bank of future U.S. energy supply facilities is considered. This data file attempts to fulfill a requirement for a county level information source useful in future energy supply and utilization projections, and the generation of closer links between energy resources, their development and use, and a comprehensive set of the effects of energy consumption. The data file format contains such items as fuel type, process type, year of planned availability, production capacity, employment, and state and county of location for each facility; these formats are described in detail. Finally, a system that has been developed incorporating the data bank of future energy supply facilities for the analysis of the biomedical and environmental consequences of energy production and consumption is described. ERA

N78-27591# Brookhaven National Lab., Upton, N. Y.
IMPACT OF SELECTED ENERGY CONSERVATION TECHNOLOGIES ON BASELINE DEMANDS

A. Doernberg Sep. 1977 101 p refs

(Contract EY-76-C-02-0016)

(BNL-50745) Avail: NTIS HC A06/MF A01

Baseline energy demands are modified by introducing successively three sets of conservation options. The implementation of improved building standards and the use of co-generation in industry are analyzed in detail. Two further sets of energy demands are presented that complete the view of a low energy use, conservation scenario. An introduction to the report covers

the complexities in evaluating conservation in view of the ways it is inextricably lined to technology, prices, policy, and the mix of output in the economy. The term as used in this report is narrowly defined, and methodologies are suggested by which these other aspects listed can be studied in the future. ERA

N78-27592# Argonne National Lab., Ill.
POTENTIAL ENERGY SAVINGS IN COMMERCIAL/RESIDENTIAL COMMUNITIES BASED ON INTEGRATED SYSTEMS DESIGN

R. E. Holtz and T. J. Marciniak 1977 17 p Presented at the Winter Ann. Meeting of the Am. Soc. of Mech. Engr., Atlanta, 22 Nov. 1977

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

(CONF-771120-21) Avail: NTIS HC A02/MF A01

Integrated Community Energy Systems (ICES) offer the potential of meeting the total energy requirements of communities in an energy conserving cost effective manner. This is accomplished mainly by (1) utilizing waste heat from electrical power generation; (2) using solid waste to help meet thermal and fuel energy demands; (3) using solar and other advanced technologies either in a central plant or dispersed in the community; and (4) developing control and operating strategies along with energy-storage technologies to meet community energy needs. In order to explore the potential for such systems, a large commercial/residential community currently under development in the Midwest was studied. Results are presented showing the energy savings possible using current, emerging, and advanced energy technologies. Along with the energy savings are estimates of the economic savings that are possible are included. ERA

N78-27593# General Electric Co., Schenectady, N. Y. Energy Systems Programs Dept.

CFCC DEVELOPMENT PROGRAM Monthly Report, Nov. 1977

Jan. 1978 27 p refs

(Contract EX-76-C-01-2357)

(FE-2357-19) Avail: NTIS HC A03/MF A01

System engineering effort has been focused on two areas, in order to guide evolving technology investigations. The first, the interaction of alternate combustor steam generator configuration addresses the control and mechanical interface issues. The second, a study of conventional cyclone utilization, is being used to guide the advanced inertial separator development. Several combustor/steam generator concepts have been conceptualized including a shippable configuration (four vessels per gas turbine) and a modified tube geometry (involute) resulting in two vessels per turbine module. In the gas turbine materials area, over 1000 hours have been accumulated on the burner rig simulations and some of the baseline materials are showing initial signs of corrosion--hence, they have removed and will undergo analysis. Materials for exposure in the PFB environment as part of the Fireside II 1000 hours test have been selected and specimen cladding has been initiated. ERA

N78-27594# Booz-Allen and Hamilton, Inc., Bethesda, Md.
VIEWPOINTS ON KEY ISSUES AND EVALUATION CRITERIA FOR ASSESSING THE POTENTIAL OF ALTERNATIVE NUCLEAR ENERGY SYSTEMS FOR IMPROVING PROLIFERATION RESISTANCE

15 Dec. 1977 107 p refs

(Contract EN-77-C-01-2644)

(TID-28078) Avail: NTIS HC A06/MF A01

A compilation and analysis of the viewpoints offered by individuals representative of the spectrum of groups interested in the proliferation problem is presented. These individuals were selected from utilities, the nuclear industry, the Federal Government, state government staff, Congressional staff, environmental organizations, universities, an energy analysis organization, national energy laboratories, and a public policy analysis organization. The major issues, concerns, and implications identified in the course of this effort are discussed. This analysis of viewpoints is intended to assist DOE in the planning and conduct of a Nonproliferation Alternative System Assessment Program (NASAP). Information is presented in the following formats: framework for analysis; alternative systems assessment criteria; integrated evaluation methodology; and public interaction. ERA

N78-27595# Sandia Corp., Livermore, Calif.

DIRECT CONTACT HEAT EXCHANGE FOR LATENT HEAT-OF-FUSION ENERGY STORAGE SYSTEMS

M. C. Nichols and R. M. Green Dec. 1977 28 p refs Presented at alternative energy sources Symp., Miami Beach, Fla., 5 Dec. 1977

(Contract EY-76-C-04-0789)

(SAND-77-8665; Conf-771203)

Avail: NTIS

HC A03/MF A01

Rudimentary computational and experimental results are presented for a thermal energy storage process based on a novel counter current, direct contact heat exchange concept, the shot tower. The process uses a phase change material and a mutually immiscible heat transfer fluid. A two-tank storage system is used, one each for cool and hot phase change material, respectively. In use, the phase change material is introduced from one of the storage tanks into a direct contact heat exchanger where it is frozen/melted while it passes through the countercurrently flowing heat transfer fluid which receives/supplies heat from/to the phase change material. Since these external heat exchangers need only be sized to meet the charge/discharge power demand, they can be quite small relative to the size of the storage tanks. The extensive and expensive heat exchanger surfaces required in conventional phase change systems can be totally eliminated. ERA

N78-27596# Aerospace Corp., El Segundo, Calif. Environment and Energy Conservation Div.

HYBRID VEHICLE TECHNOLOGY CONSTRAINTS AND APPLICATION ASSESSMENT STUDY. VOLUME 1: SUMMARY Final Report, Apr. 1975 - Jun. 1976

D. E. Lapedes, M. G. Hinton, L. Forrest, J. Kohlenberger, T. Ryan, H. Sampson, W. Smalley, C. Speisman, and H. White Nov. 1977 117 p 4 Vol.

(PB-278118/5; DOT-TSC-OST-77-23-1-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 13F

Analyses and assessments of both heat engine/battery and heat engine/flywheel-powered hybrid vehicles are presented to determine if they could contribute to nearterm (1980-1990) reductions in transportation energy consumption. The impact of hybrid vehicle use on vehicle-related exhaust emissions is determined, and the ability to accommodate a different energy resource base in the longer term is evaluated. Alternative paths for power transmission from the heat engine to the vehicle drive wheels are considered along with the potential of regenerative braking to reduce vehicle energy consumption. GRA

N78-27597# Aerospace Corp., El Segundo, Calif. Environment and Energy Conservation Div.

HYBRID VEHICLE TECHNOLOGY CONSTRAINTS AND APPLICATION ASSESSMENT STUDY. VOLUME 2: SECTIONS 1 THROUGH 4 Final Report, Apr. 1975 - Jun. 1976

D. E. Lapedes, M. G. Hinton, L. Forrest, J. Kohlenberger, T. Ryan, H. Sampson, W. Smalley, C. Speisman, and H. White Nov. 1977 225 p refs 4 Vol.

(PB-278119/3; DOT-TSC-OST-77-23-2-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 13F

The methods used and the data base employed in simulation modeling of each vehicle powertrain are presented. A technology review of powertrain components and various hybrid systems are included. GRA

N78-27598# Aerospace Corp., El Segundo, Calif. Environment and Energy Conservation Div.

HYBRID VEHICLE TECHNOLOGY CONSTRAINTS AND APPLICATION ASSESSMENT STUDY. VOLUME 3: SECTIONS 5 THROUGH 9 Final Report, Apr. 1975 - Jan. 1976

D. E. Lapedes, M. G. Hinton, L. Forrest, J. Kohlenberger, T. Ryan, H. Sampson, W. Smalley, C. Speisman, and H. White Nov. 1977 188 p refs 4 Vol.

(PB-278120/1; DOT-TSC-OST-77-23-3-Vol-3) Avail: NTIS HC A09/MF A01 CSCL 13F

Vehicle powertrain characteristics and the characteristics of the stationary generating plants are described along with physical

and performance characteristics imposed on the hybrid vehicle. Computer programs developed for the analysis and results of the powertrain component sizing analysis are included. GRA

N78-27599# Aerospace Corp., El Segundo, Calif. Environment and Energy Conservation Div

HYBRID VEHICLE TECHNOLOGY CONSTRAINTS AND APPLICATION ASSESSMENT STUDY. VOLUME 4: SECTIONS 10, 11, AND APPENDIX Final Report, Apr. 1975 - Jun. 1976

D. E. Lapedes, M. G. Hinton, L. Forrest, J. Kohlenberger, T. Ryan, H. Sampson, W. Smalley, C. Speisman, and H. White. Nov. 1977 212 p ref 4 Vol.

(PB-278121/9; DOT-TSC-OST-77-23-4-Vol-4) Avail: NTIS HC A10/MF A01 CSCL 13K

The hybrid vehicle's energy consumption and exhaust emissions are considered. Factors such as vehicle weight, peak cruise speed, and regenerative braking are discussed. Technological constraints to introduction of the hybrid vehicle and applications that could benefit most from its energy conservation potential are identified. GRA

N78-27600 National Technical Information Service, Springfield, Va.

WIND POWER, VOLUME 1. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - 1976

Audrey S. Hundemann May 1978 206 p (NTIS/PS-78/0415/6) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10B

The feasibility, use, and engineering aspects of wind power and windmills are discussed in these citations of Federally-funded research reports. Abstracts primarily cover the use of wind power for electric power generation and wind turbine design and performance. General studies dealing with comparative analysis of wind power and alternative energy sources are included, as are energy storage devices which can be used in these systems. GRA

N78-27601 National Technical Information Service, Springfield, Va.

WIND POWER, VOLUME 2. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1977 - Apr. 1978

Audrey S. Hundemann May 1978 158 p Supersedes NTIS/PS-77/0399; NTIS/PS-76/0358; NTIS/PS-75/348; COM-74-11103

(NTIS/PS-78/0416/4; NTIS/PS-77/0399; NTIS/PS-76/0358; NTIS/PS-75/348; COM-74-11103) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10B

For abstract, see N78-27600.

N78-27602 National Technical Information Service, Springfield, Va.

WIND POWER. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Apr. 1978

Audrey S. Hundemann May 1978 238 p Supersedes NTIS/PS-77/0400; NTIS/PS-76/0359

(NTIS/PS-78/0417/2; NTIS/PS-77/0400; NTIS/PS-76/0359) Avail: NTIS CSCL 10B

For abstract, see N78-27600.

N78-27603# Office of Technology Assessment, Washington, D. C.

TASK REPORTS: SLURRY COAL PIPELINES. VOLUME 2, PART 1

Jan. 1978 528 p refs (PB-278676/2; OTA-E-60-Vol-2-Pt-1) Avail: NTIS HC A23/MF A01 CSCL 13K

The costs and potential economic, social, and environmental impacts of coal slurry pipelines are analyzed. The possible effects of coal slurry pipeline development, pipeline and unit train costs, and relevant legal and regulatory issues are discussed. Findings address conditions under which slurry pipelines may be attractive in terms of cost and the influence of transportation regulatory policy. Also evaluated are the potential impacts of slurry pipeline development on the rail industry, consequences of pipeline water use as contrasted with community impacts of increased coal

train traffic, and implications of the power of eminent domain at the Federal, as opposed to the state, level. GRA

N78-27604# Office of Technology Assessment, Washington, D. C.

TASK REPORTS: SLURRY COAL PIPELINES. VOLUME 2, PART 2

Jan. 1978 804 p refs (PB-278677/0; OTA-E-60-Vol-2-Pt-2) Avail: NTIS HC A99/MF A01 CSCL 13K

For abstract, see N78-27603.

N78-27605# Illinois Dept. of Business and Economic Development, Springfield. Div. of Energy.

ILLINOIS ENERGY CONTINGENCY PLAN, EXECUTIVE SUMMARY Final Report

W. Poulakos Dec. 1977 29 p (Contract GR-25-0017-112)

(PB-278714/1; ILLDOE-77/14) Avail: NTIS HC A03/MF A01 CSCL 10A

The role of state agencies during energy contingencies is described. The executive summary outlines the information system and the various components within the energy contingency plan. The executive summary briefly discusses possible policy options which may be used by the state during energy contingencies. GRA

N78-27606# Illinois Dept. of Business and Economic Development, Springfield. Div. of Energy.

ILLINOIS ENERGY CONTINGENCY PLAN. Final Report

H. Kaufman and V. Shrivastava (Jack Faucett Associates, Inc.) Nov. 1977 188 p

(Contract GR 25-0017-112) (PB-278715/8; ILLDOE-77/13) Avail: NTIS HC A09/MF A01 CSCL 10A

An information system reported for use during energy emergencies. There are four major components to the Illinois Plan. These components are information analysis, advisory decision making, and implementation. The Plan describes the role of various state agencies during times of energy contingencies and policy options which may be considered by the state during various types of energy disruptions. Some quantification of demand reduction measures are listed in the Plan. GRA

N78-27607# Environmental Protection Agency, Denver, Colo. Office of Energy Activities.

FEDERALLY SPONSORED ENERGY RESEARCH IN THE NORTHERN GREAT PLAINS, NORTH DAKOTA, FISCAL YEAR 1976

Allen S. Lefohn Jun. 1977 37 p refs (PB-278132/6; EPA-908-4-77-008) Avail: NTIS HC A03/MF A01 CSCL 10A

An effective mechanism for transferring energy research results from the laboratory to the decision-makers is considered. A survey was initiated to summarize the federal energy effort in the State of North Dakota. This report is a summary of the information obtained from numerous state and federal publications. Recommendations regarding further actions on various aspects of energy research are included. The report serves primarily as an information mative document to inform researchers, state and federal government officials, and decision-makers at all government levels how and where the federal energy research dollar is being directed in North Dakota. GRA

N78-27608# Development Sciences, Inc., Sagamore, Mass. **FIRST ORDER ESTIMATES OF ENERGY REQUIREMENTS FOR POLLUTION CONTROL**

James L. Barker, Kenneth Maddox, James D. Westfield, and Douglas Wilcock Feb. 1978 97 p refs

(Contract EPA-68-01-4150) (PB-278274/6; EPA-600/7-78-022) Avail: NTIS HC A05/MF A01 CSCL 10A

Estimates of the energy demand attributable to environmental control of pollution from stationary point sources are presented.

This class of pollution source includes powerplants, factories, refineries, municipal waste water treatment plants, etc., but excludes mobile sources - automobiles, trucks, etc. - and nonpoint sources - sources which do not produce individual effluent streams, such as some types of farms, mines, etc. GRA

N78-27609# National Technical Information Service, Springfield, Va.

COAL GASIFICATION AND LIQUEFACTION TECHNOLOGY, VOLUME 3. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, Jun. 1976 - Apr. 1978

Diane M. Cavagnaro Apr. 1978 282 p Supersedes NTIS/PS-77/0305, NTIS/PS-76/0391, NTIS/PS-75/386 and COM-74-10967

(NTIS/PS-78/0345/5; NTIS/PS-77/0305; NTIS/PS-76/0391; NTIS/PS-75/386; COM-74-10967) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 07A

Techniques and processes of the conversion of coal to gaseous and liquid chemicals are cited in this bibliography. It also includes solvent refined coal liquids and coal derived fuels. Coal desulfurization, cleaning, or preparation which does not involve conversion to gas or liquid fuels, or in situ combustion (underground gasification of coal deposits) are not covered. (This updated bibliography contains 277 abstracts, 157 of which are new entries to the previous edition.) GRA

N78-27617# United Technologies Research Center, East Hartford, Conn.

THE EVOLUTION OF POLLUTANTS DURING THE RAPID DEVOLATILIZATION OF COAL Final Report, 1 Apr. 1976 - 30 Sep. 1977

Peter R. Solomon Nov. 1977 262 p

(Grant NSF AER-75-17247)

(PB-278496/5; R77-952588-3; NSF/RA-770422) Avail: NTIS HC A12/MF A01 CSCL 08I

Results are described of an eighteen month integrated experimental and analytical program to study the evolution of pollutants during coal devolatilization. The identification of individual reactions was facilitated by performing the devolatilization experiments in vacuum. The program investigated the devolatilization behavior of 13 coals ranging in rank from lignite to highly volatile A bituminous. The coal was brought to temperature at a nominal heating rate of 600 C/sec, held at temperatures between 300 and 1000 C for between 5 sec and 80 sec and then cooled. Measurements were made of particle temperature, the elemental composition and mass distribution of the products, and the concentration of components in the gas. GRA

N78-27621# Environmental Protection Agency, Research Triangle Park, N.C. Emission Standards and Engineering Div. **STANDARDS SUPPORT AND ENVIRONMENTAL IMPACT STATEMENT. VOLUME 2: PROMULGATED STANDARDS OF PERFORMANCE FOR LIGNITE-FIRED STEAM GENERATORS**

Nov. 1977 34 p

(PB-279008/7; EPA-450/2-76-030b)

Avail: NTIS

HC A03/MF A01 CSCL 07A

A standard of performance for the control of emissions of nitrogen oxides from new and modified lignite fired steam generators is being promulgated under the authority of section III of the Clean Air Act. When standards of performance for large steam generators were promulgated under Subpart D of Part 60, lignite fired units were exempted from the nitrogen oxides standard (the sulfur dioxide and particulate matter standards are applicable to lignite firing) because of a lack of data on attainable levels of emission from such units. Since then, sufficient data have been obtained to propose and promulgate a standard. This document contains summaries of public comments on the proposed standards, EPA responses, a discussion of differences between the proposed and promulgated standards, and the final environmental impact statement as submitted to the Council on Environmental Quality. GRA

N78-27622# PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio.

EPA UTILITY FGD (FLUE GAS DESULFURIZATION) SURVEY: DECEMBER 1977 - JANUARY 1978 Progress Report, Jul. 1977 - Jan. 1978

Bernard A. Laseke Mar. 1978 291 p

(PB-279011/1; EPA-600/7-78-051a) Avail: NTIS HC A13/MF A01 CSCL 07A

A survey of utility flue gas desulfurization (FGD) systems in the U.S. is presented. Information contributed by the utility industry, process suppliers, regulatory agencies, and consulting engineering firms, is summarized. Systems were tabulated alphabetically, by development status by utility company, process supplier, processes, waste disposal practice, and by regulatory class. Data on system design, fuel sulfur content, operating history, and actual performance are presented. Problems and solutions associated with the boilers and FGD systems are discussed. GRA

N78-27623# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.

CONTROL OF EMISSIONS FROM LURGI COAL GASIFICATION PLANTS

Mar. 1978 178 p refs

(PB-279012/9; EPA-450/2-78-012; OAQPS-1.2-093) Avail: NTIS HC A09/MF A01 CSCL 07A

Information on Lurgi coal gasification plants, their emissions, control technologies which can be used to control emissions, and the environmental and economic impacts of applying these control technologies was provided. GRA

N78-27635# Energy Research and Development Administration, Washington, D. C. Div. of Operational and Environmental Safety.

ENVIRONMENTAL MONITORING AT MAJOR US ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION CONTRACTOR SITES: CALENDAR YEAR, 1976, VOLUME 1

Aug. 1977 779 p refs 2 Vol.

(ERDA-77-104/1-Vol-1) Avail: NTIS HC A99/MF A01

Individual annual reports are presented summarizing the result of the environmental monitoring programs conducted at each of the Energy Research and Development Administration sites having a potential for environmental impact or which release a significant quantity of radioactivity or nonradioactive pollutants. Data on the levels of radioactivity and nonradioactive pollutants in effluents and the environs at each site are given, and effluent and environmental measurements and sampling results are evaluated in relation to the appropriate standards for environmental protection, including estimates of potential radiation exposures offsite. In most cases the potential offsite exposures are so low they cannot be determined by direct measurement methods but must be estimated by calculational techniques. All potential offsite exposures to members of the public from routine effluent releases in 1976 were less than 5 mrem/yr (i.e., less than one percent of the established radiation protection guidelines for exposure of the public). ERA

N78-27636# Energy Research and Development Administration, Washington, D. C. Div. of Operational and Environmental Safety.

ENVIRONMENTAL MONITORING AT MAJOR US ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION CONTRACTOR SITES: CALENDAR YEAR, 1976, VOLUME 2

Aug. 1977 738 p refs 2 Vol.

(ERDA-77-104/2-Vol-2) Avail: NTIS HC A99/MF A01

For abstract, see N78-27635.

N78-27637# Ames Lab., Iowa.

ENVIRONMENTAL EFFECTS OF BURNING SOLID WASTE AS FUEL

H. R. Shanks, J. L. Hall (Iowa State Univ., Ames), and A. W. Joensen (Iowa State Univ., Ames) 1977 6 p refs Presented at the 4th Joint Conf. on Sensing of Environ. Pollutants, New Orleans, 6 Nov. 1977

(Contract W-7405-eng-82)

(IS-M-124; Conf-771113-13) Avail: NTIS HC A02/MF A01

The city of Ames, Iowa, is burning processed solid waste as a supplemental fuel with coal in two traveling grate boilers and one tangentially fired boiler at its municipal power plant. A complete environmental study of the facility is being conducted. Results are presented for one of the traveling grate boilers while burning various amounts of processed solid waste with high sulfur content Iowa coal. ERA

N78-27659# PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio.

FLUE GAS DESULFURIZATION SYSTEM CAPABILITIES FOR COAL-FIRED STEAM GENERATORS. VOLUME 2: TECHNICAL REPORT Final Report, Apr. - Dec. 1977

T. Devitt, R. Gerstle, L. Gibbs, S. Hartman, and R. Klier Mar. 1978 514 p

(Contract EPA-68-02-2603)

(PB-279417/0; EPA-600/7-78-032b)

Avail: NTIS

HC A22/MF A01 CSCL 07A

The availability of technology for reducing SO₂ emissions from coal-fired steam generators using flue gas desulfurization (FGD) systems is described. Foreign and domestic lime, limestone, double alkali, magnesium slurry, and Wellman-Lord FGD systems are described. The design parameters and operating experiences are discussed along with steps taken to achieve high system operability, disposal of FGD systems wastes. GRA

N78-27661# PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio.

EFFECTS OF ALTERNATIVE NEW SOURCE PERFORMANCE STANDARDS ON FLUE GAS DESULFURIZATION SYSTEM SUPPLY AND DEMAND Final Report, Apr. - Dec. 1977

Vijay P. Patel and L. Gibbs Mar. 1978 114 p

(Contract EPA-68-02-2603)

(PB-279080/6; EPA-600/7-78-033)

Avail: NTIS

HC A06/MF A01 CSCL 07A

The capabilities of equipment vendors to supply and install the quantity of flue gas desulfurization systems required to meet alternative standards for coal-fired steam generators are discussed. It analyzes limiting factors affecting supply capabilities (such as the availability of components, equipment, and skilled labor). The quarantees that equipment vendors have made and are willing to make, and the penalties that they are willing to be assessed are also discussed. GRA

N78-27665# AeroVironment, Inc., Pasadena, Calif.

AIR QUALITY ANALYSIS OF THE SOUTHERN CALIFORNIA BIGHT IN RELATION TO POTENTIAL IMPACT OF OFFSHORE OIL AND GAS DEVELOPMENT Final Report

Nov. 1977 458 p refs

(Contract DI-AA550-C77-18)

(PB-279088/9; AV-FR-7112; BLM/ST-78-25) Avail: NTIS

HC A20/MF A01 CSCL 21D

Air quality impacts of oil and gas development activities resulting from the proposed leasing of offshore tracts are assessed. Pertinent air quality laws, regulations, and standards are summarized. Considered are: quantifiable emissions of nonmethane hydrocarbons, nitrogen oxides, sulfur dioxide, carbon monoxide, and total suspended particulates. Photochemical (ozone) pollutants were also developed. Air quality levels were calculated through appropriate diffusion modeling within two defined scenarios: a most probable case of combined tanker/barge transport and pipelining; and a case in which all transport is conducted by tankering/barging. Additional impacts due to possible accidents such as spills and blowouts are modeled. GRA

N78-27695# California Univ., Livermore. Lawrence Livermore Lab.

SUBSURFACE STRUCTURE OF THE SOUTHERN PORTION OF THE SALTON SEA GEOTHERMAL FIELD

Marjorie A. Chan and John D. Tewhey 1 Nov. 1977 23 p refs

(Contract W-7405-eng-48)

(UCRL-52354) Avail: NTIS HC A02/MF A01

Subsurface correlation of sedimentary strata was attempted among ten geothermal wells in the southern portion of the Salton Sea Geothermal Field. The spontaneous potential (SP) log was the principal tool used for correlation purposes. The structure that emerges from the correlation diagrams is a shallow plunging syncline with an east-west axis perpendicular to the axis of the Salton Trough. ERA

N78-27791# Los Alamos Scientific Lab., N. Mex.

DATA-BASE MANAGEMENT SYSTEM FOR SPATIAL DISPLAY OF FEDERAL OFFSHORE OIL AND GAS LEASE DATA

J. L. Sibert, Richard Phillips, and John Lohrenz 1978 12 p refs Presented at the 2d Geol. Surv. Computer Symp., Reston, Va., 22 Mar. 1978

(Contract W-7405-eng-36)

(LA-UR-77-2779; Conf-780311-1) HC A02/MF A01

A data-base management system that meets requirements for color-coded map displays and is used for Federal offshore oil and gas lease data of the LPR-5 and LPR-10 data bases is described. The data base is accessed using a powerful and easily learned query language that resembles simple English. Data base searches may be keyed on either data items or functions of data items. For example, all leases that are produced at flush level can be located with one simple query. Provision is made for graphical output, including production of high-quality color maps. The data base has a network structure however; the user need not be aware of the structure to query the data base. Examples are provided of several different types of queries and the resulting output. ERA

N78-27898# Los Alamos Scientific Lab., N. Mex.

GENERAL-PURPOSE HEAT SOURCE PROJECT, SPACE NUCLEAR SAFETY PROGRAM, AND RADIOISOTOPIC TERRESTRIAL SAFETY PROGRAM Progress Report, Jan. 1978

R. D. Baker, comp. 1978 36 p refs

(Contract W-7405-eng-36)

(LA-7184-PR) Avail: NTIS HC A03/MF A01

Activities related to the use of plutonium-238 oxide in radioisotopic power systems are reported. Topics covered include impact tests of high density fuel pellets, mechanical properties of (Pu²³⁸)(O₂) pellets, iridium formality studies, and terrestrial environmental chamber studies. ERA

N78-27922# Texas Univ. at Austin. Center for Electromechanics.

HOMOPOLAR GENERATOR DEVELOPMENT AT THE UNIVERSITY OF TEXAS

W. F. Weldon, H. G. Rylander, and H. H. Woodson 1977 9 p refs Presented at Seminar on Energy Storage, Compression and Switching, Canberra, Australia, 15 Nov. 1977

(Contract EG-77-S-05-5594)

(ORO-5594-7; Conf-771132-3) Avail: NTIS HC A02/MF A01

Homopolar generator development since 1972 is reviewed. The first homopolar generator stored 0.65 MJ was capable of self motoring to 6000 r/min in about 12 min with an armature current of 1.0 KA and could discharge in about 3.0s at a current of 14.0 kA. A high brush tester to evaluate mechanical and electrical properties of the various grades of solid brushes available is mentioned. The second homopolar generator stores 5.0 MJ of energy inertially at 5600 r/min and is basically a scaled-up version of the first generator with improved bearings and brush mechanism. Work on fast discharge and industrial problems is discussed. ERA

N78-27924# Texas Univ. at Austin. Center for Electromechanics.

TEST DATA ON ELECTRICAL CONTACTS AT HIGH SURFACE VELOCITIES AND HIGH CURRENT DENSITIES

N78-27934

FOR HOMOPOLAR GENERATORS

M. Brennan, K. M. Tolk, W. F. Weldon, H. G. Rylander, and H. H. Woodson 1977 5 p refs Presented at the 7th Symp. on Fusion Res. Proj., Knoxville, Tenn., 25 Oct. 1977 (Contract EG-77-S-05-5594)

(CONF-771029-121) Avail: NTIS HC A02/MF A01

One grade of copper graphite brush material, Morganite CMIS was tested, over a wide range of surface velocities, atmospheres, and current densities that are expected for fast discharge (less than or equal to 100 ms) homopolar generators. The brushes were run on a copper coated 7075-T6 aluminum disk at surface speeds up to 277 m/sec. One electroplated copper and three flame sprayed copper coatings were used during the tests. Significant differences in contact voltage drops and surface mechanical properties of the copper coatings were observed.

ERA

N78-27934# Los Alamos Scientific Lab., N. Mex.

FUSION APPLICATIONS OF FAST DISCHARGING HOMOPOLAR MACHINES

K. I. Thomassen Jan. 1978 43 p refs Sponsored in part by Electric Power Research Inst.

(Contract W-7405-eng-36)

(EPRI-ER-625) Avail: NTIS HC A03/MF A01

The use of fast discharging homopolar machines, with 1 to 5000 ms delivery times, is discussed for toroidal and linear theta pinches, toroidal z-pinches, liners, and Tokamaks. Typical circuits and machine designs are described.

ERA

N78-27975# Battelle Pacific Northwest Labs., Richland, Wash. Battelle Human Affairs Research Centers.

MANAGEMENT OF SOCIAL AND ECONOMIC IMPACTS ASSOCIATED WITH THE CONSTRUCTION OF LARGE-SCALE PROJECTS: EXPERIENCES FROM THE WESTERN COAL DEVELOPMENT COMMUNITIES

Marjorie R. Greene and Martha G. Curry Jun. 1977 55 p refs

(Contract EY-76-C-06-1830)

(BNWL-RAP-16) Avail: NTIS HC A04/MF A01

An introductory analysis to some of the more complex issues raised by social and economic impact management, with experiences cited from Western coal-development communities is provided. Following an introduction, the paper is divided into sections corresponding to the major social and economic impacts experienced by rural communities surrounding an energy development. Each section contains a brief introductory description of the types of problems typically associated with the impact sector, and a discussion of management strategies either proposed or implemented for the impact. The management strategies are presented in tabular form, indicating the level of government responsible for implementation.

Author

N78-27982# Los Alamos Scientific Lab., N. Mex.

PROBABILITY DISTRIBUTION OF BIDS ON OUTER CONTINENTAL SHELF OIL AND GAS LEASES

L. A. Bruckner and M. M. Johnson Mar. 1978 22 p refs

(Contract W-7405-eng-36)

(LA-7190-MS) Avail: NTIS HC A02/MF A01

The bids on oil and gas leases on the outer continental shelf are usually treated as observations from a lognormal probability distribution. Occasionally, an alternative distribution. It is demonstrated that the number of bids received on a lease is too small to distinguish clearly among possible underlying distributions. It is shown that the beta and the log-uniform distributions often cannot be rejected as unreasonable hypotheses.

ERA

N78-27988# Brookhaven National Lab., Upton, N. Y. Dept. of Applied Science.

FACILITATING DATA INTERCHANGE WITH ERDA

C. M. Benkovitz 1977 22 p refs Presented at the VIM 26 Conf., Minneapolis, 3-7 Apr. 1977

(Contract EY-76-C-02-0016)

(BNL-22595; Conf-770445-2) Avail: NTIS HC A02/MF A01

Resources of the seven ERDA multipurpose national laboratories and the advantages of sharing them are pointed out. A standard for the interchange of data among the laboratories was developed. Features of the proposed standard and its implementation are described.

Author (ERA)

N78-28015# Arkansas Univ., Little Rock. Industrial Research and Extension Center.

EFFECTS OF ENVIRONMENTAL PROTECTION REGULATION ON REGIONAL ECONOMIC DEVELOPMENT

Final Report

Sep. 1977 143 p

(Grants EDA-99-7-13324; EDA-OER-516-G-76-7)

(PB-278918/8; PUB-L-12; EDA/OER-78/006) Avail: NTIS HC A07/MF A01 CSCL 10A

Current environmental protection legislation and energy problems are examined. The effects of these two intertwined forces on regional economic development are analyzed. Evaluations of both environmental-economic trade-off and industry attraction models are presented.

GRA

N78-28039# Joint Publications Research Service, Arlington, Va.

PROSPECTS FOR POWER GENERATION FROM SPACE

I. Zorich In its Transl. on USSR Sci. and Technol. (JPRS-71393) 30 Jun. 1978 p 38-41 Transl. into ENGLISH from Nedelya (Moscow), no. 20, 1978 p 11

Copyright. Avail: NTIS HC A05/MF A01

The feasibility of generating electrical energy in space using either photoelectric batteries or solar collectors to convert solar energy to electrical energy is discussed. Methods of transmitting the converted energy to earth discussed include: laser beams and microwave radiation. Also, the possibility of placing industry in orbit near the source of energy to eliminate transmission costs is considered.

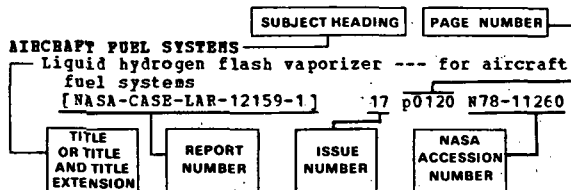
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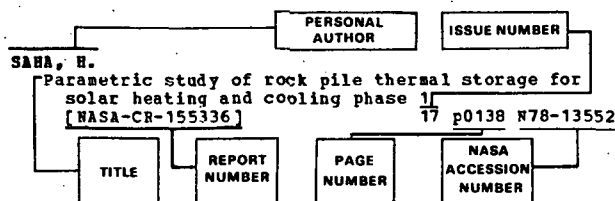
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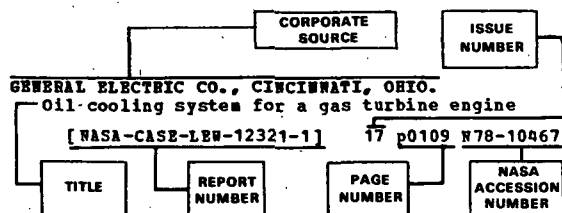
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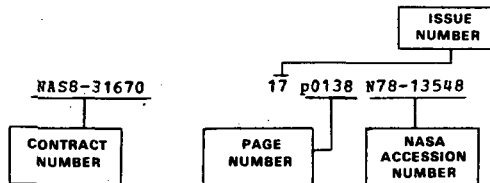
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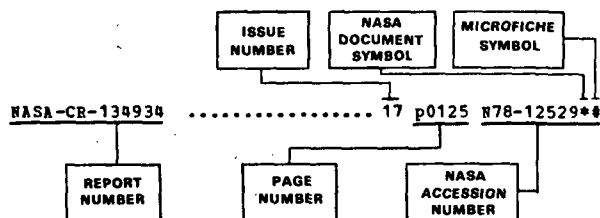
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AFAPL-TR-77-9	17	p0112	N78-10563 #
AFAPL-TR-77-15	19	p0413	N78-25096 #
AFAPL-TR-77-36	17	p0112	N78-10572 #
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AFIT-CI-78-19	19	p0403	N78-24372 #
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AFIT-LSSE-32-77B	18	p0251	N78-17487 #
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AFIT/GEP/PR/77D-3	18	p0269	N78-19663 #
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AFRL-81	17	p0119	N78-11253 #
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AFRL-88	17	p0109	N78-10308 #
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AFCSB-77-1262TB	17	p0158	N78-15213 #
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AIAA PAPER 78-268	18	p0165	A78-20781 #
AIAA PAPER 78-277	18	p0172	A78-22612 #
AIAA PAPER 78-278	18	p0166	A78-20785 #
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AIAA PAPER 78-295	18	p0178	A78-24005*
AIAA PAPER 78-307	18	p0178	A78-24008 #
AIAA PAPER 78-354	18	p0178	A78-24030 #
AIAA PAPER 78-357	18	p0178	A78-24032 #
AIAA PAPER 78-362	18	p0178	A78-24034 #
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