

ACCESSION NUMBER RANGES

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

<i>IAA</i> (A-10000 Series)	A80-21041 – A80-32626
<i>STAR</i> (N-10000 Series)	N80-16023 – N80-22254

Previous publications announced in this series/subject category include:

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ENERGY

A Continuing Bibliography

With Indexes

Issue 26

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 April 1 through June 30, 1980 in

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



INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(26)) lists 1134 reports, journal articles, and other documents announced between April 1, 1980 and June 30, 1980 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.

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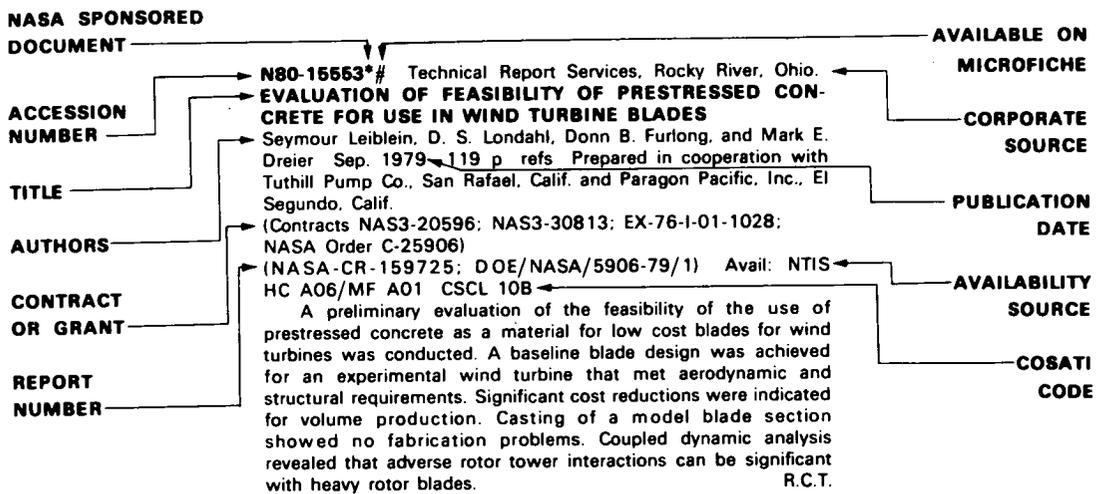
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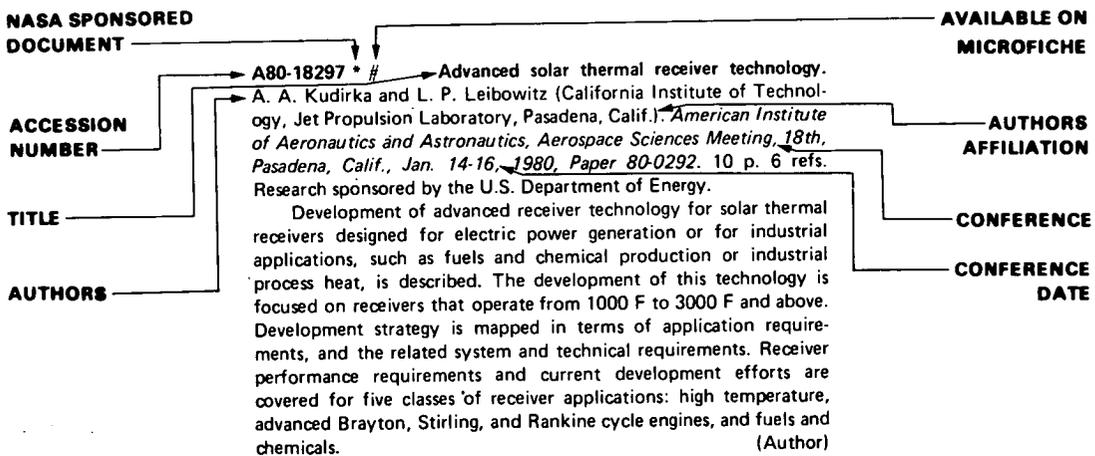
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IAA ENTRIES

A80-21089 **Shallow-homojunction GaAs cells with high resistance to 1-MeV electron radiation.** J. C. C. Fan, R. L. Chapman, C. O. Bozler (MIT, Lexington, Mass.), and P. J. Drevinsky (USAF, Rome Air Development Center, Bedford, Mass.). *Applied Physics Letters*, vol. 36, Jan. 1, 1980, p. 53-56. 14 refs. USAF-supported research.

The fabrication of single-crystal GaAs shallow-homojunction solar cells that have conversion efficiencies of about 20% at AMI has been reported. These cells employ an n(+)/p/p(+) structure, prepared by chemical vapor deposition on either GaAs or Ge substrates. The superior resistance of such cells to 1-MeV electron radiation, which produces effects approximating those due to space radiation was demonstrated. The experiments were done on four cells at fluences up to 10 to the 16th power e/sq cm of which one had both higher initial and final maximum power per unit area than any space cells previously reported. (Author)

A80-21091 **Polyacetylene, /CH/x - Photoelectrochemical solar cell.** S. N. Chen, A. J. Heeger, Z. Kiss, A. G. MacDiarmid (Chronar Corp., Princeton, N.J.), S. C. Gau, and D. L. Peebles (Pennsylvania, University, Philadelphia, Pa.). *Applied Physics Letters*, vol. 36, Jan. 1, 1980, p. 96-98. 19 refs.

Photoelectrochemical photovoltaic cells have been fabricated using polyacetylene as the active photoelectrode. Using a sodium polysulfide solution as electrolyte, the open-circuit voltage and the short-circuit current were determined under illumination of approximately 1 sun. Under present conditions, the cell efficiency is limited by the series resistance, the small effective area of the electrode configuration, and the absorbance of the solution. (Author)

A80-21104 **Canadian renewable energy prospects.** H. Swain, R. Overend, and T. A. Ledwell (Department of Energy, Mines and Resources, Renewable Energy Resources Branch, Ottawa, Canada). *Solar Energy*, vol. 23, no. 6, 1979, p. 459-470. 35 refs.

Prospects for the use of Canada's renewable energy resources are assessed. Future energy supplies and demands in Canada are examined, and the systems aspects of energy costs are discussed. Consideration is then given to the technologies of solar space and water heating, solar electricity generation, the use of forest and agricultural biomass, wind power, tidal power in the Bay of Fundy, ocean wave power, ocean thermal gradient utilization, geothermal energy conversion and hydroelectric power. It is seen that of the renewable resources, not all may be considered 'soft' in the sense of posing few dangers to the environment and deemphasizing centralized technologies, and no new ones are either technically or economically ready to replace fossil and nuclear fuels. Recommendations as to the future role of government in encouraging the transition to renewable resources are proposed. A.L.W.

A80-21105 **Performance effects of Trombe wall control strategies.** A. V. Sebald, J. R. Clinton, and F. Langenbacher (California, University, La Jolla, Calif.). *Solar Energy*, vol. 23, no. 6, 1979, p. 479-487. 12 refs. Contract No. EM-76-S-04-4221.

Trombe wall performance is analyzed for a variety of a control strategies in Albuquerque, New Mexico, Santa Maria, California and Madison, Wisconsin. Controls were considered in both the presence and absence of backup energy. The analysis was performed using hourly simulations on Solmet weather data in a thermal network model. Sensitivity of the results of wall thickness and size, building

azimuth and house insulation levels is computed. Proper controls were found to reduce backup requirements as much as 50 per cent. Alternatively, they appear to provide equivalent solar fractions with thinner and smaller walls. Finally, in the absence of backup energy, proper controls on thin walls provide better performance than standard walls of double thickness. The results given in this paper are based entirely on computer simulations and are therefore intended to enhance the reader's insight into the Trombe Wall control problem. Efforts are underway to verify the major conclusions in test structures and real houses. (Author)

A80-21106 **Solar energy storage using chemical potential changes associated with drying of zeolites.** R. A. Shigeishi, C. H. Langford, and B. R. Hollebene (Carleton University, Ottawa, Canada). *Solar Energy*, vol. 23, no. 6, 1979, p. 489-495. 20 refs.

A80-21107 **Shadow effect of adjacent solar collectors in large scale systems.** J. Appelbaum and J. Bany (Tel Aviv University, Tel Aviv, Israel). *Solar Energy*, vol. 23, no. 6, 1979, p. 497-507. 6 refs. Ministry of Energy and Infrastructure Contract No. 78-1-41.

In large scale solar systems and in other cases with limited field area (such as on tops of buildings), shadowing of collectors, (thermal or photovoltaic) by their neighbours might occur during the day. This situation calls for an optimal solution of collector deployment in a given field area for maximum or desired energy. The paper deals firstly with the shadowing analysis of vertical and inclined poles and collectors (the shadow components, height and area). This useful information is used in an example of optimal deployment of collectors in a given area (which includes the tilt angle, collector size, spacing between collectors and the number of collector rows). (Author)

A80-21108 **Accuracies achievable with indirect measurements of the direct solar irradiance component.** J. A. Secrest and I. Dirmhirn (Utah State University of Agriculture and Applied Science, Logan, Utah). *Solar Energy*, vol. 23, no. 6, 1979, p. 509-512. Contract No. EG-77-S-07-1656.

The accuracy of indirect measurements of direct solar irradiance using global and diffuse irradiance measurements is investigated as a possible means of avoiding the use of a tracking pyrheliometer, which requires frequent maintenance, to evaluate possible sites in harsh environments for focusing solar energy conversion systems. Irradiance values calculated from the subtraction of the diffuse component from the global irradiance measured by pyranometers were compared with those obtained from a tracking pyrheliometer. It is found that the use of corrections for the cosine error depending on solar zenith angle of the global pyranometer and of the error induced by the shadowband in the diffuse pyranometer enable the desired accuracy of + or - 2% with respect to direct measurements to be achieved up to zenith angles of 80 deg and time intervals of 15 min. A.L.W.

A80-21109 **Thermal energy storage in a packed bed of iron spheres with liquid sodium coolant.** B. D. Pomeroy (General Electric Co., Schenectady, N.Y.). *Solar Energy*, vol. 23, no. 6, 1979, p. 513-515. 7 refs. Contract No. EM-78-C-03-1725.

The broadening of the thermocline found during the discharge phase of packed bed iron sphere heat storage media which use liquid sodium as the coolant is discussed. The design parameters contributing to thermocline broadening due to conduction resistance in the iron, convective resistance between the sodium and the iron and axial conduction in the sodium and iron are identified, and a simple design procedure based on mathematical models of transient heat transfer effects is developed. It is shown that storage parameters such as

A80-21110

sodium flow speed, iron sphere size and bed dimensions can be selected so as to limit thermocline broadening to less than 20% of the total discharge time. A.L.W.

A80-21110 **Mirror enclosures for double-exposure solar collectors.** D. C. Larson (Drexel University, Philadelphia, Pa.). *Solar Energy*, vol. 23, no. 6, 1979, p. 517-524. 19 refs. Research supported by the U.S. Department of Energy.

Configurations of flat-mirror enclosures to reflect solar radiation onto both sides of a double-exposure flat plate solar collector are evaluated for various solar energy applications at latitudes of 35, 40 and 45 deg. Enhancements in solar energy absorbed relative to that absorbed by a single-exposure panel tilted at the latitude angle from the horizontal were calculated for direct-beam and diffuse radiation for fixed and adjustable mirror configurations surrounding a vertical collector panel. Optimal fixed mirror configurations are obtained for both winter space-heating and year-round applications, however, an adjustable mirror configuration in which the tilt of the front and rear mirrors is changed twice a year is found to be optimal for year-round applications at all three latitudes. Enhancements over single-exposure plates as great as a factor of four in the winter and two in the summer indicate the cost effectiveness of the 70% more expensive double-exposure unit. A.L.W.

A80-21112 **Optimal controllers of the second kind.** C. B. Winn and D. E. Hull, III (Colorado State University, Fort Collins, Colo.). *Solar Energy*, vol. 23, no. 6, 1979, p. 529-534. 5 refs. Contract No. EG-77-S-02-4519-A000.

An approximate analytical solution to the problem of determining the optimal flow rate through solar collectors so as to maximize the integral of the difference between the useful energy and the pumping costs incurred in collecting the solar energy has been obtained. The solution presented is an optimal feedback controller based upon measurable states of the system. The solution technique employed was that of the Pontryagin maximum principle, and an approximate analytical solution to the resulting two-point boundary value problem was obtained by means of a transformation that involved using the heat removal factor as the control. The optimal control (the mass flow rate) is then recoverable from the heat removal factor. The derivation of the optimal control law, and a discussion of implementation of the optimal control law, are presented. Finally, comparisons between these results and those presented in an earlier paper in which a numerical solution was obtained are made. (Author)

A80-21113 **Calculation of performance of N collectors in series from test data on a single collector.** R. L. Oonk (Solaron Corp., Denver, Colo.), D. E. Jones (National Bureau of Standards, Gaithersburg, Md.), and B. E. Cole-Appel (Energy Management Consultants, Lakewood, Colo.). *Solar Energy*, vol. 23, no. 6, 1979, p. 535, 536.

A80-21115 **The effect of a self consistent effective ambient temperature on collector efficiency parameters.** G. B. Smith (New South Wales Institute of Technology, Broadway, Australia). *Solar Energy*, vol. 23, no. 6, 1979, p. 541, 542.

A80-21116 **Storage of light energy by chemical systems - Comment on long-term efficiency of iterative cyclic reactions.** O. Samuel, A. Moradpour, and H. B. Kagan (Paris XI, Université, Orsay, Essonne, France). *Solar Energy*, vol. 23, no. 6, 1979, p. 543-545. 25 refs. Research supported by the Centre National de la Recherche Scientifique.

The long-term efficiency of iterative photochemical syntheses of strained molecules for solar energy storage is evaluated. The efficiency of the interconversion of norbornadiene and quadricyclane is measured in terms of reaction yields, and it is found that both the storage capacity and stability of the media degrade substantially (to about 50 percent and 78 percent of the original, respectively) after only four cycles. Calculations of the economic efficiency and costs of available energies are then presented which indicate that in order

to be useful, an iterative photochemical storage system must be capable of operating for more than 400,000 cycles with a cost of \$1/g or must cost less than \$0.003/g with a lifetime of 1440 cycles and an average reaction yield of 99.99 percent to be competitive. A.L.W.

A80-21117 **Calculation of the monthly-average transmittance-absorptance product.** S. A. Klein (Wisconsin University, Madison, Wis.). *Solar Energy*, vol. 23, no. 6, 1979, p. 547-551. 16 refs.

The paper considers the calculation of the ratio of the monthly average to the normal incidence products of the transmittance and the absorptance of solar collector covers and plates in the evaluation of the thermal performance of solar energy systems. An expression for the collector transmittance-absorptance product is presented in terms of the relative contributions of the beam, diffuse and ground-reflected radiation components, and means for estimating these components as functions of incidence angle are indicated. It is noted that experimental determinations of the incidence angle modifier can also be used to obtain the transmittance-absorptance product ratio. The monthly average of the product ratio is then calculated by the integration of the product expression and results of the integration are presented in terms of the mean incidence angle for beam radiation for various collector types at latitudes between 20 and 50 deg N, slopes between 0 and 90 deg and azimuths between 0 and 90 deg for all months of the year. The use of these expressions to compare the monthly average daily solar radiation absorbed on vertical mass walls facing south and 30 deg west of south per unit area at 43 deg N is then illustrated. A.L.W.

A80-21123 **Energy storage.** J. Jensen. London, Newnes-Butterworths, 1980. 107 p. 27 refs. \$15.75.

The book is concerned with large-scale energy storage systems. Thermal, chemical, mechanical, electrical and magnetic energy storage methods are discussed and their applications, capabilities, and limitations are analyzed. Expected technical and cost characteristics are given for selected energy storage systems. Examples of existing storage systems include solar houses in Britain and the United States, batteries for various electric vehicles, fuel cells used in the Apollo 8 flight and the Baseball II superconductive magnet for controlled thermonuclear research. Appendices contain energy tables, lists of energy storage equipment manufacturers, and research programs and organizations. V.L.

A80-21449 # **Magneto-hydrodynamic power generation - Program planning and status.** W. D. Jackson (U.S. Department of Energy, Washington, D.C.) and E. Levi (New York, Polytechnic Institute, Brooklyn, N.Y.). (*Institute of Electrical and Electronics Engineers, Summer Meeting, Los Angeles, Calif., July 16-21, 1978.*) *IEEE Transactions on Power Apparatus and Systems*, vol. PAS-98, Nov.-Dec. 1979, p. 2022-2027. 6 refs.

This paper is concerned with the phased development of the MHD power system program and the development issues which are being addressed. System engineering considerations for the development logic and design criteria are established in terms of systems - emphasizing open cycle MHD - and components - combustor, generator, materials, seed recovery, emission control, magnets and power conversion systems. (Author)

A80-21745 **Net energy production history of the Geysers Geothermal Project.** L. Icerman (Washington University, St. Louis, Mo.). *Energy* (UK), vol. 5, Jan. 1980, p. 29-33. 16 refs.

Geothermal projects at the Geysers, California, have relatively high net energy ratios for electricity-production facilities. Comparison of the net cumulative electrical energy generated at the Geysers with the cumulative thermal energy invested for construction and operation of the facility indicates a favorable energy return, even during periods of rapid systems expansion. (Author)

A80-21746 **Energy resource requirements of a solar heating system.** D. W. O. Rogers (National Research Council, Ottawa,

Canada). *Energy* (UK), vol. 5, Jan. 1980, p. 75-86. 17 refs.

The paper addresses the question of the total energy resource use of a solar hot water and space heating system compared to the traditional oil, gas and electric heating options. The methods of energy analysis have been applied to a liquid-based, short-term storage solar space and water heating system for a dwelling in Toronto, and the results indicate that the indirect use of energy resources does not have a major impact on the overall energy conservation characteristics of the system which, being in many respects a worst case, takes 1.0-3.5 years of operation to conserve the energy resources, required to build, operate and maintain the system. Over the assumed 20-year lifetime the solar heating system, sized to provide 50% of the heating requirement to a house, uses between 53 and 62% as many energy resources as a conventional system, heating the same house. The energy-conservation characteristics of the system can be completely negated by the use of thermally generated electricity as backup in a 50% solar heating system which replaces oil or gas heating. The collectors and annual operating energy for the pumps were found to be the two most significant factors in the analysis. L.M.

A80-21766 United States energy policy - The continuing failure (La politique énergétique des Etats-Unis - Toujours l'échec). W. Goldstein. *Revue de l'Energie*, vol. 30, Dec. 1979, p. 951-968. In French.

Consideration is given to United States energy policy in the face of continuing OPEC price increases and supply curtailments. It is argued that the American political system is currently incapable of putting into effect those measures which would reduce significantly American dependence on foreign oil and thus remove the current imbalance between petroleum supply and demand and stabilize the world economy. A.L.W.

A80-21825 Warm water storage in district heating systems incorporating combined heat and power plant (Warmwasserspeicher in Fernwärmesystemen mit Kraft-Wärme-Kopplung). F. Scholz (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Brennstoff-Wärme-Kraft*, vol. 31, Oct. 1979, p. 397-402. 11 refs. In German.

It is noted that district heating based on combined heat and power systems is the most favorable form of energy supply in the low-temperature household heating range, from the point of view of the energy supply and the national economy. Short term storage in large steel vessels at atmospheric pressure is shown to be available at low development cost expenditure, and can be expected to contribute greatly to reducing obstacles to the realization of combined heat and power systems. Discussion of applications and operational methods includes the possibility for such a storage system to obtain additional electrical output from an extraction turbine for covering the peaks in the electricity demand by supplying the required heat from the accumulator. M.E.P.

A80-21846 Power consumption in the high-tension field between the government's responsibility to provide energy and politics (Die Stromversorgung im Spannungsfeld zwischen Versorgungspflicht und Politik). W. Rinke (Rheinisch-Westfälische Elektrizitätswerk AG, Essen, West Germany). *Energiewirtschaftliche Tagesfragen*, vol. 30, Jan. 1980, p. 3-15. In German.

The importance of a close tie between the lawful duties of an energy provision department and politics is discussed. The economic question of energy in terms of a global viewpoint, and the stimulation of energy development within West Germany are examined together with the projected net power consumption rate and the future development capabilities of the gross national product. Attention is given to the bureaucratic processes undertaken to permit and install nuclear reactors, employing fusion and fission reactions. C.F.W.

A80-21877 # Use of nuclear reactors for simultaneous radiation and power generation as a cost effective means of hydrogen

production (Kompleksnoe energoradiatsionnoe ispol'zovanie iadernykh reaktorov - ekonomichnyi put' proizvodstva vodoroda). Ia. M. Kolotyarkin, A. Kh. Breger, and E. A. Borisov. *Atomno-Vodorodnaia Energetika i Tekhnologiya*, no. 2, 1979, p. 32-40. 39 refs. In Russian.

A80-21878 # Solar hydrogen energy (Solnechno-vodorodnaia energetika). I. V. Berezin, S. D. Varfolomeev, and P. P. Titov. *Atomno-Vodorodnaia Energetika i Tekhnologiya*, no. 2, 1979, p. 48-56. 42 refs. In Russian.

The feasibility, in principle, of power plants based on conversion of solar energy to fuel by photochemical decomposition of water is examined. The current status of solar power engineering is reviewed, and the effectiveness of energy conversion in systems utilizing biological photosynthesis is analyzed. Systems based on biophotolysis of water are discussed, and the cost effectiveness of the systems studied is assessed. V.P.

A80-21879 # Prospects of developing nuclear power plants with chemothermal accumulation of thermal energy (Perspektivy sozdaniia atomnykh energostanovok s khemotermicheskim akkumulirovaniem teplovoi energii). N. N. Ponomarev-Stepnoi, A. N. Protchenko, and A. Ia. Stoliarevskii. *Atomno-Vodorodnaia Energetika i Tekhnologiya*, no. 2, 1979, p. 184-196. 12 refs. In Russian.

It is shown that nuclear power plants employing high-temperature gas-cooled reactors can operate efficiently under variable loads on the basis of modern chemothermal principles. The technological and economic aspects of such power plants are discussed. V.P.

A80-21880 # Use of hydrogen as a fuel for automobile heat engines (Primenenie vodoroda v kachestve topliva dlia teplovykh dvigatelei avtomobilei). A. N. Podgornyi, I. L. Varshavskii, A. I. Mishchenko, and G. B. Talda. *Atomno-Vodorodnaia Energetika i Tekhnologiya*, no. 2, 1979, p. 197-205. In Russian.

The present analysis shows that automobiles running on hydrogen are not only economical but have the advantage of low exhaust toxicity, excellent ignition characteristics, and high burning rates. On the other hand, such automobiles have the drawback of a low ignition energy, which may cause backflash at the inlet pipe. Present lack of hydrogen storage facilities at gas stations limits hydrogen utilization to additions to air-fuel mixtures. V.P.

A80-21881 # Decomposition of water in a nonequilibrium plasma (O razlozhenii vody v neravnovesnoi plazme). V. P. Bochinn, V. A. Legasov, V. D. Rusanov, A. A. Fridman, and G. V. Sholin. *Atomno-Vodorodnaia Energetika i Tekhnologiya*, no. 2, 1979, p. 206-211. 9 refs. In Russian.

The present paper deals with a nonequilibrium plasmachemical process of hydrogen production by water vapor decomposition. The optimal discharge parameters with respect to process efficiency are identified. It is shown that depending on the degree of plasma ionization, the hydrogen production efficiency can be as high as 50 to 70 percent. V.P.

A80-21901 The evolution of a large laser control system - From Shiva to Nova. G. J. Suski and F. W. Holloway (California, University, Livermore, Calif.). *IEEE Circuits and Systems Magazine*, vol. 1, Sept. 1979, p. 3-10. Contract No. W-7405-eng-48.

The Nova laser system is a 200 terawatt laser facility under construction at Lawrence Livermore Laboratory. Its current operational predecessor, the 30 terawatt Shiva laser, is controlled and diagnosed via a network of 50 computers. Although the highly distributed Shiva control system has proven effective and reliable, the need for more integrated process control on Nova is leading to a more centralized architecture. An overview of these control systems is presented and their differences are discussed. (Author)

A80-21902 High temperature electronics for geothermal energy. A. F. Veneruso (Sandia Laboratories, Albuquerque, N.

Mex.). *IEEE Circuits and Systems Magazine*, vol. 1, Sept. 1979, p. 11-17. 10 refs. Contract No. DE-AC04-76PD00789.

Recent estimates indicate that geothermal energy sources could produce over 10 GW of electric power in the USA by 1990. Once a system is in operation, engineers periodically need accurate and timely downhole information from each well in order to obtain optimum production. Instrumentation for geothermal borehole measurements is being expanded beyond today's limited capabilities. Prototypical logging tools have been successfully field-tested to 275 C; a high-resolution quartz pressure transducer and a gallium phosphide diode have been successfully tested. Near-term goals of current programs are to develop instrumentation for use at 275 in pressures up to 48.3 MPa (7,000 psi). (Author)

A80-21903 **Master Control and Data Acquisition System for a Solar Central Receiver Electric Power Plant.** M. A. Soderstrand, D. M. Darsey (Sandia Laboratories, Albuquerque, N. Mex.), R. C. Rountree (Aerospace Corp., El Segundo, Calif.), R. R. Sheahan (California University, Livermore, Calif.), and C. P. Winarski (Southern California Edison Co., Los Angeles, Calif.). *IEEE Circuits and Systems Magazine*, vol. 1, Sept. 1979, p. 18-27. Research sponsored by the U.S. Department of Energy.

A design of the 10-megawatt electric Solar Central Receiver Power Plant currently under construction in Barstow, California is described. Consideration is given to the collector, receiver, and thermal storage subsystems. The circuits and systems concepts related to the Master Control and Data Acquisition Systems are emphasized. Implementation of the Master Control Subsystem, operational requirements, and software are discussed along with its status and expectations. V.T.

A80-21908 **Space manufacturing, satellite power and human exploration.** B. T. O'Leary and G. K. O'Neill (Princeton University, Princeton, N.J.). *Interdisciplinary Science Reviews*, vol. 4, Sept. 1979, p. 193-207. 82 refs.

It is suggested that satellite power stations manufactured from nonterrestrial materials may alleviate the global energy crisis as early as the 1990's. The paper shows that costs may be competitive with coal and nuclear power and could provide an environmentally acceptable, inexhaustible and continuous supply of electricity anywhere on earth. Attention is given to habitats for the work force employed in space manufacturing which would offer a choice of gravities for living and recreation. Finally, recent progress in this field and the interdisciplinary aspects of planning such a program are reviewed. M.E.P.

A80-21913 # **Photovoltaic cost blitz spawns new silicon processes.** M. Sherman-Willis. *High Technology*, Feb. 1980, p. 78-85.

The article surveys the objectives of a \$1.5 billion, 10 year solar project by the DOE to develop low cost solar energy systems. Attention is given to the DOE cost targets for photovoltaic cells which are \$2.80 per peak watt by 1982, 70 cents by 1986, and 15 cents by 1990. Discussion covers the type of production methods necessary to achieve such cost effectiveness, such as automated lines, batch factories, casting of silicon cells and eventually production of silicon sheets in ribbon form. M.E.P.

A80-21914 **Antireflection coatings on solar cells.** B. Gandham, R. Hill, H. A. Macleod, and M. Bowden (Newcastle-upon-Tyne Polytechnic, Newcastle-upon-Tyne, England). *Solar Cells*, vol. 1, Nov. 1979, p. 3-22. 11 refs.

The effective refractive index of an assembly of films is derived from first principles via the characteristic matrix and is used to find the conditions under which a solar cell can have minimum reflectance to normally incident radiation. The characteristics of ideal antireflection coatings are calculated for Ag/Si Schottky barrier cells and it is found that the refractive index of an ideal single-layer coating increases as the thickness of the metal film increases. The optimum parameters for Ag/p-Si cells antireflected by a single ZnS layer or by ZnS and cryolite layers are calculated for air mass 1 radiation and it is shown that multilayer coatings do not significantly

improve the short-circuit current.

(Author)

A80-21915 **Laser treatment of phosphorus-diffused silicon solar cells.** E. Fogarassy, R. Stuck, J. C. Muller, A. Grob, J. J. Grob, P. Siffert (CNRS, Centre de Recherches Nucléaires de Strasbourg, Strasbourg, France), Y. Salles, and D. Diquet (La Radiotechnique Compelec, Caen, France). *Solar Cells*, vol. 1, Nov. 1979, p. 23-28.

High energy ruby laser pulses were used to dissolve the precipitates formed during the thermal diffusion of phosphorus into silicon in order to improve the characteristics of diffused solar cells. A maximum open circuit voltage of 600 mV and a fill factor of 0.75 were obtained for a laser energy density of 1.1 J per sq cm. (Author)

A80-21916 **Unique high concentration solar test facility.** J. A. Cape and I. Deyhimi (Rockwell International Electronics Research Center, Thousand Oaks, Calif.). *Solar Cells*, vol. 1, Nov. 1979, p. 29-36.

A high concentration solar test facility is described in which a 60.96 cm x 66.04 cm plane mirror heliostat made from a commercial (Celestron-14) telescope mount reflects the insolation to a fixed f/4 focusing mirror 53.34 cm in diameter in an enclosed laboratory. Tracking is provided by a feedback system in which the unconcentrated sunlight is pinhole imaged onto a 1 cm quadrant detector. Photocurrent differences from opposite segments of the quadrant drive the right ascension and declination controls of the Celestron-14 mount. The tracking accuracy is better than 0.01 deg and the total system cost is less than \$11,000. (Author)

A80-21917 **An overview of photovoltaic market research.** D. Costello and D. Posner (Solar Energy Research Institute, Golden, Colo.). *Solar Cells*, vol. 1, Nov. 1979, p. 37-53. 21 refs. Research supported by the U.S. Department of Energy.

Available information on current and potential markets for photovoltaics is compared and contrasted. The major markets considered are communications, cathodic protection, international agricultural pumping and remote general power, and U.S. residential applications. Each of these markets is described by market size, competing power sources and system prices required for photovoltaics to compete. It is concluded that some growth in sales to communications and cathodic protection markets can be expected in the near term. International markets for agricultural pumping and general power systems show the greatest potential for sales in the early to mid 1980s. Major energy-displacing markets in the U.S., particularly in the residential sector, can be a large and profitable long-term market for photovoltaics. (Author)

A80-21918 **Energy analysis of CdS:Cu₂S sputtered solar cells.** R. Harrison, G. Jenkins (Sunderland Polytechnic, Sunderland, England), and R. Hill (Newcastle-upon-Tyne Polytechnic, Newcastle-upon-Tyne, England). *Solar Cells*, vol. 1, Nov. 1979, p. 55-63. 10 refs.

The paper presents energy analysis of CdS:Cu₂S sputtered solar cells. The analysis shows that sputtered thin film CdS:Cu₂S cells should give good energy paybacks by computing the energy for converting raw material into cells and the energy content of the sputtering apparatus; the process energy requirements including the RF power for sputtering, ac mains power for the vacuum pumps, dc power for heating, and the energy content of the argon gas are estimated. Finally, the energy ratio as a function of machine lifetime is calculated with cell lifetime as a parameter, showing that if the predicted cell lifetime of 20 years is achievable, the ratio will exceed 10 even for the worst case if the machine lifetime exceeds 8 years. A.T.

A80-21919 **Grain size and its influence on efficiency in polycrystalline GaAs solar cells.** A. E. Blakeslee and S. M. Vernon (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). *Solar Cells*, vol. 1, Nov. 1979, p. 81-90. 15 refs.

Several variations of the metal-organic chemical vapor deposition process for growth of polycrystalline GaAs films have been

developed. The grain size of the films ranged from less than one to several hundred microns, yet the air mass zero efficiencies of the best Schottky barrier solar cells made from films grown by each procedure were all only about 1 - 2%. The short-circuit current was quite high, as predicted, for large grain films but in nearly all cases where extra processing and higher temperatures were introduced in order to obtain larger grains the open-circuit voltage and fill factor were reduced. Clearly, enhancement of grain size alone is insufficient to yield high quality devices, and the roles of contamination and/or process-induced defects must be thoroughly investigated in order to understand and improve the low efficiencies. (Author)

A80-21920 **The temperature dependence of the characteristics of sputtered a-Si-H solar cells.** M. M. Alkai and M. J. Thompson (Sheffield, University, Sheffield, England). *Solar Cells*, vol. 1, Nov. 1979, p. 91-98. 9 refs.

It is now well established that the properties of hydrogenated amorphous silicon are highly dependent on the preparation conditions. In this paper we describe the Schottky barrier characteristics of cells incorporating a-Si-H grown at different substrate temperatures and in various hydrogen partial pressures. The characteristics of the cells in the dark and under illumination are highly dependent on the type of the dominant conduction process. The illuminated cell characteristics are described for cells with efficiencies of 2%. The open-circuit voltage V_{oc} and the short-circuit current I_{sc} are shown to be temperature dependent and the dependence is more pronounced for non-optimum cells than for optimum devices. The spectral response for the cells is also described. (Author)

A80-21921 **The doping of amorphous silicon for solar cells.** F. Riddoch, A. Wallace, and J. I. B. Wilson (Heriot-Watt University, Edinburgh, Scotland). *Solar Cells*, vol. 1, Nov. 1979, p. 99-106. 14 refs. Research supported by the Science Research Council of England; European Economic Communities Contract No. 435-78-ESUK.

Schottky barrier diodes of gold on n-type amorphous silicon give photovoltages dependent on the silicon doping. The best voltages require an undoped layer of silicon for the junction region and approximately 100 nm of heavily doped silicon adjacent to the ohmic substrate contact. There is virtually no carrier collection outside the space charge region, as is shown by the long-wave photocurrent spectral response, and a drift field is desirable. High substrate temperatures during silicon deposition increase the long-wave response of these cells but give poorer diodes. (Author)

A80-21922 **Temperature dependence of the maximum theoretical efficiency in solar cells.** N. M. Ravindra and V. K. Srivastava (Roorkee, University, Roorkee, India). *Solar Cells*, vol. 1, Nov. 1979, p. 107-109.

An expression for the variation of the maximum theoretical efficiency of a solar cell with temperature is presented. The expression relates the difference in the maximum theoretical efficiencies of the cell at 0 C and a given temperature to the difference of the fourth roots of the corresponding temperatures. Values of the maximum theoretical efficiency at various temperatures obtained from the present expression are shown to agree very well with values theoretically evaluated by Rappaport (1959) and Wysocki and Rappaport (1960), as are values of the corresponding energy gaps. Plots of the maximum theoretical efficiency and optimum energy gaps of solar cells as functions of temperature derived from the expression are also presented. A.L.W.

A80-21924 **Overview of coal energy utilization technology in Japan.** S. Tamanuki (Electric Power Development Co., Ltd., Japan). *Energy Developments in Japan*, vol. 1, Jan. 1979, p. 213-231. 5 refs.

The paper examines short-, intermediate-, and long-range planning concerning the utilization of coal technology in Japan; the discussion is based on report no. 75 issued in June 1977 by the Japanese Natural Resources Survey Committee. The problem of setting up a schedule for each phase of research and for making a

long-range strategy with a view to reviving the large-scale consumption of coal is discussed. B.J.

A80-21925 **Study of flywheel energy storage system for electric utilities.** S. Shimamura, K. Matsuno, Y. Noguchi, and Y. Tsutsui (Ministry of International Trade and Industry, Mechanical Engineering Laboratory, Tokyo, Japan). (*Seimitsu Kikai*, vol. 44, no. 1, 1978, p. 91-96.) *Energy Developments in Japan*, vol. 1, Jan. 1979, p. 233-244. Translation.

Studies on stationary flywheel energy storage system for use by electric utilities are now being carried on at the Mechanical Engineering Laboratory (MEL) as part of the national R&D projects for new energy technology called the 'Sunshine Project'. Discussions based on theoretical analyses and some experimental results are presented relative to the material, the shape, and the fabrication method of the flywheel. Experimental devices such as the flywheel performance testing machine, the fiber composite (FRP) flywheel winding machines, etc., set up at MEL are also described. (Author)

A80-21926 **Solvolytic liquefaction of coal.** H. Honda (Tokyo, Science University, Tokyo, Japan) and H. Kakiyama (Kyushu, National Industrial Research Institute, Tosu, Japan). *Energy Developments in Japan*, vol. 1, Jan. 1979, p. 255-266.

The KKS solvolysis process, which uses both coal and petroleum residues as solvent, is described. Attention is given to the compatibility of coal-tar pitch and petroleum pitch, the effect of heat treatment conditions, the effect of rank of coal on product yields, and the solvent fractionation of solvolysis pitch. A pilot plant having a processing capacity of one ton of coal a day by the solvolysis process has been constructed. B.J.

A80-21927 **Fundamental characteristics of the reverse flat plate collector.** K. Sakuta, T. Tani, S. Sawata, T. Tanaka, and T. Horigome (Ministry of International Trade and Industry, Electro-technical Laboratory, Tokyo, Japan). (*Japan Solar Energy Society, Proceedings*, vol. 3, Dec. 1977.) *Energy Developments in Japan*, vol. 1, Jan. 1979, p. 267-275. Translation.

A low-cost solar collector of the nonconcentrating type, called the reverse flat plate (RFP) collector, has been developed and found to collect solar heat at high temperatures (up to 200 C), something which cannot be achieved by conventional nonconcentrating systems. The basic characteristics of the RFP collector are summarized, and a comparison of the RFP collector to the normal flat plate collector is described. B.J.

A80-21928 **Geological and geochemical characteristics of geothermal resources in Japan.** H. Nakamura (Japan Metals and Chemicals Co., Ltd., Japan), K. Sumi (Geological Survey of Japan, Kawasaki, Kanagawa, Japan), and T. Ozawa (Tokyo Institute of Technology, Tokyo, Japan). (*Japan Geothermal Energy Association, Journal*, vol. 14, no. 2, 1977.) *Energy Developments in Japan*, vol. 1, Jan. 1979, p. 277-301. 17 refs.

The Geological Survey of Japan is carrying on geothermal studies in 30 promising areas. Exploratory wells are being drilled in order to find new geothermal areas consisting of hot water and/or dry steam systems. This paper describes the geochemical and geological characteristics of the areas under study. B.J.

A80-21929 **Development of vertical axis wind turbines.** P. N. Shankar (National Aeronautical Laboratory, Bangalore, India). *Indian Academy of Sciences, Proceedings, Section C: Engineering Sciences*, vol. C 2, Mar. 1979, p. 49-61, 63-66. 11 refs.

This paper summarizes the development of vertical axis wind turbines based on the Darrieus rotor. A performance analysis was developed which permits the estimation of the characteristics of such machines; 5 m high wind turbine using curved wooden blades was fabricated and tested. The tests confirmed the low starting torque of the turbine and wind tunnel tests were performed on model Savonius rotors to determine optimum starter bucket configurations. Finally, a straight-bladed turbine was constructed, concluding that Darrieus turbines should be useful in large systems used to generate electrical

power for the grid; for direct water pumping purposes, however, these turbines are unlikely to be suitable. (Author)

A80-21937 **Storage of solar energy.** T. B. Taylor (Princeton University, Princeton, N.J.). *Indian Academy of Sciences, Proceedings, Section C: Engineering Sciences*, vol. C 2, Sept. 1979, p. 319-330. 8 refs. Research supported by the Rockefeller Foundation.

A framework is presented for identifying appropriate systems for storage of electrical, mechanical, chemical, and thermal energy in solar energy supply systems. Classification categories include the nature of the supply system's setting; the type of energy supplied; the type of solar energy collection system used (including 'indirect' solar energy, such as wind and hydropower); the type of energy stored; and some other characteristics of the storage system. A global insolation summary is used to exhibit the diversity of requirements for solar energy storage in different settings. Comments are then made on the need and opportunities for 24 hr storage of electrical energy in batteries; backup systems that use stored chemical fuel derived from solar energy; storage of intermediate temperature heat as heat of hydration of compounds such as sulfuric acid; annual storage of low temperature heat in fresh water ponds or aquifers; and annual storage of ice produced in places with cold winters. Arguments are presented for using a systems approach to the selection of solar energy storage methods appropriate for use in specific types of settings. (Author)

A80-21938 **Studies in biogas technology. I - Performance of a convectional biogas plant.** P. Rajabapaiah, K. V. Ramanayya, S. R. Mohan, and A. K. N. Reddy (Indian Institute of Science, Bangalore, India). *Indian Academy of Sciences, Proceedings, Section C: Engineering Sciences*, vol. C 2, Sept. 1979, p. 357-363. 9 refs. Research supported by the Tata Energy Research Institute.

This paper gives an account of a conventional 5.66-cu m/day (200 cu ft/day) biogas plant which has been instrumented, operated and monitored for 2.5 years. Observations regarding input to the plant, sludge and biogas outputs, and conditions inside the digester, have been described. Three salient features stand out. First, the observed average daily gas yield is much less than the rated capacity of the plant. Secondly, the plants show ease of operation and a very slow response to reductions and cessations of dung supply. Thirdly, the unexpectedly marked uniformity of density and temperature inside the digester indicates the almost complete absence of the stratification which is widely believed to take place; hence, biogas plants may be treated as isothermal, 'uniform' density, most probably imperfectly mixed, fed-batch reactors operating at mean ambient temperature and the density of water. (Author)

A80-21939 **Studies in biogas technology. II - Optimization of plant dimensions.** D. K. Subramanian, P. Rajabapaiah, and A. K. N. Reddy (Indian Institute of Science, Bangalore, India). *Indian Academy of Sciences, Proceedings, Section C: Engineering Sciences*, vol. C 2, Sept. 1979, p. 365-375. Research supported by the Tata Energy Research Institute.

In this paper, the design basis of the conventional Khadi and Village Industries Commission biogas plants has been elucidated. It has been shown that minimization of the cost of the gas holder alone leads to the narrow and deep digesters of conventional plants. If instead, the total capital cost of the gas holder plus digester is minimized, the optimization leads to wide and shallow digesters, which are less expensive. To test this alternative, two prototype plants have been designed, constructed and operated. These plants are not only 25-40% cheaper, but their performance is actually slightly better than the conventional plants. (Author)

A80-21940 **Studies in biogas technology. III - Thermal analysis of biogas plants.** C. R. Prasad and S. R. C. Sathyanarayan (Indian Institute of Science, Bangalore, India). *Indian Academy of Sciences, Proceedings, Section C: Engineering Sciences*, vol. C 2, Sept. 1979, p. 377-386. 8 refs.

A thermal model for a conventional biogas plant has been developed in order to understand the heat transfer from the slurry

and the gas holder to the surrounding earth and air respectively. The computations have been performed for two conditions: (1) when the slurry is at an ambient temperature of 20 C, and (2) when it is at 35 C, the optimum temperature for anaerobic fermentation. Under both these conditions, the gas holder is the major 'culprit' with regard to heat losses from the biogas plant. The calculations provide an estimate for the heat which has to be supplied by external means to compensate for the net heat losses which occur if the slurry is to be maintained at 35 C. Even if this external supply of heat is realized through (the calorific value of) biogas, there is a net increase in the biogas output, and therefore a net benefit, by operating the plant at 35 C. At this elevated temperature, the cooling effect of adding the influent at ambient temperature is not insignificant. (Author)

A80-21941 **Studies in biogas technology. IV - A novel biogas plant incorporating a solar water-heater and solar still.** A. K. N. Reddy, C. R. Prasad, P. Rajabapaiah, and S. R. C. Sathyanarayan (Indian Institute of Science, Bangalore, India). *Indian Academy of Sciences, Proceedings, Section C: Engineering Sciences*, vol. C 2, Sept. 1979, p. 387-393. Research supported by the Tata Energy Research Institute.

A reduction in the heat losses from the top of the gas holder of a biogas plant has been achieved by the simple device of a transparent cover. The heat losses thus prevented have been deployed to heat a water pond formed on the roof of the gas holder. This solar-heated water is mixed with the organic input for the 'hot-charging' of the biogas plant. A thermal analysis of such a solar water-heater 'piggy-backing' on the gas holder of a biogas plant has been carried out. To test whether the advantages indicated by the thermal analysis can be realized in practice, a biogas plant of the ASTRA design was modified to incorporate a roof-top solar water-heater. The operation of such a modified plant, even under worst case conditions, shows a significant improvement in the gas yield compared to the unmodified plant. Hence, the innovation reported here may lead to drastic reductions in the sizes and therefore costs of biogas plants. By making the transparent cover assume a tent-shape, the roof-top solar heater can serve the additional function of a solar still to yield distilled water. (Author)

A80-21949 **Introduction to the study of solar technology (Introduction à l'étude de l'héliotechnique).** M. Touchais. *L'Energie Solaire et sa Maîtrise Industrielle, First Series*, no. 1, 1979, p. 3-19. In French.

The conversion of solar energy to meet the world's energy requirements by means of solar technology is discussed as preface to an introductory course in solar technology. The significance of the energy crisis of 1973 to the development of alternative sources of energy, primarily solar, is considered, and the amount of recoverable solar energy incident on the earth is estimated to be able to supply the world's energy demand. The various means of solar energy conversion, including thermal, chemical in the form of hydrogen or methane, and direct or thermal electrical, are examined, and areas of these technologies requiring further experimental investigation are indicated. Solar technology is presented as the science of the artificial applications of solar energy, with mention of its associated disciplines, and the deficiencies of the solar technology developed prior to the energy crisis are exposed. Goals for contemporary instruction in solar technology are then derived, the introductory course is outlined, and bibliographic references are presented. Differences between the sources of solar and traditional energies are also discussed. A.L.W.

A80-21950 **Solar heat production - Generalizations (La production solaire de chaleur - Généralités).** M. Touchais. *L'Energie Solaire et sa Maîtrise Industrielle, First Series*, no. 1, 1979, p. 21-41. 7 refs. In French.

The utilization of solar radiation for the production of heat is considered. The modern science of solar technology, developed in response to the recent energy crisis, is introduced, and the collection of solar radiation by means of solar concentrators and direct

collectors is examined. The general aspects of direct and indirect solar heating are considered, and the fundamental parameters in the replacement of a substantial portion of world energy consumption by solar energy are presented, including incident energy, energy regularization, distribution and necessity. The concept of insolation is introduced, and the present lack of a solar architecture is discussed. The true solar house, which captures almost all of the solar radiation it receives for various uses, is described, and it is emphasized that the science of solar technology is far from complete. The thermodynamics of solar energy conversion are also considered. A.L.W.

A80-21951 Industrial solar thermal collectors (Les insolateurs industriels à fonction thermique). M. Touchais. *L'Energie Solaire et sa Maîtrise Industrielle, First Series*, no. 2, 1979, p. 3-23. In French.

Solar collectors for the provision of medium-temperature (100-150 C) industrial heat are examined. The primary energy fluxes and secondary heat fluxes produced in all types of solar energy collectors are considered, and the dimensions, heat transfer fluids and installations of solar thermal energy collectors are discussed. The component elements of the solar collector are presented, including the transparent cover, the solar absorber, the interior cavity with its magnification, concentration and loss prevention and air circulation devices and accessory equipment, and the installation of this equipment at industrial sites is considered. Further studies required to be performed on the siting development and optimization of industrial solar energy installations are indicated, and the various types of thermal microcollectors and fixed collectors, and biological and electrical collectors are described. A.L.W.

A80-21952 The utilization of industrially produced moderate-temperature solar heat (L'utilisation de la chaleur solaire à moyenne température produite industriellement). M. Touchais. *L'Energie Solaire et sa Maîtrise Industrielle, First Series*, no. 2, 1979, p. 25-45. In French.

Consideration is given to the utilization of centrally produced moderate-temperature (above 100 C) solar-derived heat. Moderate-temperature heat requirements are discussed, and the operation of solar thermal collectors is examined, with attention given to output temperature and its regulation, radiation thresholds and heat loss prevention. Possible applications for industrially produced moderate-temperature heat, including space heating, water heating, cooling, industrial drying, and distilling are considered, and the process of heat storage is examined. The relative merits of centralized and distributed solar collectors are discussed, with consideration given to the siting of heat distribution networks along existing arteries in the case of centralized installations, and the auxiliary services necessary to the centralized stations are considered. Orders of magnitude of the thermal, and water requirements for space heating and desalination are evaluated, heat transfer fluids, including water, metals, salts and organic liquids are reviewed, and numerical examples of the substitution of solar heat for pumps, swimming pool heating, water and space heating, distillation and greenhouse heating are presented. A.L.W.

A80-21953 Industrial solar thermal concentrators (Les concentrateurs industriels à fonction thermique). M. Touchais. *L'Energie Solaire et sa Maîtrise Industrielle, First Series*, no. 3, 1979, p. 3-34. 7 refs. In French.

The conversion and concentration of solar thermal radiation are treated, and various industrial solar heaters and concentrators are presented. The principles of solar absorbers are discussed, and the concentration of solar radiation by means of lenses, mirrors and mixed systems is examined. High-temperature industrial solar thermal heaters and concentrators developed prior to the present energy crisis are described, including systems of conical and cylindrical mirrors, paraboloid mirrors, cylindrical-parabolic mirrors and mirror fields. Current realizations, plans and possibilities for solar thermal electricity conversion are presented, including heliostat, concentrator

and high-temperature insulator systems, and the experimental investigation of solar heater technology is discussed. Attention is also given to the optical properties of parabolic mirrors, the fabrication of Fresnel lenses, and the utilization of optical waveguides and light ducts in solar systems. A.L.W.

A80-21954 The industrial applications of high-temperature heat - Solar thermal and electric plants (Les utilisations industrielles de la chaleur à haute température - Les stations thermo et électro-solaires). M. Touchais. *L'Energie Solaire et sa Maîtrise Industrielle, First Series*, no. 3, 1979, p. 37-47. In French.

Consideration is given to the industrial utilization of high-temperature heat and the application of solar thermal and electrical technology to supply it. The concentration of solar energy attainable in solar furnaces and reactors is discussed, noting the generation of energy without accompanying by-products and applications of solar concentrators in metallurgical and thermochemical furnaces and photochemical reactors. The problem of heat transfer in solar heat and power plants is discussed, and the utilization of high-temperature solar heat in electrosolar plants is considered, with examinations of the thermodynamic cycles possible, the utilization of waste heat and cooling processes presented. The siting of solar installations on a scale which would displace a significant amount of petroleum-derived energy is also discussed and practical considerations in the operation of thermo- and electrosolar power stations are indicated. A.L.W.

A80-21955 The real problems of solar energy (Les vrais problèmes de l'énergie solaire). M. Touchais. *L'Energie Solaire et sa Maîtrise Industrielle, First Series*, no. 4, 1979, p. 3-49. 16 refs. In French.

The technical, organizational and nonindustrial problems of solar technology are examined. Technical problems considered include those posed by the production of high- and moderate-temperature industrial solar heat, the construction of solar-heat utilizing installations, the utilization of photovoltaic or thermo-electric cells, the direct production of energetic compounds, solar/wind stations and the utilization of solar energy in arid regions, as well as the instruction of solar technology and the ecological and climatological effect of the capture of large amounts of solar energy. Attention is also given to movable solar collectors and fixed concentrators, which are considered unworkable, improper terminology used in solar technology, and terms proposed to replace them, and a detailed selective bibliography of works dealing with modern solar technology is presented. A.L.W.

A80-21956 Electric transport - The future prospects. B. M. Bird (Bristol, University, Bristol, England). *IEE Proceedings, Part A - Physical Science, Measurement and Instrumentation, Management and Education, Reviews*, vol. 127, pt. A, no. 1, Jan. 1980, p. 21-26.

A review of prospects for increasing the use of electricity for transport is presented. Both private and nationalized organizations in UK invested heavily in research and development producing key technologies for expanding the use of electricity in transport. A comparison of power flows in refuelling with petroleum with refuelling with electricity led to consideration of the limited-range battery-electric vehicle, the hybrid vehicle, and main-line traction developments; the advanced passenger train and its braking system are also discussed. It is concluded that the government should formulate an energy strategy for using electricity for transport in the future. A.T.

A80-22042 Toroidal Trivelpiece-Gould modes. F. P. Stössel (Innsbruck, Universität, Innsbruck, Austria). *Plasma Physics*, vol. 21, Dec. 1979, p. 1031-1042. 13 refs. Österreichischer Fonds zur Förderung der Wissenschaftlichen Forschung Contract No. 2781/S.

Electron plasma waves are treated in quasi-electrostatic approximation in a toroidal cavity of rectangular cross-section in an infinitely strong azimuthal magnetic field. The differential equation for the electrostatic potential, derived from fluid equations, can be separated using cylindrical coordinates. The eigenvalue problem for

the radial dependence is solved numerically by a shooting method. Eigenvalues are given for different aspect ratios. Comparison with appropriate modes of the straight geometry shows that the toroidal frequencies generally lie some percent above those for the straight case. Plots of the eigenfunctions demonstrate clearly the influence of toroidicity. The deviation from symmetry (which should appear for straight geometry) depends not only on the aspect ratio but also strongly on the mode numbers. (Author)

A80-22046 **Short haul transport for the 1990s.** P. Robinson (British Aerospace, Aircraft Group, Kingston-upon-Thames, Surrey, England) and D. G. Brown (British Aerospace, Aircraft Group, Hatfield, Herts., England). *Aeronautical Journal*, vol. 83, Nov. 1979, p. 413-436. 23 refs.

The paper presents an analysis of market trends and technical developments in short haul air transport over the next 20 years. Regional estimates of the market are given in accordance with the ICAO breakdown for 1990 and 2000 in revenue passenger kilometers, average annual growth rates, and aircraft units. Restraints and stimuli controlling the short haul market are analyzed, e.g. economic factors, safety, communications, and ecological considerations. Technological advances will be of evolutionary, rather than revolutionary, nature. In propulsion, emphasis will be on improving specific weight, reducing complexity and cost, and increasing reliability and safety. Advances in aerodynamics will include reduction of subcritical drag and application of wing tip devices to improve lift drag ratio under low speed and cruise conditions. While aircraft configurations will remain essentially the same, substantial benefits in fuel economics and overall performance will be derived from improved materials, systems and equipment. V.L.

A80-22167 **Development of sulfur-tolerant components for the molten carbonate fuel cell.** A. F. Sammells, S. B. Nicholson, and P. G. P. Ang (Institute of Gas Technology, Chicago, Ill.). *Electrochemical Society, Journal*, vol. 127, Feb. 1980, p. 350-357. 10 refs. Research supported by the Electric Power Research Institute.

The sulfur tolerance of candidate anode and anode current collector materials for the molten carbonate fuel cell were evaluated in an electrochemical half-cell using both steady-state and transient potentiostatic techniques. Hydrogen sulfide was introduced into the fuel at concentrations of 50 and 1000 ppm; at the higher sulfur concentration nickel and cobalt underwent a negative shift in their open-circuit potentials, and high anodic and cathodic currents were observed compared with clean fuels. Exchange currents were not greatly affected by 50 ppm H₂S; but, at higher sulfur concentrations, higher apparent exchange currents were observed, indicating a probable sulfidation reaction. New anode materials including TiC showed good stability in the anodic region. Of the anode current collector materials evaluated, high stabilities were found for 410 and 310 stainless steels. (Author)

A80-22169 **Possible use of honeycomb-type structures for high power batteries and fuel cells.** J. T. Kummer (Ford Motor Co., Dearborn, Mich.). *Electrochemical Society, Journal*, vol. 127, Feb. 1980, p. 364,365.

The paper describes a possible method for constructing a Kapitza-type battery that differs from the usual thin plate approach, and may be simpler to construct, as well as a possible method for constructing a fuel cell that may offer an economic advantage over present methods. Both experiments employ a honeycomb structure of the type used as a substrate for auto exhaust catalysts. It is shown that in the case of a battery, if the alternate passageways in the honeycomb contain a positive, and a negative electrode, respectively, the structure allows for a high interface area between electrodes with considerable strength. Finally, the results of the experimental battery and fuel cell are presented and discussed with consideration given to how various materials might improve the performance of such units. M.E.P.

A80-22280 **Electricity generation choices for the near**

term. D. Bodansky (Washington, University, Seattle, Wash.). *Science*, vol. 207, Feb. 15, 1980, p. 721-728.

The alternatives available for the generation of electricity in the United States in the next few decades are evaluated. The present sources of electricity and recent trends in the amount of electricity generated by the various sources are reviewed, and widely varying projections of future energy demand are discussed, noting that electricity demand is expected to increase considerably if a significant reduction in oil consumption is achieved. The renewable energy resources hydroelectric power, biomass energy, geothermal power, direct solar power and wind energy are found to be incapable of making a major contribution to electricity expansion by the year 2000. Coal and nuclear power are then discussed as the most practical alternatives, and the advantages of nuclear power in the areas of cost and safety, despite the Three Mile Island accident, are pointed out. It is concluded that for the near future, all of the possible options deserve investigation. A.L.W.

A80-22281 **Wind power excites utility interest.** R. J. Smith. *Science*, vol. 207, Feb. 15, 1980, p. 739-742.

The impact of federally supported and independently developed wind power technology on electrical utilities in the United States is reported. The construction of a 200-ft, 3-MW wind turbine by the Southern California Edison Company wholly without federal assistance represents the first of its size to be erected by any utility; however, the Department of Energy is still greatly involved in the support of windmill prototype development and various companies have already sold small-scale designs to utilities. A proposal is currently the subject of prolonged debate in Congress which would significantly expand the program of government subsidies for windmill research and utilization. Private concerns have also entered the wind energy supply market, notably Windfarms, Ltd. with its projected 80-MW wind energy installation for the island of Oahu. The reaction of the DOE to such independent ventures has so far been ambivalent; on the one hand there is concern that the privately supplied facilities will not perform adequately, while on the other hand the end of federal support programs is anticipated. A.L.W.

A80-22348 **Turbulation of plasma in combustion chamber of an MHD generator.** A. I. Bystryi and R. V. Ganefel'd (Akademiia Nauk Ukrainskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR). (*Teplofizika Vysokikh Temperatur*, vol. 17, May-June 1979, p. 611-617.) *High Temperature*, vol. 17, no. 3, Nov. 1979, p. 508-513. 13 refs. Translation.

The turbulent characteristics of diffusion and homogeneous burning in the combustion chamber of the K-1 MHD apparatus were investigated. The experimentally determined turbulence characteristics are compared with the calculated values obtained from a thermal model of flame autoturbulation, and the evolution of the turbulent disturbances in the plasma channel of the apparatus was followed. (Author)

A80-22349 **Equivalent circuits for the channel of the magnetohydrodynamic generator.** A. A. Blitshtein, Iu. P. Gusev, S. I. Pishchikov, and V. I. Pishchikov (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR). (*Teplofizika Vysokikh Temperatur*, vol. 17, May-June 1979, p. 626-631.) *High Temperature*, vol. 17, no. 3, Nov. 1979, p. 521-525. 6 refs. Translation.

We present a method for the calculation of electrical characteristics of MHD generators based on the equivalent circuit method, which provides a unified approach to the solution of electrophysical and electrotechnical problems of MHD energy transformation. We show the relationship between the equivalent circuit parameters, the physical characteristics of the plasma flow, and the channel geometry. The main algorithmic problems of the equivalent circuit calculations are briefly analyzed, and the possibility of their application to a wide class of problems is discussed. Examples are given which illustrate the validity of the present method. (Author)

A80-22433 # Some application of Landsat imagery interpretation for petroleum targetting in India. D. Venkataraman (Oil and Natural Gas Commission, Madras, India). In: International Symposium on Remote Sensing of Environment, 13th, Ann Arbor, Mich., April 23-27, 1979, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1979, p. 911-923. 13 refs.

An assessment of the utility of space imageries in targeting for petroleum traps is presented. Interpretations of plotted lineaments in conjunction with geological, geomorphological, and geophysical data show that petroleum entrapment is more likely near the main boundary fault in the sub-Himalayan foothills which separate the fresh-water Siwalik sedimentary belt from the Pre-Tertiaries. It is concluded that in the southwestern West Bengal basin, a new geological model is proposed on imagery interpretation, and evidence is observed of the build-up in the basin of east-flowing rivers. A.T.

A80-22441 # Oil and gas exploration by pattern recognition of lineament assemblages associated with bends in wrench faults. R. Peterson (Nebraska, University, Lincoln, Neb.). In: International Symposium on Remote Sensing of Environment, 13th, Ann Arbor, Mich., April 23-27, 1979, Proceedings. Volume 2.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1979, p. 993-1014. 33 refs.

The system for exploration of oil and gas, described in the present paper, is based on the delineation of lineaments on remotely sensed images. By recognition of certain lineament patterns associated with bends in wrench faults, potential petroleum-bearing structures can be located. V.P.

A80-22456 # Estimation of primary production of vegetation in agricultural and forested areas using Landsat data. Y. Mukai and S. Takeuchi (Remote Sensing Technology Center of Japan, Tokyo, Japan). In: International Symposium on Remote Sensing of Environment, 13th, Ann Arbor, Mich., April 23-27, 1979, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1979, p. 1177-1188. 5 refs.

A method to estimate the vegetal primary production from Landsat data is shown. Since vegetal resources are grouped into two categories, agricultural and forested one, a test area for each category was selected. Multitemporal Landsat scenes covering test areas with some ground truth data were obtained. For the agricultural test area, paddyfield area data and the dry biomass data related to each growth stage were collected; for the forest test area, area data of each forest type and timber volume data were collected. Crop classification or forest type classification was performed for the respective test area using multi-temporal Landsat images, and the results of the classification were compared with corresponding ground truth data. (Author)

A80-22475 # Heat loss detection from flat roof buildings by means of aerial thermography. R. J. Brown, J. Cihlar (Department of Energy, Mines and Resources, Canada Centre for Remote Sensing, Ottawa, Canada), J. N. Barry (Philip A. Lapp, Ltd., Toronto, Canada), and D. J. Gillis (Prince Edward Island, University, Charlottetown, Canada). In: International Symposium on Remote Sensing of Environment, 13th, Ann Arbor, Mich., April 23-27, 1979, Proceedings. Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1979, p. 1429-1438. 5 refs.

Reduction of energy consumption for heating buildings has become a major goal of government and private agencies in many countries. Localized 'hotspots' on thermograms of flat roof buildings indicate structural breakdowns and other problems of concern to the building owner. Detailed interpretation of the thermograms is often complex because the signals recorded on the thermograms represent the combined effects of several variables. Thermograms were collected and interpreted for heat loss over the same flat roof buildings (industrial and institutional) in two different years. An assessment was made of the interpretation reliability from a single data set and to what extent thermal anomalies associated with ice,

snow, and water can be differentiated from excessive heat loss areas. (Author)

A80-22526 * Structure of deformed silicon and implications for low-cost solar cells. N. Mardesich (Spectrolab, Inc., Sylmar, Calif.), M. H. Leibold (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), G. B. Turner (Arco Solar, Inc., Chatsworth, Calif.), and T. G. Digges, Jr. (Virginia Semiconductor, Fredericksburg, Va.). *Metallurgical Transactions A - Physical Metallurgy and Materials Science*, vol. 10A, Dec. 1979, p. 1831-1835. 17 refs. Research supported by the U.S. Department of Energy; Contracts No. JPL-954506; No. NAS7-100.

The paper reports on an investigation of the microstructure and minority carrier lifetime of silicon in uniaxially compressed silicon samples, the objective of which was to determine if it is feasible to produce silicon solar cells from sheet formed by high temperature deformation. It is reported that recrystallization was found to be incomplete in both fine and large grained materials, and that the major mode of recrystallization appears to be migration of existing boundaries into the deformed regions. Also, minority carrier diffusion length was found to be drastically reduced after deformation, perhaps due to contamination or cooling rate, and recovered only slightly with annealing. It is concluded that these results suggest that high temperature deformation of silicon for direct production of sheet for high efficiency solar cells is not practical. It is noted that potential may exist for its use as a coarse grained substrate. M.E.P.

A80-22687 * Durability of foam insulation for LH2 fuel tanks of future subsonic transports. E. L. Sharpe (NASA, Langley Research Center, Hampton, Va.) and R. G. Helenbrook (Bell Aerospace Textron, Buffalo, N.Y.). In: Nonmetallic materials and composites at low temperatures; Proceedings of the Conference, Munich, West Germany, July 10, 11, 1978. New York, Plenum Press, 1979, p. 207-230. 6 refs.

Organic foams were tested to determine their suitability for insulating liquid hydrogen tanks of subsonic aircraft. The specimens, including nonreinforced foams and foams with chopped glass reinforcements, flame retardants, and vapor barriers, were scaled to simulate stress conditions in large tanks. The tests were conducted within aluminum tank compartments filled with liquid hydrogen and the boil-off rate was used as the criterion of thermal performance. It was found that while all insulations deteriorated with increased cycles, two nonreinforced polyurethane foams showed no structural deterioration after 4200 thermal cycles (equivalent to 15 years of airline service). It was also found that fiberglass reinforcement and flame retardants impaired thermal performance and reduced useful life of the foams. Vapor barriers enhanced structural integrity without any deterioration in thermal properties. V.L.

A80-22690 Compressive fatigue tests on a unidirectional glass/polyester composite at cryogenic temperatures. E. L. Stone, L. O. El-Marazki, and W. C. Young (Wisconsin, University, Madison, Wis.). In: Nonmetallic materials and composites at low temperatures; Proceedings of the Conference, Munich, West Germany, July 10, 11, 1978. New York, Plenum Press, 1979, p. 283-290. 7 refs. Research supported by the U.S. Department of Energy.

The fatigue testing of a unidirectional glass-reinforced polyester composite at cryogenic temperatures to simulate the cyclic compressive loads of the magnet support struts in a superconductive magnetic energy storage unit is reported. Right circular cylindrical specimens were tested at 77, 4.2 K and room temperature at different stress levels using a 1-Hz haversine waveform imposed upon a constant baseload in a load-controlled closed-loop electrohydraulic test machine. Two failure modes, uniform mushrooming near one end and a 45 deg fracture line through the middle of the specimen, are observed, with no systematic difference in fatigue life between the modes. Fatigue lives obtained at 77 and 4.2 K are found to be similar, with fatigue failure at 100,000 cycles occurring at stress

levels of 70 and 75% of the ultimate compressive strengths of specimens at room temperature and 77 K, respectively. The room temperature fatigue lives of the glass/polyester specimens are found to be intermediate between those reported for glass/epoxy composites with different glass contents costing over twice as much.

A.L.W.

A80-22739 # Open-cycle MHD powerplants - Performance, cost and technology demonstration strategies. R. A. Harvey, S. T. Demetriades, C. D. Maxwell, and J. L. Miller (STD Research Corp., Arcadia, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0180*, 11 p. 13 refs. Research supported by the Electric Power Research Institute.

The paper summarizes studies of the performance, cost, and operational characteristics of the principal coal burning Open-Cycle MHD (OCMHD) power plant options, including systems with directly-fired air preheaters, systems with separately-fired air preheaters and systems using oxygen enrichment. The study concludes that directly-fired plants of 1000 MWe capacity offer heat rates of 7500 Btu/kWh and will cost approximately 1100 \$/kW in 1976 dollars and that the separately-fired and oxygen-enriched plant options are suitable vehicles for MHD technology demonstration and early commercial installations. The concept of installing an OCMHD system as a retrofit to an existing, fossil-fueled steam generating plant is determined to be technically feasible and appears to be economically suited to a research and development project of an electric utility.

(Author)

A80-22745 # Current transport mechanisms in the boundary regions of MHD generators. S. T. Demetriades, D. A. Oliver, and C. D. Maxwell (STD Research Corp., Arcadia, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0249*. 17 p. 21 refs.

Elementary models are presented of the behavior of electrode voltage drops, interelectrode insulators, anodes and cathodes, and transboundary layer and interelectrode arcing in slagging or cleanwall, hot or cold, MHD channels. Simple calculations are presented of MHD channel interelectrode insulator failure distribution probabilities, interelectrode current leakage, and transboundary and interelectrode arcing (including computations of the number of arcs on electrodes). These models and calculations are designed to enhance the understanding of the underlying principles of the STD/MHD codes rather than provide detailed or complete engineering design calculations. As a consequence, they require only a small number of critical results from these codes. It is hoped that these models clarify the influence of some of the more interesting physical mechanisms on current transport in the boundary regions of MHD generators especially as applicable to MHD channel design.

(Author)

A80-22764 In-situ combustion retorting of oil shale. M. C. Branch (Colorado, University, Boulder, Colo.). *Progress in Energy and Combustion Science*, vol. 5, no. 3, 1979, p. 193-206. 67 refs.

The in situ (underground) combustion retorting of underground western United States oil shales are reviewed. The chemical compositions, thermal properties and ignition temperatures of the oil shales found in various locations are surveyed, and the kinetics of the pyrolytic conversion of kerogen, the dominant form of organic matter in western oil shales, to bitumen and oil and gas and the endothermic decomposition of carbonate minerals are examined. Investigations of the oxidation of the char remaining on oil shale after kerogen pyrolysis and organic liquid and gas removal, which provides the energy for in situ combustion oil shale retorting, are discussed, and consideration is given to models and experimental investigations of the structure of an in situ combustion retorting zone. It is concluded that, although a complete understanding of the physical and chemical processes involved in the retorting of oil shale by in situ combustion has not yet been achieved, predictions are sufficiently detailed to provide qualitative estimates of the effects of

process variables on retorting rates, oil yield and effluent gas properties.

A.L.W.

A80-22766 Incineration of industrial waste. R. K. Tanner (European Environmental Enterprise, Zurich, Switzerland). *Progress in Energy and Combustion Science*, vol. 5, no. 3, 1979, p. 245-251.

Consideration is given to the problem of the disposal of industrial wastes, and solutions offered by the design of an industrial waste incineration plant are presented. The characteristics of the industrial wastes produced in West Germany and the facilities provided for their disposal are surveyed, with particular emphasis on those in the area of Hesse. The special waste incineration plant under construction for the Hessische Industriemüll GmbH is then described, taking into account the rotary kiln for the combustion of solid wastes, the combustion chamber for liquid wastes and polluted water, the heat recovery boiler, electrostatic precipitator, flue gas scrubber, flue gas reheater, and turbogenerator system contained in each of the two 25,000-ton/year capacity units of the plant. The commissioning of the plant is scheduled for autumn, 1980.

A.L.W.

A80-22768 Effect of coal particle size on the coal hydrogenation reaction - In relation to the plasticity of coal. R. Yoshida, K. Ishida (Government Industrial Development Laboratory, Sapporo; Nagoya Institute of Technology, Tajimi, Japan), T. Yoshida, S. Ueda, I. Sekiguchi, Y. Nakata, S. Yokoyama, T. Okutani, Y. Yoshida (Government Industrial Development Laboratory, Sapporo, Japan), and Y. Jomoto (Government Industrial Development Laboratory, Sapporo; Muroran Institute of Technology, Muroran, Japan). *Fuel Processing Technology*, vol. 3, Jan. 1980, p. 1-5. 10 refs.

The effect of coal particle size on the catalytic hydrogenation of dry coal was investigated for three Hokkaido coals (Japan) of different ranks. It was found that the effect of coal particle size on conversion is dependent on coal rank. A greater difference in conversion with respect to coal particle size is noticed for coals of lower carbon content. The physical appearance of the products in the autoclave after the reaction suggests that the effect of particle size on conversion is dependent on the plastic properties of the heated coal sample. When the reaction proceeds with coal in the plastic state, the effect of particle size is small. As indicated by the product distribution, the plastic properties of a coal sample are related to the yield of asphaltene (hexane insoluble/benzene solubles) and/or the structural parts of original coal which yield asphaltene.

(Author)

A80-22770 Surface-active materials from Athabasca oil sands. S. E. Moschopedis, K. F. Schulz, J. G. Speight, and D. N. Morrison (Alberta Research Council, Edmonton, Canada). *Fuel Processing Technology*, vol. 3, Jan. 1980, p. 55-61. 13 refs.

Surface-active derivatives can be separated, or chemically-derived, from Athabasca bitumen. These materials have the ability to lower the surface tensions of aqueous solutions as well as substantially reduce the interfacial tensions of aqueous-organic systems. As such, they do appear to have a beneficial effect on bitumen recovery processes.

(Author)

A80-22788 Urban activity allocation under criteria of transportation energy efficiency. M. C. Romanos (Illinois, University, Urbana, Ill.) and M. L. Hatmaker (Arizona Dept. of Transportation, Phoenix, Ariz.). *International Journal of Energy Research*, vol. 4, Jan.-Mar. 1980, p. 1-10. 24 refs.

A linear programming optimization technique is applied to the problem of allocating new land using activities in an existing urban area. While it is recognized that energy is not yet as decisive a factor in the determination of household and firm locational patterns as other factors such as accessibility and time costs, the model attempts to resolve land allocation problems by means of minimizing total transportation energy costs alone. Such an analysis may serve as a benchmark against which other policies and their energy repercussions could and should be measured.

(Author)

A80-22789 Synergetics of the fission electric cells. I. Ursu and I. I. Purica (Institutul Central de Fizica, Bucharest, Rumania). *International Journal of Energy Research*, vol. 4, Jan.-Mar. 1980, p. 19-30. 20 refs.

The processes that take place in cells for the direct conversion of nuclear fission energy into electrical energy are investigated. It is shown that the use of the catastrophe theory is needed to describe an adequate model for the behavior of the cells. Three models of cells with electrostatic suppression of the secondary electrons are described. It is shown that, in these cases, the fold and cusp catastrophe model are sufficient. The description in terms of the catastrophe theory allows the choice of some parameters in order to overcome the experimental difficulties with the purpose of obtaining higher voltages and acceptable efficiencies. (Author)

A80-22790 Domestic space-heating and solar energy in Ireland. A. Raftery, P. Shier, and T. Obilade (Trinity College, Dublin, Ireland). *International Journal of Energy Research*, vol. 4, Jan.-Mar. 1980, p. 31-39. 12 refs.

Five systems which use solar energy to heat houses are discussed and evaluated for thermal performance and cost-effectiveness by the use of a computer simulation model based on a typical Irish house. It is shown that such systems are currently unviable when compared with systems using oil, gas and off-peak electricity. The most economic solar system is that which uses rock as storage medium. Further, it is demonstrated that thermal performance is relatively insensitive to changes in storage volume. (Author)

A80-22791 Some geometrical design aspects of a linear Fresnel reflector concentrator. R. N. Singh, S. S. Mathur, and T. C. Kandpal (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research*, vol. 4, Jan.-Mar. 1980, p. 59-67. 9 refs.

A somewhat new approach to the design of solar concentrators of Fresnel reflector geometry is outlined. The constituent mirror elements of the concentrator surface are characterized by three parameters: shift, tilt and width. The evaluation of these parameters and the concentration characteristics are investigated on the basis of a simple ray optical model. (Author)

A80-22792 Analyses of single and double exposure solar air heaters. P. K. Bansal and S. C. Kaushik (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research*, vol. 4, Jan.-Mar. 1980, p. 69-79.

This paper presents an investigation of the performance of single and double exposure solar air heaters. A conventional solar air heater consists of a flat passage between two metallic plates through which heating fluid (air) is made to pass. The conduction loss along the lengths of the plates in the direction of the air flow and the radiation loss of heat from the absorbing plate to the bottom plate have been incorporated in the analyses. The analyses consist of the exact solutions of the heat balance equations for the absorbing plate, bottom plate and the air stream. Analytical expressions for the plate and the air stream temperatures as a function of distance along the direction of air flow and some other parameters have been derived. It is found that the heat conduction effects are negligible in both the air heaters and the reradiation of heat from the absorbing plate to the bottom plate is also insignificant. (Author)

A80-22793 End effects with a slowly varying magnetic field in a MHD channel with segmented electrodes. P. R. L. Sarma, M. L. Mittal (Indian Institute of Technology, Bombay, India), and V. K. Rohatgi (Bhabha Atomic Research Centre, Bombay, India). *International Journal of Energy Research*, vol. 4, Jan.-Mar. 1980, p. 81-90. 13 refs. Research sponsored by the Department of Atomic Energy of India.

The end effects phenomenon is investigated in a MHD channel with finitely segmented electrode walls when the applied magnetic field decays as a sinusoidal function at the entrance and is constant inside the channel. The governing equations to determine the electric

potential are solved numerically by the successive overrelaxation method. The normal current distribution and the electrical efficiency are calculated for various types of electrode spacing. It is found that the leakage currents are more for the case when the electrode length is greater than the insulator length, and the end losses are less.

(Author)

A80-22794 A speculation on a general photoelectrochemical reactor. V. Guruswamy and J. O. Bockris (Texas A & M University, College Station, Tex.). *International Journal of Energy Research*, vol. 4, Jan.-Mar. 1980, p. 91, 92. 6 refs.

The applicability of photoelectrochemical reactors employing inorganic semiconductor couples to chemical syntheses is considered. The TiO₂-LaCrO₃/GaP couple is presented as a promising electrode system, and possible structures of such a system are outlined. The dependences of reactions obtained on the potential difference of the given couple is pointed out, and an analogy with biological enzyme systems is noted. The possibility of using multi-coupled photoelectrochemical reactors in domestic waste disposal systems in place of biological systems is also discussed. A.L.W.

A80-22833 * # Microwave power beaming for long range energy transfer. E. J. Nalos, W. W. Lund, Jr., O. Denman, and S. M. Rathjen (Boeing Aerospace Co., Seattle, Wash.). In: *European Microwave Conference*, 8th, Paris, France, September 4-8, 1978, Proceedings. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1979, p. 573-578. Contract No. NAS9-15196.

Current studies by NASA have identified space solar power as a potential long term viable candidate for efficient energy transfer at orbital ranges using a microwave beam. This paper will describe some of the power-aperture relationships leading to a potential feasible design of a power beaming system. The topics include a discussion of the system constraints, the transmitter and spaceborne array configuration, and the error budget levied by microwave system requirements. (Author)

A80-22867 Hydrogen storage in metal hydrides. J. J. Reilly (Brookhaven National Laboratory, Upton, N.Y.) and G. D. Sandrock (International Nickel Co., Inc., New York, N.Y.). *Scientific American*, vol. 242, Feb. 1980, p. 118, 119, 121 (4 ff.).

The use of metal hydrides as a hydrogen-storage medium for hydrogen-powered vehicles is discussed. Various metal hydrides are compared by their hydrogen content and energy density, and their suitability as a storage medium is evaluated against a set of criteria, such as ease of formation and decomposition, availability, cost, and safety. Compounds based on iron-titanium hydride are shown to be practical for use in motor vehicles as well as in other applications, including energy storage for peak leveling in electric power systems, compressors, pumps, and air-conditioners. V.L.

A80-22868 Energy accounting of alternative energy sources. F. Roberts. *Applied Energy*, vol. 6, Jan.-Feb. 1980, p. 1-20.

An energy accounting study was performed in the United Kingdom of five alternative energy resource systems - solar, geothermal, wind, wave and tidal power. The paper gives the data sources, the assumptions, an outline of the procedure, results and some general comments for each case. A detailed comparison with regard to likely energy ratios is not possible; however, a value of about 10:1 is seen as reasonable for the future. Based on such an energy ratio the likely factor saving for wind, wave and tidal energy systems is around 33:1. In the case of solar and geothermal energy it could vary from 6:1 through 23:1, depending upon system design, local conditions, etc. Energy pay-back times are short for all the systems, the longest being about four-and-a-half years. Finally, it is noted that our primary non-renewable fuels could be considerably conserved by using them to operate renewable energy resources even if economic analysis shows that at the present time such a policy is hardly justified. L.M.

A80-22869 Application of centrifugal separation to the production of hydrogen from coal. L. O. Williams (Martin Marietta Aerospace, Denver, Colo.). *Applied Energy*, vol. 6, Jan.-Feb. 1980, p. 63-70.

A 50-cm model centrifuge made of lightweight composite materials such as Kevlar, boron or carbon filaments, and capable of separating pure hydrogen from a coal-water-reaction gas mixture on a continuous basis is proposed. For the release of hydrogen, water vapor at 1000-1800 C is injected into a coal-containing retort where primarily hydrogen and carbon monoxide are produced. The emerging hot gas is utilized to heat incoming water and coal in a counter-current flow with the hydrogen separated from all the heavier gases by centrifugation and supplied to the user. The heavy gases are subjected to centrifugation to remove most of the sulphur dioxide and similar noxious materials for recovery, and the relatively pure carbon monoxide is burned with air to provide the final superheat to obtain the necessary hot water vapor. Coupled with a hydrogen-air fuel cell of 80% efficiency, the process would provide a coal-to-electricity system of 58% thermodynamic efficiency. For use in combustion processes such as home heating, process energy, transportation fuel, etc, the hydrogen contains 61.5% of the potential energy in the starting coal. L.M.

A80-22940 Energy by reverse electro dialysis. R. E. Lacey (Southern Research Institute, Birmingham, Ala.). *Ocean Engineering*, vol. 7, no. 1, 1980, p. 1-47. 32 refs. Contract No. EG-77-C-05-5544.

The use of reverse electro dialysis, a reverse desalination process, to derive energy from the difference between the chemical potentials of concentrated and dilute salt solutions is evaluated. The process employs the flows of brine and dilute solutions through alternating cells bounded by cation- and anion-exchange membranes in a stack placed between two electrodes to generate a voltage by the passage of salt through the membranes. Potential sources of brine include the salt domes of oil and gas wells, salt water lakes, and geothermal brines. Experiments have shown the technical feasibility of reverse electro dialysis, and have confirmed equations derived to predict their performance. Calculations show that in order for reverse electro dialysis to be economically attractive, the internal resistance of the cells should be minimized and net output power maximized by using large concentration ratios between the brine and the dilute solution, the minimum dilute compartment and diffusive boundary layer thicknesses, low-resistance, highly selective membranes and appropriate manufacturing methods. A.L.W.

A80-22976 A control strategy for a variable-speed wind energy conversion system (Stratégie de commande pour un système de conversion de l'énergie éolienne à vitesse variable). A. Jacob, V. Rajagopalan (Québec, Université, Trois-Rivières, Canada), and D. Veillette. *Canadian Electrical Engineering Journal*, vol. 5, Jan. 1980, p. 16-20. 10 refs. In French. Research supported by the Department of Energy, Mines and Resources, Natural Sciences and Engineering Research Council, and Université de Québec.

In this article, a method of calculating an optimal control strategy for a variable-speed wind power generation scheme incorporating a squirrel cage induction machine and operating in a self-excited induction generator mode is discussed. This scheme also uses a conventional three-phase thyristor rectifier, a line-commutated inverter and an economical auxiliary commutated-voltage-source inverter. The three regulated variables are: (1) drive speed as a function of available mechanical energy by manipulating the resistive torque developed by induction generator; (2) induction motor power consumption during start-up of the wind machine of vertical axis type; (3) operating slip of the induction machine, thereby limiting start-up and braking currents. The developed strategy is also suitable for any other variable-speed drive system incorporating an induction machine. (Author)

A80-23014 # Thin solid solution films Zn/x/Cd(1-x)/S. M. S. Lakova and D. I. Dimova (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Sl'nceva Energiia i Novi Energiini Iztochnitsi,

Sofia, Bulgaria). *Bolgarskaia Akademiia Nauk, Doklady*, vol. 32, no. 9, 1979, p. 1195-1198. 7 refs.

A vapor deposition technique for the preparation of thin films of Zn(x)Cd(1-x)S is described, and the electrical properties of films made with this technique are examined. The technique makes it possible to vary the composition and resistivity of films by varying the composition of the initial material at a constant evaporation temperature. The use of such films in solar cells is mentioned. B.J.

A80-23101 Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volumes 1-5. Conference sponsored by the U.S. Department of Energy, et al. Edited by T. N. Veziroglu and W. Seifritz (Zürich, Eidgenössische Technische Hochschule, Zurich, Switzerland). Oxford and New York, Pergamon Press (Advances in Hydrogen Energy I), 1979. Vol. 1, 509 p.; vol. 2, 580 p.; vol. 3, 718 p.; vol. 4, 595 p.; vol. 5, 661 p. Price of five volumes, \$250.

Papers are presented on recent developments in hydrogen energy systems, including primary energy sources; electrolytic, thermochemical, and hybrid hydrogen production; hydrogen production from fossil fuels; transmission and distribution, and storage. Other topics include nuclear energy as a primary energy source for hydrogen production, the conversion of solar energy into hydrogen, improvements in alkaline electrolysis technology, the development of solid polymer electrolyte electrolysis systems, the atomic sulfur-iodine water splitting cycle, the electrolysis of hydrobromic acid, the ZnSe thermochemical hydrogen production cycle, and the industrial-scale production of hydrogen from natural gas, naphtha, and coal. Attention is also given to solar-thermochemical hydrogen production from water, plasma-chemical hydrogen production, photoelectrochemical hydrogen production, gas distribution equipment for hydrogen, cryogenic hydrogen storage, and the development of low-cost nickel-rare earth hydrides for hydrogen storage. A.L.W.

A80-23102 Nuclear energy as a primary energy source for hydrogen production. R. Schulten (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1.

Oxford and New York, Pergamon Press, 1979, p. 3-24. Work currently under way in West Germany on the development of nuclear reactors to supply high-temperature (300-1000 C) process heat for coal liquefaction and gasification and the production of hydrogen to meet future energy demands is reviewed. The AVR reactor in Jülich, which has been supplying heat at a maximum temperature of 950 C since 1975, is described, with consideration given to its helium heat transfer system, charging and discharge system and the types of fuel elements to be investigated. The 300-MW Thorium High-Temperature Reactor (THTR) currently under construction and expected to be operational by 1980, which is based on the AVR design, is then presented, and work on the realization of a high-power process heat reactor, based on the design of the THTR, is discussed, with particular attention given to the once-through-then-out charging of the pebble bed reactor. The development of coal modification processes using nuclear heat is reported, and it is pointed out that the ideal application of the high-temperature reactor could be the production of hydrogen from water using thermochemical and hybrid processes. A.L.W.

A80-23103 * Storage, transmission and distribution of hydrogen. J. H. Kelley and R. Hagler, Jr. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1.

Oxford and New York, Pergamon Press, 1979, p. 25-53. 8 refs. Contract No. NAS7-100.

Current practices and future requirements for the storage, transmission and distribution of hydrogen are reviewed in order to

identify inadequacies to be corrected before hydrogen can achieve its full potential as a substitute for fossil fuels. Consideration is given to the storage of hydrogen in underground solution-mined salt caverns, portable high-pressure containers and dewars, pressure vessels and aquifers and as metal hydrides, hydrogen transmission in evacuated double-walled insulated containers and by pipeline, and distribution by truck and internal distribution networks. Areas for the improvement of these techniques are indicated, and these technological deficiencies, including materials development, low-cost storage and transmission methods, low-cost, long-life metal hydrides and novel methods for hydrogen storage, are presented as challenges for research and development. A.L.W.

A80-23104 Present state and outlook of the electrolytic H₂-production route. A. Menth and S. Stucki (Brown, Boveri et Cie. AG, Research Centre, Baden, Switzerland). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 55-63. 17 refs.

The present state of water electrolysis systems is reviewed, and potential future electrolytic processes for the production of hydrogen are presented. The history and current realizations of the KOH electrolysis unit are discussed, and the performance of these units under different pressure conditions is indicated. Attention is then given to the development of advanced alkaline electrolyzers, solid polymer electrolyte electrolyzers, high-temperature ceramic electrolyzers, photoelectrochemical water splitting processes and hybrid electrolytic-thermochemical water splitting processes. It is concluded that, with improvements in the areas of cell voltage, current density and produced gas pressure by research and development in electrode materials and interface electrochemical reactions, water electrolysis has the potential to play an important role in a future hydrogen market. A.L.W.

A80-23105 Nuclear methane reforming for coal gasification. J. Rastoin, J. Malherbe (Commissariat à l'Énergie Atomique, Gif-sur-Yvette, Essonne, France), J. Pottier, and A. Lecoanet (Gaz de France, Paris, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 67-76.

Prospects for the large-scale production of hydrogen and coal gasification using nuclear heat are discussed, and a detailed study of the nuclear steam reforming of methane for hydrogen production is presented. Conditions favoring the expansion of the chemical hydrogen market in France and thus the applicability of nuclear methane reforming are indicated, and reasons for the selection of a process utilizing liquid-phase high-pressure hydrogen derived from nuclear methane reforming for simultaneous coal liquefaction and gasification by the Groupe d'Étude de Gazéification par Voie Nucléaire are outlined. The adaptation of the steam reforming of natural gas to a nuclear source of heat is then considered, with attention given to the process gas pressure reactor size and layout, and steam reforming parameters. Reactor options are then examined, and choices of a core outlet temperature of 850 C and an intermediate circuit are discussed. A.L.W.

A80-23106 Hydrogen production from nuclear fission product waste heat and use in gas turbines. M. E. Nelson, E. L. Keating, D. R. Govan, R. J. Banchak, and J. R. Corpus (U.S. Naval Academy, Annapolis, Md.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 77-108. 9 refs.

An analysis has been made on the feasibility of producing hydrogen using fission product waste heat and its subsequent combustion in gas turbines. The work has been performed in three distinct phases. In the first phase, a system using radioactive waste heat has been designed, which produces electricity. The electrical

power output of this system has been calculated as a function of fission product decay time, solidified form of fission products, as well as numerous other parameters. In the second phase, the electrical energy produced is used to electrolyze water, which in turn produces hydrogen. The amount of hydrogen produced (lb/hr) has been calculated for varying electrical inputs, electrolyzer efficiencies, and feedwater temperatures. This hydrogen is then assumed to be liquified and stored. Finally, the third phase considers the burning of this hydrogen in a standard marine gas turbine. (Author)

A80-23107 On the potential of solar energy conversion into hydrogen and/or other fuels. J. Gretz (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 109-129. 21 refs.

The thermodynamics and energetics of the splitting of water to obtain hydrogen for use as a chemical raw material are examined. The major characteristics of the CEC 1-MW heliostatic demonstration plant are presented as a reference energy source. The water decomposition techniques of electrolysis, thermal conversion, photolysis and bioconversion are then considered, and the economics of the different techniques are estimated. Qualitative considerations on the influence of large-scale solar power plants on climate are also presented to demonstrate the lack of atmospheric temperature change and the minimal temperature reduction under the solar collectors. A.L.W.

A80-23108 The theoretical design of a solar engine for the production of hydrogen. L. D. Ryan (Western Michigan University, Kalamazoo, Mich.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 131-145. 7 refs.

A simple engine based on the Stirling cycle has been developed for the conversion of solar energy into hydrogen by the electrolysis of water. In place of the costly and complicated displacement piston of the Stirling engine, the present design employs the rotation of the entire engine through 180 deg within the heat source and another 180 deg for cooling. Solar energy from a concentrating collector is focused on energy-conducting rings, which transfer energy to the gas above one of two pistons. A patent search has confirmed the uniqueness of the design. The efficiency of the engine has been calculated to be the same as that of the Stirling engine and the Carnot efficiency, and expressions for the heat transfer to the conducting rings have been derived. Optimization of the present design is expected to lead to a version which is cost effective as well as efficient. A.L.W.

A80-23109 OTEC for hydrogen production. A. Lavi and L. C. Trimble (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 147-167.

OTEC is discussed as the most promising technology for the conversion of solar energy to hydrogen by the electrolytic decomposition of water. The operating characteristics of OTEC units are outlined, with its continuous operation, cost dependence on temperature difference, and economy of scale noted, and OTEC electricity costs are estimated. The transmission of OTEC electricity to its users is considered, and water electrolysis is proposed as a simple means for the chemical conversion of OTEC power. The economics of an OTEC electrolysis plant are then considered, and it is estimated that hydrogen can be produced at a cost from \$1.41 to \$1.91/kg, being cheaper than hydrogen produced from other energy sources if the cost of OTEC electricity is \$0.30/kWh or less. Electricity generated from OTEC hydrogen is also shown to be potentially competitive with that derived from liquefied natural gas or nuclear fission. A.L.W.

A80-23110 The utilization of ocean hydropower systems for advanced electrolytic hydrogen energy production technology. J. R. Puryear. In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 169-172.

A80-23111 The kinetics of oxygen evolution on non-traditional electrocatalytic materials. G. Fiori, C. Mandelli, C. M. Mari, and P. V. Scolari (Milano, Università, Milan, Italy). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 193-213. 24 refs. Research supported by the Commission of the European Communities.

The kinetics of oxygen evolution on electrodes based on mixed oxides with perovskite structures are investigated in relation to the efficiency of the electrodes for electrolytic hydrogen production. Samples of NiLa₂O₄, NiPr₂O₄ and NiNd₂O₄ were deposited on platinum sheets and the current potential curves and quasi-steady polarization curves of cells in which the electrodes were placed were measured. Results obtained at different KOH concentrations indicate that the oxidation consists of two initial electrochemical steps, the second of which is rate determining. A change in the slope of the Tafel line at high current densities is attributed to the occupation of active sites on the electrode surface. A comparison indicates the performances of electrodes containing noble metals and those containing the more common transition metals to be similar, thus favoring the development and investigation of the reaction mechanism of materials such as spinels, perovskites and perovskite-like mixed oxides.

A.L.W.

A80-23112 Improvements in electrolysis technology in alkaline solution. A. J. Appleby and G. Crépy (Compagnie Générale d'Electricité, Marcoussis, Essonne, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1.

Oxford and New York, Pergamon Press, 1979, p. 227-240. 9 refs. Research supported by the Commission of the European Communities.

Potential technologies for the improvement of alkaline electrolyzer performance in the next five to ten years are discussed. Studies of electrode catalysts, separator materials and bipolar electrolyzer designs capable of allowing electrolysis to proceed at higher current densities, lower working potentials, and temperatures no higher than 120 C to reduce electrical requirements and overall development and capital costs are reviewed. It is concluded that the simplest technology for an advanced alkaline electrolyzer is that based on a thin nickel bipolar plate, with a separator retained between two undulating pierced screens and gas bubble removal on the face of the electrode. Teflon-bonded potassium hexatitanate shows promise as a separator material, and nickel molybdate and nickel oxide/iron molybdate catalysts have been found to exhibit a low cost and a high performance, respectively.

A.L.W.

A80-23113 The use of porous metallic diaphragm for hydrogen mass-production with alkaline water electrolysis. P. Perroud and G. Terrier (Commissariat à l'Énergie Atomique, Centre d'Études Nucléaires de Grenoble, Grenoble, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1.

Oxford and New York, Pergamon Press, 1979, p. 241-253. 5 refs. Research supported by the Délégation Générale à la Recherche Scientifique.

A80-23114 The significance of studies with palladium to basic problems of electrolytic hydrogen evolution. F. A. Lewis (Belfast, Queen's University, Belfast, Northern Ireland). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978.

Volume 1. Oxford and New York, Pergamon Press, 1979, p. 279-290. 51 refs.

Palladium and palladium alloys possess an ability to equilibrate readily with molecular hydrogen and to permit its rapid internal permeation. Changes of electrode potential and physical properties can be accurately correlated with hydrogen chemical potentials. These features have proved valuable in establishing the contribution to hydrogen overpotential of the chemical potential corresponding to the concentration of molecular hydrogen dissolved adjacent to the electrode surface and governed by diffusive transport through the Brunner-Nernst layer. Recently studies with these electrodes have been concerned with the possible influence of local variations of hydrogen chemical potential on other components of hydrogen overpotential, modes of hydrogen bubble evolution, electrolytic hydrogen isotope separation factors and hydrogen isotope exchange with aqueous solutions.

(Author)

A80-23115 Electrodes for generation of hydrogen and oxygen for seawater. J. E. Bennett (Diamond Shamrock Corp., Painesville, Ohio). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 291-309. 10 refs.

Factors influencing the relative rates of the evolution of chlorine and oxygen in seawater electrolysis systems are examined in order to investigate means for ensuring the selective evolution of oxygen. The relative efficiencies under different conditions of chlorine and oxygen evolution in conventional seawater electrolysis for the production of hypochlorite are compared to demonstrate that under usual salinities and temperatures and using conventional anodes, chlorine evolution is predominant despite the thermodynamically preferred oxygen reaction. The theory of seawater electrolysis is then developed to show how mass transfer limitations and reaction kinetics suppress oxygen evolution at the anode. Conditions of seawater electrolysis favoring oxygen evolution are proposed, and an anode coating which selectively evolves oxygen from chloride solutions at 95% efficiency in concentrated brine by a proposed mechanism in which the deposited manganese dioxide coating limits chlorine mass transfer is then presented.

A.L.W.

A80-23116 Unipolar water electrolyzers - A competitive technology. R. L. LeRoy (Noranda Research Centre, Pointe Claire, Quebec, Canada) and A. K. Stuart (Electrolyser Corp., Ltd., Etobicoke, Ontario, Canada). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 359-375. 22 refs.

An analysis of the costs of electrolytic hydrogen produced by improved unipolar electrolyzers currently under development is presented. Consideration is given to the voltage-current performance of unipolar and bipolar electrolyzer designs, and performance improvements to be expected from the reduction of contributions to cell voltage, the application of electrode catalysis in unipolar designs, and the use of solid polymer electrolytes in bipolar designs. The capital costs of electrolyzer operation, including cells and accessories, installation and start-up, rectification, and electric power, are analyzed to obtain an expression for total hydrogen cost, which is applied to different electrolyzer technologies. Costs of the present unipolar and bipolar technologies are found to be comparable, as are those of future unipolar technology and solid polymer electrolyte technology.

A.L.W.

A80-23117 Development of Billings SPE electrolyzer. B. C. Campbell (Billings Energy Corp., Provo, Utah). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 377-390. 10 refs.

A small-scale solid polymer electrolyte electrolyzer for hydrogen production has been developed to comply with requirements for low capital cost and high reliability. The original cell employed Nafion as

the electrolyte, nickel as the cathode catalyst, and lead dioxide as the anode catalyst in a filter-press cell design, and was found to operate at an efficiency of 30% at current densities of 400 milliamp/sq cm. Estimates of a service life of 1500 hours for this device led to the replacement of the lead dioxide and nickel electrodes by platinum-plated titanium to prevent galvanic corrosion and catalyst decomposition. The modified cell has been found to operate at an efficiency of 45% at 600 milliamp/sq cm and pressures from 3 to 10 MPa, with an indicated reliability of one year maintenance-free operation and seven years total service life and a competitive hydrogen cost, despite the use of a precious metal. A.L.W.

A80-23118 Hydrogen production by high temperature electrolysis of water vapour. W. Doenitz, R. Schmidberger, E. Steinheil (Dornier System GmbH, Friedrichshafen, West Germany), and R. Streicher (Lurgi Kohle und Mineralotechnik GmbH, Frankfurt am Main, West Germany). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1.

Oxford and New York, Pergamon Press, 1979, p. 403-421. Research sponsored by the Bundesministerium für Forschung und Technologie.

The high-temperature electrolysis of steam is presented as a potentially efficient means of hydrogen production. The thermodynamic advantages of high-temperature electrolysis are indicated, and technologies to be developed for steam electrolysis are examined, including electrolysis cells composed of an oxygen electrode, a water vapor-hydrogen electrode, a solid electrolyte and material to interconnect cells in series, and overall process engineering. These considerations are illustrated for the design and development of the German High Operating Temperature Electrolysis reactor. Ultimate efficiencies of greater than 50% are predicted. A.L.W.

A80-23119 Development and operation of a high current density high pressure advanced electrolysis cell. M. G. Nayar, P. Ragunathan, and S. K. Mitra (Bhabha Atomic Research Centre, Bombay, India). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 1. Oxford and New York, Pergamon Press, 1979, p. 451-467.

This paper deals with the development work in Bhabha Atomic Research Centre, India, on alkaline water electrolysis cells. Indigenous development of an advanced type high amperage high pressure electrolyser using porous nickel electrodes for tonnage production of hydrogen is described. Methods of producing porous nickel plaques and other cell components are also presented. Operation and performance characteristics of the cells are reported. (Author)

A80-23120 Irreversibility analysis of hydrogen separation schemes in thermochemical cycles. K. E. Cox (California, University, Los Alamos, N. Mex.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 471-498. 8 refs. Research sponsored by the U.S. Department of Energy.

Six processes have been evaluated as regards irreversibility generation for hydrogen separation from binary gas mixtures. The results are presented as a series of plots of separation efficiency against the mol fraction hydrogen in the feed gas. Three processes, condensation, physical absorption and electrochemical separation indicate increasing efficiency with hydrogen content. The other processes, physical and thermal adsorption, and diffusion show maxima in efficiency at a hydrogen content of 50 mol percent. Choice of separation process will also depend on such parameters as condition of feed, impurity content and capital investment. For thermochemical cycles, schemes based on low temperature heat availability are preferable to those requiring a work input. (Author)

A80-23121 A feasibility study on thermochemical water-splitting cycles using sulfur compounds. M. Dokiya, K. Fukuda, T.

Kameyama, and H. Yokokawa (National Chemical Laboratory for Industry, Tokyo, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 499-512. 14 refs. Research supported by the Agency of Industrial Science and Technology.

Several thermochemical cycles were studied: (1) Cu-Cl hybrid cycle, (2) SO₂ hybrid cycle, (3) SO₂-I₂ cycle, (4) SO₂-I₂-Benzene cycle, (5) SO₂-Methanol-Iodine cycle and (6) SO₂-H₂S cycle. Except for the Cu-Cl hybrid cycle, these cycles utilize sulfur compounds and involve the thermal decomposition reaction of sulfuric acid as the oxygen evolving reaction. A test performance of an iron catalyst was carried out for 120 hrs. on 60 wt% sulfuric acid at 800-850 C under 1 atm. It is concluded that a cycle which involves methanol and iodine is the most promising. (Author)

A80-23122 Chemical studies on the general atomic sulfur-iodine thermochemical water-splitting cycle. J. H. Norman, K. J. Mysels, D. R. O'Keefe, S. A. Stowell, and D. G. Williamson (General Atomic Co., San Diego, Calif.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2.

Oxford and New York, Pergamon Press, 1979, p. 513-543. 15 refs. Research sponsored by the American Gas Association and General Atomic Co.

Developments in the sulfur-iodine thermochemical cycle are discussed which include (1) experiments showing that the SO₂-H₂O-I₂ reaction can be carried out at temperatures above the melting point of I₂; (2) a description of the catalytic thermal decomposition of H₂SO₄ vapors for the first transition metal period; (3) a study of the separation of HI from HI-H₂O-I₂ mixtures which details the breaking of the H₂O-HI azeotrope using H₃PO₄ as an extractive distillation agent; and (4) a study of the catalytic decomposition of HI for which activated carbon is used as a catalyst which is contacted with gaseous components only. The conversion advantages of obtaining condensed state iodine are elucidated. (Author)

A80-23125 The reaction of sulfur dioxide with water and a halogen - The cases of bromine and iodine. G. De Beni, G. Pierini, B. Spelta, D. van Velzen, and H. Langenkamp (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 617-648. 15 refs.

The paper describes experimental work on the reaction of SO₂, H₂O and X₂ (where X = Br or I). The reaction with iodine results in separation problems which may be surmounted by the use of a large excess of SO₂ and/or by the addition of suitable organic solvents. The results obtained with SO₂ only and with addition of diethylether and TBP are discussed, with the consideration of application of this reaction in possible thermochemical cycles. The reaction with bromine is much more advantageous than with iodine. Equilibrium measurements show that high sulfuric acid concentrations are attainable. A simple mathematical model for the reaction rate in packed columns has been developed which satisfactorily fits the experimental data. (Author)

A80-23126 Development, design and operation of a continuous laboratory-scale plant for hydrogen production by the Mark-13 cycle. D. van Velzen, H. Langenkamp, G. Schütz, D. Lalonde, J. Flamm, and P. Fiebelmann (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 649-665. 11 refs.

The paper describes the state of the art of the experimental work carried out at the JRC-Ispra, noting that the aim of the project

is to construct a reliable small scale model of the process which should yield valuable information for further scaling-up. Apposite design and/or simulation rules have been applied in the design calculations for the process. Features of the plant, which uses the Mark-13 process are surveyed; the anticipated net hydrogen production rate is 4.0 gmol/h - i.e., 100 l/h S.T.P. M.E.P.

A80-23127 Equilibrium effects in high-pressure hydrogen production from thermochemical water-splitting cycles. J. D. Schreiber, J. R. Dafler, and S. E. Foh (Institute of Gas Technology, Chicago, Ill.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 669-685. 25 refs.

The paper examines equilibrium effects in high-pressure hydrogen production for thermochemical water-splitting cycles. The hydrogen production steps of these cycles were classified according to the ratio of the mole numbers of gaseous products to the mole number of gaseous reactants indicating the temperature of the hydrogen production step. Generalized relationships are presented for hydrogen production steps so that the Gibbs free energy change is zero, and relationships between the hydrogen mole fraction and product pressure are defined. Finally, the trade-offs between product streams composition and input heat temperatures are assessed, showing that the degree of feed stream impurities which can be tolerated can be determined. A.T.

A80-23128 Electrochemical aspects of the H₂SO₄-SO₂ thermoelectrochemical cycle for hydrogen production. A. J. Appleby and B. Pichon (Compagnie Générale d'Electricité, Marcoussis, Essonne, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 687-707. 16 refs. Délégation Générale à la Recherche Scientifique et Technique Contract No. 76-7-1514; European Economic Communities Contract No. 183-77-EHF.

Oxidation of SO₂ has been studied on electrode surfaces in sulfuric acid solutions as a function of acid concentration and temperature. Most work was conducted on platinum electrodes of high surface area with sulfuric acid as the final product. The reaction rate at constant potential vs hydrogen is strongly dependent on sulfuric acid concentration and temperature has little effect. In some potential and SO₂ partial pressure ranges, the process has a very low SO₂ reaction order which can ensure uniform hydrogen current density in a practical system at high SO₂ conversion rates. The limiting steps in engineered SO₂-depolarized hydrogen production cells are reviewed. (Author)

A80-23129 Electrolysis of hydrobromic acid. G. H. Schuetz, P. J. Fiebelmann, and D. R. Lalonde (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerca, Ispra, Italy). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 709-730. 14 refs.

The electrolysis of hydrobromic acid is of interest for hybrid cycles. It is shown that the electrolysis is feasible on a laboratory scale with bipolar graphite electrodes. Graphite is actually the only practical material. The high hydrogen overvoltage of graphite can be reduced to a large extent by adding small amounts of Pd or Pt salts directly to the electrolyte. The bromine overvoltage is much lower than that for chlorine and can be neglected. The working temperature may be higher than for present day H₂O or HCl electrolysis. Under conventional conditions several kA/m² can be obtained below 1 V. (Author)

A80-23130 The decomposition of hydrogen bromide using iron bromide and magnetite. C. F. V. Mason (California, University, Los Alamos, N. Mex.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2.

land, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 731-745. 12 refs. Research sponsored by the U.S. Department of Energy.

A means of thermochemically decomposing hydrogen bromide has been investigated experimentally using the reaction between magnetite and HBr as the bromine producing step. A high yield of Br₂ was formed in a short time. For the hydrogen producing step, the direct hydrolysis of ferrous bromide was confirmed as having an unfavorable equilibrium. However, introduction of magnesium oxide into an aqueous solution of FeBr₂ and subsequent heating of the insoluble product gave H₂ and Fe₃O₄ in good yields. The main drawback in these reactions is the heat required to dry and dehydrate magnesium bromide to reform MgO by hydrolysis. (Author)

A80-23131 Energy balance calculations and assessment of two thermochemical sulfur cycles. D. Léger, P. Lessart, J. P. Manaud, R. Benizri, and P. Courvoisier (Commissariat à l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, Essonne, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 747-760. 7 refs.

A study of the formation and decomposition of sulfuric acid for hydrogen production by water-splitting is presented. Thermochemical analyses of cycles involving reactions using iron sulphide and copper and magnesium oxides and bromides are discussed; the quantities of reactants and products are calculated and flow diagrams prepared. The enthalpy diagrams are plotted and energy balances evaluated using the helium from a 3000 MWth high temperature nuclear reactor as a heat source and devising internal heat exchange. A.T.

A80-23132 Recent research on thermochemical hydrogen production at the Oak Ridge National Laboratory. C. E. Bamberger (Oak Ridge National Laboratory, Oak Ridge, Tenn.) and D. M. Richardson. In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 763-769. 15 refs. Contract No. W-7405-eng-26.

The paper deals with two new cycles derived from a study of the chemical feasibility of thermochemical cycles for the production of hydrogen from water. The new thermochemical cycles consist essentially of three and five chemical reactions, respectively. The reactions involved have been demonstrated experimentally and are well described in the literature. V.P.

A80-23133 The ZnSe thermochemical cycle for hydrogen production - Chemical and process design studies. O. H. Krikorian (California, University, Livermore, Calif.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2.

Oxford and New York, Pergamon Press, 1979, p. 791-807. 16 refs. Contract No. W-7405-eng-48.

Problems during initial stages of the development of the ZnSe thermochemical cycle are described. The recent chemical studies include work on the steam hydrolysis of ZnCl₂(l) at 780 to 980 K to produce ZnO(s) and HCl(g), and on the mechanism of decomposition of H₂Se(g) at 673 to 748 K. Process design and cost analyses for the cycle give a conservative cost estimate of about \$13/GJ for hydrogen production. It is anticipated that as work on this cycle progresses, chemical and process-design innovations will lower production costs. (Author)

A80-23134 A study of the cerium-chlorine system for thermochemical production of hydrogen. C. M. Hollabaugh, E. I. Onstott, T. C. Wallace, Sr., and M. G. Bowman (California, University, Los Alamos, N. Mex.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2.

Oxford and New York, Pergamon Press, 1979, p. 809-828. 12 refs. Research sponsored by the U.S. Department of Energy.

Experimental studies of the reaction rates for the cerium chloride cycle for producing H₂ thermochemically have shown that all the reactions occur at useful rates without interfering side reactions. Reaction models were developed to describe the course of the 3 reactions: the hydrochlorination of CeO₂, the hydrolysis of CeCl₃ and the H₂ producing reaction. These models indicate that the rate controlling steps include chemical reaction, product layer diffusion and gas transport into the powdered reactant. The reaction of oxidation of water with Cl₂ to produce O₂ was not included in these studies. (Author)

A80-23135 **Br-Ca-Fe water-decomposition cycles for hydrogen production.** H. Kameyama and K. Yoshida (Tokyo, University, Tokyo, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 829-850. 7 refs.

Experimental results of two kinds of Br-Ca-Fe cycles named 'UT-2' and 'UT-3' processes are described. First, data on reaction kinetics are given. Then, several problems to be solved for its industrialization are discussed: method for the reaction performance, method for separation of gaseous products, method for supporting of solid reactants and method for heating as well as cooling of reactors. The efficiencies of both processes based on the flow sheets are finally estimated. (Author)

A80-23136 **Experimental verification of the mercury-iodine thermochemical cycle for the production of hydrogen from water - ANL-4.** E. H. Appelman, F. Schreiner, and B. M. Abraham (Argonne National Laboratory, Argonne, Ill.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2.

Oxford and New York, Pergamon Press, 1979, p. 851-907. 13 refs. Research sponsored by the U.S. Department of Energy.

A80-23137 **The magnesium-iodine cycle for the thermochemical decomposition of water.** W. Kondo, S. Mizuta, T. Kumagai, Y. Oosawa, Y. Takemori, and K. Fujii (National Chemical Laboratory for Industry, Tokyo, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2.

Oxford and New York, Pergamon Press, 1979, p. 909-921. 10 refs.

A thermochemical water-splitting cycle comprising four chemical reactions carried out at 600 C or below was developed by utilizing magnesium oxide in the alkaline earth metal-iodine cycles. Difficulty in the redox reaction of iodine with magnesium oxide could be surmounted by an excess of iodine and high temperature compared with the case of calcium oxide. Advantages of the present cycle over the calcium-iodine cycle are 1) magnesium iodide can be hydrolysed completely at 400 C or below and the reaction rate is considerably high, while the hydrolytic conversion of calcium iodide is only 70 - 80% at 700 C, and 2) magnesium iodate can be decomposed at 600 C, while calcium iodate is decomposed at 800 C. (Author)

A80-23138 **Thermochemical water splitting cycles - Impact of thermal burdens and kinetics.** B. M. Abraham (Chicago, University, Chicago, Ill.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 923-234. 5 refs.

Equations are rigorously derived for evaluating the thermal efficiency of a thermochemical water splitting cycle, from which it is possible to assess the impact of each heat burden or loss separately. It is shown that the equations of continuity are coupled and, as a consequence, heat flow is found to be the rate determining process

for the operation of a thermochemical water splitting plant. It is noted that since the heat flow is rate determining, the chemical rate of reaction must be fast relative to heat flow even in the asymptotic approach to completion. It is concluded that recycling of reactants, which is required if the change in G is greater than or equal to 0, will probably result in an uneconomical cycle. M.E.P.

A80-23139 **A kinetic investigation of the reforming of natural gas for the production of hydrogen.** G. A. Karim and M. M. Metwally (Calgary, University, Calgary, Alberta, Canada). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 937-956. 24 refs. Research supported by the National Research Council of Canada and University of Calgary.

An analysis of the thermal uncatalyzed reaction of a homogeneous mixture of steam and methane for the production of hydrogen on the basis of detailed chemical kinetics is presented. The kinetic behaviour of a homogeneous mixture of steam/methane is investigated over a temperature range of 1400 - 3000 K, pressure range of 0.5 - 10 atm, and steam/methane ratio range of 1.0 - 5.0. The reaction is attractive for temperatures over 1800 K, and it has been shown that near equilibrium conditions can be achieved within a residence time of about 10.0 seconds. The addition of O₂ to the reacting mixture of methane and steam is also investigated, and it has been found that the addition of a small amount of O₂ has only a small effect on the composition of the products. (Author)

A80-23140 **The economics of producing hydrogen from a small air-blown coal gasifier.** L. D. Hadden (Billings Energy Corp., Provo, Utah). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 983-1005. 5 refs.

In the quest to implement hydrogen energy concepts, the lack of modest quantities of low cost hydrogen is often encountered. Production of hydrogen from coal is commercial in many of the world's ammonia plants. In this study a hydrogen production facility is described which would be appropriate for a single large user or small municipality. The cost of hydrogen from this plant is competitive with existing fuels and represents a new alternative for the utilizing coal including those with high sulfur content. (Author)

A80-23141 **Industrial scale production of hydrogen from natural gas, naphtha and coal.** W. Balthasar and D. J. Hambleton (Kinetics Technology International, Zoetermeer, Netherlands). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 1007-1028.

This paper reviews the three major routes for the production of hydrogen from fossil fuels. Today, there is considerable interest in the production of hydrogen via the gasification of coal. Existing processes and developments are listed. The partial oxidation processes which utilize feedstocks ranging from light hydrocarbons to heavy fuel oil are attractive due to feedstock flexibility. Hydrogen production based on the steam reforming of light hydrocarbons has become the most widely used process as a result of, in general, better economics. (Author)

A80-23142 **Optimization of a thermochemical water splitting cycle - Thermodynamic analysis - Experimental work with a solar furnace.** B. Cheynet, C. Bernard (Grenoble, Ecole Nationale Supérieure d'Electrochimie et d'Electrometallurgie, Saint-Martin-d'Hères, Isère, France), and M. Ducarroir (CNRS, Laboratoires des Ultra-Réfractaires, Font-Romeu, Pyrénées-Orientales, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1031-1049. 8 refs.

A computation method, based on the minimization of the total Gibbs energy, is presented for the study and selection of thermochemical cycles for hydrogen production. In the case of the 'Fe-O-H-Br' system a three-step cycle is generated. The calculations show the characteristic behavior of the hydrolysis reaction in relation with different parameters. The experimental results are in good agreement with the theoretical equilibrium and illustrate the reliability of the thermodynamic approach. This reaction is also experimentally studied in a fluidized-bed reactor heated by the concentrated radiation beam of an arc image furnace. (Author)

A80-23143 **Solar-thermochemical production of hydrogen from water.** J. R. Schuster and J. L. Russell, Jr. (General Atomic Co., San Diego, Calif.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1051-1066. 9 refs.

Several methods for the thermochemical production of hydrogen from water are described. It is noted that thermochemical water splitting using the sulfur-iodine cycle has the potential to be an efficient approach. This cycle uses high-temperature heat that could be supplied by a solar concentrator. It is suggested that the fixed mirror solar concentrator incorporates features that make it well suited to the solar-thermochemical production of hydrogen. B.J.

A80-23144 **Solar beam-assisted electrolyser applied to Yokohama Mark 5 and 6.** T. Ohta, N. Kamiya, T. Otagawa, M. Suzuki (Yokohama National University, Yokohama, Japan), S. Kurita, and A. Suzuki (IHI Technical Laboratories, Tokyo, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1067-1084. 7 refs. Research supported by the Ministry of International Trade and Industry.

The paper examines optimum operating conditions for the Yokohama Mark 5 and 6 hybrid hydrogen-producing systems. An electrochemical approach is used to calculate energy storage using photochemical reactions, and conditions of maximum storage are examined. The potential difference of the two systems, i.e., Fe(3+)/Fe(2+) and I3(-)/I(-), was considered as the stored energy. It is found that in order to achieve optimum conditions the photochemical cell should be thin and the concentration of I3(-) should be high with an appropriate Fe(2+)/I3(-) ratio. B.J.

A80-23145 **Separation of hydrogen from the mixture of hydrogen iodide, hydrogen and iodine in thermogravitational column.** S. Tanisho, N. Wakao, and T. Ohta (Yokohama National University, Yokohama, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1085-1106. 10 refs.

Theoretical calculations and experimental results show that the thermogravitational column can be used to separate hydrogen from a hydrogen iodide/hydrogen-iodine gas mixture. The advantage of this method is that the decomposition of hydrogen iodide into hydrogen and iodine occurs in the bulk space and the iodine deposited on the cold wall can be recovered easily. It is found that the recovery efficiency largely depends on the feed location, the width of the annular spacing between hot and cold walls, the temperature difference between the walls, and the axial temperature distribution. B.J.

A80-23147 **On the study of hydrogen production from water using solar thermal energy.** S. Ihara (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tokyo, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1121-1133. 10 refs.

Theoretical thermal efficiency of hydrogen production by one-step water splitting utilizing solar heat at high temperatures is

calculated. Carnot efficiency is assumed for the conversion of effective work input, and the solar collection efficiency is considered for the total energy input. The overall efficiency shows its maximum in the range of temperature between 1500 and 2700 K depending upon the solar concentration ratio and the method of product separation. The technical feasibility of direct splitting method is discussed on the basis of those calculated results. (Author)

A80-23148 **Hydrogen production from fusion reactors coupled with high temperature electrolysis.** J. A. Fillo, J. R. Powell, M. Steinberg, F. Salzano (Brookhaven National Laboratory, Upton, N.Y.), R. Benenati, V. Dang, S. Fogelson, H. Issacs, H. Kouts, and M. Kushner. In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1135-1168. 6 refs. Research sponsored by the U.S. Department of Energy.

Preliminary studies at Brookhaven show that high temperature electrolysis (HTE) has the highest potential for the production of hydrogen from fusion reactions. A fusion-to-hydrogen efficiency of 70% appears possible with 1800 C HTE units and 60% power cycle efficiency; an efficiency of 50% appears possible with 1400 C HTE units and 40% power cycle efficiency. Based on efficiency results HTE methods appear to have potentially lower unit process or capital costs compared to thermochemical or direct decomposition methods. B.J.

A80-23149 **Plasmochemical cycle of hydrogen production from the water.** I. G. Belousov, V. A. Legasov, V. D. Rusanov, and I. V. Kurchatov (Akademii Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1169-1181. 7 refs.

The paper is devoted to the two-stage plasmochemical cycle of hydrogen generation from the water, based on decomposition of the carbon dioxide in a nonequilibrium gas-discharge plasma with the subsequent hydrogen production from the carbon oxide by steam conversion. Comparison is given of the plasmochemical cycle with the electrolysis and thermochemical ones. Some general questions of choice of the cycle for the industrial technology are briefly considered. (Author)

A80-23151 **Spin-aligned hydrogen.** W. C. Stwalley (Iowa, University, Iowa City, Iowa). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1209-1213. 30 refs. Research supported by the Petroleum Research Fund.

Spin-aligned hydrogen is a hypothetical form of hydrogen, which consists of hydrogen atoms maintained exclusively in their lowest electronic energy magnetic sublevels under low-temperature, high-magnetic-field conditions. This paper briefly reviews the properties of spin-aligned hydrogen and the current prognosis for its experimental preparation. B.J.

A80-23152 **Hydrogen generation via photoelectrolysis of water - Recent advances.** A. J. Nozik (Allied Chemical Materials Research Center, Morristown, N.J.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1217-1246. 93 refs.

The current status of hydrogen production by the photoelectrolysis of water using sunlight is reviewed. Advances in the theoretical understanding of the energetics and mechanisms of photoelectrolysis are examined, and the development of new semiconductor electrode materials is discussed. The problems associated with the achievement of a cost-effective photoelectrolysis system are considered. B.J.

A80-23153 **Photoelectrochemical generation of hydrogen**

with hybrid electrodes. K. Yazawa and H. Morisaki (University of Electro-Communications, Chofu, Tokyo, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1247-1251. 5 refs.

A novel semiconductor electrode structure is described which enables the stable photoelectrolysis of water in a single cell without any auxiliary power source. A TiO₂ thin film is fabricated on a Si solar cell either by chemical vapor deposition or by thermal oxidation of a sputtered Ti film in vacuum. This structure of electrodes has several advantages: (1) TiO₂ film is anodically biased by the solar cell, and the efficiency of its catalytic action to decompose water is greatly improved; (2) photons with energy higher than 3.0 eV of the solar radiation are absorbed in the TiO₂ film and those with energies between 1.2 and 3.0 eV are used in the solar cell; and (3) the electrode is free from the corrosion problem. (Author)

A80-23154 Photochemical production of hydrogen from water. E. Broda (Wien, Universität, Vienna, Austria). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1253-1265. 35 refs.

Various techniques of photochemical production of hydrogen are reviewed. These include plant photosynthesis, energy farming, and water photolysis with membranes. The latter technique is emphasized with attention given to single- and double-phase systems, the use of two photosystems in succession, photolysis with visible light, and artificial photolytic membranes. The technical feasibility of the water photolysis technique is assessed. B.J.

A80-23155 Bio-solar hydrogen production. A. Mitsui (Miami, University, Miami, Fla.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1267-1291. 166 refs. NSF Grants No. AER-75-11171-A01; No. AER-77-11545.

Biological hydrogen photoproduction is reviewed, with emphasis on research on hydrogen photoproduction in salt water systems under way at the University of Miami Marine School. Consideration is given to: (1) the advantages of biological hydrogen production as a source of fuel and biomass, (2) the key areas of research in this field, and (3) the economic potential and feasibility of such systems. B.J.

A80-23156 Attempts to produce hydrogen by coupling hydrogenase and chloroplast photosystems. T. Yagi (Shizuoka University, Shizuoka, Japan) and H. Ochiai (Shimane University, Matsue, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1293-1307. 58 refs. Ministry of Education, Science, and Culture Grant No. 211112.

An attempt has been made to develop a hydrogen-producing system consisting of chloroplasts and bacterial hydrogenase, separated by an electron carrier. The main difficulties with the development of such a system are the photoinactivation of chloroplast photosystems, the oxygen-sensitivity of bacterial hydrogenase, and the autooxidation of the reduced form of electron carriers. Ways to overcome these difficulties are described. B.J.

A80-23157 Thermo-electrochemical cycles for power and hydrogen production. M. Steinberg (Brookhaven National Laboratory, Upton, N.Y.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1309-1325. Contract No. EY-76-C-02-0016.

The thermo-electrochemical (TEC) power cycle combines the electrochemical decomposition of a compound at a state where the

free energy change is low and the recombination of the same or a different compound at a state where the free energy change is high. The difference in free energies gives a net difference in emf which results in a net power output for the system. The power cycle combines the operation of an electrolyzer at a high-temperature, low-emf condition and a fuel cell at a low-temperature, high-emf condition. The principles of operation are illustrated by an H₂-O₂-H₂O system and an H₂-O₂-Cl₂-HCl system. B.J.

A80-23158 Analysis of the potential transmission of hydrogen by pipeline in Switzerland. E. Anderson, J. Davies, M. Kornmann, and G. Capitaine (Battelle, Geneva Research Centre, Geneva, Switzerland). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1347-1372. 25 refs. Research supported by the Fonds National Suisse de la Recherche Scientifique.

It is shown that the pipeline transmission of hydrogen under optimum conditions in new, full-capacity pipelines will be 25-50% more expensive than natural-gas transmission. However, for a given pipeline diameter and for pipeline operation at throughputs significantly below maximum capacity, which is the current situation for national gas pipelines in Switzerland, there would be no capacity problems, and transport costs would be virtually the same if hydrogen were transported. The major technical problem concerning the transmission of hydrogen gas at high pressure is the possibility of slow fatigue-crack growth from existing cracks or crack-like defects in the pipe body or weld. B.J.

A80-23159 Mixture properties for hydrogen supplementation of natural gas. N. R. Baker and W. D. Van Vorst (California, University, Los Angeles, Calif.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1373-1400. 25 refs.

It has been suggested that manufactured gases, such as SNG or hydrogen, will be required to supplement and eventually replace the natural gas reserve. Such a proposal requires that both methane and hydrogen, in varying amounts, be transmitted, distributed, and used in the existing natural gas supply network. This paper examines the prediction of the properties of hydrogen-methane mixtures and presents the results of computation of Joule-Thomson coefficients, inflammability limits, quenching distances and diameters, minimum ignition energies, and the flame stability of mixtures of several compositions. B.J.

A80-23160 Small scale ammonia production as a means for hydrogen storage. J. Jourdan and R. Roguenant (Rhône-Poulenc Industries, Courbevoie, Hauts-de-Seine, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1401-1429. 5 refs.

The paper considers ammonia production as a means of hydrogen storage in production of solar electricity. A 75 t/d ammonia plant based on this concept is described, showing that it would serve energy needs of isolated regions including electricity, gas, ammonia fertilizer, and easy to store back-up hydrogen source. The electricity and fertilizer needs of a population in the 10 to 50 thousand range could be met by a 100 MWe peak solar power station coupled to a 75 t/d ammonia plant; specific examples are given within these ranges. A.T.

A80-23161 A study on hydrogen storage by use of cryoadsorbents. C. Carpetis and W. Peschka (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference,

Zurich, Switzerland, August 21-24, 1978. Volume 3.
Oxford and New York, Pergamon Press, 1979, p. 1433-1456. 14 refs.

The paper reports investigations on the techniques and economics of hydrogen storage by means of cryoadsorption. Also a comparison with alternative storage methods is included. The hydrogen storage capacity of several adsorbents in the temperature range from 65 K to 150 K has been investigated experimentally. Basing on these data economics and operating conditions for minimum total costs of the system are calculated. Utilization-factor and capacity-factor parameters are shown to be decisive for outlining the favorable ranges of application for competitive hydrogen storage methods.

(Author)

A80-23162 **The cryogenic storage of hydrogen.** J. J. Thibault (L'Air Liquide, Sassenage, Isère, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1457-1473.

Liquefaction processes are reviewed, noting the problems with large size liquefiers, and examples of industrial liquefiers are given. Attention is also given to the storage and distribution equipment, such as storage tanks (fixed and mobile), transfer lines and cryogenic pumps. Finally, the different factors entering in the choice of a given distribution process are discussed.

M.E.P.

A80-23163 **The role of metal hydrides in hydrogen storage and utilization.** F. E. Lynch (Denver, University, Denver, Colo.) and E. Snape (MPD Technology Corp., Waldwick, N.J.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1475-1524. 28 refs.

The paper reviews some of the more immediate, practical applications of hydrides and discusses some of the technical and economic limitations of hydride systems. Examples are given of specific hardware which utilize hydrides and their cost/performance characteristics are compared with more conventional systems. In addition, the economic and technical advantages of using metal hydride storage tanks in conjunction with electrolyzers are illustrated, and compressors and pumps based on metal hydrides are described. Finally, some of the methods of characterizing hydrides for specific applications are also reviewed.

M.E.P.

A80-23164 **Use of binary titanium alloys for hydrogen storage.** O. de Pous and H. M. Lutz (Battelle, Geneva, Switzerland). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1525-1541. 12 refs.

A study of intermetallic binary compounds such as Ti3M, Ti2M, and TiM for hydrogen storage is presented. The reversibility of hydrogen exchange depends on the relative thermal stabilities of intermetallic compounds, defined as the enthalpy of formation. This parameter also represents the heat required for hydrogen release from its storage system; the permanence of the intermetallic composition during hydrogen absorption and desorption is related to the range of variation of the operating temperature and pressure. A.T.

A80-23165 **Cubic metal-alloys for hydrogen storage.** H. Buchner, M. Stohrer, and O. Bernaur (Daimler-Benz AG, Stuttgart, West Germany). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1543-1560. 16 refs.

Various hydride forming elements are investigated with reference to the use of metal hydrides for hydrogen storage. Hydrides of Mg- and Ti-based binary intermetallic compounds are suggested as

mobile hydrogen storage systems for automotive propulsion. The pressure and temperature dependence of the hydrogen-to-metal ratio of the alloys and the hydride capacity are determined. The magnetic susceptibility of the phase is measured and the band structure at the Fermi level is analyzed along with hydrogenation effects. Guidelines for further research are proposed.

V.L.

A80-23166 **Mixing effects of different types of hydrides.** S. Suda and M. Uchida (Kogakuin University, Tokyo, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1561-1573. 10 refs.

A method for synthesizing a mixture which has new hydriding and dehydriding properties is presented and a series of hydriding alloy mixtures composed of LaNi5 and Ti0.8Zr0.2Cr0.8Mn1.2 were selected to demonstrate the validity of the proposed method. Experimental results were reported for the equilibrium behaviors of the (xLaNi5 + (1-x)Ti0.8Zr0.2Cr0.8Mn1.2)H(y) system, where x is the weight fraction of LaNi5 and y is the numbers of hydrogen atoms absorbed in a mole of alloy mixture and ranges from 3.0 to 6.7. The rate studies were also undertaken under various temperature and composition conditions. From the results, the mixed hydrides were expected to find various uses in thermodynamic cycles and many types of energy systems, and on the more practical scene, in the safety device developments and use of hydriding alloy mixtures from economical standpoints.

(Author)

A80-23168 **Effect of the interstitial hole size and electron concentration on complex metal hydride formation.** O. de Pous and H. M. Lutz (Battelle, Geneva, Switzerland). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1597-1611. 16 refs.

The influence of the interstitial hole size and the electron density of intermetallic compounds is discussed from the view point of utilizing these materials for hydrogen storage. Intermetallic compounds with electron to metal atom ratios ranging from four to seven have been found to form complex metal hydrides with temperatures of decomposition above ambient for a hydrogen pressure of one atmosphere. Higher electron concentrations lead to a lowering of the hydrogen content and a consequent decrease in the storage capacity. In a series of isoelectronic materials, the thermal stability of complex metal hydrides has been found to increase with the metal-metal distance characteristic of the parent metal lattice. Experimental results shows the extent to which the selection of a suitable material for hydrogen storage is limited.

(Author)

A80-23169 **Effect of Ni, Ce and Co on hydrogen absorption by La-Ni alloys.** Y. C. Huang, M. Tada, T. Watanabe, and K. Fujita (Tokai University, Kanagawa, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1613-1623. 19 refs.

An assessment on the influence of Ni, Ce, and Co to the solubility and equilibrium pressure of hydrogen, in the systems for La-Ni, and Misch metal-Ni alloys have been made by means of measuring pressure-temperature-composition relationships. The hydrogen pressure at plateau, which indicates two-phase coexistence, was shown almost at the same value, above Ni/REM ratio is more than 2 to 5, and the plateau region of isotherms was increased with increasing of Ni content. Ce would increase the plateau pressure of hydrogen in La-Ni alloys, and the experiment was carried out up to the La-0.4Ce-0.6Ni-5 alloy. However, an addition of Co would decrease the plateau of hydrogen pressure remarkably for La-Ce-Ni-5 alloy.

(Author)

A80-23170 **Development of low cost nickel-rare earth hydrides for hydrogen storage.** G. D. Sandrock (International Nickel

Research and Development Center, Suffern, N.Y.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1625-1656. 24 refs.

Development of low-cost nickel-rare earth hydrides for hydrogen storage is presented. A survey was made to develop ternary substituted MNi alloys with reasonable plateau pressures, with substitutions of Ca for M and Cu, Fe, Mn, or Al for Ni. All elements were suitable for lowering the room-temperature plateau pressure of MNi; properties surveyed included plateau pressure, hysteresis, H-storage capacity, density, raw material cost per unit of hydrogen storage capacity, and crystallographic parameters. (Author)

A80-23171 Technological aspects and characteristics of industrial hydrides reservoirs. P. Guinet, P. Perroud, and J. Rebière (Commissariat à l'Énergie Atomique, Centre d'Études Nucléaires de Grenoble, Grenoble, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1657-1675. 14 refs. Research supported by the Institut de Recherches sur les Transports, Commission des Communautés Européennes, and Délégation Générale à la Recherche Scientifique et Technique.

An investigation of the hydrogen sorption capacity, reaction rate, and loss of capacity vs time and hydrogen purity of industrial FeTi and Mg alloys is presented. The amount of hydrogen stored in the FeTi reservoir, the maximum outflow rate, and the maximum working pressure were determined; the improved heat transfer capability of the heat exchange systems increases the discharge rate and the maximum hydrogen content. The capacity of the Mg₂Cu reservoir was measured, and its inflow and outflow rates were determined using a scale model. A.T.

A80-23172 Development of high-temperature hydrides for vehicular applications. H. Buchner, O. Bernauer, and W. Strauss (Daimler-Benz AG, Stuttgart, West Germany). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1677-1688. 7 refs.

It is noted that dilute solutions of magnesium compounds in magnesium improve the hydrogen exchange kinetics without too great a loss of the high magnesium storage capacity. The paper reports on an investigation of the magnesium/magnesium-nickel system and the magnesium/magnesium-yttrium system. Attention is given to the optimization of storage capacity, absorption and desorption kinetics and dissociation enthalpy with respect to vehicular applications. M.E.P.

A80-23173 The influence of Al on the hydrogen sorption properties of intermetallic compounds. I. Jacob and D. Shaltiel (Jerusalem, Hebrew University, Jerusalem, Israel). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1689-1706. 16 refs.

The hydrogen sorption properties of Al containing Laves phase intermetallics are studied and the absorption capacity of various intermetallic compounds were measured at hydrogen pressure of 20 atm and at room temperature. Desorption characteristics of the obtained hydrides were also studied at several different temperatures. Attention is given to the behavior of those systems whose hydrogen capacity was measured at approximately 70 atm and room temperature, and at about 40 atm and liquid nitrogen temperature. The relative stability of the hydrides of these pseudobinary compounds was determined by measuring the desorption isotherms at room temperature. C.F.W.

A80-23174 Iron oxide reduction kinetics by hydrogen. J. Bessières, A. Bessières, and J. J. Heizmann (Metz, Université, Metz, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 1731-1746. 9 refs. Research supported by the Délégation Générale à la Recherche Scientifique et Technique.

The iron oxide kinetics by hydrogen is examined. The reduction reaction is complex because several elementary or multiple reactions occur together; different routes for the reduction with a gas and the chemical kinetics of the single, double, and triple reactions were determined. The true kinetics of each single reaction which proceeds within multiple reductions is determined using a reaction triangle which determines the relative rate of three reactions. A.T.

A80-23175 Hydrogen-fueled railroad motive power systems - A North American view. R. T. Alpaugh (U.S. Department of Energy, Washington, D.C.), W. J. D. Escher (Escher Technology Associates, St. Johns, Mich.), and M. Novil (Institute of Gas Technology, Chicago, Ill.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 1793-1827. 19 refs. Contract No. WA-76-4707; No. EC-77-X-01-1883.

Results of initial feasibility studies carried out in 1976-77 in the U.S. on hydrogen as an alternative to petroleum-based diesel fuel upon which North American railroads are totally dependent, are presented. Positive technical and economic feasibility are indicated. Feedback on this concept from industry and government railroad organizations, though generally favorable, strongly indicate the need for a hardware in-service demonstration of a hydrogen-fueled locomotive. A program plan for accomplishing this is discussed, and the status of the project is reviewed. (Author)

A80-23176 Design considerations for the Riverside hydrogen bus. R. L. Woolley (Billings Energy Corp., Provo, Utah). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 1829-1849. 10 refs.

Design considerations for the prototype hydrogen-fueled bus are examined. It is required that the hydrogen system could be switched to an alternate conventional fuel, and that safety, range, power, refuel time, flashback elimination and NO_x reduction, and hydride tank weight and loading density be considered. Safety requirements included factors of safety of two for hydrogen tanks and lines, and overdesign of the support structure; finally, the six flow circuits in the system including hydrogen delivery, heat exchange fluid, induction water, and pneumatic and intake air are described. A.T.

A80-23177 Hydrogen injection two-stroke spark ignition engine. S. Furuhashi and H. Azuma (Musashi Institute of Technology, Tokyo, Japan). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 1851-1878. Research supported by the Ministry of Education.

The paper discusses hydrogen injection into a two-stroke engine to improve the thermal efficiency and to suppress NO_x formation. A three-cylinder microcar engine modified into a hydrogen injection type was tested showing good performance and low NO_x and HC emissions. It was also shown that it was not more advantageous to inject hydrogen fuel near the top dead center than to inject at the initial stage of the compression stroke. A.T.

A80-23178 Hydrogen energy in United States Post Office delivery systems. V. R. Anderson (Billings Energy Corp., Provo, Utah). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 1879-1901.

A United States Postal Service delivery vehicle (1/4 ton DJ-5F) has been converted to operate on hydrogen fuel, under Contract No. 1-4231-B77-0073 with the United States Postal Service. This paper presents details and general specifications of the vehicle and engine conversion, including design of the iron-titanium storage system and of the related controls and safety equipment. Engine modifications include: a gaseous fuel IMPCO carburetor, a water induction system and changes in the ignition system. Power control is obtained by throttling the air-hydrogen mixture. Waste heat in the engine water cooling system is circulated through the hydride tank to drive off hydrogen. The method for recharging the system is also described.

(Author)

A80-23179 Hydrogen fuel in air transportation and its effects around airports. K. S. Varde (Michigan, University, Dearborn, Mich.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 1903-1916. 13 refs.

Based on the characteristics of hydrogen fuel a model analysis is conducted to predict the pollution that might be generated from a hydrogen fueled aircraft. Specific consideration is given when the aircraft is idling at the terminal and during full power conditions. The kinetic model predicts the dominant pollutant to be the oxides of nitrogen with other related species being in very small quantities.

(Author)

A80-23180 Materials and performance characteristics of the HYCSOS chemical heat pump and energy conversion system. D. M. Gruen, M. Mendelsohn, I. Sheft, and G. Lamich (Argonne National Laboratory, Argonne, Ill.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4.

Oxford and New York, Pergamon Press, 1979, p. 1931-1946. 15 refs. Research sponsored by the U.S. Department of Energy.

The paper examines a HYCSOS chemical heat pump which uses two metal hydrides with different free energies of formation enabling hydrogen to flow from one to another of the hydrides under the influence of thermal gradients. The hydrogen flows between two pairs of four vessels which function as the generator/condenser and evaporator/absorber elements of conventional absorption refrigerators; the pump materials are based on the AB₅ alloys which absorb hydrogen and have a large hydrogen storage capacity.

A.T.

A80-23181 A metal hydrogen heat pump as topping process for power generation. G. Alefeld (München, Technische Universität, Garching, West Germany). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4.

Oxford and New York, Pergamon Press, 1979, p. 1947-1957. 8 refs.

The paper discusses a metal hydrogen heat pump as a topping device for power generation. It is shown that the reaction rate of the topping process is high; that alloys with long-time stability such as Nb or Va materials will be available since heat transfer occurs at changing temperatures so that it is not necessary to use hydrides which have a flat plateau for the pressure vs concentration; and that the metal vapor pressure can be ignored compared to that of H₂. It is concluded that hydrogen-resistant materials are available for 500 C and 200 bar service.

A.T.

A80-23182 Prospects for an alkaline hydrogen air fuel cell system. H. Van den Broeck (ELENCO, Mol, Belgium), M. Alfenaar, G. Hovestreydt (Dutch State Mines, Geleen, Netherlands), A. Blanchart, G. Van Bogaert (Studiecentrum voor Kernenergie, Mol, Belgium), M. Bombeke, and L. Van Poucke (BEKAERT, Zwevegem, Belgium). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 1959-1969.

The paper examines the potential of the alkaline hydrogen air fuel cells. Alkaline vs acid fuel cells are compared; alkaline cells are preferred when cheap hydrogen is available and maximum heat recovery is not required. Features of fuel cells are considered, including energy conservation, absence of air and noise pollution, and production of direct current electricity. Finally, applications are described in the chlorine electrolysis industry, city buses, and forklift trucks.

A.T.

A80-23183 Numerical physical property data for metal hydrides utilized for hydrogen storage - Three primary candidate materials. L. J. Swartzendruber, G. C. Carter, D. J. Kahan, M. E. Read, and J. R. Manning (National Bureau of Standards, Metallurgy Div., Washington, D.C.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 1973-2011. 43 refs.

Research supported by the U.S. Department of Energy.

Physical property data are presented for three intermetallic compounds which are considered primary candidate materials for safe hydrogen storage in stationary and mobile applications. The materials are FeTi, LaNi₅, and Mg₂Ni. The properties cover equilibrium dissociation pressures, van't Hoff equation parameters, heats of reaction, reaction rates, diffusion, thermal conductivities, heat transfer coefficients, hydride densities, lattice parameters and expansion upon hydriding, and phase diagrams.

(Author)

A80-23184 Hydrogen in iron-titanium - Experimental investigations of structure, heat of solution, diffusion, and hydriding kinetics. E. Lebsanft, D. Richter, J. Töpler, H. Wenzl (Kernforschungsanlage Jülich GmbH, Institut für Festkörperforschung, Jülich, West Germany), W. Schäfer, and G. Will (Bonn, Universität, Jülich, West Germany). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 2013-2032. 19 refs.

The structure of the beta-phase of the FeTi-D system was determined to be orthorhombic. The hydrogen diffusion coefficient in FeTiH was measured by quasielastic neutron scattering and thermodynamic parameters of the FeTi-H system were discussed. In very dilute solutions the heat of solution is 1 eV per H-atom due to the occupation of Fe vacancies or other traps by the hydrogen atoms. Nucleation phenomena of the beta-phase in the alpha-phase play an important role in the hydriding kinetics and in the thermodynamics of the system.

(Author)

A80-23186 Hydrogen embrittlement, stress state and design considerations. M. R. Louthan, Jr., R. P. McNitt, J. Murali, N. Sridhar, and T. S. Sudarshan (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4.

Oxford and New York, Pergamon Press, 1979, p. 2053-2073. 7 refs. Contract No. E(40-1)-5255.

Delayed failure studies and dynamic tests in gaseous hydrogen were used to investigate the effects of stress state on the hydrogen compatibility of AISI 4340 and A-106 steel. Test results demonstrate the difficulty of using short time dynamic tests to predict the effects of hydrogen on the long time behavior of engineering structures under static loads. Analysis of the variables which control the hydrogen localization mechanism supports the test results and emphasize that extrapolation of data obtained under one set conditions to any other set of service conditions should be made very carefully.

(Author)

A80-23189 Material corrosion investigations for the General Atomic sulfur-iodine thermochemical water-splitting cycle. P. W. Trester and S. S. Liang (General Atomic Co., San Diego, Calif.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24,

1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 2113-2159. 9 refs. Research sponsored by the American Gas Association, General Atomic Co., University of California, and Northeast Utilities Service Co.

Material corrosion resistance to H₂SO₄ vapor and HI and I₂ solutions in the sulfur-iodine thermochemical water-splitting cycle was investigated. Alloys Incoloy 800H, stainless steel 304, and Inconel 600 were corroded along the grain boundaries in the decomposing H₂SO₄ vapor. A high-silicon iron alloy and a Ni-30 Mo alloy were resistant to HI(x), along with Ti, Zr, Ta, and Mo; a perfluorocarbon elastomer, borosilicate glass, and carbon materials were also resistant. The aluminized Incoloy 800H showed good resistance to oxidizing environment and was selected as the candidate material for high-temperature heat exchangers. A.T.

A80-23190 Optimal development strategies for a whole energy system based on hydrogen. M. Pavelescu, H. Dumitrescu (Institute for Nuclear Power Reactors, Bucharest, Rumania), and M. Stoica (Chemical School Group, Bucharest, Rumania). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 2163-2178. 15 refs.

The paper is dealing with the problem of implementation in a whole power system of two nuclear subsystems from which the second with a time delay will produce, by means of the HTGR's and then the CGFBR's, Hydrogen. The mathematical model for such a system is introduced as well as a try of optimization concerning its evolution in time in order to have both the minimum of conventional fuel and nuclear fuel consumption. The problem of optimization was solved by use of a mathematical bimatrix game model without side payments. (Author)

A80-23191 Thermochemical or hybrid cycles of hydrogen production techno-economical comparison with water electrolysis. F. Deneuve and J. P. Roncato (Gaz de France, Direction des Etudes et Techniques Nouvelles, Paris, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 2179-2203. 7 refs.

A comparison of thermochemical or hybrid cycles of hydrogen production with water electrolysis is presented. The thermochemical cycles are not competitive with electrolysis because of lower thermal efficiency; the introduction of an electrolytic step in a hybrid cycle slightly improves the efficiency and provides a potential for lower investment costs than for thermochemistry. This change is insufficient, however, and direct electrolysis of water remains the best method of producing hydrogen by water decomposition. A.T.

A80-23192 A method for the techno-economic evaluation of chemical processes - Improvements to the 'OPTIMO' code. A. Broggi, R. Joels, G. Mertel, and M. Morbello (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 2205-2230.

The paper describes the improved chemical engineering code developed for the evaluation and analysis of multistep processes. The original code was retained with respect to retention of the mass and energy balances as the basis of a heat exchange network synthesis; however, the program has now been extended to accommodate a more detailed nuclear reactor-chemical plant coupling and new routines were prepared so that the hydrogen production cost can be estimated. A.T.

A80-23193 Health benefits derived from a planned hydrogen community. R. M. Zweig (Pollution Control Research Institute, Riverside, Calif.). In: Hydrogen energy system; Proceedings of the

Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 4. Oxford and New York, Pergamon Press, 1979, p. 2231-2245. 37 refs.

The paper examines health benefits derived from a planned hydrogen community. The health effects of pollutants are discussed, including those of carbon monoxide, sulfur compounds, hydrocarbon combustion particulates, lead, and photochemical oxidants; costs of pollution control are given, exemplified by over \$1 million spent in the Los Angeles area. Riverside, Calif. uses hydrogen for its nonpolluting qualities, including development of a Dial-A-Ride bus which uses hydrogen fuel eliminating CO, HC, PbO₂, and SO_x from its emissions. A.T.

A80-23194 Present state and future prospects of thermochemical hydrogen production. G. E. Beghi (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2299-2322. 21 refs.

A80-23195 Main requirements on the nuclear installations used for hydrogen production and in technological processes. V. A. Legasov, N. N. Ponomarev-Stepnoi, A. N. Protsenko, A. Ia. Stoliarevskii, and Iu. F. Chernilin (Akademii Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2365-2376. 5 refs.

A80-23196 Testing aqueous caustic electrolyzers at high temperatures. J. N. Murray and M. R. Yaffe (Teledyne Energy Systems, Timonium, Md.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2397-2412. 7 refs. Research supported by the U.S. Department of Energy.

Increasing the electrochemical cell operating temperature allows an improvement of the operating energetics of hydrogen production by alkaline solution water electrolysis. Alternative materials for the cell separator were tested; the usability of structural polymers as a cell frame, the stability of the selected anode electrocatalyst, and the possibility of the plumbing and piping selected introducing corrosion products which could affect the cathode electrocatalyst were determined. This paper describes the studies of alkaline electrolyzers and materials for operation at temperatures up to 150 C. (Author)

A80-23197 Theoretical efficiency limit of water electrolysis and practical means to approach it. S. Kunstreich and J. Sterlini (Compagnie Electro-Mécanique, Paris, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2413-2431. Commission of the European Communities Contract No. 063-76-EHF.

The paper shows that the inherent losses of water electrolysis increase with the temperature to obtain better cell efficiency. The theoretical efficiency limit of a complete system is described with and without energy recovery process; a gas conditioning and energy recovery process which can be adapted to various H₂ and O₂ utilization conditions and perform ideal thermodynamical operations to approach an ideal overall efficiency of the system was investigated. It was shown that at 200 C and 30 bar the overall efficiency can be improved by 10 percent, and at the overall efficiency of 90 percent the pressure can be reduced to 30 bar. A.T.

A80-23198 Engineering impact on the validity of the Mark-16 thermochemical cycle. W. R. A. Goossens, M. Klein, L. H. Baetslé (Centre d'Etude de l'Energie Nucléaire, Mol, Belgium). In: Hydrogen energy system; Proceedings of the Second World Hydrogen

Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2445-2463. 6 refs. Research supported by the Commission of the European Communities.

The paper presents mass and energy balances for the Mark-16 thermochemical cycle using thermodynamical information. It was shown that the product separation units related to the hydrogen iodide decomposition step influence the potential validity of the thermodynamical cycle; the thermal efficiency of the Mark-16 cycle dropped by adding the energy consumption of the product separation units related to the acids decomposition step to the energy consumption under ideal thermodynamical conditions for the chemical reaction steps. A.T.

A80-23199 **A high energy hybrid system: Hydrogen - chlorine - solar - water.** B. B. Stewart (Solar Reactor Corp., Miami, Fla.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2505-2520. 5 refs.

A new solar and hydrogen fuel system (Solar Reactor process) is described which produces extremely high energy, uses common reclaimable materials, is adaptable to most power generation units, and is environmentally acceptable. The system is based on hydrogen combusted in solar or light-activated chlorine followed by product dilution and electrolysis to produce the starting materials, hydrogen and chlorine. The high energy of the Solar Reactor process is achieved by using a hybrid system involving light absorption and conversion (57.9 Kcal), hydrogen-chlorine combustion (44.1 Kcal), and hydrogen chloride dilution (36.0 Kcal). The energies are based on one mole of hydrogen or chlorine. A total input of 94.4 Kcal (HCl electrolysis cell) is required to generate the hydrogen and chlorine for each cycle. An 80% recovery of the total output of 138 gives 110 Kcal for a net energy production of 16 Kcal. Comparisons with several commercial systems show that this hybrid system is the most energetic. (Author)

A80-23200 **Hydrogen production from water using fission-pumped laser.** K. C. Bordoloi and F. A. Bynum (Louisville, University, Louisville, Ky.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2523-2544. 35 refs.

A method is described for producing hydrogen as an alternative energy carrier and fuel. It is proposed that a fission-pumped gas laser designed to produce short wavelength ultraviolet rays be used to produce hydrogen in bulk; by selecting a proper mixture of gases and operating conditions a light rich in ultraviolet wavelengths can be produced. The ultraviolet rays will allow the photolysis of water into hydrogen and oxygen; the quantum efficiency and reaction mechanisms of several possible wavelength-dependent photolysis schemes are considered, and a description of experiments to simulate the practical hydrogen production is given. A.T.

A80-23201 **Laser-fusion production of hydrogen by radiolytic-thermochemical cycles.** H. J. Gomberg and W. W. Meinke (KMS Fusion, Inc., Ann Arbor, Mich.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2545-2569. 17 refs. Contract No. ES-77-C-02-4149.

The paper examines laser-fusion production of hydrogen by radiolytic-thermochemical cycles. In laser fusion the simple geometric arrangement which produces fusion in a small pellet generates very large fluxes of 14-MeV neutrons emanating in all directions. These energetic neutrons interact with chemical systems in a radiolysis chamber; hydrogen is split from water in a cyclic process combining radiolysis and thermally driven reactions. It was concluded that radiolytic-thermochemical processes can be competitive with other methods for utilizing laser-fusion energy to produce hydrogen. (Author)

A80-23202 **Model for hydrogen production on illuminated transition metal surfaces.** J. Keller, C. Keller, and W. Baltensperger (Zürich, Eidgenössische Technische Hochschule, Zurich, Switzerland). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2573-2585. 19 refs.

The paper considers a model for hydrogen production on illuminated transition metal surfaces. The storage properties of the transition metal alloys for which the model is described may be used to separate the atomic hydrogen from the reaction area; a hydrogen storage material is characterized by the energy of absorption of atomic hydrogen nearly equaling the energy of the H₂ bond per atom, so that the hydrogen stored near saturation corresponds to an atomic hydrogen cellular liquid. It was shown that light would provide energy in a hydrogen production unit to split the input molecule R-H at the transition metal containing surface, and hydrogen can be then stored in a slab of the intermetallic material. A.T.

A80-23203 **Kinetics of hydrogen absorption and desorption by ternary LaNi₅ type intermetallic compounds.** L. Belkbir, N. Gérard (Dijon, Université, Dijon, France), A. Percheron-Guégan, and J. C. Achard (CNRS, Laboratoire de Chimie Métallurgique et Spectroscopie des Terres Rares, Meudon, Hauts-de-Seine, France). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2589-2612. 17 refs.

The paper presents the kinetic rules of formation and decomposition of the hydrides derived from LaNi₅ type compounds. A comparison is made between LaNi₅H₆ and more stable hydrides LaNi_{5-x}M_x in terms of the pressure and the number and time of cycles. Measurements are performed by a differential volumetric device acting at constant pressure during hydrogen absorption and desorption. In addition, the influence of the gaseous impurities in industrial hydrogen (H₂O, CO₂, CH₄) on the kinetics and hydrogen capacity is studied showing a good poisoning resistance of these compounds. A.T.

A80-23204 **A plan for active development of LH₂ for use in aircraft.** G. D. Brewer (Lockheed-California Co., Burbank, Calif.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2685-2697. 7 refs.

A plan for an experimental airline equipped with liquid hydrogen (LH₂)-fueled aircraft flying commercial cargo between the U.S., Western Europe, and the Middle East is presented. Liquid hydrogen provides lower life cycle cost and consumption and minimum environmental pollution compared with synthetic Jet A fuel made from coal. The plan includes development of facilities for production and liquefaction of hydrogen at four air terminals; the operating experience with the aircraft and ground facilities will be shared to disseminate the information about this system. A.T.

A80-23205 **Electronic fuel injection techniques for hydrogen powered I.C. engines.** C. A. MacCarley and W. D. Van Vorst (California, University, Los Angeles, Calif.). In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2747-2792. 32 refs. Research supported by the U.S. Postal Service.

Numerous studies have demonstrated the advantages of hydrogen as a fuel for Otto Cycle engines due to high thermal efficiency and low exhaust pollutant levels. Characteristic of hydrogen engine operation using pre-mixed intake charge formation is a problem of pre-ignition resulting in an intake manifold 'backfire'. Additional problems include high NO_x production when using certain equivalence ratios and power output degradation due to low fuel

energy/volume density. Techniques for direct and manifold fuel injection are discussed as means for overcoming these problems. Emphasis is placed on the need for total engine control, integrating control of fuel injection, ignition timing, intake air throttling, and vehicle subsystems within a central electronic unit. An electronically actuated fuel injection valve and a prototype electronic control system are developed. These are applied in manifold and direct injection system geometries, and evaluated in engine testing. System effectiveness and feasibility are discussed. (Author)

A80-23206 Technico-economic study of distributing hydrogen for automotive vehicles. Y. Bréelle, C. Meyer (Institut Français du Pétrole, Rueil-Malmaison, Hauts-de-Seine, France), P. Gelin, and G. Petit (Commissariat à l'Énergie Atomique, Gif-sur-Yvette, Essonne, France). (*Revue de l'Énergie*, vol. 30, Apr. 1979, p. 342-357.) In: Hydrogen energy system; Proceedings of the Second World Hydrogen Energy Conference, Zurich, Switzerland, August 21-24, 1978. Volume 5. Oxford and New York, Pergamon Press, 1979, p. 2793-2827. 21 refs. Translation.

The technical and economic feasibility of storing and distributing hydrogen in liquid or gas form as a fuel for motor vehicles is analyzed, and two possible energy converters - the hydrogen motor and the hydrogen battery - are compared. It is concluded that at present the distribution of gaseous hydrogen presents fewer technological difficulties than that of liquid hydrogen. The energy yield of hydrogen compares favorably with that of fuels synthesized from coal and with gasoline when used in a hydrogen battery. The cost of hydrogen used in a hydrogen motor ranges from two to four times that of present fuels (natural gas, gas oil, high-octane gasoline). The cost of hydrogen used with a hydrogen battery is about twice that of gas oil and natural gas. C.K.D.

A80-23218 Advances in energy systems and technology. Volume 2. Edited by P. Auer (Cornell University, Ithaca, N.Y.). New York, Academic Press, Inc., 1979. 277 p. \$26.

The topics covered are: the development of solar power satellites, sea thermal power, the economics and system design for on-site solar energy systems, and models for energy technology assessment. The articles address technological issues or issues in a broader systems context, which are closely related to technological issues. B.J.

A80-23219 The development of solar power satellites. P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.; Sunsat Energy Council, Washington, D.C.). In: Advances in energy systems and technology. Volume 2. New York, Academic Press, Inc., 1979, p. 1-48. 49 refs.

The SPS concept is reviewed with particular attention given to technology options for conversion in space (photovoltaic and thermal-electric) and for power transmission to earth (microwave and laser transmission). Also discussed are SPS in the space transportation system, orbital assembly and maintenance, SPS/utility power pool interface, and SPS economic considerations and environmental impacts. B.J.

A80-23220 Sea thermal power - Competitive electricity and chemicals from the sea. J. H. Anderson (Sea Solar Power, Inc., York, Pa.) and D. F. Mayer. In: Advances in energy systems and technology. Volume 2. New York, Academic Press, Inc., 1979, p. 49-100. 17 refs.

Sea thermal power (STP) is reviewed with attention given to operating cycles, environmental impact, energy transmission, the development of a 100-MW sea solar power plant, and the economic perspective. A detailed development program is proposed and consideration is given to program cost and the outlook for the future. B.J.

A80-23221 Onsite solar energy systems - Economics and system design. H. C. Kelly (Office of Technology Assessment, Washington, D.C.). In: Advances in energy systems and technology.

Volume 2. New York, Academic Press, Inc., 1979, p. 101-178. 91 refs.

On-site solar energy systems are discussed with reference to scale considerations, costs and ownership, costs of competing energy, risk, and net costs to society. A method for evaluating the quantitative worth of solar energy is presented, and attention is given to the design of solar equipment and to basic issues in solar design. B.J.

A80-23222 Models for energy technology assessment. R. G. Richels (Electric Power Research Institute, Palo Alto, Calif.) and J. P. Weyant (Stanford University, Stanford, Calif.). In: Advances in energy systems and technology. Volume 2. New York, Academic Press, Inc., 1979, p. 179-260. 68 refs.

The need for energy technology assessment models is discussed along with problems of model implementation. The evolution of fixed-demand/single-fuel models, interfuel substitution models, and models with price-sensitive demands is examined; consideration is given to the incorporation of uncertainty and the link to the macroeconomy. A taxonomy for energy technology assessment models is presented, and models for assessing breeder-based energy are examined as an example. Finally, the state of the art of energy technology assessment is surveyed. B.J.

A80-23224 Heat pumps. R. D. Heap. London, E. & F. N. Spon, Ltd.; New York Halsted Press, 1979. 164 p. 305 refs. \$19.95.

With increasing energy costs and changing cost relativities, potential heat pump applications deserve a thorough reassessment. Such a reassessment is the objective of this book. The topics covered include the general, historical, and theoretical background material; vapor compression equipment; general aspects of system design, with particular reference to the design of space heating systems employing heat pumps; domestic, commercial, and industrial applications; and the relevance of some methods of economic analysis to the selection of heat pump systems. V.P.

A80-23272 Recombination in the space-charge region of Schottky barrier solar cells. P. Panayotatos and H. C. Card (Columbia University, New York, N.Y.). *Solid-State Electronics*, vol. 23, Jan. 1980, p. 41-47. 21 refs. NSF Grant No. ENG-76-15063.

The expression for the recombination rate as a function of voltage, of illumination level, and of position in the space-charge region of the semiconductor is derived analytically. The recombination current density is derived by numerical integration of the above expression. The results show good agreement with experiment for the typical Au-n type Si near-ideal Schottky barrier solar cells, and the comparison provides information on the uncovering of deep recombination centers by the hole quasi-Fermi level under increasing illumination. It is found that the principal effect of recombination under illumination is the reduction of the photocurrent. A rather surprising but gratifying result is that, once the above effect is taken into account by using short-circuit currents rather than photocurrents, the remaining (voltage dependent) effect of recombination is extremely close to the one in the dark, provided the increase in 'uncovered' recombination centers with illumination is taken into account. (Author)

A80-23293 Monitoring urban population and energy utilization patterns from satellite data. R. Welch (Georgia University, Athens, Ga.). (*International Society for Photogrammetry and International Union of Forest Organization, International Symposium on Remote Sensing for Observation and Inventory of Earth Sciences and the Endangered Environment, Freiburg im Breisgau, West Germany, July 2-8, 1978.*) *Remote Sensing of Environment*, vol. 9, Feb. 1980, p. 1-9. 12 refs.

Urban population trends in China and energy utilization patterns in the United States have been assessed from LANDSAT and Defense Meteorological Satellite Program (DMSP) images. Regression models developed from population data and urban area measurements on LANDSAT images provide insights into the success of Chinese urban planning policies for cities with populations of

500,000 to 2,000,000 people. Studies of the relationships between population, urban area, and electric-energy utilization patterns have been conducted from DMSP images of the United States. Microdensitometer profiles of illuminated cities recorded on nighttime (visual band) images are used in combination with the map boundaries of the built-up areas to create unique three-dimensional representations of the urban centers. The volumes of these three-dimensional figures may be computed and plotted with respect to population and/or energy utilization data to model regional patterns of use. (Author)

A80-23307 # The potential for development of high performance light aircraft. D. J. Marsden (Alberta, University, Edmonton, Canada). (*Canadian Aeronautics and Space Institute, Annual General Meeting, 25th, Ottawa, Canada, May 3, 1979.*) *Canadian Aeronautics and Space Journal*, vol. 25, 4th Quarter, 1979, p. 359-369.

The present study assesses the potential for improved performance of state-of-the-art light aircraft on the basis of available information on overall dimensions, installed power, cruising speed and all-up weight. The contribution to overall drag of undercarriage, engine cooling, and wing profile drag is estimated, and the impact of drag reduction on overall performance is discussed. It is shown that the cruise speed of a typical two-place single-engine aircraft with installed power of 100 hp, all-up weight of 1600 lb, and a cruise speed at 7000 ft altitude of 117 mph can be increased to 137 mph by making the under-carriage retractable and doing some further moderate clean-up of aerodynamic surfaces. Further modifications including a 50% reduction in wing area and addition of a full-span slotted flap to retain low landing speed will increase the cruise speed to 160 mph. More radical configuration changes to increase wing loading and place the propeller at the rear of the fuselage can increase cruising speed to 200 mph with no increase in the installed engine power. Fuel economy will be improved to 45 miles per gallon. L.M.

A80-23317 New standards in research and development (Neue Massstäbe für Forschung und Entwicklung). M. Grüner (Bundesministerium für Wirtschaft, Bonn, West Germany). *DFVLR-Nachrichten*, Feb. 1980, p. 3, 4. In German.

It is pointed out that in the present situation of energy and raw materials shortage, research and development problems can no longer be solved by customary or traditional means, and certainly not by seeking short-term solutions. It is imperative that the present scientific, economic, and administrative effort be planned and implemented with a view to the distant future. V.P.

A80-23326 Economically working big scale solar power stations pneumatic light-weight construction. H. Kleinwachter and J. Kleinwachter. *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1979, p. 9-14. 7 refs.

The concepts of large 'power bowls' and the smaller 'pneumatic solar farms', protected against wind and weather under transparent domes, are discussed from the economic and technical points of view. It is argued that extremely lightweight pneumatically deformed mirror-membrane concentrators can be built cheaply with sufficient optical precision. B.J.

A80-23327 Theoretical concentrations of solar radiation by central receiver systems. T. Sakurai and Y. Shibata (Tohoku University, Sendai, Japan). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1979, p. 15-18.

Solar concentrations by central receiver systems have been calculated theoretically assuming that plane heliostat-mirrors, sufficiently small in dimension, cover a circular field without clearance. The volume and area concentration were found to be maximum when the radius of heliostat-field was nearly the same as the height of receiver. The optimum radius showed a slight increase with increasing obliquity of incident radiation and the effect of the geometry of curved mirror on the concentration was discussed. (Author)

A80-23328 Solar and geothermal energy (Energie solaire et géothermie). M. Touchais. *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1979, p. 19-22. 6 refs. In French.

The use of solar energy as a complementary source to raise the energy yield of low-temperature geothermal fluids is discussed. Applications of solar energy to low-temperature and high-temperature geothermal sources are considered; in particular, the use of solar energy to increase the energy yield of low pressure and temperature steam in the Tuscany geothermal fields is examined. B.J.

A80-23329 Multifunctional collectors for dwellings - Examples of application (Système de toiture insolateur à fonctions multiples - Exemples d'application). J. Allier. *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1979, p. 34-37. In French.

The paper describes the design, construction, and testing of medium-temperature solar collectors intended for solar house heating systems. Particular attention is given to the design of the glass cover. The basic design philosophy of such collectors is considered, with attention given to the realization of polyvalent collectors, the regulation of solar heat in the heat cycle, and the recovery of waste heat. B.J.

A80-23330 Status and development of production of cheap hydrogen. P. Brennecke, H. Ewe, and E. Justi (Braunschweig, Technische Universität, Braunschweig, West Germany). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1979, p. 38-43. 22 refs.

The production of hydrogen by electrolysis is reviewed with attention given to the thermodynamics of the process, the design and characteristics of water electrolyzers, and new techniques of electrolysis. It is suggested that the most promising new approaches are the ELOFLUX cell (an alkaline electrolyzer that uses only high-porosity electrodes) and the solid polymer electrolyte water electrolyzer with cationic membranes. Other possibilities for hydrogen production using high temperature heat include thermochemical cycles, the electrochemical reduction of water vapor, and chemical cycles that use sulfuric acid solutions. B.J.

A80-23331 Solar energy electrochemical storage. P. Cristea and R. Tuduce (Bucuresti, Institutul Politehnic, Bucharest, Rumania). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1979, p. 44-47. 12 refs.

Solar electric power generation requires heat or electricity storage to ensure a continuous supply for users. Electrochemical storage by high-performance molten-electrolyte batteries of Li/S type is well suited to this purpose. In particular, the specific energy and specific power of the LiAl/LiCl-KCl/FeS battery are high enough to meet the requirements of both off-peak electric energy storage and electric-vehicle propulsion. B.J.

A80-23332 Autonomous solar electricity production with hydraulic active storage systems on the territory. R. Visentin (Calabria, Università, Cosenza, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1979, p. 48-51.

A general approach to the autonomous operation of solar power plants is developed with particular reference to the importance of the geographical location. Attention is given to a solar power generation system that operates in conjunction with hydraulic storage; this system also permits regulation of water for use in agricultural areas. The development of such systems in the Mediterranean area is considered. B.J.

A80-23333 Theoretical study of the heating of air in a plane honeycomb solar collector (Etude théorique du chauffage de l'air dans un insolateur plan alvéolaire). C. Pince and M. Daguénet (Perpignan, Université, Perpignan, France). *Coopération Méditer-*

ranéenne pour l'Energie Solaire, *Revue Internationale d'Héliotechnique*, 2nd Semester, 1979, p. 55-58. In French.

The paper describes the procedure of air heating in a honeycomb collector with reference to the characteristics of this type of collector and its practical advantages. A theoretical method for obtaining a parametric equation for the efficiency of the collector is presented. The effects of collector characteristics and of climatic variables on efficiency parameters are investigated. B.J.

A80-23366 # MHD equilibrium and stability of axial symmetric toroidal plasma with an elliptic cross section of triangular deformation. T.-C. Ma. *Acta Physica Sinica*, vol. 28, Nov. 1979, p. 833-840. 5 refs. In Chinese, with abstract in English.

Expanding the magnetic flux in terms of the deviation from the magnetic axis, the MHD equilibrium and localized mode instability of an axial symmetric plasma torus with a small triangular and elliptical deformation on its cross-section was investigated. The optimization of the configuration has been analyzed and an optimal factor of the triangular deformation given. The analysis shows that it is possible to strengthen ohmic heating substantially by selecting suitable factors of the triangular deformation. (Author)

A80-23404 Enhancement of the efficiency of neodymium lasers by conversion of the pump radiation in a luminescent liquid. K. L. Vodop'ianov, N. N. Il'ichev, A. A. Maliutin, G. A. Matiushin, and V. M. Podgaetskii (Akademiiia Nauk SSSR, Fizicheskii Institut, Gorki, USSR). (*Kvantovaiia Elektronika /Moscow*), vol. 6, Aug. 1979, p. 1795-1798. *Soviet Journal of Quantum Electronics*, vol. 9, Aug. 1979, p. 1059-1061. 11 refs. Translation.

A80-23496 The open-circuit voltage of n(+)-n-p high-low-emitter /HLE/ junction solar cells in concentrated sunlight. W.-Z. Shen and C.-Y. Wu (National Chiao Tung University, Hsinchu, Nationalist China). *Journal of Applied Physics*, vol. 51, Jan. 1980, p. 466-473. 12 refs. National Science Council of Nationalist China Contract No. 68E-0404(02).

Simple analytical expression for the open-circuit voltage of a n(+)-n-p(p(+)-p-n) high-low-emitter (HLE) junction solar cell, which is valid for both the low and high levels of optical illuminations, is presented. Based on the principle of superposition, the open-circuit voltage of a n(+)-n-p high-low-emitter junction solar cell is expressed in terms of the short-circuit current density and the known saturated dark current. Effects of the high-low junction, the energy-gap shrinkage, and the dimensions of the HLE junction solar cell on the open-circuit voltage are included. The numerical results of the derived expression are found to be in good agreements with the exact numerical analysis of Sah et al. The optimal design considerations based on the known characteristics of the open-circuit voltage are also discussed. (Author)

A80-23499 Nickel pigmented anodic aluminum oxide for selective absorption of solar energy. A. Anderson (Granges Aluminium, Finspang, Sweden), O. Hunderi (Norges Tekniske Hogskole, Trondheim, Norway), and C. G. Granqvist (Chalmers Tekniska Hogskola, Goteborg, Sweden). *Journal of Applied Physics*, vol. 51, Jan. 1980, p. 754-764. 78 refs.

The paper gives an experimental and theoretical treatment of the spectral reflectance of electrolytically colored anodized aluminum surfaces developed for efficient photothermal conversion of solar energy. The optical performance was studied by the recording of hemispherical reflectance or specular reflectance in conjunction with diffuse light scattering. In addition, the structure of the coatings was investigated by scanning electron microscopy on fractured specimens, Auger electron spectroscopy combined with depth profiling by sputtering, and atomic absorption analysis. A multilayer model is formulated, which features a sheath near to the Al interface comprised of metallic Ni particles in an Al₂O₃ matrix. M.E.P.

A80-23511 Royal Society, Discussion on Solar Energy, London, England, November 15, 16, 1978, Proceedings. *Royal*

Society (London), Philosophical Transactions, Series A, vol. 295, no. 1414, Feb. 7, 1980. 168 p.

Works covered include solar space heating with air and liquid systems, results of solar heating experiments, systematic design assessment techniques for solar buildings, and research at the building research establishment into the application of solar collectors for space and water heating in buildings. Other topics are examined such as heterojunction solar cells, photoelectrochemical cells and the microbial productions of energy sources from biomass. C.F.W.

A80-23512 Solar space heating with air and liquid systems. G. O. G. Lof (Colorado State University, Fort Collins, Colo.). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 349-359. Research sponsored by the U.S. Department of Energy.

Detailed performance data on several types of solar heating and cooling systems in buildings of identical designs are presented, compared and the results interpreted. Maintenance and repair requirements are noted and contrasted, and forecasts of their use in various applications are presented. It is concluded that an air-heating solar system can effectively provide space and domestic water heating in residential buildings. C.F.W.

A80-23513 Results of solar heating experiments. B. J. Brinkworth (University College, Cardiff, Wales). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 361-373. 27 refs.

Results of solar heating experiments are presented employing full scale systems. The purpose of the study is to develop solar components, verify predicted characteristics, establish principles of good design and demonstrate the performance of systems in routine use. Trials show that solar energy can make a significant contribution to the requirements for heating domestic hot water and living spaces. The experiments on solar heating ranged from laboratory tests on individual components to long term trials with full scale systems in everyday use. C.F.W.

A80-23514 Systematic design assessment techniques for solar buildings. J. K. Page, G. G. Rodgers, and C. G. Souster (Sheffield, University, Sheffield, England). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 379-401. 24 refs. Research supported by the Science Research Council, Building Research Establishment, and European Economic Community.

The paper describes the various approaches developed for the detailed modelling of the relevant climatic input variables for systematic design assessments for solar housing techniques. A report is made of the techniques developed to generate systematic short wave radiation data for vertical and inclined surfaces for different types of weather. The analysis is based on different types of days, such as sunny, average and overcast. Work on the accurate estimation of the magnitude of the associated weather variables affecting heat transfer in the external environment is also reported, covering air temperature, wind speed and long wave radiation exchanges. C.F.W.

A80-23515 Research at the Building Research Establishment into the applications of solar collectors for space and water heating in buildings. S. J. Leach (Building Research Establishment, Watford, Herts., England). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 403-412; Discussion, p. 412-414. 11 refs.

A80-23516 Solar heating and air conditioning. J. B. Comly (General Electric Co., Schenectady, N.Y.). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*)

Royal Society (London), Philosophical Transactions, Series A, vol. 295, no. 1414, Feb. 7, 1980, p. 415-422. 12 refs.

The paper discusses the relative merits and the state of development of several solar boosted heat pump systems with regard to their ability to provide air conditioning using conventional vapor compression refrigeration cycles. A brief description is given of the status of solar fired air conditioning. Clues to an approach to cool storage in solar air conditioning systems are given by an assessment of cool storage in peak electrical loads from conventional air conditioning equipment. A system using hydrated salts in a rolling cylinder thermal energy storage device for compact and effective cool storage is also described. C.F.W.

A80-23517 Non-convecting solar ponds. H. Tabor (Scientific Research Foundation, Jerusalem, Israel). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 423-433. 18 refs.

A salt gradient is imposed on a black-bottomed pond about 1 m deep; this creates a density gradient (positive measured downwards) which suppresses convection when the pond is heated from the bottom by absorbed solar radiation. Between 15 and 25% of the incident radiation, depending upon pond cleanliness, reaches the bottom and can be decanted by stratified hydrodynamic flow of the bottom layer. Temperatures approaching the boiling point have been recorded. At 32 deg latitude and under Israel sunshine conditions, estimated annual thermal output from a pond of 1 square kilometer is equivalent to 43,000 t of fuel oil. A method of avoiding salt diffusion, which would slowly destroy the gradient, is described. Practical problems include suppression of surface mixing by wind and the possible effects of heating large areas of ground. (Author)

A80-23518 Present status and future prospects of silicon solar cell arrays and systems. H. Durand (Commissariat à l'Energie Solaire, Paris, France). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 435-443. 7 refs.

The first part of this paper deals with the present state of the art of the single crystal silicon cell industry: production volume, cost breakdown and main technologies. In the second section, improvements of the single crystal technologies, caused by mass production and automated physical processes, are described. These developments are compared, with regard to both cost and performance, with the future polycrystalline (or 'semicrystalline') materials, including amorphous silicon films. The various approaches, i.e. vapour or liquid film deposition, or oriented bulk ingot crystallization, are discussed. The third part assumes that very low cost goals can be achieved, either through the development of sophisticated single crystal technology, or through a polysilicon breakthrough. Future markets for photovoltaic conversion, including medium-size power generating plants, are then considered. (Author)

A80-23519 Heterojunction solar cells. S. Wagner (Solar Energy Research Institute, Golden, Colo.). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 445-450; Discussion, p. 450, 451. 10 refs.

This paper gives a qualitative description of semiconductor-semiconductor heterojunction solar cells. The two groups of heterojunctions of greatest economic potential, very highly efficient cells for concentrator applications and moderately efficient thin film cells for flat plates, are described with examples. These examples illustrate the role of heterojunctions in surface passivation, monolithic multijunction devices, devices with semiconductors of only one conductivity type and low-temperature fabrication techniques. (Author)

A80-23520 Photoelectrochemical cells. A. J. Nozik (Solar Energy Research Institute, Golden, Colo.). (*Royal Society, Dis-*

ussion on Solar Energy, London, England, Nov. 15, 16, 1978.) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 453-470. 38 refs.

The application of photoelectrochemical systems based on photoactive semiconducting electrodes to the problem of solar energy conversion and chemical synthesis is discussed. Three types of cells are described: electrochemical photovoltaic cells (wherein optical energy is converted into electrical energy); photoelectrolysis cells (wherein optical energy is converted into chemical free energy); and photocatalytic cells (wherein optical energy provides the activation energy for exoergic chemical reactions). The critical semiconductor electrode properties for these cells are the band gap, the flat-band potential, and the photoelectrochemical stability. No semiconductor electrode material is yet known for which all three parameters are simultaneously optimized. An interesting configurational variation of photoelectrolysis cells, labelled 'photochemical diodes', is described. These diodes comprise cells that have been collapsed into monolithic particles containing no external wires. Recent advances in several areas of photoelectrochemical systems are also described. (Author)

A80-23521 Photolysis of water for H₂ production with the use of biological and artificial catalysts. D. O. Hall, M. W. W. Adams, P. Morris, and K. K. Rao (King's College, London, England). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 473-476. 12 refs. Research supported by the Commission of the European Communities, Imperial Chemical Industries, and Science Research Council.

An aqueous mixture of chloroplasts, hydrogenase and electron transfer catalyst on illumination liberates H₂, the source of the H atoms being water. The rate and duration of H₂ production from such a system depends on the stability of chloroplast and hydrogenase activities in light and oxygen. Both chloroplasts and hydrogenases can be stabilized to a certain degree by immobilization in gels or by incubation in bovine serum albumin. Natural electron carriers of hydrogenases are ferredoxin, cytochrome c₃ and NAD. Viologen dyes and synthetic iron-sulphur particles (Jeevanu) can substitute for the biological carriers. Methyl viologen, photoreduced in the presence of chloroplasts, can liberate H₂ in combination with Pt (Adam's catalyst). An aqueous solution of proflavine can be photoreduced in the presence of organic electron donors such as EDTA, cysteine, dithiothreitol, etc.; the reduced proflavine can subsequently liberate H₂ with MV-Pt, MV-hydrogenase, ferredoxin-hydrogenase or cytochrome-hydrogenase systems. (Author)

A80-23522 Energy from the biological conversion of solar energy. N. K. Boardman (Commonwealth Scientific and Industrial Research Organization, Div. of Plant Industry, Canberra, Australia). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 477-487; Discussion, p. 487-489. 30 refs.

The paper examines the possible energy contributions by employing trees and other biological solar collectors. Attention is given to the potential availability of biomass for fuel production, emphasizing the average annual production of various types of biomass. It is concluded that biomass will not be able to contribute a substantial fraction of the world's energy demands but it was also noted that photosynthesis can make a useful contribution, particularly in countries with a relatively low per capita consumption of energy or with large areas of rain-fed productive land. C.F.W.

A80-23523 Microbial production of energy sources from biomass. R. C. Righelato (Tate and Lyle, Ltd., Reading, Berks., England). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 491-500; Discussion, p. 500. 32 refs.

The biochemical options available for the microbial production of energy sources from biomass is reviewed and some of the technology available for microbial conversion is discussed with particular reference to present limitations and how they may be overcome. Attention is given to the chemical process of anaerobic fermentation emphasizing the chemical reaction of glucose into pyruvic acid. The capital costs and energy consumption of ethanol and methane and their production are discussed. It is concluded that anaerobic fermentation of carbohydrates and digestion of biomass-containing effluents can be used as methods for achieving greater energy availability. C.F.W.

A80-23524 Indirect utilization of solar energy. H. Bondi (Department of Energy, London, England). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 501-506.

Wind and wave energy are examined as means for indirect solar energy utilization. The advantages and disadvantages of making use of wind energy by the waves that are created on the ocean surface are discussed. Various devices for converting wave power into electrical energy are studied, including a device that is designed to turn the motion of the water into air motion which in turn drives an air turbine. It is noted that predicting the future for wave power is difficult but that the total power of waves that break on the English shore is probably more than the total electricity generating capacity of England. C.F.W.

A80-23525 Effect of solar power satellite transmissions on radio-astronomical research. B. Anderson and B. Lovell (Manchester, Victoria University, Jodrell Bank, England). (*Royal Society, Discussion on Solar Energy, London, England, Nov. 15, 16, 1978.*) *Royal Society (London), Philosophical Transactions, Series A*, vol. 295, no. 1414, Feb. 7, 1980, p. 507-511. 5 refs.

The paper examines the use of solar powered satellites as an additional energy source. Calculations indicate that severe restrictions will be placed on the use of radio telescopes on earth for the study of radio emission from celestial objects. It is determined that for a single solar powered satellite it would be possible to operate with the receiver protected by suitable filters at radio frequencies well separated from 2.45 GHz and at angles of look well displaced from the satellite. C.F.W.

A80-23533 Technical development of the Diffuser Augmented Wind Turbine (DAWT) concept. K. M. Foreman and B. L. Gilbert (Grumman Aerospace Corp., Bethpage, N.Y.). *Wind Engineering*, vol. 3, no. 3, 1979, p. 153-166. 8 refs. Contract No. EY-76-C-2-2616.

An attractive advanced wind energy concept is the Diffuser Augmented Wind Turbine (DAWT), which involves the addition of a turbine wake diffuser making possible a greatly increased mass flow rate through the wind turbine. The technical challenge has been to develop a compact diffuser to minimize the equipment cost and complexity associated with a given power augmentation capability. A phased three-year investigation, involving three test facilities and based upon the use of both multibladed turbines and of screens to simulate turbine pressure drop, has led to the development of several compact diffuser designs that appear technically and economically attractive. Model tests with a nonoptimized DAWT configuration have demonstrated power augmentation for a given turbine diameter and wind speed by a factor of about 3.5 compared with an ideal conventional system. Further DAWT system refinements are expected to raise this factor to the range between 6 and 8. Corresponding improvements in plant capacity factor through other operational advantages may potentially bring the busbar cost of generated electricity to economically competitive levels. (Author)

A80-23534 Describing wind data. D. T. Swift-Hook (Central Electricity Generating Board, Applied Physics Div., Leatherhead, Surrey, England). *Wind Engineering*, vol. 3, no. 3, 1979, p. 167-186.

When assessing a potential wind-power site for which wind data are available, it is important to know for what fraction of the time wind of any given speed is available. It is noted that wind data are usually presented as the amount of time various wind speeds are exceeded, i.e. as cumulative probabilities. The distributions are usually (half-) bell-shaped indicating that, for most of the time, the wind is in some preferred range that can be specified in terms of its 'upper' and 'lower' velocities. It follows that many sets of data fit Weibull distribution curves; the parameter alpha adjusts the shape of the bell and can be found by various methods, including the slope of a Weibull plot, from 'upper' and 'lower' or 90% and 10% velocities, from the slope along the straightest part of the curve, or by calculation using individual points. It is concluded that a wide range of wind speeds can be summarized by specifying two parameters: the standard wind speed and the shape factor. L.M.

A80-23535 Wind energy research and development at Lincoln. R. E. Chilcott (Lincoln College, Canterbury, New Zealand). *Wind Engineering*, vol. 3, no. 3, 1979, p. 187-196. 14 refs.

Wind and energy research and development work undertaken at Lincoln College, New Zealand, and covering such activities as wind-energy surveying and resource assessment, wind-environment amelioration and wind-power utilization, is discussed. Results show that in order to provide reliable air generator systems techniques developed for aircraft, helicopters and wind-sensitive structures have to be used, for example, helicopter blades, coupled to a hydraulic variable-pitch agricultural-aircraft-type propeller hub. Provided that these methods are applied to produce economic systems, (estimated at 10 cents/KWh) wind power can make a small but significant contribution to electricity supplies. The impact of wind turbines on the environment remains to be seen. With rising oil prices the increased use of agricultural and horticultural shelter and the fairing of road transport vehicles to reduce fuel consumption are expected as immediate impacts, associated with wind-environment amelioration. L.M.

A80-23536 A statistical methodology for study of wind characteristics from a close array of stations. T. N. Goh and G. K. Nathan (University of Singapore, Singapore). *Wind Engineering*, vol. 3, no. 3, 1979, p. 197-206. 8 refs.

A method for improving the effectiveness of meteorological data interpretation is described, the goal being to develop analytical tools for use in the selection of wind power station sites. Wind measurements were collected from six stations within a 700 sq km area on and off Singapore. Autoregressive and stochastic-dynamic modelling techniques were applied to analyze simultaneous data from all stations, and the analysis was done in two stages: a single station analysis, involving time series modelling in addition to the usual graphical presentation of data summary, and further investigations in which the interstation relationship was expressed through impulse response functions. The approach has the advantage of yielding mathematical models that carry essential characteristics of data interdependence in both time and space in only a small collection of parameter values, and comparisons of wind characteristics can be made through numerical values of model parameters as well as model forms. L.M.

A80-23537 An oscillatory wind energy convertor. G. Ahmadi (Shiraz University, Shiraz, Iran). *Wind Engineering*, vol. 3, no. 3, 1979, p. 207-215. 18 refs. Research supported by Shiraz University.

The paper reviews the concept of wind energy conversion through the oscillation of an aerodynamically unstable system and a small wind energy convertor model of H section is presented. The unit is mounted on a shaft connected to a mechanical rectifier and the restoring couple is supplied by a steel rod pendulum. The model was tested at the exit of a wind tunnel, and a nonlinear theory predicting the power coefficient for such a model was developed. The test results are compared to the theoretical predictions showing a good correlation between theoretical and experimental values. It is also shown that the efficiency of energy conversion decreases with

increasing wind speed. It is concluded that although the oscillating convertor has the advantage of simple design and low construction cost, which may make it attractive for use in remote areas of developing countries, the low value of its power coefficient is considered a deficiency. L.M.

A80-23833 Material requirements for coal gasification (Anforderungen an Werkstoffe für den Einsatz bei der Kohlevergasung). G. Kalwa (Mannesmann-Forschungsinstitut GmbH, Duisburg, West Germany). (*Deutscher Verband für Materialprüfung, Jahrestagung, Stuttgart, West Germany, Oct. 8-11, 1979.*) *Materialprüfung*, vol. 22, Jan. 1980, p. 27-32. In German.

It is noted that coal gasification processes, especially those with nuclear process heat, require the use of high temperature resistant metals. Attention is given to the various forms of high temperature corrosion which influence the service life of these construction materials. It is concluded that a sensible alloy development should lead to a material with a high corrosion resistance and high temperature stability which can be formed into small diameter pipes with present technology and can be welded reliably. M.E.P.

A80-23938 # Scale-up of advanced MHD generators. C. D. Maxwell, S. T. Demetriades, D. A. Oliver, A. A. Vetter, and T. F. Swean (STD Research Corp., Arcadia, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0179.* 18 p. 33 refs.

The steady state performance and fluid mechanical behavior of linear, combustion-driven MHD power generators from laboratory-scale to commercial-scale are characterized through numerical analysis of seven real generator designs. Despite the diverse philosophies embodied in these designs, the power extraction parameters and quasi-three-dimensional fluid behavior correlate well with appropriate interaction parameters. The scale dependence of transverse conductivity nonuniformity and its influence on generator performance are examined, and the impact of the unconventional flow field in the MHD generator upon the design and performance of other MHD System components is discussed. (Author)

A80-23953 # The STD/MHD codes - Comparison of analyses with experiments. A. A. Vetter, C. D. Maxwell, and S. T. Demetriades (STD Research Corp., Arcadia, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0024.* 17 p. 39 refs. Contract No. EX-76-C-01-2243.

In the present paper, the STD Research MHDQ3D code is used to simulate experimental tests of the Avco Mark VI-C Faraday-connected and the UTSI diagonal-conducting-wall MHD power-generating channels. The simulations are analyzed and the results are compared with experimental data. Additional analyses provide insight into phenomena that occur in MHD generators, but cannot be measured adequately. V.P.

A80-23954 # Transient response of large experimental MHD power generator flowtrain systems. D. A. Oliver, R. D. Crouse, C. D. Maxwell, and S. T. Demetriades (STD Research Corp., Arcadia, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0025.* 14 p.

STD Research Corporation's TRANSIENT code family can model, simulate, and reveal with great precision a very large number of transient phenomena in MHD power generator flow trains. Typical cases for several of these transient episodes for MHD flow trains are discussed. These include the start-up and shutdown transient, the flowtrain response to downstream fluctuations imposed by a periodically stalled diffuser, and self-excited large amplitude magnetoacoustic instabilities in multiple load diagonal operation of the MHD generator. Detailed discussion of important processes occurring in such transient situations such as Hall voltage overshoots is presented. (Author)

A80-23956 # The state-of-the-art of cryogenic heat pipes. R. C. Prager and A. Basilius (Hughes Aircraft Co., Torrance, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0211.* 5 p. 16 refs.

The paper reviews the design and fabrication of cryogenic heat pipes. Working fluids and materials are considered. Attention is given to the published experimental results obtained with cryogenic working fluids at temperatures below 125 K, with comment on the utility and properties of each fluid. V.T.

A80-23998 # Kinematic synthesis of drive mechanisms for solar concentrating collector using auxilliary mirrors. A. L. Dilpare (Florida Institute of Technology, Melbourne, Fla.) and A. J. Morales. In: *World Congress on the Theory of Machines and Mechanisms, 5th, Montreal, Canada, July 8-13, 1979, Proceedings. Volume 2.*

New York, American Society of Mechanical Engineers, 1979, p. 1460-1463. 8 refs.

A novel solar concentrating collector has been developed wherein the flat plate collector remains stationary throughout the day, while the solar tracking function is obtained with a pair of contiguous nonparallel flat mirrors. Geometric optics are used to derive the required angular relationship between the auxiliary mirrors and the incident solar angle as a function of the mirror/collector width ratio. Synthesis to obtain a drive mechanism used an analytic method to drive a simple four-bar mechanism having structural errors on the order of a few degrees. This mechanism may be driven with either an optical servo solar tracker, or with a simple 24 hour clock. Another four-bar mechanism was synthesized to generate the collector diurnal elevation angular change, and may also be driven with a 24-hour clock. The results of a computer analysis of collector gain and efficiency using the simplified mechanisms are presented in terms of daily averages, and the overall annual average; the annual average functional efficiency of the drive mechanism is found to be 93.39 per cent. (Author)

A80-24070 Aerial thermography - A tool for making people aware of energy conservation (La thermographie aérienne - Outil de sensibilisation aux économies d'énergie). J. Ruelland, G. Forgues (Bureau des Economies d'Énergie, Montreal, Canada), and H. Audet (Ministère des Terres et Forêts, Centre Québécois de Coordination de la Télédétection, Sainte-Foy, Quebec, Canada). In: *Remote sensing and resources management; Congress, 1st, Montreal, Canada, November 1977 and Congress, 2nd, Sherbrooke, Quebec, Canada, May 3, 4, 1979, Proceedings.* Sainte-Foy, Quebec, Canada, Association Québécoise de Télédétection, 1979, p. 205-209. 6 refs. In French.

In 1978 the Energy Conservation Office of Quebec sponsored a program whose objective was to use the aerial thermography of buildings in order to make people aware of the need for energy conservation. The aerial data were collected on April 6 and 7, 1978, and a clinic was held in Joliette, the site of the experiment, at the end of May. All home owners and tenants were invited to see the thermal condition of their homes and to talk with experts. B.J.

A80-24071 Problems concerning the interpretation of thermographic data for the detection of energy losses from buildings (Problèmes d'interprétation des thermographies pour la détection des pertes d'énergie des bâtiments). C. Prévost (Université Laval, Quebec, Canada) and F. Bonn (Sherbrooke, Université, Sherbrooke, Quebec, Canada). In: *Remote sensing and resources management; Congress, 1st, Montreal, Canada, November 1977 and Congress, 2nd, Sherbrooke, Quebec, Canada, May 3, 4, 1979, Proceedings.*

Sainte-Foy, Quebec, Canada, Association Québécoise de Télédétection, 1979, p. 211-222. 7 refs. In French.

The potential of aerial thermography for detecting heat losses from buildings was assessed in a pilot program conducted in Joliette, Quebec. This paper describes the experiment and the procedure of data interpretation. The Joliette images showed that it is possible to detect 98 per cent of houses with an insulation level of R 15 or less.

It was not possible, however, to distinguish a moderately insulated house from a well insulated one. B.J.

A80-24072 Thermography at the earth's surface and the energy efficiency of buildings (Thermographie au sol et économie d'énergie dans les bâtiments). J. Laforest and M. Thériault (Ministère des Travaux Publics et de l'Approvisionnement, Direction de la Construction, Québec, Canada). In: Remote sensing and resources management; Congress, 1st, Montreal, Canada, November 1977 and Congress, 2nd, Sherbrooke, Quebec, Canada, May 3, 4, 1979, Proceedings. Sainte-Foy, Quebec, Canada, Association Québécoise de Télédétection, 1979, p. 223-230, 6 refs. In French.

A portable thermography system was used to determine heat losses from four buildings in different regions of Quebec during the winter of 1978-1979. The system consisted of an IR camera (type AGA 750) operating in the 2-5.6 micron range along with an imager yielding a dynamic representation of the temperature gradients of the objects studied. The experiment is described in detail, and some causes of heat loss are identified. B.J.

A80-24124 Exotic energy R&D has potential. J. T. Miskell. *Energy*, vol. 5, Winter 1980, p. 6, 7.

The paper examines the use of wave power or ocean gradient differential as one aspect of energy production along with the farming of biomass as a feedstock for methane production. Attention is given to various cost estimates for projects such as the conversion of kelp to methane that will hopefully result in a reasonable yield. The design features of a turbine wind tower or tornado machine are discussed and some of the advantages of the design are presented. C.F.W.

A80-24125 Water turbine technology for small power stations. T. Salovaara (Oy Tampella Ab, Tempeke, Finland). *Energy*, vol. 5, Winter 1980, p. 23, 24.

The paper examines hydro-power stations and the efficiency and costs of using water turbines to run them. Attention is given to different turbine types emphasizing the use of Kaplan-turbines and runners. Hydraulic characteristics and mechanical properties of low head turbines and small turbines, constructed of fully fabricated steel plate structures, are presented. C.F.W.

A80-24223 Gradient bounds for plasma confinement. I. Stakgold (Delaware, University, Newark, Del.). *Mathematical Methods in the Applied Sciences*, vol. 2, no. 1, 1980, p. 68-72, 11 refs. Army-supported research.

The problem of plasma confinement in a tokamak machine has recently attracted considerable mathematical attention. In the present article, gradient bounds for the solution are obtained through the use of differential inequalities and the Hopf maximum principle. These estimates, which take slightly different forms in the plasma and vacuum regions, become exact in the one-dimensional case. An estimate is also given for the distance from the boundary of the interior point where the maximum of the solution is attained. (Author)

A80-24256 Control performance of an air-blown fixed bed coal gasification combined cycle plant in utility power systems application. D. J. Ahner, A. S. Brower, A. S. Patel (General Electric Co., Schenectady, N.Y.), and G. Quentin (Electric Power Research Institute, Palo Alto, Calif.). In: Joint Automatic Control Conference, Denver, Colo., June 17-21, 1979, Proceedings. New York, American Institute of Chemical Engineers, 1979, p. 601-608.

This paper presents the effects of integrated air-blown fixed bed coal gasification/combined cycle (GCC) power generation on the control performance of a utility power system. The logic of the GCC station control, major plant subloops and the power system control are illustrated and discussed, stressing the impact and/or modification of these controls for this new type of energy supply. Results of digital computer simulations, showing the transient response of the plant and electrical system power flows in response to system disturbances, are presented. (Author)

A80-24319 Numerical modeling of heat flow in underground coal liquefaction. F. K. Fong and D. R. Skidmore (Ohio State University, Columbus, Ohio). In: Numerical methods in thermal problems; Proceedings of the First International Conference, Swansea, Wales, July 2-6, 1979. Swansea, Wales, Pineridge Press, Ltd., 1979, p. 805-814, 5 refs.

A stable numerical method, called the method of alternating variables, has been developed to solve the conjugated nonlinear heat transfer problems encountered in the in-situ coal liquefaction process. The method simplifies the calculation of implicit approximations. One or two iterations are sufficient for accurate solution (plus or minus 1 C). When applied to hyperbolic equations with inherent discontinuity, the alternating variable method solves the implicit approximations explicitly with high accuracy. V.L.

A80-24482 Low-density ignition scenarios in injection-heated tokamaks. J. A. Holmes, J. A. Rome, W. A. Houlberg, Y.-K. M. Peng, and S. J. Lynch (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Nuclear Fusion*, vol. 20, Jan. 1980, p. 59-67, 20 refs.

Plasma heating and ignition by neutral injection have been studied using a Monte-Carlo neutral-injection computer code coupled to a single-fluid, one-dimensional (1-D) transport code and a two-dimensional (2-D) flux-conserving equilibrium code. It is shown that, by taking advantage of central alpha-heating, profile effects, and flux surface shifts in elongated plasmas, it is possible to ignite a modelled, prototypical reactor plasma using 45-30 MW of 100-150 keV (D-super-plus) neutral beams. To do this, the plasma is started at full bore but with a density below that needed for ignition. Because of the decreasing beam line efficiency with increasing energy, it is found that a nearly constant extracted power of about 85-95 MW is needed for ignition in the range studied. There is thus little economic difference in this energy range. However, higher-energy beams around 150 keV imply fewer injectors and perhaps lower impurity production rates during heating to ignition. (Author)

A80-24487 Two-stroke tokamak reactor. L. M. Degtiarev (Akademiia Nauk SSSR, Institut Prikladnoi Matematiki, Moscow, USSR), V. I. Pistunovich, and V. D. Shafranov (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Nuclear Fusion*, vol. 20, Jan. 1980, p. 102, 103, 8 refs.

The scheme of a two-stroke tokamak reactor without a divertor is considered. The reactor operates with short pulses, at the end of which the whole of the plasma column is expelled automatically from the working chamber into an auxiliary vacuum chamber where quenching of the discharge takes place. Then fresh deuterium-tritium mixture is admitted into the working chamber, the discharge is initiated, and the cycle repeats itself. (Author)

A80-24498 Model for description of transient behavior of a tokamak discharge. A. Airoidi Crescentini, G. Grosso, G. Lampis, and E. Lazzaro (EURATOM and CNR, Laboratorio di Fisica del Plasma, Milan, Italy). *Nuovo Cimento B, Serie 11*, vol. 54B, Dec. 11, 1979, p. 426-434, 7 refs.

The transient behaviour of a tokamak discharge is analysed through a simple electro-dynamical model. From this model indications are obtained on the macroscopic parameters, controlled by the experimentalists, defining the range of existence and gross stability of the discharge. The findings of the analysis are compared with the experimental results of the tokamak Thor. (Author)

A80-24512 The thermodynamics of heating. I - The second law and conventional heating systems (Zur Thermodynamik des Heizens. I - Der zweite Hauptsatz und die konventionellen Heizsysteme). H. D. Baehr (Hamburg, Hochschule der Bundeswehr, Hamburg, West Germany). *Brennstoff-Wärme-Kraft*, vol. 32, Jan. 1980, p. 9-15, 14 refs. In German.

The paper introduces a 'heating number' to enable better determination of the primary energy use of a heating system. This number is defined as the relationship between the yearly heat requirement and the primary energy consumption. Its maximum which is fixed by the laws of nature, is calculated with the help of the second law of thermodynamics. It is shown that the maximum of

the 'heating number' depends on the heating comfort required and on the frequency curve of the ambient temperature. Finally, it is noted that this maximum lies between 16 and 20 for the Federal Republic of Germany and could be obtained from an ideal reversible heating system. M.E.P.

A80-24531 Photovoltaics. I - Solar-cell arrays. J. J. Loferski (Brown University, Providence, R.I.). *IEEE Spectrum*, vol. 17, Feb. 1980, p. 26-31.

Semiconductor photovoltaic devices such as silicon photovoltaic cells and thin-film copper-sulfide/cadmium-sulfide cells are discussed, as well as gallium arsenide single-crystal, polycrystalline GaAs, compound, amorphous silicon, and electrochemical solar cells. Attention is given to the economics of solar-cell power systems, a combination of efficiency and cost that must be met before electricity can be generated at a price comparable to that for conventional systems. Analyses of flat-plate and concentrator systems are presented together with a look at methods of improving overall efficiency. C.F.W.

A80-24532 Photovoltaics. II - Flat panels. M. Wolf (Pennsylvania, University, Philadelphia, Pa.). *IEEE Spectrum*, vol. 17, Feb. 1980, p. 32, 33.

The paper discusses the future of solar cell technology with emphasis on high performance and a reduction of present fabrication costs. Methods of producing pure silicon are discussed, including the edge-defined film growth method and the capillary action shaping technique. Attention is given to the major steps in the solar-cell fabrication sequence of junction formation, contact metallization, and application of an antireflection coating. C.F.W.

A80-24533 Photovoltaics. III - Concentrators. C. E. Backus (Arizona State University, Tempe, Ariz.). *IEEE Spectrum*, vol. 17, Feb. 1980, p. 34-36.

Photovoltaic concentration systems that redirect sunlight falling on a surface to a smaller solar-cell surface concentrating the intensity of sunlight many times are examined. It is noted that solar cells for concentrating systems must be designed for low internal resistance as well as for high sunlight intensities. Two designs of silicon cells are presented that perform well at high concentrations; these are interdigitated back-contact cells and vertical multijunction cells. Attention is given to heat tapping of reemitted light. C.F.W.

A80-24534 Photovoltaics. IV - Advanced materials. J. J. Loferski (Brown University, Providence, R.I.). *IEEE Spectrum*, vol. 17, Feb. 1980, p. 37, 38.

The paper examines compound semiconductor solar cell development, which includes the development of thin-film polycrystalline cells and tandem concentrating collector cells. Attention is given to the low-cost processes of copper sulfide/cadmium sulfide and gallium arsenide cells. Various binary-compound semiconductors such as indium phosphide and cadmium telluride are also examined. C.F.W.

A80-24535 Photovoltaics. V - Amorphous silicon cells. D. E. Carlson (RCA Laboratories, Princeton, N.J.). *IEEE Spectrum*, vol. 17, Feb. 1980, p. 39-41. Research supported by the U.S. Department of Energy.

Hydrogen amorphous silicon alloys that enable fairly efficient output currents of solar cells are investigated. It is noted that amorphous silicon produced from a glow discharge in silane gas has very few defect states. Attention is given to the fabrication techniques such as the deposition process and the parameters involved; the process of forming typical Schottky barrier cells is also discussed. C.F.W.

A80-24537 Cheap electricity from French tides. H. Andre (Electricité de France, Annecy, Haute-Savoie, France). *IEEE Spectrum*, vol. 17, Feb. 1980, p. 54-57.

A tidal power plant built in Saint-Malo, France is examined, and some of the problems that have resulted in recent years are analyzed.

These include mechanical problems due to turbine runner-blade seal failure and electrical problems involving electroerosion and structural station difficulties. The effects of tidal power plants on the environment are discussed, and it is noted that all possible side effects of the operations are very limited. Attention is given to the basic requirements for constructing power sites. C.F.W.

A80-24660 # Technical evaluation of gaseous suspensions of graphite for the absorption of concentrated solar radiation. M. A. M. Abdelrahman. Research supported by the Ecole Polytechnique Fédérale de Lausanne, Zurich, Juris-Verlag (Ecole Polytechnique Fédérale de Lausanne, Institut de Thermique Appliquée, Communication, No. 6), 1979, 174 p. 81 refs.

The applicability of gaseous suspensions of graphite particles as absorbers of concentrated solar radiation is investigated. Conventional solar energy absorbers are considered, and it is shown that the direct absorption of solar energy by absorbing fluids presents important advantages in efficiency and corrosion resistance compared to absorption by surfaces. In the absence of existing black fluids, suspensions of graphite particles one micron in diameter are presented as satisfying the optical requirements for an absorbing fluid. The agglomeration and deposition of particles suspended in a gas are then considered, and a mathematical model of particle suspension behavior is derived. The model is found to agree with results of an experimental study during the first 20 minutes of the experiment, diverging later due to the fact that later suspension evolution becomes independent of time. It is also found, both theoretically and experimentally, that coating the graphite particles with a silicone base layer will prevent agglomeration and deposition and allow solar absorption efficiency to be maintained at a high level. A.L.W.

A80-24661 Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978. Course sponsored by the European Atomic Energy Community, European Physical Society, Ministero della Pubblica Istruzione, et al. Edited by B. Brunelli. Oxford, Pergamon Press, Ltd., 1979, 482 p. \$72.64.

Specific topics discussed are mirror reactors, two-component tokamaks, and low-Q fusion devices. Particular attention is given to such topics as the physics of field-reversed mirrors, superconducting magnets for mirror machines, neutral beam injectors, and nonelectric fusion energy applications. B.J.

A80-24664 The physics of field reversed mirrors. R. F. Post (California, University, Livermore, Calif.). In: *Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978.* Oxford, Pergamon Press, Ltd., 1979, p. 53-85. 16 refs. Contract No. W-7405-eng-48.

The use of field-reversed mirrors in controlled fusion studies is described. Analytical treatments and computer simulation studies have demonstrated equilibrium solutions both in the fluid limit and in the large-orbit limit. Several experimental methods for achieving field-reversed states are described including: (1) the use of relativistic electron beams to create a field-reversing current ring, (2) the use of the reversed theta pinch or REB pulses to create field-reversing diamagnetic currents in a long cylinder cylindrical plasma, and (3) the field-reversed mirror created by the tangential injection of high-current neutral beams. B.J.

A80-24665 The mirror fusion test facility. R. F. Post (California, University, Livermore, Calif.). In: *Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978.* Oxford, Pergamon Press, Ltd., 1979, p. 87-104. Contract No. W-7405-eng-48.

The MFTF is a large new mirror facility under construction at Livermore for completion in 1981-82. Its magnet, employing superconducting NbTi windings, is of Yin-Yang form and will weigh 200 tons. MFTF will be driven by neutral beams of two levels of current and energy: 1000 amp of 20-keV (accelerating potential)

pulsed beams for plasma startup; 750 amp of 80-keV beams of 0.5-second duration for temperature buildup and plasma sustainment. Two operating modes for MFTF are envisaged: The first is operation as a conventional mirror cell with a confinement parameter equal to approximately 10 to the 12th sec/cu cm and an ion energy of 50 keV, where the emphasis will be on studying the physics of mirror cells. The second possible mode is the further study of the field reversed mirror idea, using high-current neutral beams to sustain the field-reversed state. MFTF has been oriented so that it could comprise one end cell of a scaled-up tandem mirror experiment. Also, if MFTF were to succeed in achieving a field-reversed state it could serve as an essentially full-sized physics prototype of one cell of a field-reversed mirror fusion power plant. (Author)

A80-24666 **The economic significance of Q for mirror reactors - Combinations of Q and M which look promising.** R. W. Werner (California, University, Livermore, Calif.). In: Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 105-120.

The mirror reactor is suspect as an economic power producer because of its Q parameter, the fusion power output divided by the power input. This paper demonstrates that unless promising combinations of Q and M (the blanket energy multiplication) are found the mirror reactor will never be economically feasible. B.J.

A80-24667 **Tandem mirror reactors.** G. A. Carlson (California, University, Livermore, Calif.). In: Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 121-138.

Preliminary fusion reactor designs based on the tandem mirror confinement concept have been developed. These include a 100 MWe fusion power reactor and a nearer-term fusion-fission hybrid reactor with reduced plasma confinement and technology requirements. The design and basic characteristics of these reactors are reviewed. B.J.

A80-24668 **Field-reversed mirror reactor.** G. A. Carlson (California, University, Livermore, Calif.). In: Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 139-154. 6 refs.

The conceptual design of a fusion power reactor based on the field-reversed mirror confinement concept has been completed. The reactor design is a multicell arrangement where a series of field-reversed plasma layers are arranged along the axis of a long superconducting solenoid which provides the background magnetic field. This paper discusses the analytical model for this reactor, parametric studies, and some of the particulars of the reference case reactor design. B.J.

A80-24670 **Mirror hybrid reactors.** R. W. Moir and J. D. Lee (California, University, Livermore, Calif.). In: Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 191-216. 11 refs.

The driven two-component tandem mirror seems well-suited to application as a fuel-producing hybrid reactor because of its cylindrical geometry, steady state operation, and relatively low technology. Development sequences are underway that could lead to a two-component tandem hybrid fuel-producing reactor. They include a tandem mirror experiment, a modified mirror fusion test facility, and then a pilot plant. B.J.

A80-24671 **Beam and plasma direct converters.** R. W. Moir (California, University, Livermore, Calif.). In: Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 217-235. 7 refs.

Two types of direct converters, one for beams and one for plasma, are under development, with voltages and power densities approaching reactor-like conditions. Direct conversion allows positive ion beams to be made into neutrals efficiently up to 150 keV for D(0), 225 keV for T(0), and 300 keV for He-3(0). Direct conversion raises the efficiency of producing neutral beams, can save millions of dollars when applied to next-generation experiments, and can improve the power balance of driven reactors. B.J.

A80-24672 **Superconducting magnets for mirror machines.** G. A. Carlson (California, University, Livermore, Calif.). In: Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 237-250. 5 refs.

The evolution of superconducting magnet systems, particularly Baseball and Yin-Yang coil systems, for standard mirror and tandem mirror machines is described. Attention is given to magnet shape, magnet size, magnetic field strength, magnetic design considerations, and the current status of magnet development for mirror machines. B.J.

A80-24674 **Plasma parametric studies and potential applications of driven fusion reactors.** R. W. Conn (Wisconsin, University, Madison, Wis.). In: Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978.

Oxford, Pergamon Press, Ltd., 1979, p. 297-345. 20 refs. Research supported by the Wisconsin Electric Utilities Research Foundation.

Analytical and computational models for investigating the dynamic performance of plasmas in TCA (two-component amplifier), MFA (Maxwellian fusion amplifier), or ignition modes of operation are presented. In particular, examples of thermal burn instability in each of these operating modes are given. The potential application of TCA or MFA in reactors aimed at engineering testing, materials irradiation, and hybrid applications is examined. The potential of the driven tokamak as a hybrid is analyzed based on plasmas operating in the TCA and MFA modes. B.J.

A80-24675 **Neutral beam injectors.** F. P. G. Valckx (EURATOM and Commissariat à l'Énergie Atomique sur la Fusion, Département de Physique du Plasma et de la Fusion Contrôlée, Fontenay-aux-Roses, Hauts-de-Seine, France). In: Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 347-367. 34 refs.

Four types of ion sources are described and compared: the duopigatron, the field free LBL source, the periplasmatron, and the Bucket-source. Both multiaperture and multislit type extraction systems are treated. In addition, the paper considers different sources of negative ions, and reviews basic designs of negative-ion neutral injectors. B.J.

A80-24676 **Non-electric fusion energy applications.** S. L. Bogart (U.S. Department of Energy, Div. of Magnetic Fusion Energy, Washington, D.C.). In: Driven magnetic fusion reactors; Proceedings of the Course, Erice, Italy, September 18-26, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 371-402.

Studies aimed at assessing the feasibility of nonelectric fusion energy applications are reviewed, with particular reference to the Inexhaustible Energy Resources Planning Study. Particular attention is given to fusion-fission energy systems and synthetic chemical fuel production by fusion reactors. B.J.

A80-24717 **The price of oil in the year 2000.** G. A. Hazelrigg, Jr. (ECON, Inc., Princeton, N.J.). In: Astrodynamic 1979; Proceedings of the Conference, Provincetown, Mass., June 25-27, 1979. Part 1. San Diego, Calif., American Astronautical Society; Univelt, Inc., 1980, p. 843-861. 9 refs. (AAS 79-172)

A mathematical model that projects the price of oil in the year 2000 is presented, by characterizing the long-run economic forces to

which the decision makers are subject. The model is based upon well-established characteristics of human behavior and modern control theory. Attention is given to the stochastic demand function. Results show that it is not in the best interest of OPEC to raise the price of oil beyond that indicated by the optimal trajectories. C.F.W.

A80-24735 Power plant impacts on visibility in the west - Siting and emissions control implications. D. A. Latimer (Systems Applications, Inc., San Rafael, Calif.). *Air Pollution Control Association, Journal*, vol. 30, Feb. 1980, p. 142-146. Research supported by the U.S. Environmental Protection Agency.

A80-25021 # The theory of a free-field inductive MHD-propulsor (K teorii induktsionnogo MGD-dvizhitelia so svobodnym polem). V. I. Iakovlev (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR). *Akademiia Nauk SSSR, Doklady*, vol. 249, no. 6, 1979, p. 1342-1345. 7 refs. In Russian.

The paper investigates the energy characteristics of a free-field inductive MHD-system. The model body set into motion is taken to be a flat plate of finite width and infinite length in a boundless conducting fluid. The problem is one of determining the electromagnetic field parameters necessary to set the plate into motion. The use of current-amplitude modulation to control the energy parameters of the MHD system is discussed. B.J.

A80-25026 # Common properties of bacterial and visual rhodopsins - The conversion of optical energy into electric-potential difference (Obshchnost' svoistv bakterial'nogo i zritel'nogo rodopsinov - Prevrashchenie energii sveta v raznost' elektricheskikh potentsialov). V. I. Bol'shakov, A. L. Drachev, L. A. Drachev, G. R. Kalamkarov, A. D. Kaulen, M. A. Ostrovskii, and V. P. Skulachev (Akademiia Nauk SSSR, Institut Khimicheskoi Fiziki; Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Akademiia Nauk SSSR, Doklady*, vol. 249, no. 6, 1979, p. 1462-1466. 15 refs. In Russian.

A80-25061 Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Symposium sponsored by the Montana Energy and MHD Research and Development Institute, Montana College of Mineral Science and Technology, and Montana State University. Edited by R. J. Rosa (Montana State University, Bozeman, Mont.). Bozeman, Mont., Montana State University, 1979. 480 p. \$20.

The Symposium focused on open cycle systems, slag seed and air heaters, magnet and materials, liquid metal and closed cycle, discharge and plasma effects, control-inverters, and inhomogeneities and combustion. Papers were presented on design and performance predictions for the first CDIF power train, approximate three-dimensional solution for finitely segmented frame-type MHD channels, radiative and convective heat transfer in the MHD generator duct, an evaluation of candidate seed processing systems, wettability and corrosion of MHD ceramics by rosebud coal slag, and fluctuations in combustion MHD generator systems. A.T.

A80-25062 # Design description and performance predictions for the first CDIF power train. G. Enos, J. Morenskii, S. Petty, and A. Solbes (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. A.1.1-A.1.9. Research supported by the U.S. Department of Energy.

The paper considers the range of inlet plasma conditions to the supersonic MHD power channel for the CDIF power train and describes the features of a slagging combustor that produces these conditions. Channel performance characteristics are predicted including the diagonal and Faraday regimes; the major engineering features of the flow train components are described with emphasis on the MHD channel; the channel gas dynamic conditions are presented,

including the distributions of static pressure, Mach number, conductivity, current density, and electric field. A.T.

A80-25063 # Long duration channel development and testing. A. Demirjian, V. Hruby, S. Petty, and A. Solbes (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. A.3.1-A.3.11. Research supported by the U.S. Department of Energy.

The paper presents long duration CDIF reference channel development and testing. Anode designs of copper protected by noble metal caps and copper cathodes were evaluated for long term resistance to electrochemical erosion; the channel was resistively loaded as an ideal Faraday and operating parameters were selected to duplicate those expected in power station service. Fly ash from a power plant was injected into an oil fired combustor to simulate the carryover rate from a coal fired combustor. The test was conducted with inspection points for photographic records, and material analyses were made on several electrode/insulator/slag samples. A.T.

A80-25064 # Electrical characteristics of an arc-mode slagging electrode generator. J. K. Koester and R. M. Nelson (Stanford University, Stanford, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. A.4.1-A.4.9. Research supported by the Electric Power Research Institute.

The paper considers the electrical characteristics of an arc-mode slagging segmented Faraday generator studied with voltage probes, an ac resistance instrument, and a wide-view optical port. Cathode gap deterioration was observed during operation with the ac resistance instrument and correlated with the decrease in Hall voltage performance. Experiments on nonuniform loading were performed in clean fuel and slagging channels; the experimental Faraday and Hall voltage distributions compared well with a superposition of currents rule utilizing empirically determined influence coefficients. A.T.

A80-25065 # Study of the U-25B MHD generator system in strong electric and magnetic fields. A. D. Iserov, V. I. Maksimenko, G. I. Maslennikov, A. P. Nefedov, M. Ia. Panovko, D. S. Pinkhasik, V. D. Semenov, Iu. N. Sokolov, I. A. Vasil'eva (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR), and K. Tempelmeyer (Argonne National Laboratory, Argonne, Ill.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. A.5.1-A.5.14. 7 refs.

A study of the U-25B MHD generator system in strong electric and magnetic fields is presented. It demonstrated that the MHD flow train has operated for over 50 hr with little difficulty, and that no significant problems occurred due to vibration, stress, or fluctuation of the electrical and gasdynamic parameters of the system components. The MHD generator produced a maximum power of 575 kW, a maximum Hall voltage of 4240 V, and a maximum Hall field of 2100 V/m; data obtained from two tests show that the effective plasma conductivity and channel mass flow must be increased to increase the U-25B channel power. A.T.

A80-25066 # Local analysis of electrical performance of the U-25B generator. J. D. Teare, W. C. Unkel, J. F. Louis (MIT, Cambridge, Mass.), and J. K. Koester (Stanford University, Stanford, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. A.6.1-A.6.9. 10 refs. Research supported by the U.S. Department of Energy.

The electrical performance of the No. 1 channel in the U-25B facility is examined, based on data from Tests 2, 3 and 4 (March, June and December 1978). Since the channel behavior has not been well modeled by the overall performance codes, the present analysis concentrates on local electrical behavior, using the measured static

pressures in a mixed mean analysis of the combustor and channel to determine local fluid and plasma parameters. Measured axial electric field versus load current density characteristics are extrapolated to given values of open circuit electric field and short circuit current density at various axial locations as functions of mass flow rate, magnetic field and oxygen enrichment. Comparisons with theoretical performance based on 'layer models' show that the effective non-uniformity factor is much larger than would be expected for the upstream section of the generator, and the paper discusses several phenomena which could be contributing to the discrepancies between theory and experiment. The discussion emphasizes the need for improved basic instrumentation as well as advanced diagnostics to aid in the interpretation of data from future U-25B tests. (Author)

A80-25068 # Radiative and convective heat transfer in the MHD generator duct. L. M. Biberman, S. A. Medin, A. Kh. Mnatsakanian, V. N. Zatelepin, M. B. Zhelezniak (Akademii Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR), and G. A. Liubimov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints.

Bozeman, Mont., Montana State University, 1979, p. B.5.1-B.5.6. 13 refs.

The paper presents calculations of MHD flow and radiative-conductive heat transfer in the high power MHD generator duct. The calculations are based on the hydraulic approximation of the magnetohydrodynamic equations including radiative heat losses. The results show that the radiative heat flux to the duct walls of a future large MHD power station is comparable with the convective flux and should be taken into account in the MHD flow calculations. A.T.

A80-25069 # Investigations of heat transfer from plasma flux to electrode and insulating walls of the MHD generator channel. B. Zaporowski and J. Roszkiewicz (Poznan, Politechnika, Poznan, Poland). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints.

Bozeman, Mont., Montana State University, 1979, p. B.6.1-B.6.6.

A80-25070 # Application of black-liquor boiler technology to MHD heat and seed recovery equipment design. P. R. Sheth, R. L. Lawit, and M. G. Klett (Gilbert Associates, Inc., Reading, Pa.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints.

Bozeman, Mont., Montana State University, 1979, p. C.1.1-C.1.6. 15 refs. Contract No. 01-78-ET-11058.000.

A80-25071 # Condensation and deposition of seed in the MHD bottoming plant. K. H. Im, J. Patten, T. R. Johnson, and K. Tempelmeyer (Argonne National Laboratory, Argonne, Ill.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints.

Bozeman, Mont., Montana State University, 1979, p. C.2.1-C.2.7. 23 refs. Research supported by the U.S. Department of Energy.

The paper considers the computer model for the prediction of the growth of deposition of seed particles in the steam and air heater sections of the MHD bottoming plant. The model represents a hot combustion gas stream with vaporized seed and entrained slag particles of a selected size distribution flowing through a bank of cooled tubes. It was shown that in the absence of slag particles, the bulk of the seed vapor condenses in the gas stream to form particles in the 0.02-0.2 micron diameter range; in the presence of the submicron slag particles formed upstream in the MHD diffuser, the largest fraction of the seed vapor condenses on the existing entrained particles causing them to grow to approximately one micron. A.T.

A80-25072 # An evaluation of candidate seed processing systems for open cycle MHD. E. J. Lahoda and T. E. Lippert (Westinghouse Electric Corp., Pittsburgh, Pa.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont.,

June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. C.3.1-C.3.6. 6 refs. Research supported by the Electric Power Research Institute and Westinghouse Electric Corp.

In coal burning systems, if potassium carbonate is added to the plasma, potassium sulfate results at the low temperature end of the plant. Recovery and conversion of this potassium sulfate back to carbonate in the seed regeneration process provides one method for sulfur removal and control. This paper summarizes an economic and technical evaluation of eight options for sulfur control. They include the double alkali, Engel-Precht, formate, ACP/Tempella, PERC, Markant and a Westinghouse process, as well as conventional limestone SO₂ scrubbers. (Author)

A80-25073 # A four-component model for the vaporization of seeded slags - The system KO_{0.5}-CaO-AIO_{1.5}/SiO₂. I. Eliezer, N. Eliezer, R. Howald, and P. Viswanadham (Montana State University, Bozeman, Mont.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints.

Bozeman, Mont., Montana State University, 1979, p. C.4.1-C.4.7. 22 refs. Research supported by the Montana Energy and MHD Research and Development Institute; Contract No. ET-78-C-01-3087.

The paper considers a model for the vaporization of seeded slags with emphasis on the KO(0.5)CaO-AIO(1.5)SiO₂ system. The equilibrium pressures were measured over a number of compositions in this system, presenting typical data on the effect of varying the CaO mole fraction. The thermodynamic analysis of a four-component system from which compositions and vaporization-condensation equilibria in the MHD system can be obtained is prepared from the properties of the pure components with successive additions of data on binary and ternary subsystems. Sample calculations using this model to predict the slag-seed behavior under MHD operational conditions are presented which include the mean values of the temperatures, amounts, and compositions of slag and seed species expected at selected points of the MHD system. A.T.

A80-25074 # Wettability and corrosion of MHD ceramics by Rosebud coal slag. R. Guidotti, L. Bentsen, and J. Rasmussen (Montana Energy and MHD Research and Development Institute, Inc., Butte, Mont.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints.

Bozeman, Mont., Montana State University, 1979, p. C.5.1-C.5.6. 5 refs.

The interaction of natural Rosebud coal slag with a variety of commercial oxide refractories has been investigated by measurement of the wettability using the sessile-drop method. Contact angles were measured as a function of temperature up to 1500 C. The effect of refractory composition and porosity upon wetting behavior of natural Rosebud in air was studied and the interfacial region was examined to observe the extent of chemical reaction. The effect of K₂SO₄-seed upon wettability behavior was also explored. (Author)

A80-25075 # Operability and materials testing for MHD air heaters. D. P. Saari, R. R. Smyth, C. J. Kniebel, and L. R. White (Fluidyne Engineering Corp., Minneapolis, Minn.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints.

Bozeman, Mont., Montana State University, 1979, p. C.6.1-C.6.8. 14 refs. Contract No. EX-78-C-01-3005.

The experimental program and test facilities for MHD heater development are described. Significant results with respect to heater operability and materials performance are shown. Stable air heater operation and removal of seed/slag deposits have been demonstrated in a test facility. Fusion cast magnesia-spinel has been identified as a candidate material for full-scale air heaters and is now being subjected to long term evaluation. (Author)

A80-25076 # Particulate size and rates of pressure drop increase in an MHD air preheater. H. W. Townes, T. C. Reihman, C.

J. Mozer, and T. A. Ameel (Montana State University, Bozeman, Mont.). In: Symposium on the Engineering Aspects of Magneto-hydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. C.8.1-C.8.5. Research supported by the Montana Energy and MHD Research and Development Institute; Contract No. ET-78-C-01-3087.

Rates of pressure drop increase are given for three particulate sizes for flows with fly ash in a regenerative heat exchanger. The pressure drop measurements were made across a ceramic regenerative heat exchanger typical of that which would be used in an indirectly-fired open-cycle MHD system. The pressure drop increase across the ceramic bed was measured for 100 hours of operation for each particle size. The top ceramic temperature was above the melting temperature of the slag. (Author)

A80-25077 # Superconducting MHD magnets - Technology development, procurement and the path to commercial scale. P. G. Marston, D. B. Montgomery, J. E. C. Williams, and A. M. Dawson (MIT, Cambridge, Mass.). In: Symposium on the Engineering Aspects of Magneto-hydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. D-1.1.1 to D-1.1.8. Research supported by the U.S. Department of Energy.

The paper considers the characteristics of the superconducting MHD magnets. It is shown that the synergism of the parallel procurement and technology development permits a dynamic interaction of the CDIF, CFFF and Stanford concepts; the CDIF superconducting magnet which reduces cumulative loads and frictional heating to a minimum and the Stanford magnet which will modify quench behavior so that the design will be fail-safe without a dynamic energy-dumping system are discussed. Finally, studies of shipping of magnets, the properties of materials of construction, and of systems engineering of cryogenic systems are presented. A.T.

A80-25078 # A modular design for a superconducting magnet for the ETF and larger MHD generators. J. L. Zar (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: Symposium on the Engineering Aspects of Magneto-hydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. D-1.2.1 to D-1.2.7. Research supported by the Massachusetts Institute of Technology; Contract No. EF-77-C-01-2614.

The paper describes a new design for superconducting magnets for MHD generators whose magnet parts, the windings, and structure can be shop built and shipped to the site for assembly. The design reduces labor costs and uses a pair of saddle and race track coils for the winding and a cryogenically stable conductor. The vacuum tank, a splice box in the windings, and the force containment structures of high strength aluminum are discussed; the welding of the winding assemblies which compensates for the differential thermal expansion between the windings and the structure by the use of corrugated shim plates is described. A.T.

A80-25079 # A superconducting dipole magnet for the CFFF MHD facility at the University of Tennessee Space Institute. S.-T. Wang, L. R. Turner, R. C. Niemann, L. Genens, W. Pelczarski, J. Goczny, J. Hoffman, K. Mataya, H. Ludwig, and S.-H. Kim (Argonne National Laboratory, Argonne, Ill.). In: Symposium on the Engineering Aspects of Magneto-hydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. D-1.3.1 to D-1.3.6. Research supported by the U.S. Department of Energy.

The paper describes a superconducting dipole magnet for the CFFF MHD. The design of the MHD system consisting of the superconducting magnet, magnet cryostat, a helium refrigerator, and instrumentation are discussed, noting that the magnet will have an on-axis peak field of 6 T and an MHD channel warm aperture of 80 cm diameter at the MHD channel inlet. The conductor design, coil configurations, and coil structure are examined, and cryostability, magnetic forces, and design of bore tube, end flanges, and ring girder

are described. Finally, the cryostat and cold mass support, and instrumentation for magnet protection and operation are analyzed. A.T.

A80-25080 # The effect of electrochemical and arcing phenomena on electrode performance. L. H. Cadoff, S. K. Lau, and B. R. Rossing (Westinghouse Research and Development Center, Pittsburgh, Pa.). In: Symposium on the Engineering Aspects of Magneto-hydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. D-1.4.1 to D-1.4.11. 26 refs. Contracts No. EX-76-C-01-2248; No. DE-AC-01-79-ET-15529.

Laboratory studies aimed at understanding the mechanisms of electrochemical corrosion between liquid coal slag and ionically conducting ZrO₂ based electrodes will be presented. Based on these results, a comprehensive analytical model is derived which permits detailed analysis of the role of slag properties as well as electrode polarization on the nature of electrochemical reactions under hot slagging conditions. Criteria for electrode material selection will be discussed. An experimental arrangement to measure anode arc erosion rates is also described. Arc erosion rates for both copper and platinum anodes as a function of substrate temperature and slag-seed chemistry are presented. These results are compared to erosion rates obtained from other test rigs and MHD channels. (Author)

A80-25083 # Control of liquid metal-gas two phase flow by application of axial magnetic field. Y. Fujii-e, M. Saito, H. Nagae, and S. Inoue (Osaka University, Suita, Japan). In: Symposium on the Engineering Aspects of Magneto-hydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. D-2.1.1 to D-2.1.10. 7 refs.

Due to electromagnetic interaction, a pressure gradient occurs in the liquid metal-gas two-phase flow producing the pinch effect in the cross section perpendicular to the flow. An experiment conducted with NaK-N₂ two-phase flow in a rectangular channel located in a magnet 50 cm long (B is equal to 1.5 T) is examined, in which the external axial field is superposed on the induced one. Consideration is given to the impact of the pinch effect on void distribution and to the influence of void redistribution on the slip ratio and the axial pressure drop. It is concluded that the control of the void distribution by superposing the axial magnetic field is possible without disturbing the main interaction which causes the pressure drop in the axial direction and without changing the liquid-gas slip ratio. L.M.

A80-25084 # High-power-density liquid-metal MHD generator results. G. Fabris, E. S. Pierson, I. Pollack, P. Dauzvardis, and W. Ellis (Argonne National Laboratory, Argonne, Ill.). In: Symposium on the Engineering Aspects of Magneto-hydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. D-2.2.1 to D-2.2.6. 9 refs. Navy-supported research.

The experimental results presented herein satisfy one major goal in demonstrating the technical feasibility of two-phase LMMHD (liquid-metal MHD), i.e., operating an MHD generator at power densities equal to or above that anticipated for practical power systems. Power densities of up to 32 MWe/cu m and efficiencies higher than 0.6 at high void fractions were attained for a small 20-kWe generator. Slip ratio, pressure distribution, and voltage profile data are also given. Supporting analytical and experimental studies are summarized. All results are encouraging for the development of large high-efficiency LMMHD generators. (Author)

A80-25085 # High-temperature liquid-metal MHD generator experiments. P. F. Dunn, E. S. Pierson, J. D. Staffon, I. Pollack, and P. V. Dauzvardis (Argonne National Laboratory, Argonne, Ill.). In: Symposium on the Engineering Aspects of Magneto-hydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. D-2.2.7 to D-2.2.12. 9 refs. Navy-NSF-supported research; Contract No. W-31-109-eng-38.

Detailed data were obtained for the world's first high-temperature two-phase liquid-metal MHD generator under open-circuit conditions. Both single-phase (sodium) and two-phase (sodium and nitrogen) flows were used in the temperature range of approximately 490 to 740 K. The data presented includes pressures, voltages, and slip ratios (ratio of gas velocity to liquid velocity). The two-phase pressure-gradient data were well predicted by a simplified two-phase MHD correlation that includes the effect of a pure-liquid shunt layer between the electrodes. The slip ratio is shown to decrease with increasing temperature, implying higher generator and system efficiencies. (Author)

A80-25086 # Experiments on the nonuniform discharge structure in noble gas MHD generators. W. M. Hellebrekers, A. Veefkind, and C. A. Borghi (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. D-2.4.1 to D-2.4.7. 11 refs.

The nonuniform discharge structures in a noble gas MHD generator are investigated in two MHD shock channels. The anode and cathode of one electrode pair are divided into nine fragments which are mounted flush on the wall and connected by resistors so that the current through each fragment can be measured. Consideration is given to fluctuation levels, the characteristic length between streamers, and their sizes. Characteristic times for the transport of particles are evaluated for plasma parameters. High-speed camera pictures taken under various conditions show an extension of the streamer along magnetic field lines, caused by the large heat flux in this direction. Voltage distribution measurements in the relaxation region of the generator indicate large anode drops. L.M.

A80-25088 # Experimental studies of an inert gas disk MHD generator with a small seed fraction. S. Shioda, H. Yamasaki, K. Matsutani, and H. Sato (Tokyo Institute of Technology, Tokyo, Japan). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. D-2.6.1 to D-2.6.7. 8 refs.

Experiments (DISK-II) for inert gas disk generators with a stagnant gas pressure of 3 atm. and a seed fraction of .00005 have been conducted. When the seed was fully ionized and the ionization instability was suppressed, the effective Hall parameter and the effective conductivity recovered to 6.5 and 50 mho/m, respectively. The electrical efficiency of 73% and the power density of 13.3 MW/cu m have been achieved even though the magnetic field was low (0.98 Tesla). These results indicate the possible operation of nonequilibrium disk MHD generator with small seed fractions. The recovery factor increased to 85% and it was shown to depend on the amount of fluctuations which still remained in the stabilized region. (Author)

A80-25089 # Impurity effects on non-equilibrium MHD gas heated by a fossil fuel-fired heat exchanger. K. Yoshikawa, K. Okada, and M. Ishikawa (Kyoto University, Uji, Japan). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. E.1.1-E.1.6. 11 refs.

A80-25090 # Plasma measurements of Joule heating effects in the near electrode region of an open cycle MHD generator. R. K. James and C. H. Kruger (Stanford University, Stanford, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. E.4.1-E.4.6. Contract No. EX-76-C-01-2341.

A80-25091 # Electrical nonuniformities in U-25 MHD channels. A. E. Buznikov, V. I. Kovbasiuk, S. I. Pishikov, and B. Ia. Shumiatskii (Akademii Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR). In: Symposium on the Engineering Aspects of

Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. E.5.1-E.5.6. 8 refs.

Electric current and voltage nonuniformities in channels of the U-25 MHD generator are investigated. Measurements of current nonuniformities were performed in diagonal channels with frames having floating and gradually varying potential distributions obtained using an active potential divider. High-intensity arcs with currents exceeding 100 A are observed on the electrodes of the floating-potential channels, demonstrating the requirement for voltage stabilization by a potential divider. The nonsymmetric high-intensity arcs on the frame are discussed as the cause of voltage distribution nonuniformities, and electrical nonuniformities caused by arcing in the end zones are considered. A.L.W.

A80-25092 # Design, construction and initial operation of an MHD inverter system for the Mark VI generator. A. Chaffee, I. Quijano, A. Solbes (Avco Everett Research Laboratory, Inc., Everett, Mass.), A. Humphrey, and J. Mandalakas. In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. F.1.1-F.1.11. Research sponsored by the Electric Power Research Institute.

The design, integration, and initial operating characteristics of the 250-KVA power converter for the Mark VI MHD generator are presented. The forced commutated voltage source system consists of two series-connected bridge inverter units comprised of three pole modules based on the McMurray pulse commutated unit and connected into a 480-V ac line with an isolating transformer. CMOS all-digital PWM logic design is used for run, stop and trip functions, and phase angle, notch angle and voltage control, with a stepless power factor control. During subsystem fabrication and interconnection, problems were encountered with the magnetics, dV/dt circuits, dc circuit breaker, series operation of the inverter bridges, control, and control logic of the system. The ac current/inverter phase angle curves indicating the phase shift to be due mainly to inductance and the broadening to be due to losses (on the order of 10 kW) in the magnetics, and means to reduce harmonic losses between the inverter and the ac line, have been obtained. The system has been used to invert 200 kW into a 480 V line for 12.7 hours, and the integration of a multiphase lock loop and a closed loop control system into the inverter is planned. A.L.W.

A80-25093 # A rotary inverter system for a multiple-electrode MHD generator. C. S. J. Lamb, S. Ramakrishnan, and H. K. Messerle (Sydney, University, Sydney, Australia). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. F.2.1-F.2.3.

Coupling of magnetohydrodynamic generators to existing power grids requires dc to ac conversion. Most of the present day research teams are considering the use of solid-state inverters for this task. In this paper, a rotary inverter system is proposed which makes use of a parallel-connected rotary motor driving a conventional alternator. The advantages are direct connection to a multiple-electrode MHD generator, simple construction, and easy operation. (Author)

A80-25094 # Characterization of dynamic influences in a coal-fired MHD system. M. H. Scott, W. E. Baucum, and G. A. Suneson (Tennessee, University, Tullahoma, Tenn.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. F.3.1-F.3.6. 8 refs. Contract No. EX-76-C-01-1760.

Experimental measurements of parameters influencing the performance of an open-cycle coal-fired MHD generator system are presented. Narrow- and wide-band variations in oxidizer and fuel flow rates, the combustion process, and generator activity were determined in terms of coal flow rate, dynamic pressure in the combustor and electrical parameters. Experimental results are used

to calculate inverse conductivity variations, which are then compared with values obtained theoretically from considerations of an axially nonuniform conductivity and a varying electrode voltage drop.

A.L.W.

A80-25095 # First-principle component models for control system simulation of MHD-steam plants. D. A. Pierre and D. A. Rudberg (Montana State University, Bozeman, Mont.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. F.4.1-F.4.6. 13 refs. Research supported by the Montana Energy and MHD Research and Development Institute; Contract No. ET-78-C-01-3087.

The first-principle, lumped-parameter subsystem models for the CNCD unit, typical steam-water path units, the boiler feed pump, the steam drum, steam turbines, the air compressor, and the spray attenuator are discussed. The models can predict time-varying changes in combustion gas temperature and enthalpy, and temperature within each major component of the combined-cycle system. Methods of connecting the component models for the computer simulation of a typical MHD-steam cycle are considered along with relationships between control variables and system state variables. It is concluded that alternative coordinated control strategies can be imbedded in the simulation to assist in the specification of overall control topology and controller parameters. L.M.

A80-25096 * # Oxygen-enriched air for MHD power plants. R. W. Ebeling, Jr., J. C. Cutting (Gilbert Associates, Inc., Reading, Pa.), and J. A. Burkhart (NASA, Lewis Research Center, Cleveland, Ohio). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. G.1.1-G.1.9. 16 refs. Research supported by the U.S. Department of Energy.

Cryogenic air-separation process cycle variations and compression schemes are examined. They are designed to minimize net system power required to supply pressurized, oxygen-enriched air to the combustor of an MHD power plant with a coal input of 2000 MWt. Power requirements and capital costs for oxygen production and enriched air compression for enrichment levels from 13 to 50% are determined. The results are presented as curves from which total compression power requirements can be estimated for any desired enrichment level at any delivery pressure. It is found that oxygen enrichment and recuperative heating of MHD combustor air to 1400 F yields near-term power plant efficiencies in excess of 45%. A minimum power compression system requires 167 MW to supply 330 lb of oxygen per second and costs roughly 100 million dollars. Preliminary studies show MHD/steam power plants to be competitive with plants using high-temperature air preheaters burning gas. L.M.

A80-25097 # Conceptual design of an MHD/steam power plant of pilot scale /ETF/ and preliminary analyses of early commercial MHD power plants. F. Becker, F. Hals, R. Kessler, L. Westra (Avco Everett Research Laboratory, Inc., Everett, Mass.), W. Morgan (Chas T. Main, Inc., Boston, Mass.), and C. Bozzuto (Combustion Engineering, Inc., Windsor, Conn.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. G.3.1-G.3.20. 6 refs. Research supported by the U.S. Department of Energy.

A80-25098 # A 250 MWt MHD Engineering Test Facility /ETF/ system design. C. H. Marston, C. S. Cook, L. Terrey, and B. Zauderer (General Electric Co., Philadelphia, Pa.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. G.4.1-G.4.8. 8 refs. Research supported by the U.S. Department of Energy.

A conceptual design study was performed to establish a Reference Design for the MHD Engineering Test Facility. The design is for a complete 250 MW (thermal) MHD/Steam plant for

component and system development and long term operation as a demonstration plant. Selection of individual components must be made considering the impact on other components and overall system operation and with full attention to flexibility for development purposes. A two-stage combustor with a fluidized bed first stage and a double vortex second stage was chosen for considerations of potential slag-free operation, and electrical isolation between combustor stages. High performance ceramic regenerative air preheaters, utilizing pressurized combustion in the individual heat exchanger domes, and capable of delivering air at 3000 F, are recommended. Limited oxygen enrichment was considered for test flexibility. Both diagonal wall and Faraday, subsonic, linear MHD generators are compatible with the system. (Author)

A80-25099 * # Coupled generator and combustor performance calculations for potential early commercial MHD power plants. T. C. Dellinger, J. G. Hnat, and C. H. Marston (GE Space Sciences Laboratory, King of Prussia, Pa.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. G.5.1-G.5.11. 8 refs. Contract No. DEN3-52.

A parametric study of the performance of the MHD generator and combustor components of potential early commercial open-cycle MHD/steam power plants is presented. Consideration is given to the effects of air heater system concept, MHD combustor type, coal type, thermal input power, oxygen enrichment of the combustion, subsonic and supersonic generator flow and magnetic field strength on coupled generator and combustor performance. The best performance is found to be attained with a 3000 F, indirectly fired air heater, no oxygen enrichment, Illinois no. 6 coal, a two-stage cyclone combustor with 85% slag rejection, a subsonic generator, and a magnetic field configuration yielding a constant transverse electric field of 4 kV/m. Results indicate that optimum net MHD generator power is generally compressor-power-limited rather than electric-stress-limited, with optimum net power a relatively weak function of operating pressure. A.L.W.

A80-25100 # National R&D program on MHD in Japan. S. Korenaga, T. Homma, and I. Todoriki (Agency of Industrial Science and Technology, Tokyo, Japan). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. H.1.1-H.1.6.

The paper considers research in magnetohydrodynamic (MHD) electric power generation in Japan. Various components of the MHD power generation were developed and tested including superconducting magnets, helium refrigerators and liquefiers, air preheaters, seed recovery devices, and materials for the fabrication of generating channels. In the current phase of this program, generators known as Mark VII and VIII are to be developed and tested, and basic research is scheduled on MHD generation. A.T.

A80-25101 # Preliminary assessment of the requirements and potential of open cycle MHD as an electric utility power plant. F. D. Retallick, D. A. McCutchan, T. E. Lippert, and K. D. Le (Westinghouse Electric Corp., Pittsburgh, Pa.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. H.2.1-H.2.5.

Commercialization of MHD will be contingent on three major factors; performance, plant availability and economics. These three factors are interrelated in a complex manner in the electric utility environment. Simulation of this environment has been performed as a guide to MHD power plant development. The worth of availability is found to be between 10-20 \$/kWe depending on the specific utility characteristic. MHD duct lifetime requirements for attaining competitive power plant availability are a strong function of the cycle arrangement (method of preheat and/or oxygen enrichment) and the duct replacement time, varying between 2500 to 9700 hours as extremes. Significant reductions in these requirements may be

possible with simultaneous operation of dual channels, each having a capability in excess of 50% of the power plant rating. Market penetration analysis of MHD by geographic region of the U.S. between 1995-2000 shows a major potential for MHD. The geographic regions and coal type have been classified as favorable, marginal or low in potential. (Author)

A80-25102 # The retrofit approach to MHD demonstration and commercialization. J. W. Griswold, J. W. Moyer, and M. C. Wehrey (Southern California Edison Co., Los Angeles, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. H.3.1-H.3.8. 7 refs.

The paper presents the retrofit approach as a means to demonstrate MHD technology. The anticipated benefits of retrofitting are discussed along with some ground rules from a utility point of view, the key decisions to be made, the retrofit path to demonstration, and an opinion on the potential market for MHD retrofit installations. V.T.

A80-25103 # A modular approach to an engineering test facility and beyond. R. Johnson and D. Rudberg (Montana State University, Bozeman, Mont.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. H.4.1-H.4.7. Research supported by Montana State University and Montana Energy and MHD Research and Development Institute; Contract No. ET-78-C-01-3087.

The concept of using a new baseload coal-fired power plant as a bottoming plant for a MHD/steam generator engineering test facility is examined. Consideration is given to three possible system configurations with increasing levels of combustion gas coupling. The first configuration allows the interaction of only the steam and water flows, duplicating many components and resulting in an expensive system lacking versatility and of low efficiency. The second configuration integrates the combustion gas from the topping cycle after clean-up with that from the bottoming cycle and requires the use of a low-pressure Kraft boiler in both portions. The third configuration integrates the seed/slag-laden combustion into one half of the bottoming plant and represents the most flexible configuration, with the highest combined-cycle efficiency. Either of the last two configurations is considered superior to the first as a test facility. A.L.W.

A80-25104 # The transition MHD power plant concept. S. Way. In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. H.6.1-H.6.6. 8 refs.

In order to hasten the realization of commercial MHD power generation, with its attendant benefits, a transition type power plant may be designed and constructed. The plant could meet the needs for preliminary pilot plant experience, and could then evolve into a functioning commercial power installation. Its projected size would be 172 MW net electrical output, and station efficiency would be 43-44%. The MHD-dc power generated would be 80 MW. Initial operation at 50 MW-MHD power, instead of the normal 80 MW, would furnish preliminary experience. Under those conditions the top temperature would be reduced, and air preheat would be 1320 K instead of 1348 K. The MHD system is combined with a simple non-reheat steam bottom plant, which can be operated alone when the MHD generator is out of service. (Author)

A80-25105 # Fluctuations in combustion MHD generator systems. J. P. Barton, J. K. Koester, and M. Mitchner (Stanford University, Stanford, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. J.1.1-J.1.8. 6 refs. Contract No. EX-76-C-01-2341.

Inherent fluctuations in electrode current, electric field, and pressure within a subsonic, combustion-driven, MHD generator system have been measured and analyzed. An analysis of the fluctuation measurements as a function of the MHD generator operating parameters has provided information concerning the nature of the inherent disturbances. The results indicate that the inherent disturbances consist of a combination of axial acoustical standing waves and local, convected conductivity nonuniformities. The effects of these inherent property fluctuations upon actual MHD generator operation are presented and discussed. A theoretical model, utilizing a linearized analysis of the MHD generator, gives qualitative agreement with the experimental observations. The use of this model to predict the importance of these effects for generators operating at high magnetic interaction is considered. (Author)

A80-25106 # Fluctuations in MHD generators. J. S. Walker (Illinois, University, Urbana, Ill.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. J.2.1-J.2.3. NSF Grant No. ENG-74-23778.

It is shown that the experimental results, presented by Barton, Koester and Mitchner (1977) in reference to pressure and voltage fluctuations in a subsonic, combustion, segmented Faraday generator, are consistent with the analytical results of the fluid transients study in MHD duct flows. A family of wave modes is found in MHD duct flows which occur only in the magnetic field and involve hydrodynamic and electromagnetic variables. Consideration is given to natural frequencies for these modes, and it is shown that there is a continuous distribution of natural frequencies throughout the low frequency range 0-200 Hz. The analytical model does not include such effects as nonuniformities in seed concentration, incomplete combustion fluctuations and arcs. L.M.

A80-25107 # Experiments concerning inhomogeneities in combustion MHD generators. R. M. Kowalik and C. H. Kruger (Stanford University, Stanford, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. J.3.1-J.3.6. 7 refs. Contract No. EX-76-C-01-2341.

Two sets of inhomogeneity experiments have been run in the Stanford facility. The first set investigated the effects of currents and applied magnetic fields on plasma luminosity fluctuations. The second set of experiments demonstrated the feasibility of local conductivity fluctuation measurements with a laser-induced fluorescence diagnostic. The laser-induced fluorescence diagnostic should be applicable in many MHD channels; a discussion of its capabilities and limitations is presented in the paper. (Author)

A80-25108 # Kinetics of char burnout and ash vaporization in coal-fired MHD combustors. R. Shuck, T. Hastings, C. Mims, and A. Sarofim (MIT, Cambridge, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. K.1.1-K.1.9. 9 refs. Research supported by the U.S. Department of Energy and Electric Power Research Institute.

A computer model which simulates coal combustion in a simple MHD combustor has been assembled. Data from parallel experimental work on devolatilization, char oxidation, and ash vaporization at MHD conditions provide input parameters to the model and prove checks on some of the assumptions therein. Trade-offs between ash vaporization and char utilization predicted by the model are shown. Finally, the importance of CO₂, H₂O, O₂, O, and OH to char oxidation is indicated from both theoretical and experimental considerations. (Author)

A80-25109 # Progress in coal combustion research at Avco Everett Research Laboratory, Inc. F. E. Becker, D. B. Stickler, M. M. Delichatsois, and A. Ballantyne (Avco Everett Research Laboratory,

Inc., Everett, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. K.2.1-K.2.7. Research supported by the U.S. Department of Energy.

The experimental operation of a pulverized coal combustor coupled to either a regenerative air heater system or a hot vitiated air source is discussed. Combustor performance at conditions appropriate for MHD power system requirements indicate 25-35 ms combustor residence times for optimum thermal performance for single stage combustors. In addition, the analytical model of Stickler, et al. (1979) appears capable of describing the coal combustion process in simple flow fields. Parametric studies to give direction for combustor optimization indicate definite gains in performance for more finely pulverized coal, higher oxidizer preheat temperature and faster input mixing of the pulverized coal and oxidizer streams.

J.P.B.

A80-25110 # Wall combustion in high-swirl combustors. P. M. Chung (Argonne National Laboratory, Argonne; Illinois, University, Chicago, Ill.) and R. S. Smith (Argonne National Laboratory, Argonne, Ill.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. K.3.1-K.3.8. 13 refs. Research supported by the U.S. Department of Energy.

The burning rate of char along the wall of an idealized swirl combustor is analyzed. Combustion by O₂, H₂O, and CO₂ is considered. The combustion rate largely depends on the swirl and roughness of the char layer-gasphase interface, which set the turbulence level, and on the gaseous reactant Damkohler number. In general, the higher the pressure and the smaller the char particle size, the more efficient the gas core combustion is, when compared to wall combustion. On the other hand the reverse is true at lower pressures and for the larger particles. (Author)

A80-25111 # One-stage cyclone combustor for coal fired test stand of 4MW thermal power. T. Kozlowski, Z. Rybacki, and W. S. Brzozowski (Instytut Badan Jadrowych, Swierk, Poland). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. K.4.1-K.4.6.

Experimental results are presented on the 4 MW coal-fired MHD test rig at Swierk. Stable operation of a single-stage coal combustor was achieved during several runs of 4-6 hours duration. The protection of the inner walls by a slag layer is highly effective. Heat losses due to cooling of the combustor walls have not exceeded the predicted values and may be reduced to several percents in full scale combustor operation. The achieved intensity of heat release is very near that required for commercial operation. The percentage of seed absorbed by the slag is high, 15-20%. B.J.

A80-25112 # High slag rejection, high carbon conversion rate, air cooled cyclone coal combustor for MHD regenerative heat exchangers. S. Omori, C. S. Cook, E. Tate, D. Rogers, and K. Dickinson (GE Space Sciences Laboratory, King of Prussia, Pa.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. K.5.1-K.5.10. 13 refs. Contracts No. EX-76-C-01-2238; No. ET-78-C-01-3106.

A80-25113 # Development of a slagging cyclone gasifier for MHD applications. R. J. Demski, J. T. Yeh, J. I. Joubert, and D. Bienstock (U.S. Department of Energy, Pittsburgh Energy Technology Center, Pittsburgh, Pa.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. K.6.1-K.6.7. 6 refs.

The paper discusses experimental results obtained at atmospheric pressure with a vertical cyclone gasifier designed for MHD applications. The gasifier represents the first stage of a two-stage

combustion system which will provide an MHD plasma relatively free of coal ash. Development of a successful vertical cyclone gasifier design was completed in April of 1978. Slag rejection rates in excess of 95 percent were achieved at coal-feed rates of 100 to 125 lb/hr, stoichiometric air levels of temperatures ranging from 2820 to 2900 F. Larger versions of the successful gasifier design are now undergoing further tests in the PETC Atmospheric-Pressurized MHD Combustor Test Facilities. (Author)

A80-25114 # Scaling MHD cyclone coal combustors. R. J. Wright (U.S. Department of Energy, Pittsburgh Energy Technology Center, Pittsburgh, Pa.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 18th, Butte, Mont., June 18-20, 1979, Preprints. Bozeman, Mont., Montana State University, 1979, p. K.6.8-K.6.14. 18 refs.

The paper presents a scaling relationship for MHD cyclone coal combustors. Similarity is achieved using a constant ratio of particle reaction time to gas residence time and an expression is derived for equal heat release per unit wall area in terms of the mass flow rate, the cyclone diameter, and the diameter of a representative particle. Coal particle scaling is required to achieve similarity in ash carryover and in the ratio of particle reaction time to gas residence time. The scaling relationship permits prediction of the heat loss as a percent of thermal input at various scale factors; scale-up of a two-stage MHD coal combustor demonstrates the use of the scaling relationship. A.T.

A80-25115 The OTEC connection - Power from the sea. D. Petty (Solar Energy Research Institute, Golden, Colo.). *Solar Engineering Magazine*, vol. 5, Feb. 1980, p. 10-12.

OTEC is discussed as a means of contributing to United States energy self-sufficiency. The technology involved in the conversion of ocean thermal gradients found in tropical regions to electricity transmittable by submarine cable is examined, with attention given to the operating principles of open- and closed-cycle Rankine engines and design considerations for the evaporators, condensers and heat exchangers. The environmental impact and economics of OTEC are considered, and Department of Energy research projects in areas of OTEC technology including heat transfer, biofouling, environmental assessment, underwater electrical transmission and mooring and test plants are indicated. It is pointed out that US islands presently offer excellent markets for early commercial OTEC plants, with Gulf Coast markets requiring further technology developments to be economically attractive. A.L.W.

A80-25116 Co-generation at a practical plant level - Single stage steam turbine generator set replaces pressure reducing station to reduce plant energy consumption. J. Feuell. *Turbomachinery International*, vol. 21, Jan.-Feb. 1980, p. 18-22.

A80-25152 # The role of navigation satellites in oil exploration. J. G. Morgan (Chevron Geophysical Co., Houston, Tex.). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 119-126. 9 refs.

The paper examines the requirements of the oil and gas exploration communities for navigation and positioning (with particular reference to seismic surveys, well site surveys, and drilling vessel positioning) and describes the role played by the Transit satellite system in oil and gas exploration. Emphasis is placed on some problems facing the civil user of Transit, particularly the problem of the time gap between some satellite fixes. B.J.

A80-25159 # GPS application to seismic oil exploration. C. Johnson and P. Ward (Texas Instruments, Inc., Dallas, Tex.). In: Navigation satellite users; Proceedings of the National Aerospace Symposium, Springfield, Va., March 6-8, 1979. Washington, D.C., Institute of Navigation, 1979, p. 163-169.

The NAVSTAR Global Positioning System (GPS) is considered in terms of the requirements of the geophysical oil exploration industry. The suitability of the GPS for both marine and land surveys

is discussed, as are receiver requirements in terms of C/A-code and P-code. It is noted that the space vehicles of the GPS provide a three-dimensional estimate of the user's position to 10 m and velocity to 0.01 m/s, as well as absolute GPS time to a few nanoseconds. J.P.B.

A80-25170 Mercury partitioning in a power plant plume and its influence on atmospheric removal mechanisms. S. E. Lindberg (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Atmospheric Environment*, vol. 14, no. 2, 1980, p. 227-231. 33 refs. Contract No. W-7405-eng-26.

Air samples were collected isokinetically in the plume of a major coal-fired power plant during helicopter flights. The dominant form of mercury in the plume was elemental Hg vapor, ranging from 92 to 99% of the total Hg concentration in air. There was no evidence of significant gas to particle conversion during plume aging. The predominance of the vapor form is conducive to long-range transport and removal by precipitation scavenging. (Author)

A80-25253 # Solar power satellites and the ITU - Some U.S. policy options. S. Gorove (Mississippi University, University, Miss.). In: *Annals of air and space law. Volume 4.* Montreal, McGill University; Toronto, Carswell Co., Ltd.; Paris, Editions A. Pedone, 1979, p. 505-517. 31 refs.

The purpose of the paper is to focus on some of the legal problems that may arise in connection with proposed use of solar power satellites, with special regard to the role of the International Telecommunications Union and some related U.S. policy options. Attention is given to geostationary orbit availability and the radio spectrum and to microwave frequency allocation. C.F.W.

A80-25259 Geothermal energy and the environment - The global experience. M. J. Pasqualetti (Arizona State University, Tempe, Ariz.). *Energy* (UK), vol. 5, Feb. 1980, p. 111-165. 277 refs.

The paper discusses the impact of environmental problems on the world's geothermal generating stations. The significant impacts include conflicts in land use, air pollution, subsidence, water pollution, induced seismicity, blowouts, and noise. Development of geothermal resources has been slowed down in some countries: in U.S., the emission of hydrogen sulfide produced a problem; in Japan, land use in national parks and waste-water disposal resulted in difficulties; and in El Salvador, waste-water disposal presented a difficulty. Geothermal development faces many regulations and difficulties, particularly in U.S., a country which could stimulate a global acceleration in this field with appropriately relaxed controls. A.T.

A80-25260 A performance and economic evaluation of annual cycle energy storage /ACES/. R. S. Miller (General Electric Co., Schenectady, N.Y.). *Energy* (UK), vol. 5, Feb. 1980, p. 183-190. 5 refs.

The performance of a residential annual energy storage scheme utilizing ice storage and a three-coil heat pump is evaluated for a range of climates and storage sizes. Comparisons are made with conventional electric resistance heat with central air conditioning or an electric air-to-air heat pump. Economic evaluations are made with payback and with present value life-cycle costing. Annual energy storage is found to be uneconomical. (Author)

A80-25261 A central solar domestic hot water system - Performance and economic analysis. D. Wolf, A. Tamir, and A. I. Kudish (Negev University, Beersheba, Israel). *Energy* (UK), vol. 5, Feb. 1980, p. 191-205. 5 refs. Research supported by the Ministry of Commerce, Industry and Tourism and Ministry of Energy.

A solar-assisted central hot water system was retrofitted onto one of the student dormitory complexes. The system consisted of twenty commercial solar collectors, of the pipe and plate type, and central hot water tank connected to two dormitory buildings. The system has two loops: (1) a solar loop, in which the heated water circulates between the collector panels and the central hot water

tank, and (2) a consumer loop, where the solar-heated water circulates between the central hot water tank and the dormitory. The solar-heated water circulates through the individual electric hot water tanks which serve as individual hot water storage and booster units, and the mains water is introduced at the bottom of the central tank to replace consumed water. The description of the system, the design and its performance, together with an economic analysis, are presented. (Author)

A80-25322 Quiescent and turbulent plasmas under mirror-configurations of magnetic field. R. Hatakeyama, N. Sato, H. Sugai, and Y. Hatta (Tohoku University, Sendai, Japan). *Plasma Physics*, vol. 22, Jan. 1980, p. 25-40. 32 refs.

Particle reflection and trapping are investigated on plasma flows injected into mirror configurations of magnetic field. Detailed measurements are made on a collisionless plasma whose ion energy distribution is controlled before entering into the mirror configuration, and the results are well explained by the orbit theory. When the plasma density is so high that the ion-ion collision mean free path is comparable to the mirror length, we can observe a clear plasma trapping due to the collisions. An instability around the ion-cyclotron frequency is excited in order to trap a collisionless plasma, and enhanced tail heating of ion energy distribution is observed in addition to the trapping. (Author)

A80-25444 Native oxide and external dielectric polycrystalline GaAs MIS solar cells. R. Singh (Waterloo, University, Waterloo, Ontario, Canada) and T. N. Bhar (District of Columbia, University, Washington, D.C.). *International Journal of Electronics*, vol. 47, Nov. 1979, p. 509-513. 10 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada.

The polycrystalline MIS solar cell is a potential candidate for converting solar energy to electrical energy for large scale terrestrial applications. In this paper, native oxide and external added dielectric polycrystalline GaAs MIS solar cells have been modelled. Two assumptions were made: (1) the potential barrier near the grain boundary has no effect on the barrier height of the device; (2) the main effect of the grain boundary is to reduce the minority carrier lifetime of the polycrystalline semiconductor. The performance of Au-polycrystalline GaAs MIS solar cells have been calculated as a function of the grain size of the crystallites. The native oxide device was modelled as a parallel combination of Schottky barrier and MIS solar cell. These calculations show that in case of native oxide devices, if the fractional areas of Schottky parts is greater than about 10 to the -4th to 10 to the -3rd, the beneficial effect of the interfacial layer will not be observed. (Author)

A80-25472 Discharge start-up in a tokamak with a poloidal divertor. Iu. K. Kuznetsov, S. A. Lebed', and O. S. Pavlichenko (Akademii Nauk Ukrainskoi SSR, Fiziko-Tekhnicheskii Institut, Kharkov, Ukrainian SSR). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 123-131. 14 refs. Translation.

The paper considers the problem of organizing a regime with an expanding magnetic limiter in a tokamak with a poloidal divertor in order to suppress skin effects in the current rise stage. Various laws of limiter expansion may be applied by regulating the current in the divertor conductor. The paper also considers some questions relating to the ionization of the working gas (hydrogen) in a tokamak: the role of processes involving molecules, and controlled influx of the gas. The analysis is performed by means of numerical calculations of a zero-dimensional and one-dimensional model of the initial stage of the discharge. (Author)

A80-25473 Shape control of doublets. R. L. Miller (General Atomic Co., San Diego, Calif.). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 133-147. 27 refs. Contract No. EY-76-C-03-0167.

A 1-1/2-D tokamak transport code is used to model the evolution of doublet geometry on the transport time scale. The doublet shape is determined by the plasma current profile and the current flowing in the field-shaping coils. The current profile is

determined in turn by the assumed transport mechanisms for the densities and temperatures and by an auxiliary heating which may be present. In a large hot machine, such as Doublet III, the time-dependent current profile will also depend upon the assumed initial profile because the skin time is long. As the plasma current evolves, the field-shaping coils must be actively programmed to preserve a desired shape. Using an idealized transport model and a DIII-size plasma, the effects of these key elements upon shape evolution are illustrated, and control of doublet equilibria on a transport time scale is demonstrated for this model. The components of the current profile (p' and ff') obtained should serve as a guide to selecting realistic profiles for MHD stability studies. (Author)

A80-25474 **Transverse confinement of a high-pressure plasma in a corrugated magnetic field.** S. L. Musher and M. D. Spektor (Akademiia Nauk SSSR, Institut Avtomatiki i Elektrometrii, Novosibirsk, USSR). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 149-157. 10 refs. Translation.

The confinement of a high-pressure plasma in a multi-mirror magnetic configuration with a corrugated metal casing is studied analytically and numerically. Equations are derived describing the dynamics of a dense plasma in a corrugated magnetic field and it is shown that the structure of the magnetic lines of force is maintained during the transverse expansion of a hot plasma. The energy confinement time is found to be of the order of the ratio of the square of the characteristic radius of the device to the thermal diffusivity under the assumption that the thermal diffusivity is Bohm-like. (Author)

A80-25475 **Characteristics of lower-hybrid-wave-driven steady-state tokamak power reactors.** S. Y. Yuen, D. Kaplan, and D. R. Cohn (MIT, Cambridge, Mass.). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 159-169. 21 refs. Contract No. ET-78-S-02-4646.

The use of lower hybrid waves for current drive in steady-state tokamak power reactors is studied. Constraints imposed by RF wave propagation are considered. The effect of the decoupling of electron and ion temperatures is studied and is found to enhance the ratio of fusion power to dissipated power. Trade-offs for parameters of RF-driven steady-state reactors are determined. It is found that RF-driven steady-state current operation is especially suitable for high-field high-density reactor designs. For example, this study indicates that a tokamak power reactor characterized by a major radius of 6 m, a magnetic field on axis of 7.5 T, and a fusion power output of 2500 MW could be driven in steady-state operation with an RF power level equal to 2.5% of the fusion power output. (Author)

A80-25476 * **The effect of a weak vertical magnetic field on fluctuation-induced transport in a Bumpy-Torus plasma.** Y. C. Kim, E. J. Powers, J. Y. Hong (Texas, University, Austin, Tex.), J. R. Roth, and W. M. Krawczonek (NASA, Lewis Research Center, Cleveland, Ohio). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 171-176. 11 refs. Research supported by the Texas Atomic Energy Research Foundation; Grant No. N5G-3089.

A80-25478 **Spatial profiles of light impurity ions in the Alcator A tokamak plasma.** K. I. Chen, J. L. Terry, H. W. Moos (Johns Hopkins University, Baltimore, Md.), and E. S. Marmor (MIT, Cambridge, Mass.). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 189-195. 22 refs. Contract No. EY-76-S-02-2711; No. ET-78-C-02-3019.

Spatial profiles of the concentrations of the highly ionized light impurities (O V, O VI, N V) have been obtained in the Alcator A tokamak by using an absolutely calibrated 0.4-m normal-incidence ultraviolet monochromator. In the inversion process, account has been taken of the observed up-down asymmetries in the UV emissions from these impurity ions. The concentrations of oxygen and nitrogen at the periphery relative to the local electron density are found to be 0.05-0.1% and 0.08-0.15%, respectively, at the time of the peak electron density. The positions and breadths of these shells have been studied as functions of electron density and plasma current. The shells show sharply defined outer edges near the local virtual limiter radius while the inner edges appear to be determined by the temperature profile. (Author)

A80-25479 **Neutral-beam injection calculations for torsatrons.** D. T. Anderson, J. L. Shohet (Wisconsin, University, Madison, Wis.), S. Rehker (Max-Planck-Institut für Plasmaphysik, Garching, West Germany), and J. A. Tataronis (New York University, New York, N.Y.). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 197-202. 8 refs. Contract No. ET-78-S-02-5069.

A numerical investigation of the effectiveness of neutral-beam heating in two torsatron-type devices has been undertaken. A modified version of a well-known deposition and orbit code was used for this purpose. It was found that, for beam currents within the applicable range of the model, neutral beams can efficiently heat either a 'classical' or an 'ultimate' torsatron plasma provided the injection is tangential to the magnetic axis. These results were obtained by following ionized test particles down to thermalization. Efficiency of the injection drops as the angle approaches perpendicular, because of relatively poor containment of helically trapped orbits within the assumed plasma volume. (Author)

A80-25480 **Active burn control of nearly ignited plasmas.** L. Bromberg, D. R. Cohn (MIT, Cambridge, Mass.), and J. L. Fisher (MIT; Charles Stark Draper Laboratory, Inc., Cambridge, Mass.). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 203-207. 10 refs. Contract No. EG-77-S-02-4183-A002.

The stabilization of thermal runaway in nearly ignited plasmas by actively controlled auxiliary heating is considered. The use of a variable amount of auxiliary heating for burn control can greatly increase the values of the power multiplication factor Q (fusion power/auxiliary heating power) relative to those values permitted with constant auxiliary heating. A one-dimensional calculation is used to determine the maximum allowable deviation from thermal equilibrium as a function of the equilibrium temperature and Q . The results are applied to tokamak plasmas. The effect of the auxiliary heating deposition profile upon Q is determined. For fixed deviation from thermal equilibrium, significantly higher values of Q can be obtained with central ion heating relative to those obtained with edge ion heating. Central electron heating has about the same order of effectiveness as edge ion heating. For central temperatures of about 25 keV, Q approximately 25 can be obtained if the deviation in the ion temperature is held below 15%. (Author)

A80-25481 **Space- and time-resolved study of impurities by visible spectroscopy in the high-density regime of JIPP T-II tokamak plasma.** K. Kadota, M. Otsuka, and J. Fujita (Nagoya University, Nagoya, Japan). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 209-212. 8 refs.

A80-25482 **Anomalous diffusion of alpha particles in a tokamak reactor due to the trapped-ion mode.** V. A. Mazur (Akademiia Nauk SSSR, Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniia Radiovoln, Irkutsk, USSR). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 213-218. 7 refs. Translation.

The anomalous diffusion of alpha particles (product of DT fusion) in a field of trapped-ion turbulence is considered. It is shown that allowance for the slight nonpotential character of this mode considerably increases the diffusion coefficient. For the parameters of tokamak reactors currently being planned the diffusion coefficient is found to be two orders of magnitude greater than the electron diffusion coefficient. (Author)

A80-25483 **Observation of radio-frequency-driven plasma current in the octopole tokamak.** R. J. La Haye, C. J. Armentrout, R. W. Harvey, C. P. Moeller, and R. D. Stambaugh (General Atomic Co., San Diego, Calif.). *Nuclear Fusion*, vol. 20, Feb. 1980, p. 218-222. 10 refs.

A toroidally unidirectional slow wave is launched at a frequency well above the lower hybrid resonance. The effects of the wave on the toroidal plasma current are presented and compared with predictions of quasi-linear electron Landau damping theory. (Author)

A80-25494 Fluidized bed combustion of high sulphur coals. R. Haque, M. L. Dutta (Regional Research Laboratory, Jorhat, India), and R. K. Chakrabarti (Central Mine Planning and Design Institute, Ltd., Ranchi, India). *Institute of Energy, Journal*, vol. 52, Dec. 1979, p. 173-177. 12 refs.

This paper presents the work carried out on fluidized bed combustion of high sulphur coals in a 20 kg/h capacity coal burning test rig using limestone as the bed material. Effects of various combustion variables have been studied with reference to determining the combustion efficiency and efficiency of sulphur retention. Fluidized bed combustion has been found to be a good solution for minimizing atmospheric pollution and achieving efficient combustion of low grade high sulphur coals. (Author)

A80-25495 Pumped water storage. V. G. Newman (Central Electricity Generating Board, Planning Dept., London, England). (*Symposium on Energy Storage, Fawley, England, May 11, 1978.*) *Institute of Energy, Journal*, vol. 52, Dec. 1979, p. 178-184.

The history, current state of development and future developments of electrical energy storage through the pumping of water to a higher elevation are reviewed. Developments in the turbine and pump units of pumped water energy storage plants since their introduction in the 1890s are surveyed, and it is pointed out that the advantages of reversible pump-generator machines have led to their widespread adoption over the past 20 years in place of separate pumps and turbines. Progress made since 1950 in increasing unit capacities to almost 400 MW, operating heads to over 1400 m and efficiencies to better than 78% for supplying peak energy demands and providing reserve capacities to cover sudden generating losses by pumping water during weekday nights and weekends is indicated. Possible sites for additional pumped water storage facilities are considered, and the impact of alternative energy supplies on pumped water storage system operation is discussed. A.L.W.

A80-25496 Thermal storage in density-stratified fluids and phase-change materials. B. J. Brinkworth (University College, Cardiff, Wales). (*Symposium on Energy Storage, Fawley, England, May 11, 1978.*) *Institute of Energy, Journal*, vol. 52, Dec. 1979, p. 193-196. 13 refs.

Consideration is given to the thermodynamics and fluid mechanics of solar heat storage in density-stratified fluids and phase-change materials. Various solid and liquid sensible heat storage materials are examined, and the process of density stratification in liquid stores is considered, noting methods designed for delivering heat to maintain the stratification. The design of latent heat storage systems to meet the requirements of high energy density and rapid charging is discussed, and experimental investigations of convective heat transfer during melting are presented. It is concluded that the present state of thermohydrodynamics is insufficient to meet the needs of thermal storage design, which requires the minimization of convection in sensible heat storage systems and its maximization in latent heat systems. A.L.W.

A80-25657 Spectral selectivity of high-temperature solar absorbers. D. M. Trotter, Jr. and A. J. Sievers (Cornell University, Ithaca, N.Y.). *Applied Optics*, vol. 19, Mar. 1, 1980, p. 711-728. 42 refs. Research supported by the Solar Energy Research Institute; NSF Grant No. DMR-76-81083.

Numerical calculations of the thermal emissivity ϵ (TH) and normal incidence solar absorptivity α (s) of model spectrally selective solar absorbers at high temperatures are reported. The model absorbers consist of Drude metal substrates coated with layers that are successively made better and better approximations to a selective solar absorber. The emissivity of the bare metal substrates ϵ (TH)M is calculated as a function of temperature. Then the metal substrate is coated with a homogeneous dielectric layer of index $n(L)$ and it is found that ϵ (TH) of the coated metal increases monotonically with $n(L)$ from ϵ (TH)M at that temperature. The dielectric layer is then replaced by a selectively absorbing layer with the optimum physically realizable spectral absorptivity, and maximum values of α (s) and minimum values

of ϵ (TH) are calculated as functions of operating temperature and layer thickness. Finally, the homogeneous selective layer is replaced with one having a complex refractive index graded linearly through the thickness of the film. It is found that, compared with homogeneous films of the same thickness, the graded films typically have a higher α (s) and a lower ϵ (TH). For films thick enough to be useful absorber surfaces, however, the improvements in α (s) and ϵ (TH) are small. (Author)

A80-25679 # Energy conversion and corrosion processes in electrochemical solar cells with semiconductor electrodes (Energieumwandlung und Korrosionsprozesse in elektrochemischen Solarzellen mit Halbleiterelektroden). J. Gobrecht. Berlin, Technische Universität, Fachbereich Physik, Dr.-Ing. Dissertation, 1979. 132 p. 124 refs. In German.

The irradiated phase-interface between semiconductors and redox electrolytes is studied together with possible corrective measures for stabilizing photocorrosion. Analyses of the properties of individual electrochemical components of solar cells are presented. Results show the instability of various semiconductor combinations, especially those of Group II-VI and Group III-V. C.F.W.

A80-25689 The development of fluidized bed combustion. J. Highley (Coal Research Establishment, Cheltenham, Glos., England). *Environmental Science and Technology*, vol. 14, Mar. 1980, p. 270-275.

The development of fluidized bed coal combustion for electricity generation at a lower capital cost and reduced sulfur dioxide emission levels is outlined. Attention is given to the elimination of coal crushing from the standard fluidized bed combustion procedure to attain a higher combustion efficiency with washed coal and modifications to conventional boiler design. The conversion of fire-tube boilers for use with oil burners to fluidized bed coal combustion is discussed, and new boilers developed for use with fluidized combustion are presented. Applications of fluidized bed combustion in drying processes and waste incineration are also pointed out, and research in combined thermodynamic cycle power generation using fluidized bed combustion is discussed. A.L.W.

A80-25690 Combined flue gas desulfurization and water treatment in coal-fired power plants. R. H. Borgwardt (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Research Triangle Park, N.C.). *Environmental Science and Technology*, vol. 14, Mar. 1980, p. 294-298. 14 refs.

Pilot plant experiments were carried out to investigate the feasibility of replacing makeup water in limestone flue gas desulfurization (FGD) scrubbers with a simulated cooling tower blowdown. Tests were conducted while forcing the oxidation of the scrubber slurry to gypsum and maintaining Cl(-) concentrations at levels expected with the use of high-sulfur coals of moderate chloride content. Results show that all of the makeup water could be replaced with blowdown containing up to 690 ppm Na(+) when operating at SO₂ make-per-pass below 8 mmol/l and a tightly uncontrolled discharge of soluble salts and trace elements from a power plant can be markedly reduced by the application of water treatment units such as vapor-compression evaporation as an integral part of the FGD scrubber. Such systems should be more effective in maximizing water reuse and should have lower energy requirements than the direct application of water treatment to blowdown streams. A.L.W.

A80-25771 European Conference on Controlled Fusion and Plasma Physics, 9th, Oxford, England, September 17-21, 1979, Invited Papers. Conference sponsored by the European Physical Society. Abingdon, Oxon, England, Atomic Energy Research Establishment, 1980. 387 p. \$28.

The contributed papers report developments both in magnetic field systems and in inertial confinement methods employing lasers and relativistic beams. Specific studies include theoretical research in

fusion reactors, disruption investigations, stellarator research, tokamak, mirror machines, and hybrid fusion-fission reactor research, ICRF heating, and doublet plasmas. Other studies include DITE tokamak with injection and bundle divertor, REB accelerator for ICF, and investigation of laser fusion physical processes. V.L.

A80-25777 # US tokamak research. H. P. Furth (Princeton University, Princeton, N.J.). In: European Conference on Controlled Fusion and Plasma Physics, 9th, Oxford, England, September 17-21, 1979, Invited Papers. Abingdon, Oxon, England, Atomic Energy Research Establishment, 1980, p. 309-319. 14 refs. Contract No. EY-76-C-02-3073.

Experimental results obtained on ISX-B, Alcator C, PDX, and PLT tokamaks are discussed. The neutral-beam-heated ISX-B is the first tokamak device to have reached a beta level of approximately 3%. Alcator C, in its initial half-field operation, has obtained plasma containment time values exceeding 20 msec and has found a modified empirical scaling pattern. The Poloidal Divertor Experiment (PDX) has entered initial round-plasma operation at currents up to 500 kA. Low-power ion-cyclotron heating on PLT has given bulk-ion-temperature rises up to 600 eV and energetic efficiencies exceeding those of neutral-beam heating. V.L.

A80-25785 # Progress in the production and energy flux concentration of the REB accelerator for ICF. V. P. Smirnov (Akademii Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). In: European Conference on Controlled Fusion and Plasma Physics, 9th, Oxford, England, September 17-21, 1979, Invited Papers. Abingdon, Oxon, England, Atomic Energy Research Establishment, 1980, p. 473-484. 17 refs.

It is noted that the energy flux concentration on the surface of a thermonuclear target is the main problem at the present stage of the ICF investigations with high power pulse generators as an energy source. Present efforts are aimed mainly at achieving high efficiency in the transmission and at investigating the mechanisms of an efficient energy deposition on the outer surface of the pellet. The recent results obtained on the energy flux concentration at the Rudakov division of the Kurchatov Institute are outlined. M.E.P.

A80-25786 # Controlled fusion research in China. Z. Li (Southwestern Institute of Physics, Loshan, Communist China). In: European Conference on Controlled Fusion and Plasma Physics, 9th, Oxford, England, September 17-21, 1979, Invited Papers. Abingdon, Oxon, England, Atomic Energy Research Establishment, 1980, p. 485-489.

Developments in fusion research in China are reviewed. Specific fields discussed include fusion reactors, toroidal magnetic confinement, and mirror magnetic confinement. Technical details are given for several operating tokamaks and for a mirror device with superconducting coils and vacuum ionization of a 100-keV neutral beam. Other studies include fast pulsed discharges, plasma focus experiments, and laser fusion research. V.L.

A80-25885 Development of a spherical reflector/tracking absorber solar energy collector. G. Grossman and E. Fruchter (Technion - Israel Institute of Technology, Haifa, Israel). *Israel Journal of Technology*, vol. 17, no. 1, 1979, p. 5-11. 6 refs. Research sponsored by the U.S.-Israel Binational Science Foundation and Israel Ministry of Commerce and Industry.

A concentrating solar collector based on the Stationary Reflector/Tracking Absorber (SRTA) concept was built and tested. The collector consists of a 2.5 m diameter fixed spherical mirror, which concentrates solar radiation on a cylinder-shaped tubular absorber tracking the sun. The system was exposed to weather conditions for more than a year and tested at different operating temperatures. The design of the mirror and absorber and their method of fabrication, the automatic tracking mechanism and the heat removal system are described. Experimental results are given and compared with a theoretical performance prediction. Total efficiency of 42% has been obtained for a wide range of outlet

temperatures up to 150 C. Higher temperatures, up to 300 C, have been reached but could not be maintained at no-boiling conditions. The results of this study indicate the possibility of obtaining higher efficiencies with a better mirror surface, and the practical independence of the efficiency on the operating temperatures for a wide range of the latter. The system is hence capable of providing heat at high temperatures sufficient for space heating and air conditioning and for compact heat storage. (Author)

A80-25886 Technology and performance of a high concentration solar cell power supply. J. Mandelkorn and G. Yekutieli (Weizmann Institute of Science, Rehovot, Israel). *Israel Journal of Technology*, vol. 17, no. 1, 1979, p. 12-18. 13 refs.

A prototype, 25 watt output, high concentration solar cell power supply has been constructed using immediately available components (1977). Concentration ratio of about 100 x minimized cell cost without incurring high costs for critical optics and tracking. The power supply consists of 36 1 x 1 cm cells in series, a corresponding number of 10 cm x 10 cm Fresnel lenses mounted above the cells, and a sun position detector and tracker. The overall operating efficiency of the power supply is 7.5%. The supply is described in terms of individual components and subsystem design, structure, and fabrication. (Author)

A80-25887 Optimization of a solar water heating system for a Negev kibbutz. D. Faiman (Negev, University, Sde Boger and Beersheba, Israel), J. M. Gordon, and D. Govaer (Negev, University, Sde Boger, Israel). *Israel Journal of Technology*, vol. 17, no. 1, 1979, p. 19-28. Research supported by the Ministry for Immigrant Absorption of Israel.

A technical and economic analysis of the costs and benefits of adding solar energy to the centralized hot water system already existing at a Negev kibbutz is presented. Detailed estimates were received from five Israeli manufacturers. Taking into account the technical capabilities of the collectors, the local climatological data and the domestic hot water requirements, it was possible to estimate for each proposed system the amount of useful energy it could provide and hence, the money to be saved in reduced fuel oil costs. The analysis was developed in such a way as to determine if a proposed system can repay its initial cost and to estimate a net savings over the anticipated life of the system. In a majority of the scenarios considered, all of which neglect the possibility of increases in the real price of fuel, of the five systems considered only two exhibited attractive economic and technical capabilities. (Author)

A80-25888 Alkanes obtained by thermal conversion of Green River oil-shale kerogen using CO and H₂O at elevated pressure. S.-L. Chong, J. J. Cummins, and W. E. Robinson (U.S. Department of Energy, Laramie Energy Technology Center, Laramie, Wyo.). *Israel Journal of Technology*, vol. 17, no. 1, 1979, p. 36-50. 19 refs.

The alkanes produced from the reaction of Green River and oil-shale kerogen with CO and H₂O at temperatures of 300 to 450 C were characterized by GLC and GC-MS. The amount of alkanes generally increases with a higher reaction temperature, and at 450 C it is higher than that produced by the Fischer assay method. This study shows that the isoprenoid-type structures are a significant part of the structure of Green River kerogen, and that the components produced from the kerogen in the CO-H₂O reaction below 400 C are essentially the same as those in the natural bitumen. (Author)

A80-25889 Gasification of oil shale. Y. Schachter (Bar-Ilan University, Ramat Gan, Israel). *Israel Journal of Technology*, vol. 17, no. 1, 1979, p. 51-57. 14 refs.

Kerogen can be converted into gas by heating. Because of its very fine distribution reactions take place within a few seconds. A simple mixture of gases is obtained: hydrogen, methane, ethylene, carbon monoxide and carbon dioxide. Residual carbon reacts with steam, carbon dioxide or oxygen. Above 850 C virtually total conversion takes place. In the presence of carbonates the carbon dioxide formed on decomposition reacts with kerogen coke in situ.

The oxides react with hydrogen sulphide. With shales lacking carbonates the same effects can be obtained by admixing carbonate-containing mineral. The gases formed can be used as feedstock for the chemical industry, fuel, or for the production of hydrogen or methanol. The gasification of oil shale seems, under certain conditions, economically more attractive than production of oil. (Author)

A80-26001 # Simplified correlations for prediction of NO_x/ emissions from MHD power plants. J. Hopenfeld (U.S. Department of Energy, MHD Div., Germantown, Md.). *Journal of Energy*, vol. 3, Nov.-Dec. 1979, p. 335-343. 16 refs.

Exact numerical solutions of NO_x concentrations in coal-fired MHD boilers are employed to develop simple correlations of the boiler parameters, which would allow a sufficient residence time for NO_x to decompose to EPA-allowed levels. These simple correlations take into account boiler diameter, stoichiometry, and degree of slag carryover. The correlation method provides results within + or - 10% of the more exact numerical calculations. The mathematical model underlying the present results considers ideal gas flow with chemical reactions and heat losses to the walls of a cylindrical vessel. The chemical reactions for NO_x decomposition are described with the chemical reaction rate constants taken from the JANAF tables. The flue gas is cooled by radiation from both gaseous constituents and slag particles. Secondary combustion is not taken into account. In general, the results indicate that radiant boilers in commercial MHD generating plants would operate at stoichiometric ratios in the range of 0.9 to 0.95. Stoichiometric ratios near 0.85 would be required to meet more strict NO_x requirements than currently proposed by the U.S. EPA. (Author)

A80-26002 # Study of a vortex augmentor for a wind-powered turbine. J. E. Hubbart (Georgia Institute of Technology, Atlanta, Ga.). *Journal of Energy*, vol. 3, Nov.-Dec. 1979, p. 344-348. 5 refs.

An experimental investigation of an augmentor which employs a vortex to create a low pressure sink for the discharge of a wind-powered turbine is reported. The test model has a horizontal axis with the vortex produced by an annular cascade of stator vanes surrounding the turbine duct. The maximum value of the experimental power coefficient was only about one-third of the ideal flow limit. Furthermore, the power augmentation with this vortex pump was only slightly higher than that obtained when the stator-vane annulus was completely blocked. Thus, it is concluded that this type of vortex augmentor is ineffective. (Author)

A80-26003 # Space-manufactured satellite power systems. R. H. Miller and D. L. Akin (MIT, Cambridge, Mass.). *Journal of Energy*, vol. 3, Nov.-Dec. 1979, p. 373-375. 6 refs.

The tradeoffs between using lunar rather than terrestrial materials for solar power satellite (SPS) manufacturing are examined, particularly the effects of uncertainties in the two primary cost drivers on these tradeoffs: human productivity in space and the cost of transportation to low earth orbit (LEO). Two cases were chosen for comparison, namely, assembly in LEO from terrestrial materials and transportation of the completed SPS to geosynchronous earth orbit (GEO), and materials refined on the moon but parts manufactured and SPS assembled at GEO. It is found that the tradeoff between the use of lunar or terrestrial materials is critically dependent on productivity in space, with the crossover occurring at about 5 kg/h. J.P.B.

A80-26004 # The Lanchester-Betz limit. K. H. Bergey (Oklahoma, University, Norman, Okla.). *Journal of Energy*, vol. 3, Nov.-Dec. 1979, p. 382-384.

Everyone involved in the development of wind machines is familiar with the so-called Betz limit. It defines an upper limit to the amount of energy in the wind that can be converted to usable power. The output of a windpower generator may be measured by the change in wind velocity across the windmill rotor. In 1915 Lanchester had shown that the maximum power is obtained from a

windmill when the residual velocity downwind from the rotor is 1/3 that of the free wind, and that the maximum theoretical efficiency is 16/27 or 59.3%. Betz derivation, however, was published in 1920. Arguments are presented in support of the proposition that the so-called Betz limit be referred to in the future as the Lanchester-Betz limit. There seems to be no doubt that Lanchester's derivation preceded Betz's derivation. S.D.

A80-26169 Soft-energy provision - A new Utopia (Sanfte Energieversorgung - Eine neue Utopie). D. Oesterwind, O. Renn, and A. Voss (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Energiewirtschaftliche Tagesfragen*, vol. 30, Feb. 1980, p. 111-117. 26 refs. In German.

A new 'soft-energy' alternative to the present energy problems is discussed, which emphasizes solar heating and cooling systems, as well as biomass conversion and combinations of the systems. Advantages of the proposed system include, (1) almost no transportation and distribution costs, (2) short construction times (3) and easy comprehension. The question of adapting this system in West Germany is considered together with its social and economic consequences. C.F.W.

A80-26175 Biogas - Fuel of the future. E. J. DaSilva (UNESCO, Div. of Scientific Research and Higher Education, Paris, France). *Ambio*, vol. 9, no. 1, 1980, p. 2-9. 43 refs.

The potential and economic feasibility of the bioconversion of organic residue into methane fuel is discussed. Since it uses renewable resources otherwise polluting the environment, biogas generation serves a triple function: waste removal, management of the environment, and energy production. It is found that 1000 cu ft of biogas has an energy equivalent of 600 cu ft of natural gas, 6.4 gallons of butane, 5.2 gallons of gasoline, or 4.6 gallons of diesel oil. Details of the biogas plant design, construction, and operation are provided along with the status of biogas in various countries and some R&D tasks. Some of the problems impeding the efficiency of biogas generation, such as the reduction of steel in current gas plant designs, efficient burners, heating of digesters with solar radiation, coupling of biogas systems with other nonconventional energy sources, and design of large-scale plants for communities, are outlined. It is concluded that biogas shows promise as a future source of energy for both developed and developing countries. L.M.

A80-26184 Possible energy savings through tribological measures - Especially in automobiles (Mögliche Energie-Einsparung durch tribologische Massnahmen - Insbesondere beim Kraftfahrzeug). W. J. Bartz (Esslingen, Technische Akademie, Esslingen, West Germany). *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie*, vol. 33, Feb. 1980, p. 78-87. 57 refs. In German.

The efficiency of internal combustion engines and gears is analyzed. Their influence and the state of friction is discussed to assess the order of magnitude of fuel savings that can be achieved through lubricants. These figures are compared with the results achieved elsewhere to establish a practical value for efficiency. C.F.W.

A80-26309 Thermodynamics of heating. II (Zur Thermodynamik des Heizens. II). H. D. Baehr (Hamburg, Hochschule der Bundeswehr, Hamburg, West Germany). *Brennstoff-Wärme-Kraft*, vol. 32, Feb. 1980, p. 47-57. 18 refs. In German.

It is shown that in contrast to the conventional heating systems discussed in the first part of the investigation, primary energy can only be saved by heating systems in which greatest portion of the heating energy is obtained from sources such as waste heat or the environment, rather than primary energy. The heating numbers of three heat pump heating systems are calculated and compared with each other. Finally, it is shown that the combined heat and power systems frequently achieve a better primary energy utilization than heat pump systems. M.E.P.

A80-26340 Carrier generation, recombination, and transport in amorphous silicon solar cells. R. Williams and R. S. Crandall

(RCA Laboratories, Princeton, N.J.). *RCA Review*, vol. 40, Dec. 1979, p. 371-389. 44 refs. Research sponsored by RCA; Contract No. ET-78-C-03-2219.

The discovery of the amorphous silicon solar cell has stimulated work in many laboratories to develop a cheap, efficient, and practical cell. The ability to deposit large-area thin films of this material, with its high optical absorption and relatively good electron lifetime, offers great promise for the development of solar cells. However, the charge-carrier generation and transport are quite different from that found in the more familiar single-crystal silicon. A proper design for a solar cell must take these differences into account. Attention is given to charge-carrier generation, recombination, and transport through insulator layers, and it is shown how these affect solar cell performance. (Author)

A80-26344 # New approaches to sailing. B. Smith. *Astronautics and Aeronautics*, vol. 18, Mar. 1980, p. 36-47.

It is noted that sailing involves no thermodynamic cycle and generates little heat, and that sailboats react mechanically to the force of the wind without any train of energy-losing conversions in the path of the action. The paper investigates some possible configurations for sail powered vessels, such as a blimp sail boat, hybrid motor-sailer, and a tanker sailed with the gases derived from the well yielding the oil. Attention is also given to some model aerohydrofoils which have been experimented with. M.E.P.

A80-26466 Thin film CdSe photoanodes for electrochemical photovoltaic cells. M. A. Russak, J. Reichman (Grumman Aerospace Corp., Bethpage, N.Y.), H. Witzke, S. K. Deb, and S. N. Chen (Optel Corp., Princeton, N.J.). *Electrochemical Society, Journal*, vol. 127, Mar. 1980, p. 725-733. 28 refs.

Electrochemical photovoltaic cells rely on the junction formed between a semiconductor and electrolyte to accomplish photovoltaic conversion. As a result, they offer certain technical features that make them an attractive alternative to all solid-state solar cells, especially if thin film photoelectrodes are used. This paper describes the fabrication and evaluation of thin film CdSe electrodes for use with sulfide/polysulfide electrolyte in these cells. The effects of electrode preparation and electrolyte concentration on efficiency and stability are presented. I-V curves and action spectra are also discussed. Simple depletion layer theory is applied to monochromatic photocurrent curves and a correlation between efficiency and minority carrier diffusion length is shown. Conversion efficiencies (AM1) as high as 5% are reported. (Author)

A80-26511 # Selective optical surfaces for solar energy converters (Selektivnye opticheskie poverkhnosti preobrazovatelei solnechnoi energii). M. M. Koltun. Moscow, Izdatel'stvo Nauka, 1979. 215 p. 213 refs. In Russian.

Optical surfaces and coatings with selective spectral characteristics are studied with reference to solar cells and arrays for power generation in space and on the ground. Detailed optical, electrical, and thermal properties are given for solar energy concentrators, radiators, transparent thermoreflexive windows, and thermal collectors. It is shown that selective surfaces make it possible to collect up to 90% of the energy contained in the incident solar radiation and to increase the efficiency of photovoltaic generators by 50%. The service life of solar arrays can be increased through the use of selective coatings by a factor of up to several hundreds. V.L.

A80-26681 Combined ADI iteration and implicit central difference numerical method for solving nonlinear conjugated partial differential equations with moving boundary heat transfer in in-situ coal liquefaction. F. K. Fong and D. R. Skidmore (Ohio State University, Columbus, Ohio). In: *Advances in computer methods for partial differential equations - III; Proceedings of the Third International Symposium, Bethlehem, Pa., June 20-22, 1979.*

New Brunswick, N.J., International Association for Mathematics and Computers in Simulation, 1979, p. 120-126. 12 refs. Research supported by the Ohio State University, West Virginia University, U.S. Bureau of Mines, and U.S. Department of Energy.

A80-26708 Application of computer models to the retorting of oil shale. D. A. Crowl and R. A. Piccirelli (Wayne State University, Detroit, Mich.). In: *Advances in computer methods for partial differential equations - III; Proceedings of the Third International Symposium, Bethlehem, Pa., June 20-22, 1979.* New Brunswick, N.J., International Association for Mathematics and Computers in Simulation, 1979, p. 341-350. 28 refs. Contract No. EX-76-C-01-2346.

The development of various models for describing the physical processes that occur in a single particle of oil shale is discussed. The current development of these single particle models is described and some of the problems in the numerical solution of partial differential equations are outlined. Attention is given to the pseudo-steady state pressure approximation, and to the distributed parameter and quasi-shrinking core models. C.F.W.

A80-26813 Free space microwave power transmission systems for microwave powered atmospheric platforms. W. C. Brown (Raytheon Co., Waltham, Mass.). In: *EASCON '79; Electronics and Aerospace Systems Conference, Arlington, Va., October 9-11, 1979, Conference Record. Volume 3.* New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 550-556. 13 refs.

The microwave power transmission system consists of the efficient conversion of ordinary electrical power into microwave power, the forming of a microwave beam, accurately aimed at the platform, and the efficient capture and conversion of the microwave power into ordinary electrical power at the platform. A special device, the rectenna, with a dc power output to mass ratio of one kilowatt per kilogram, efficiently captures and rectifies the microwave power even though there may be substantial attitude and position change of the platform. The rectenna can be designed for any voltage and is tolerant of changes in load impedance. The balance of the system is also described and an estimate of system cost is made. (Author)

A80-26820 * # Airborne spacecraft - A remotely powered, high-altitude RPV for environmental applications. J. W. Youngblood, W. L. Darnell, R. W. Johnson, and R. C. Harris (NASA, Langley Research Center, Hampton, Va.). *Institute of Electrical and Electronics Engineers, Electronics and Aerospace Systems Conference, Arlington, Va., Oct. 9-11, 1979, Paper. 7 p. 14 refs.*

A high-altitude, unmanned, propeller-driven electric airplane is proposed for remote sensing of environmental phenomena. With motive power from surface-mounted solar arrays or microwave receivers, flight endurance of weeks to months could be anticipated. The proposed system offers unique capability for monitoring oceanic and atmospheric characteristics on local or regional scales. Coastal marine and tropospheric research activities, which require temporal resolutions of 2-72 hours, would be prime application areas. Potential missions might include the monitoring of ocean disposals, episodic marine biological events, and river/ocean interactions. Preliminary sizing and performance calculations are presented along with possible mission scenarios and payload complements. (Author)

A80-27057 Preparation and photovoltaic properties of screen printed CdS/Cu(x)S solar cells. H. Matsumoto, N. Nakayama, and S. Ikegami (Matsushita Electric Industrial Co., Ltd., Wireless Research Laboratory, Osaka, Japan). *Japanese Journal of Applied Physics*, vol. 19, Jan. 1980, p. 129-134. 15 refs. Research supported by the Agency of Industrial Science and Technology.

CdS/Cu(x)S solar cells were prepared by using a screen printing method. A low resistivity CdS film was obtained by screen printing CdS paste on a glass substrate and then sintering it in N₂ gas including a small amount of Cd vapor. A Cu(x)S layer was formed on the surface of a CdS film and Ag paint electrode or Ni paint electrode was applied to the Cu(x)S layer, which was then heat treated in N₂ gas. Fabrication of a low resistivity CdS film and heat treatment in N₂ gas after applying electrodes were important factors in obtaining a high efficiency cell. The stability of the cell was influenced by the electrode material on the Cu(x)S layer. (Author)

A80-27058 Application of plasma focus device to compression of toroidal plasma. K. Ikuta (Nagoya University, Nagoya, Japan). *Japanese Journal of Applied Physics*, vol. 19, Jan. 1980, p. 157-160. 8 refs.

A new concept of compressing a toroidal plasma using a plasma focus device is considered. Maximum compression ratio of toroidal plasma is determined merely by the initial density ratio of the toroidal plasma to a sheet plasma in a focus device because of the Rayleigh-Taylor instability. An initiation scenario of plasma-liner is also proposed with a possible application of this concept to the creation of a burning plasma in reversed field configurations, i.e., burning plasma vortex. (Author)

A80-27099 Organic content of particulate matter in turbine engine exhaust. D. J. Robertson, R. H. Groth, and T. J. Blasko (United Technologies Corp., Commercial Products Div., East Hartford, Conn.). *Air Pollution Control Association, Journal*, vol. 30, Mar. 1980, p. 261-266.

Solid particulate matter, mainly carbon, emitted into the air from the combustion of fossil fuels contains a variety of organic species adsorbed on it. In an examination of these particulates from the combustion of kerosene-type fuels in a gas turbine engine, attention was focused on polynuclear aromatic compounds, phenols, nitrosamines, and total organics. The particulates were collected using a high-capacity pumping system and 293-mm diameter teflon filters through which was passed up to 43 cu m of exhaust gas. Extraction of the organic matter was done in a Soxhlet extractor using hexane usually. The engine was operated at idle, approach, climb, and take-off power settings with low-sulfur and high-sulfur (0.25%) fuels. Most of the PAH were small 3 and 4 fused ring compounds with very few, at low concentrations, 5 and 6 fused ring species. No nitrosamines were found and except in a few cases, at low levels, no phenols. PNA and total organic levels decreased with increase in a power setting and were higher in the exhaust from low sulfur fuels. Less than 1% of the organic matter emitted by the engine was absorbed on the particulate matter. (Author)

A80-27195 Transverse self-focusing of a Gaussian beam - Moment method. S. K. Sinha and M. S. Sodha (Indian Institute of Technology, New Delhi, India). *Physical Review A - General Physics, 3rd Series*, vol. 21, Feb. 1980, p. 633-638. 13 refs.

The present paper investigates the self-focusing and self-trapping of a Gaussian laser beam propagating transverse to the static magnetic field in a plasma. In order to accomplish this, moment theory has been adopted, as opposed to the paraxial-ray approximation, which has so far been the basis for most of the analyses of self-focusing in the recent past. An equation for the beam width has been set up and solved numerically; the condition for self-trapping of the beam has also been obtained. (Author)

A80-27204 Use of solar energy under terrestrial conditions - Automated production of solar generator components (Nutzung der Sonnenenergie unter terrestrischen Bedingungen - Automatisierte Fertigung von Solargenerator-Komponenten). *VDI-Z*, vol. 122, no. 4, Feb. 1980, p. 141-143. In German.

A80-27263 Theory of current generation by electrostatic traveling waves in collisionless magnetized plasmas. K. Kato (Nagoya University, Nagoya, Japan). *Physical Review Letters*, vol. 44, Mar. 24, 1980, p. 779-781. 16 refs.

A80-27269 Future large cargo aircraft technology. R. H. Lange (Lockheed-Georgia Co., Advanced Concepts Dept., Marietta, Ga.). *Lockheed Horizons*, Spring 1980, p. 16-24.

Some innovative design concepts are surveyed which show potential for significant improvements in aerodynamic efficiency, operating economics, and operational efficiency. Topics examined include military/civil commonality issues, and cargo capacity. Atten-

tion is given to the environmental impact of future cargo aircraft covering advanced composite materials, advanced aircraft propulsion, aircraft drag reduction, alternate fuels, and innovative design concepts. M.E.P.

A80-27270 The changing horizons for technical progress. H. R. H. Hopps (Lockheed-California Co., Burbank, Calif.). *Lockheed Horizons*, Spring 1980, p. 32-39.

Some new technologies are surveyed that offer the possibility of obsoleting the present concept of a jet transport. Attention is given to such areas as laminar flow control, all-wing concepts, superlarge aircraft, advanced turboprops, air cargo, avionics, hydrogen, VTOL and V/STOL. Also covered are a nuclear-powered airplane and a supersonic transport. It is concluded that new developments will be of an evolutionary manner rather than a sudden jump to a new generation of aircraft, as in the past. M.E.P.

A80-27276 Numerical investigation of current driven dissipative drift wave turbulence including finite beta and quasilinear effects in a tokamak plasma. J. Weiland (EURATOM and Chalmers University of Technology, Institute for Electromagnetic Field Theory, Goteborg, Sweden). *Physical Society of Japan, Journal*, vol. 48, Jan. 1980, p. 238-246. 39 refs. Research supported by the Japan Society for the Promotion of Science.

Excitation of dissipative drift wave turbulence with waves propagating perpendicular to the density gradient is studied numerically, taking an average over the gradient coordinate. Situations where the plasma current is the main source of instability and situations closer to an ordinary dissipative drift wave excitation are investigated in the presence of finite beta effects and ion viscosity. The main saturation mechanism is quasilinear modification of the background density. In addition to the usual current induced growth, the current is also found to decrease the finite beta stabilization. (Author)

A80-27278 Toroidal effects on nonlocal collisionless drift instability. K. Itoh, T. Tuda (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan), and S. Inoue (Hiroshima University, Hiroshima, Japan). *Physical Society of Japan, Journal*, vol. 48, Jan. 1980, p. 258-263. 10 refs.

Toroidal curvature effects on the electrostatic collisionless drift instability in a sheared magnetic field is investigated. The magnetic curvature drift of ions reduces or even annihilates the shear convective damping and causes the mode ballooning. It is found that the universal mode is stable (or marginally stable at most) so long as the convective damping remains finite, and the critical current density for the current-driven drift instability becomes lower. (Author)

A80-27321 High photocurrent polycrystalline thin-film CdS/CuInSe₂ solar cell. R. A. Mickelsen and W. S. Chen (Boeing Aerospace Co., Seattle, Wash.). *Applied Physics Letters*, vol. 36, Mar. 1, 1980, p. 371-373. Contract No. EG-77-C-03-1458.

A polycrystalline thin-film CdS/CuInSe₂ heterojunction solar cell with an efficiency of 5.7% has been prepared using a simultaneous elemental evaporation technique to deposit the CuInSe₂ film. The cell's short-circuit current of 31 mA/sq cm under 100 mW/sq cm is the highest ever reported for a 1-sq-cm cell. Heat treatments have been found to improve cell efficiency and to also change the cell I-V and C-V characteristics. (Author)

A80-27337* Silicon ribbon growth using scanned lasers. A. Baghdadi (National Bureau of Standards, Washington, D.C.), R. J. Ellis, and R. W. Gurtler (Motorola, Inc., Solar Energy Research and Development Dept., Phoenix, Ariz.). *Applied Optics*, vol. 19, Mar. 15, 1980, p. 909-913. 7 refs. Contract No. JPL-954376.

The recent demand for low-cost photovoltaic arrays has renewed the interest in growing silicon in ribbon form. The approach used in the present paper for the growth of low-cost silicon ribbon is shown

schematically. A pair of scanned, focused CO₂ laser beams is directed onto both sides of a preformed silicon ribbon. A narrow (about 1 mm high) molten zone is formed across the full width of the ribbon. As the silicon ribbon is passed through the laser-heated zone, large grains are produced in the recrystallized ribbon. The laser beam path is outlined schematically. As a general rule, the lenses are not positioned so as to bring the laser beams to a fine focus, since highly focused beams would vaporize the silicon surface rather than serve to melt the bulk. Silicon ribbon has been grown at rates up to 13.3 cm/min by this approach. The best solar cell fabricated so far on this material has a conversion efficiency of 12.7%. S.D.

A80-27340 Choice of an optimum multichannel Nd:glass laser system for fusion experiments. L. A. Bolshov, A. M. Dykhne, N. G. Kovalskii, A. N. Kolomiiskii, T. K. Kirichenko, M. I. Pergament, Iu. P. Rudnitskii, R. V. Smirnov, A. N. Starostin, and V. M. Cherniak (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Applied Optics*, vol. 19, Mar. 15, 1980, p. 924-929. 9 refs.

A comparison has been made between proposed configurations for Nd-glass laser systems for fusion. Detailed theoretical modeling of pulse propagation has been carried out using a linearized model with the variables taken to be time, axial coordinate, and one transverse coordinate. A non-temporally varying, three-spatial dimension model was also used to correct the linearized two-spatial dimension calculations. A 100,000 J system using 200 slab amplifiers and 20 spatial filters and having a 0.0001 rad divergence appears feasible.

(Author)

A80-27417 Methanol derivation from North Dakota lignite and use as a fuel. E. C. Glass, A. L. Freeman, and T. O. Wentworth (Northern States Power Co., Minneapolis, Minn.). (*U.S. Department of Energy and University of North Dakota, Biennial Lignite Symposium, 10th, Grand Forks, N. Dak., May 1979.*) *I & EC - Industrial and Engineering Chemistry, Product Research and Development*, vol. 18, Dec. 1979, p. 288-291.

Methanol has the potential for a significant replacement of oil in the U.S. Its utilization by electric and gas utilities and by industry appears favorable. Methanol has an advantage over oil where a very clean flame is required. It can also be converted to gasoline at a modest cost. A process design firm has performed an engineering evaluation and a study of economic feasibility of a plant producing 2.5 billion gallons of methanol annually from North Dakota lignite. A range of costs for methanol from \$18 to \$28/bbl (1978 \$) of oil equivalent is indicated depending mainly on type of financing.

(Author)

A80-27418 # Application of liquefaction processes to low-rank coals. W. G. Willson, C. L. Knudson, G. G. Baker (U.S. Department of Energy, Grand Forks Energy Technology Center, Grand Forks, N. Dak.), T. C. Owens, and D. E. Severson (North Dakota, University, Grand Forks, N. Dak.). (*U.S. Department of Energy and University of North Dakota, Biennial Lignite Symposium, 10th, Grand Forks, N. Dak., May 1979.*) *I & EC - Industrial and Engineering Chemistry, Product Research and Development*, vol. 18, Dec. 1979, p. 297-310. 6 refs.

The Grand Forks Energy Technology Center and the University of North Dakota researchers are conducting research on the liquefaction behavior of low-rank coals necessary to apply major developing processes to these distinctly different coals. In a 5-lb coal/h continuous process unit, synthesis gas, raw lignite, and anthracene oil solvent were reacted at elevated temperatures in single pass tests in a continuous-stirred tank reactor (CSTR). Product yield fractions were correlated with percent coal in the feed slurry, hydrogen donor (tetralin) concentration, and temperature. The molecular weight of the soluble but nondistillable yield fraction was markedly reduced by increasing temperature. In batch autoclave systems, work has been conducted to establish rates and product distributions from several liquefaction solvents. Two solvents were chosen for subsequent tests aimed at determining the catalytic effects of diverse mineral matter in eight different low-rank coals.

(Author)

A80-27419 Performance of low rank coals in the Exxon Donor Solvent Process. W. N. Mitchell, K. L. Trachte, and S. Zaczepinski (Exxon Research and Engineering Co., Baytown, Tex.). (*U.S. Department of Energy and University of North Dakota, Biennial Lignite Symposium, 10th, Grand Forks, N. Dak., May 1979.*) *I & EC - Industrial and Engineering Chemistry, Product Research and Development*, vol. 18, Dec. 1979, p. 311-314.

The Exxon Donor Solvent Coal Liquefaction Process (EDS) handles a full range of coals ranging from bituminous through subbituminous to lignites. The overall process performance based on the 50 lb/day Recycle Coal Liquefaction Unit (RCLU) and the 1 ton/day Coal Liquefaction Pilot Plant (CLPP) is summarized as a function of process conditions and coal rank. Special emphasis is placed on the conversion and yield response of the range of coals demonstrated in the EDS process to date. In addition to the liquefaction potential, the operability issues associated with operating on low rank coals are addressed. More specifically, the relationship between the operating severity and the liquefaction bottoms viscosity is explored in detail. Also, the calcium carbonate scale deposition and agglomerates formation in the process reactors is covered. As part of this discussion, process and mechanical solutions to this problem are summarized. (Author)

A80-27420 Lignite and coal in the U.S. energy future. W. L. Fisher (Texas, University, Austin, Tex.). (*U.S. Department of Energy and University of North Dakota, Biennial Lignite Symposium, 10th, Grand Forks, N. Dak., May 1979.*) *I & EC - Industrial and Engineering Chemistry, Product Research and Development*, vol. 18, Dec. 1979, p. 314-317.

The future energy situation of the United States is discussed, with particular emphasis on the potential role of coal and lignite production in increasing domestic energy supplies. The greater than expected increase in energy conservation since 1973 is indicated, however it is pointed out that energy production has not increased at a rate necessary to meet projected energy demands, even assuming a demand growth rate of 2% yearly. Limitations to increased oil, natural gas and nuclear energy production, which would prevent a drastic increase in imported energy or drastic reduction in energy consumption, are outlined. Coal and lignite production is then presented as the only feasible means of meeting the nation's energy demand in the short term, if administrative, legal, environmental, physical, economic, social and political constraints can be overcome. A.L.W.

A80-27567 Possible solution of the controlled thermonuclear fusion problem based on magnetogasdynamic energy storage. V. N. Mokhov, V. K. Chernyshev, V. B. Iakubov, M. S. Protasov, V. M. Danov, and E. I. Zharinov. (*Akademiia Nauk SSSR, Doklady*, vol. 247, no. 1, 1979, p. 83-86.) *Soviet Physics - Doklady*, vol. 24, July 1979, p. 557-559. 14 refs. Translation.

Extensive studies have been made of the compression of spherical targets by means of intense laser beams. In the present paper the effectiveness of an approach to controlled thermonuclear synthesis, based on the compression of thermonuclear targets by a magnetic field is demonstrated theoretically and experimentally. V.P.

A80-27649 An economic analysis of air pollution from coal-fired power plants. R. Mendelsohn (Washington, University, Seattle, Wash.). *Journal of Environmental Economics and Management*, vol. 7, Mar. 1980, p. 30-43. 24 refs.

The benefits of air pollution control techniques on a coal-fired power plant are simulated with a scientifically based environmental model. Air pollution abatement techniques are assessed in terms of their resource cost (measured in dollars) and their effectiveness in reducing environmental damage (measured in dollars and healthy days lost). Which air pollution techniques are most efficient depend upon how much a day of health should be valued. Other factors of potential interest such as uncertainty and equity are also simulated through the model. The paper demonstrates that scientific evidence

can be organized around economic principles in order to develop more rational and effective environmental policies. (Author)

A80-27656 * Nuclear Science Symposium, 26th and Symposium on Nuclear Power Systems, 11th, San Francisco, Calif., October 17-19, 1979, Proceedings. Symposia sponsored by IEEE, DOE, and NASA. Edited by C. R. Kerns (Fermi National Accelerator Laboratory, Batavia, Ill.). *IEEE Transactions on Nuclear Science*, vol. NS-27, Feb. 1980. 958 p.

The paper covers the studies presented on nuclear science and nuclear power systems symposiums. The studies deal with nuclear radiation detectors, nuclear circuits and systems, space and medical instrumentation, as well as with environmental and reactor instrumentation. Data preprocessing and acquisition are discussed. Emphasis is placed on the engineered safety features of nuclear systems. V.T.

A80-27672 Design considerations of a CAMAC system for large tokamak JT-60. T. Kumahara, A. Ogata, T. Matoba, I. Kondo, and Y. Suzuki (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan). (*IEEE, DOE, and NASA, Nuclear Science Symposium, 26th, San Francisco, Calif., Oct. 17-19, 1979.*) *IEEE Transactions on Nuclear Science*, vol. NS-27, Feb. 1980, p. 637-640.

Microprocessor based distributed intelligence CAMAC system is adopted in control and monitoring of a large tokamak device JT-60. Such novel techniques as hierarchical serial highways, auxiliary controllers with standard highway ports, a variable word-length data transfer, byte serial data transfer with single cable of optical fiber pair, hand-shaking timing system with error recovery capability, flying capacitor multiplexers for temperature monitor and digital integrators for electromagnetic probe are introduced in the CAMAC system. Outlines of the new techniques as well as system configuration of JT-60 CAMAC system are described. (Author)

A80-27677 Combined magnetic levitation and propulsion - The Mag-Transit concept. R. G. Rule and R. G. Gilliland (Boeing Aerospace Co., Automated Transportation Systems Organization, Seattle, Wash.). *IEEE Transactions on Vehicular Technology*, vol. VT-29, Feb. 1980, p. 41-49. 12 refs.

Mag-Transit is a unique combination of magnetic levitation and propulsion for people mover applications. Linear induction motors are used for levitation, propulsion, braking, and guidance. Since there are a minimum of moving parts there is a potential for a substantial increase in system reliability and availability as compared to conventional systems. Modern solid-state technology provides the capability to condition sufficient quantities of electrical energy to control motor excitation, and thereby levitation, within a closed-loop servo system. Real time measurements of air gaps and vehicle accelerations are used to compute the desired levitation force. In addition, the solid-state electronics provides the ability to control independently the speed of the vehicle by a continuously variable excitation frequency to the motors. An overview is provided of the Mag-Transit concept from a control system standpoint. Results from a dynamic simulation of a test vehicle configuration are presented. (Author)

A80-27729 A storage tank for vehicular storage of liquid hydrogen. L. O. Williams and D. E. Spond (Martin Marietta Aerospace, Denver, Colo.). *Applied Energy*, vol. 6, Mar.-Apr. 1980, p. 99-112.

This article outlines a concept for a new method of fabricating cryogenic liquid hydrogen storage tanks with emphasis on the application of liquid hydrogen as an automotive fuel. It includes a recapitulation of the properties of hydrogen and gasoline for reference, a discussion of automotive fuel utilisation rates, a thermal analysis of the liquid hydrogen boil-off rate for a reference storage container and the new concept tank. In addition, an analysis of the tank concept and its method of assembly line fabrication are provided. The conclusions reached are that this fabrication concept would provide a liquid hydrogen storage tank of improved thermal performance, that the tank could be potentially less expensive to

build than current technology tanks, and that the tank would be suitable for automotive containment of liquid hydrogen. (Author)

A80-27730 Tubular solar collector. P. K. C. Pillai and R. C. Agarwal (Indian Institute of Technology, Delhi, India). *Applied Energy*, vol. 6, Mar.-Apr. 1980, p. 125-132. 13 refs.

Details of the design and development of an inexpensive solar collector system which does not make use of a blackened metal plate as an absorber are given in this paper. A spiral-shaped plastic tube coated with a black paint constitutes the solar absorber. Unlike other flat plate collectors, the working fluid moves through a spiral path in this collector. As the liquid moves progressively towards the centre, its temperature gradually rises and in the process it absorbs a part of the heat transferred radially from the centre of the collector, thus reducing heat losses. (Author)

A80-27731 Large energy storage systems for utilities. S. L. Ridgway, J. L. Dooley, and R. P. Hammond (R & D Associates, Marina del Rey, Calif.). *Applied Energy*, vol. 6, Mar.-Apr. 1980, p. 133-142.

The paper shows that steel lined cavities deep underground, using the rock to provide containment, are economical and practical in large capacities for energy storage. It is shown that by reducing the cavity pressure, steam is flashed from the hot water and used to drive peaking turbines when needed; at low load periods surplus steam is condensed in the water to recharge the vault. The saturation pressure of the hot water is borne by the overburden pressure of the rock formation in which the storage vault is constructed. Finally, it is estimated that the cost of a facility to deliver 1000 MW of peaking power for 10 h would fall in the range of \$250-350 million. M.E.P.

A80-27752 # The energy problem: Its effect on aircraft design. I - Supply and demand. W. Tye. *Aircraft Engineering*, vol. 52, Mar. 1980, p. 9-11.

Energy demands for aircraft by the year 2000 are discussed, considering fuel supply shortages that are expected to result in a 7% cut in the availability of aviation fuel. Attention is given to the use of kerosine with higher aromatic content and an expected trend toward fuels more like diesel oil, as well as consequent engine and aircraft modifications. J.P.B.

A80-27924 A model for the Sulphur Springs geothermal field St. Lucia. K. H. Williamson (Institute of Geological Sciences, London, England). *Geothermics*, vol. 8, no. 2, 1979, p. 75-83. 23 refs. Research supported by the Ministry of Overseas Development of England.

A model to explain the behavior of the Sulphur Springs geothermal field has been derived from downhole temperature records in the exploration boreholes. The model incorporates a main reservoir at 1-1.5 km depth, intersected by steeply inclined fissures which carry steam and gas to the well bores, and to the natural fumaroles. A substantial decline in the gas content of the steam could have serious consequences where the fissures are utilized as conduits between the boreholes and the deep reservoir. Further development of the field should concentrate on the fissures around 300 m or on the reservoir itself around 1000-1500 m. (Author)

A80-28012 Metal/air batteries: Their status and potential - A review. K. F. Blurton and A. F. Sammells (Institute of Gas Technology, Chicago, Ill.). *Journal of Power Sources*, vol. 4, Dec. 1979, p. 263-279. 49 refs.

Lithium, aluminum, magnesium, zinc and iron/air batteries are compared with particular emphasis on the suitability of each system for electric vehicle propulsion. The relative merits of mechanically and electrically rechargeable batteries are given, together with systems employing static and circulating electrolytes. It is concluded that, due to the institutional difficulties associated with the deployment of recharge systems for mechanically rechargeable batteries in electric vehicles, electrically rechargeable systems are more viable for commercialization in the near term. C.F.W.

A80-28013 Current trends in the development of sodium-sulphur batteries. G. R. Lomax (Chloride Silent Power, Ltd., Runcorn, Ches., England). (*Institute of Electrical and Electronics Engineers, International Telephone Energy Conference, Washington, D.C., Oct. 25-27, 1978.*) *Journal of Power Sources*, vol. 4, Dec. 19, p. 301-308.

The current status of sodium-sulphur technology in CSPL is outlined. 350 W h cells have now been developed with energy densities of 0.36 W h/cc and 0.16 W h/g, and much of the R & D effort is now being directed towards battery design. Because it must be thermally insulated, the shape of the battery and the thickness of the insulation are significant, and it is possible to realize gross battery energy densities of between 0.1 W h/cc and 0.25 W h/cc, volumetric energy density normally being the more critical. These are some three times greater than for conventional lead-acid batteries, and combined with operating characteristics which differ markedly from conventional batteries, they could offer a number of interesting applications in addition to road transport and load levelling.

(Author)

A80-28014 Lead-acid batteries for remote photovoltaic applications. H. J. Schaetzle and D. P. Boden (C & D Batteries, Plymouth Meeting, Pa.). (*Institute of Electrical and Electronics Engineers, International Telephone Energy Conference, Washington, D.C., Oct. 25-27, 1978.*) *Journal of Power Sources*, vol. 4, Dec. 19, p. 327-336.

The various load profile characteristics most commonly encountered in photovoltaic installations are analyzed in conjunction with solar array and battery performance data and used to generate battery specifications with particular respect to operating characteristics and cycle life requirements. The design of lead-acid batteries for photovoltaic applications is discussed and illustrated with both operating, maintenance, and cycle life data. Other performance characteristics of lead-acid photovoltaic batteries are described including the effects of operating temperature and the correct choice of charging method for various operational requirements. (Author)

A80-28015 # Photovoltaic power for telecommunications. H. Kelly (Office of Technology Assessment, Washington, D.C.). (*Institute of Electrical and Electronics Engineers, International Telephone Energy Conference, Washington, D.C., Oct. 25-27, 1978.*) *Journal of Power Sources*, vol. 4, Dec. 19, p. 337-347. 11 refs.

Photovoltaic equipment may be an attractive power source for many kinds of communication equipment in the next five years. The first applications will be found in remote parts of the U.S. and in new systems installed overseas in areas remote from electric distribution grids. By the end of the 1980's, the equipment may compare favorably with grid electricity in some regions. This paper will discuss the kinds of improvements in equipment performance and manufacturing techniques which may lead to photovoltaic systems capable of competing in the communications industry, and estimate the cost of power which could be obtained if such improvements are achieved. It will review some of the problems of system design which must be confronted in constructing systems capable of meeting realistic demand patterns, and outline a technique for optimizing the size of components. (Author)

A80-28016 Plastic bonded electrodes for nickel-cadmium accumulators. III - Influence of active layer composition on galvanostatic and potentiostatic discharge curves. B. Klapste, J. Mrha, K. Micka, J. Jindra, and V. Marecek (Ceskoslovenska Akademie Ved, Ustav Fyzikalni Chemie a Elektrochemie, Prague, Czechoslovakia). *Journal of Power Sources*, vol. 4, Dec. 19, p. 349-360. 16 refs.

A80-28200 # Investigation of heat and mass transfer for a regenerator model of a solar cooling system (Issledovanie teplo- i massoobmena na modeli regeneratora solnechnoi kholodil'noi ustanovki). A. Khandurdyev, A. Kakabaev, and A. Nurgel'dyev (Turkmenkii Gosudarstvennyi Universitet, Ashkhabad, Turkmen SSR). *Akademiia Nauk Turkmenkoi SSR, Izvestiia, Seriya Fiziko-*

Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk, no. 6, 1979, p. 14-18. 9 refs. In Russian.

A80-28251 OCEANS '79; Proceedings of the Fifth Annual Combined Conference, San Diego, Calif., September 17-19, 1979. Conference sponsored by the Institute of Electrical and Electronics Engineers and Marine Technology Society. New York, Institute of Electrical and Electronics Engineers, Inc., 1979. 815 p. \$33.75.

Topics included in this work are on advanced surface craft, electromagnetic systems for ocean surface monitoring and communications, ocean energy, Space Shuttle support. Individual subjects such as the use of semi-submerged ships to support new technology at sea, buoyant module VHF antenna design for submerged systems/aircraft communications, a system for undersea storage of thermal energy, ocean wave concepts as well as the solid rocket booster dewatering set, and the SRB retrieval support craft are presented. C.F.W.

A80-28257 SEAS - A system for undersea storage of thermal energy. J. D. Powell (California, University, La Jolla, Calif.) and J. R. Powell (Brookhaven National Laboratory, Upton, N.Y.). In: OCEANS '79; Proceedings of the Fifth Annual Combined Conference, San Diego, Calif., September 17-19, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 527-532.

Methods of storing medium grade (200 to 275 C) thermal energy are of great economic interest for electric generation and process heat. Storage of water heated by land-based energy sources and pumped to ocean or lake depths great enough that the ambient hydrostatic pressure equals the saturation pressure appears to be a low cost, safe, and technically feasible method for storing large volumes of hot water. (Author)

A80-28258 Flap type weather proof ocean wave energy converter. F. H. Hsu (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). In: OCEANS '79; Proceedings of the Fifth Annual Combined Conference, San Diego, Calif., September 17-19, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 541-545.

A wave energy extraction system is presented that consists of one centrally located main body and two cylindrical flaps situated on each side of the main body and joined to it by two linkage arms. It is noted that this system can be operated not only on the ocean surface but also at submerged level. Attention is given to the system function which is divided into three stages: pre roll resonance, the roll resonant period and post roll resonance. Conclusions show that the device is not intended to replace the major power plants now in operation, but can be used to supplement the power needs for coastal regions, islands or offshore platforms, etc. C.F.W.

A80-28259 The MINI-OTEC test. R. L. Waid (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). In: OCEANS '79; Proceedings of the Fifth Annual Combined Conference, San Diego, Calif., September 17-19, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 548-552. Research supported by the Lockheed Missiles and Space Co.

MINI-OTEC is the first at-sea, closed-loop OTEC system using warm surface water and cold deep water to generate electrical power. The thermal resource and current environment at the test site, Keahole Point, Hawaii, are discussed. The OTEC power system and components are described as are the components of the ocean system. At-sea operating experience of an OTEC plant, including biofouling effects and countermeasure effectiveness, are the primary objectives of the project. The characteristics and loads of vortex-induced flow around the cold water pipe are described. (Author)

A80-28260 # Ocean wave energy conversion concepts. M. E. McCormick (U.S. Naval Academy, Annapolis, Md.). In: OCEANS '79; Proceedings of the Fifth Annual Combined Conference, San

Diego, Calif., September 17-19, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 553-558. 10 refs.

Nine ocean wave energy conversion techniques are described and discussed. These techniques include the use of heaving and pitching bodies, cavity resonators, wave focusing, pressure devices, surging devices, paddles, outriggers and combination devices. Examples of each technique are presented, and required subsystems are described. Finally a comparison study is performed based on efficiency, operational practicality and cost. (Author)

A80-28261 Coriolis Program - A review of the status of the ocean turbine energy system. P. B. S. Lissaman and R. L. Radkey (AeroVironment, Inc., Pasadena, Calif.). In: OCEANS '79; Proceedings of the Fifth Annual Combined Conference, San Diego, Calif., September 17-19, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 559-565. 12 refs.

The goal of the Coriolis Program is to develop an energy system to generate electrical power via an array of large ducted turbines moored about 30 km east of Miami in the Florida Current of the Gulf Stream. Numerous studies have been made of the technical, economic, and environmental issues involved. Here, the program background is given, and the system as currently envisaged is described. The Florida Current resource is discussed, using estimates of the power available from the momentum flux. Important environmental issues are reviewed and estimates of effects are given which show that the program will have no adverse local or global effects. A recent U.S. Department of Energy sponsored study of the hydrodynamic and hydroelastic behavior of key system components is described. In this work, theoretical and experimental studies show that the catenary turbine rotors will be free of adverse vibrations, and that the proposed mooring system will be stable and well damped. Finally, the overall Coriolis Program plan is reviewed and the next phases for the design and construction of a small scale (11 m diameter) prototype are discussed. (Author)

A80-28262 Salinity gradient energy conversion. G. D. Mehta, S. C. Jain, M. D. Fraser (InterTechnology/Solar Corp., Warrenton, Va.), S. J. Senatore, and H. L. Rothstein (Ebasco Services, Inc., New York, N.Y.). In: OCEANS '79; Proceedings of the Fifth Annual Combined Conference, San Diego, Calif., September 17-19, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 566-571. 7 refs. Contracts No. EG-77-G-01-4066; No. EG-77-C-05-5560; No. DE-AC05-79ET21001.

The feasibility of Osmo-Hydro Power /TM/ (OHP) systems, as conceived by ITC/Solar, to generate electricity in a practical and economic manner from aqueous saline solutions is discussed. Initial design of a 50-kWe system using brackish water and saturated brine is presented. Preliminary estimates show that for larger units the capital cost of such a system will be around \$4,000 to \$5,000 per net kWe. (Author)

A80-28271 Hydrogen energy research programs in Japan. T. Ohta (Yokohama National University, Yokohama, Japan) and M. V. C. Sastri (Indian Institute of Technology, Madras, India). *International Journal of Hydrogen Energy*, vol. 4, no. 6, 1979, p. 489-498.

The paper reviews the hydrogen energy research programs carried out under the Sunshine Project in Japan. Work on both electrolytic and thermochemical processes for large-scale hydrogen production is discussed. New methods for hydrogen production, such as direct thermal decomposition of water and photo-electrolysis of water with semiconductor electrodes are outlined. Storage and transportation of hydrogen and hydrogen burners are emphasized. V.T.

A80-28272 Present state and future prospects of thermochemical hydrogen production. G. E. Beghi (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). (*World Hydrogen Energy Conference, 2nd*,

Zurich, Switzerland, Aug. 1978.) *International Journal of Hydrogen Energy*, vol. 4, no. 6, 1979, p. 499-512. 20 refs.

Thermochemical decomposition of water as a method of producing hydrogen is a relatively recent subject of research. First studies are mentioned, giving definitions and indicating methodology for analysis. Chemical reactions of 'pure' and 'hybrid' thermochemical cycles for the main processes under study are mentioned. For the experimental activities in progress, the recent demonstration of the technical feasibility on the laboratory scale is reported, based on some complete circuits in operation or under construction. For the technico-economic evaluations the different calculations are given and the uncertainty existing is emphasized; a figure of about 8 \$/9J for hydrogen production cost seems to meet good consensus. Further experimental data, particularly in some research areas, are necessary to give evidence of the competitiveness of thermochemical processes: the next few years will be critical in contributing to give an answer as to the prospects of this new method for hydrogen production. (Author)

A80-28273 Basic chemistry of a new cycle, based on reactions of Ce(III) titanate, for splitting water. C. E. Bamberger and D. H. Nichols (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *International Journal of Hydrogen Energy*, vol. 4, no. 6, 1979, p. 513-516. 10 refs. Contract No. W-7405-eng-26.

The chemistry of a new thermochemical cycle for splitting water is described. It consists essentially of three reactions: (1) Ce(IV), as CeO₂, is reduced to Ce(III) by reaction with TiO₂, evolving oxygen and forming one or more Ce(III) titanates; (2) the Ce(III) titanates react with molten NaOH to evolve hydrogen, and form CeO₂ and Na-titanate; and (3) the sodium titanate is hydrolyzed by boiling water into a hydrous titanium dioxide and a sodium hydroxide solution. The cycle has been demonstrated with regenerated materials. (Author)

A80-28274 Open-loop thermochemical cycles for the production of hydrogen. W. L. Conger (Kentucky University, Lexington, Ky.). *International Journal of Hydrogen Energy*, vol. 4, no. 6, 1979, p. 517-522.

The concept of open-loop thermochemical cycles (cycles which have additional or other feedstocks than water and produce materials in addition to hydrogen and oxygen) is introduced. Preliminary analysis of possible feedstocks available indicates substantial quantities of hydrogen could possibly be produced through open-cycles. The advantages of open-cycles include the conversion of unwanted waste products to useful products while producing hydrogen. A compilation of open processes which would have SO₂ in addition to water as feedstock and which would produce sulfuric acid in addition to hydrogen and oxygen is given. (Author)

A80-28275 Engineering impact on the validity of the Mark-16 thermochemical cycle. W. R. A. Goossens, M. Klein, and L. H. Baetslé (Centre d'Etude de l'Energie Nucléaire, Mol, Belgium). *International Journal of Hydrogen Energy*, vol. 4, no. 6, 1979, p. 523-534. 8 refs. Research supported by the Commission of the European Communities.

Mass and energy balances are presented for the entire Mark-16 thermochemical cycle in order to evaluate the impact of practical constraints on the validity of the cycle. In particular, a detailed analysis of the hydrogen iodide decomposition step of this cycle is considered. It is found that adding the energy consumption of the product separation units related to the HI decomposition step to the energy consumption under equilibrium conditions for the chemical reaction steps shows a thermal efficiency of 0.31 for the Mark-16 cycle. J.P.B.

A80-28276 Nuclear methane reforming for coal gasification. J. Rastoin, J. Malherbe (Commissariat à l'Energie Atomique, Gif-sur-Yvette, Essonne, France), J. Pottier, and A. Lecoanet (Gaz de France, Saint Denis, Seine-St.-Denis, France). *International Journal of Hydrogen Energy*, vol. 4, no. 6, 1979, p. 535-540.

The paper studies hydrogen for chemical industries and coal gasification prospects along with nuclear methane reforming. Consideration is given to coal gasification using nuclear energy hydrogen and methane steam reforming. It is noted that nuclear reforming can be competitive with autothermic reforming for hydrogen production.

V.T.

A80-28277 Kinetics of hydrogen absorption and desorption by ternary LaNi₅-type intermetallic compounds. L. Belkbir, N. Gérard (Dijon, Université, Dijon, France), A. Percheron-Guégan, and J. C. Achard (CNRS, Laboratoire de Chimie Métallurgique et Spectroscopie des Terres Rares, Meudon, Hauts-de-Seine, France). *International Journal of Hydrogen Energy*, vol. 4, no. 6, 1979, p. 541-557. 27 refs.

Kinetic rules of formation and decomposition of the hydrides derived from LaNi₅-type compounds are determined. Comparison between LaNi₅H₆ and more stable hydrides is made in terms of pressure, number and time of cycles. Measurements are performed by a differential volumetric device functioning under constant pressure, during hydrogen absorption and desorption. The influence on the kinetics and hydrogen capacities of the gaseous impurities contained in industrial hydrogen is studied as a function of the number of cycles, showing a good resistance to poisoning of the above mentioned compounds. (Author)

A80-28278 Physical, chemical and energy aspects of underground hydrogen storage. P. O. Carden and L. Paterson (Australian National University, Canberra, Australia). *International Journal of Hydrogen Energy*, vol. 4, no. 6, 1979, p. 559-569. 24 refs.

Large scale energy storage is becoming an important consideration as we turn more towards nuclear power and the utilization of renewable sources such as solar energy. Underground storage of hydrogen in aquifers has been suggested as an inexpensive method of providing the required energy storage. With this theme in mind, the losses associated with gas storage in aquifers are discussed. These losses include physical leakage of gas, loss of gas through underground chemical reactions and the energy requirements associated with storing and recovering the gas. Although underground storage of hydrogen appears a most promising solution to the problem of large scale energy storage it is shown that much remains to be done to confirm this. For example, better estimates of hydrogen diffusion through water saturated porous media are required. (Author)

A80-28305 Comparison of Hg/0.6/Cd/0.4/Te LPE layer growth from Te-, Hg-, and HgTe-rich solutions. J. E. Bowers, J. L. Schmit, C. J. Speersneider (Honeywell Corporate Technology Center, Bloomington, Minn.), and R. B. Maciolek (Minnesota Mining and Manufacturing, St. Paul, Minn.). *IEEE Transactions on Electron Devices*, vol. ED-27, Jan. 1980, p. 24-28. 21 refs. Contract No. F33615-77-C-5142.

A80-28307 Properties of ion-implanted junctions in mercury-cadmium-telluride. A. Kolodny and I. Kidron (Technion - Israel Institute of Technology, Haifa, Israel). *IEEE Transactions on Electron Devices*, vol. ED-27, Jan. 1980, p. 37-43. 26 refs.

A80-28330 Computer modeling of a two-junction, monolithic cascade solar cell. M. F. Lamorte and D. H. Abbott (Research Triangle Institute, Research Triangle Park, N.C.). *IEEE Transactions on Electron Devices*, vol. ED-27, Jan. 1980, p. 231-249. 51 refs. USAF-supported research.

The paper presents an analytic method predicting the performance characteristics of a two-junction monolithic cascade solar cell as a function of temperature. Material selection criteria for cascade structures are provided. The characteristics include the family of solar cell V-I curves, conversion efficiency, voltage at the maximum power point, dark current of top and bottom cells, fill factor, and special response. V.T.

A80-28331 Open-circuit voltage and interface study of

silicon MOS solar cells. K. Rajkanan (General Instrument Corp., Hicksville, N.Y.), R. Singh (Colorado State University, Fort Collins, Colo.), and J. Shewchun (Brown University, Providence, R.I.). *IEEE Transactions on Electron Devices*, vol. ED-27, Jan. 1980, p. 250-254. 42 refs. Research supported by the U.S. Department of Energy and National Research Council of Canada.

The paper presents theoretical and experimental studies carried out on the open-circuit voltage of Al-SiO(x)-(p-type)Si solar cells. Emphasis is placed on a phenomenological model taking into consideration the effects of pinholes which are expected to be present in the ultrathin oxides involved in MOS solar cells. V.T.

A80-28337 MOS and oxide-charge-induced (OCI) BSF solar cells. A. Neugroschel (Florida, University, Gainesville, Fla.). *IEEE Transactions on Electron Devices*, vol. ED-27, Jan. 1980, p. 287-290. 20 refs.

New structures in which the heavily doped region in the base of a back-surface-field (BSF) solar cell is eliminated are proposed. Instead, the desired high concentration of majority carriers at the back surface is obtained by the Coulomb attraction utilizing the oxide formed on this surface. The origin of the Coulomb attraction is either charge in the oxide (OCI-BSF cell) or a small gate voltage which draws no power (MOS-BSF cell) applied to a metal-oxide-semiconductor structure. V.T.

A80-28425 Stirling engine design and feasibility for automotive use. Edited by M. J. Collie. Park Ridge, N.J., Noyes Data Corp. (Energy Technology Review, No. 47), 1979. 480 p. \$36.

The book is based on two reports dealing with theoretical considerations in the design of Stirling engines for automotive use, and with a feasibility study for an 80-100-hp automotive Stirling engine. The basic principles of heat engines are explained, and the Stirling engine is introduced, with attention given to the variety of Stirling engine types and their utility in comparison to other machines. Engine analysis is treated starting from elementary principles through cycle analysis, and analysis methodologies are classified as first, second or third order depending upon their degree of complexity and probable application. Current high-power engines are briefly described, and an extensive bibliography on Stirling engines and a directory of companies and individuals active in Stirling engine development are presented. A 170-hp-engine-powered vehicle of the 4500-lb inertia weight class is then presented, and results of vehicle and dynamometer engine tests are indicated. The vehicle, engine controls, and engine systems considerations of a 80-100-hp downsized Stirling engine design study are described, together with the results of the study. A.L.W.

A80-28426 # Future trends in the automobile. D. Downs (Ricardo Consulting Engineers, Shoreham-by-Sea, Sussex, England). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume 0 - Opening ceremony. Symposium sponsored by the Studiengesellschaft Nahverkehr and Bundesministerium für Forschung und Technologie. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 132-144.

Automotive trends are discussed with regard to fuel, engines, air pollution and noise. Turbocharging, high compression (15:1) operation, and diesel engines are considered, as well as the use of a wide cut petroleum fuel from the mid-distillation range of crude petroleum, and liquefied petroleum gas. Attention is given to controlling air pollution from HC, CO, and NO_x emissions by exhaust catalysts, stratified charge combustion, or indirect injection diesel engines. In addition, noise reduction by improvements in combustion, engine design, and engine shielding is considered, as well as vehicle modifications regarding aerodynamics, weight, and transmission. J.P.B.

A80-28427 # Air transport and travel in 2000 - Future requirements. R. Abraham (Deutsche Lufthansa AG, Cologne, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979,

Proceedings. Volume 0 - Opening ceremony. Symposium sponsored by the Studiengesellschaft Nahverkehr and Bundesministerium für Forschung und Technologie. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 199-221.

Air transportation over the next 20 years is discussed, considering increased business and tourist air travel, and the competitiveness of air travel with other forms of transportation as well as with advanced forms of communication. Attention is given to the improved use of available capacity, advances in aviation technology such as active flight control systems, and to improvements in fuel consumption, maintenance costs, and maximized payloads. J.P.B.

A80-28431 # The dual-mode bus and further bus developments in France. B. Dupont (Institut de Recherche des Transports, Arcueil, Val-de-Marne, France). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume A1. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 145-160.

The paper describes two electric vehicles for mass transport which are both equipped with Ni/Cd batteries and are currently undergoing testing in France. Attention is given to the dual mode trolley bus, a large-capacity trolley bus which can be powered either from overhead contact lines or by batteries. The batteries are recharged during passage along route sections with overhead contact lines. Also discussed is the electric mini-bus for inner-city areas, noting that it has a capacity of approximately 25 passengers and is designed for battery recharging at special points along the short inner-city routes. M.E.P.

A80-28458 # The development of the magnetically suspended transportation system in the Federal Republic of Germany. D. Rogg (Dornier System GmbH, Friedrichshafen, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume B2. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 89-124. 26 refs.

The German maglev development program is reviewed with reference to the objectives of government support, the details of the development-program phases, and vehicle design and operation. Two applications are considered: maglev as a long-distance transportation system coordinated with other systems, and maglev as a solution to specific transportation tasks in the medium-distance range. B.J.

A80-28470 International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volumes C1 & C2 - Motor vehicle and road traffic technologies. Symposium sponsored by the Studiengesellschaft Nahverkehr and Bundesministerium für Forschung und Technologie. Bonn, Bundesministerium für Forschung und Technologie, 1979. Vol. C1, 463 p.; vol. C2, 129 p.

Modern vehicle propulsion systems are presented along with alternative forms of energy for use in a road traffic technology and requirements to be met by the automobile of the future. Trends in the construction of Otto engines in the USA and the future of the Diesel engine are discussed. Hybrid, electric, and alcohol driven vehicles are described. Requirements for vehicle design from the viewpoint of accident research are outlined. V.T.

A80-28471 # A technical conception for highly developed spark-ignition engines. H.-J. Förster and D. Gwinner (Daimler-Benz AG, Stuttgart, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume C1. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 15-38.

The paper examines future developments in spark-ignition engines including control of exhaust gas emissions. The optimization

of combustion, shorter warm-up time, turbocharging, increasing the engine compression, and consumption at idling speed were examined; the future choice of the engine operating curve will be more strongly affected by fuel consumption, leading to more direct rear axle ratios or additional overdrives. It is shown that future engines will use more electronics for mixture proportioning and ignition timing, more fuel injection, utilize light alloys and ceramics, have higher compression ratios and lower idling speeds, and specify engine operating curves to provide good fuel consumption. A.T.

A80-28472 # Trends in the construction of Otto engines in the U.S. F. W. Bowditch and S. W. Martens (GM Technical Center, Warren, Mich.). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume C1. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 39-54. 13 refs.

The paper presents the developments in the construction of Otto cycle gasoline engines in the U.S. It has been found that almost 25% of the hydrocarbons emitted came from crankcase emissions, so that the first hydrocarbon controls consisted of a positive crankcase ventilating system followed by an exhaust treatment, including injection of secondary air. CO formation was dependent on carburation and manifolding, and control of nitrogen oxides was accomplished with introduction of inert gases to the intake charge. It is concluded that effective exhaust system should be aided by the use of an oxidizing exhaust catalytic converter and setting the engine operating parameters for maximum fuel. A.T.

A80-28473 # The future of the Diesel engine - A critical analysis. P. Hofbauer and H.-A. Kuck (Volkswagenwerk AG, Wolfsburg, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume C1. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 55-73.

An analysis of the future of the Diesel engine in passenger automobiles is presented. The disadvantages of a 1.5 liter swirl chamber Diesel engine were compared with the Otto engine with respect to low power to weight ratio and high noise level; modification of the swirl chamber configuration increased the power to weight ratio of the natural aspirated engine to 3 kg/kW. Turbocharging of the Diesel engine increased the power to weight ratio up to the range of Otto engines, and the results of the project were utilized in a demonstration vehicle with a capsulated turbocharged Diesel engine. A.T.

A80-28474 # Advanced engine concepts - The Ford Proco engine. E. J. Horton (Ford of Europe, Inc., Basildon, Essex, England). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume C1. Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 74-97.

The paper presents the Ford Proco engine designed as a fuel efficient engine for passenger automobile and light truck applications. The Proco combustion process using swirl movement induced through the intake port and squish action to provide fuel efficiency and air utilization are discussed along with the thermodynamics of economy improvement due to higher efficiency and compression ratio. A 6.6 liter single cylinder system and the combustion system configuration incorporated in an experimental 6.6 liter V8 multi-cylinder research engine are discussed; dynamometer mapping procedures applied to the V8 Proco engine are examined. Finally, emission and fuel economy projections, power characteristics, and peak combustion gas pressure are considered, and it is concluded that the 6.6L V8 Proco research engine can provide a 20% improvement in fuel economy over a carbureted engine of the same size. A.T.

A80-28475 # Hybrid drive-systems for municipal buses. J. Helling (Aachen, Technische Hochschule, Aachen, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume C1. Bonn, Bundesministerium für For-

A80-28476

schung und Technologie, 1979, p. 98-125.

The paper examines hybrid drive-systems for municipal buses. The three types of buses which use these systems and their longitudinal dynamics are described, noting high efficiency, reduction of energy consumption, and improvement of passenger comfort requirements. The energy consumption analyzed relative to the vehicle mass is plotted, and an expression is determined for energy consumption per passenger kilometer; the energy content of the storage component and its weights and costs are examined. Finally, the structure of transmission and operation of hybrid drive-system designs with diesel, flywheel, and infinitely variable transmissions are considered, concluding that the optimal component of the storage unit would be the flywheel and the differential gearing system in the selection of the transmission. A.T.

A80-28476 # Experience with alcohol fuels. W. Bernhardt (Volkswagenwerk AG, Wolfsburg, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume C1.

Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 126-142. 7 refs. Research supported by the Bundesministerium für Forschung und Technologie.

The paper considers the use of methanol and ethanol as alternative automotive fuels. Both alcohols are the best fuel materials with respect to raw material availability, economy, handling, and exhaust emissions; prototype vehicles are being developed for the use of alcohol. The 15% methanol/gasoline blend and the 20% ethanol/gasoline blend can be used in the intermediate stage of the alcohol fuel technology; they were investigated in a fleet test, showing many advantages of the alcohol blends and alcohol fuels compared to conventional fuel. A.T.

A80-28477 # Marginal conditions in automobile construction and their implications on the design of upper-category vehicles. B. Strackerjan (Daimler-Benz AG, Stuttgart, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume C1.

Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 230-252.

The paper discusses design of an upper-category research vehicle based on marginal conditions in transport, energy, and road accident volume. Energy conservation is discussed in terms of fuel consumption at various speeds, and drive units are examined including gas turbines and reciprocating piston engines. Aerodynamic drag is expected to have an important effect on the upper-category vehicle with a large amount of intercity driving; exhaust gas and emissions are considered, and finally safety statistics are examined relative to vehicle design and economy discussed through reduction of maintenance and repair. A.T.

A80-28481 # Possibilities and limits of the conception of an up-to-date compact vehicle for the nineties. D. Reister (Bayerische Motoren Werke AG, Munich, West Germany). In: International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume C2.

Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 39-50.

The paper investigates the problem of how to achieve essential reductions of fuel, energy, and raw materials and improvements in exhaust and noise emissions and safety without affecting the appeal of the passenger vehicle in respect to driving and transport characteristics, economy and efficiency. The paper describes a BMW proposal for a compact vehicle. Attention is given to fuel consumption reduction, optimization of air resistance, selection of optimal drive, optimization of driving performance and consumption, and reduction of exhaust gas emission. Consideration is also given to reduction of noise emission and improvement of safety. M.E.P.

A80-28482 # The contribution of Volkswagenwerk AG to the automobile concept of the 90's. U. Seiffert (Volkswagenwerk AG, Wolfsburg, West Germany). In: International Symposium on

Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Proceedings. Volume C2.
Bonn, Bundesministerium für Forschung und Technologie, 1979, p. 116-131.

A methodic approach to the development of an automobile concept for the 90's is presented. Attention is given to the need for the design of an automobile to permit fast responses to changes in market demand. It is shown that one base model should be used so that compliance with government standards in different countries can be assured with a minimum of modifications. Also discussed are the need for good fuel economy and the use of alternative fuels. Finally, consideration is given to the need for engineering measures to be aimed at reducing repair and maintenance costs so that the increasing cost of labor can be compensated for. M.E.P.

A80-28484 # Electric vehicle in Japan. M. Sugitani (Daihatsu Motor Co., Ltd., Osaka, Japan). *International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Paper. 21 p.*

The paper describes the development of the electric vehicle (EV) in Japan since 1965. The development of experimental vehicles, of new high energy density batteries, and of electric motors and control devices is discussed; oil consumption, noise prevention and road tests are examined. An experimental vehicle was tested in a pollution-free industrial park, and in 1975 electric sight-seeing vehicles with a DC shunt motor and a transistor hybrid control system were exhibited. Since 1976, the Japan Electric Vehicle Association and Electric Vehicle Council were established, and in 1978 the Electric Vehicle Engineering Research Association was organized for R&D work of mass-producible commercial type EV models. A.T.

A80-28485 # Future prospects for use of the gas turbine for automobiles. G. M. Thur (U.S. Department of Energy, Washington, D.C.). *International Symposium on Traffic and Transportation Technologies, Hamburg, West Germany, June 18-20, 1979, Paper. 8 p.*

The development of gas turbine engines for use in automobiles is reviewed, and prospects for the replacement of automobile internal combustion engines by gas turbine engines are assessed. The replacement of aircraft internal combustion engines by exhaust-driven turbocharger engines and gas turbine engines is outlined, and problems with the previous attempts to commercialize the automotive gas turbine engine, associated with material cost and availability, engine efficiency and acceleration are identified. Subsequent requirements for emission reduction and fuel economy are then discussed as conditions favorable for the further development of gas turbine engines using ceramics in the hot sections. Work on ceramic engine parts is discussed, and the development status of U.S. and European automotive gas turbine programs is presented, noting current efforts in improving the design criteria for light-duty gas turbine engines and the commercialization and production of heavy-duty engines. A.L.W.

A80-28735 Magneto-optical switch for synchronization of CO₂ and red laser beams. R. K. Ahrenkiel, S. J. Thomas (California University, Los Alamos, Calif.), G. A. Prinz, J. J. Krebs, and W. G. Maisch (U.S. Navy, Naval Research Laboratory, Washington, D.C.). *IEEE Journal of Quantum Electronics*, vol. QE-16, Mar. 1980, p. 253-255. 5 refs. Research sponsored by the U.S. Department of Energy.

In CO₂ laser fusion systems low-jitter synchronization of a shorter wavelength probe laser with the pulsed CO₂ fusion driver is desirable. In this paper a new method of beam synchronization using the thermomagnetic effect is described. The large Faraday effect, which has been reported for certain magnetic insulators, is utilized to switch a red HeNe laser beam. Synchronization of CO₂ and red HeNe laser beams is obtained by using a CO₂ laser to quench the ferrimagnetic Faraday effect in thin films of (Co,Cr,Fe)₃O₄ and (Co,Rh,Fe)₃O₄ which have a large Faraday effect at 6328 Å. Switching occurs in subnanosecond times; it occurs when the

absorption of CO₂ laser radiation by lattice or restrahlen absorption is sufficient to heat the film above the Curie temperature. S.D.

A80-28801 **Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.** Conference sponsored by the American Institute of Aeronautics and Astronautics and Solar Energy Research Institute. New York, American Institute of Aeronautics and Astronautics, Inc., 1980. 310 p. \$35.

Papers are presented concerning the technology, and economics of wind energy conversion systems. Specific topics include the aerodynamic analysis of the Darrieus rotor, the numerical calculation of the flow near horizontal-axis wind turbine rotors, the calculation of dynamic wind turbine rotor loads, markets for wind energy systems, an oscillating-wing windmill, wind tunnel tests of wind rotors, wind turbine generator wakes, the application of a multi-speed electrical generator to wind turbines, the feasibility of wind-powered systems for dairy farms, and wind characteristics over uniform and complex terrain. Attention is also given to performance tests of the DOE/NASA MOD-1 2000-kW wind turbine generator, the assessment of utility-related test data, offshore wind energy conversion systems, and the optimization of wind energy utilization economics through load management. A.L.W.

A80-28802 # **A comparison of aerodynamic analyses for the Darrieus Rotor.** R. E. Wilson and W. R. McKie (Oregon State University, Corvallis, Ore.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 1-7. 15 refs. (AIAA 80-0605)

A comparison is made of the single streamtube, multiple streamtube, fixed wake and free wake analyses of a straight bladed Darrieus Rotor using potential flow aerodynamics. The angle of attack, lift coefficient, circulation and loads are examined for a rotor operating at maximum performance. The unsteady aerodynamic forces are evaluated with special consideration given to wake crossing transients. (Author)

A80-28803 # **Aerodynamic interference between two Darrieus wind turbines.** P. R. Schatzle, P. C. Klimas, and H. R. Spahr (Sandia Laboratories, Albuquerque, N. Mex.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 8-13. 7 refs. Research supported by the U.S. Department of Energy. (AIAA 80-0606)

The effect of aerodynamic interference on the performance of two curved bladed Darrieus-type vertical axis wind turbines has been calculated using a vortex/lifting line aerodynamic model. The turbines have a tower-to-tower separation distance of 1.5 turbine diameters, with the line of turbine centers varying with respect to the ambient wind direction. The effects of freestream turbulence were neglected. For the cases examined, the calculations showed that the downwind turbine power decrement (1) was significant only when the line of turbine centers was coincident with the ambient wind direction, (2) increased with increasing tip-speed-ratio, and (3) is due more to induced flow angularities downstream than to speed deficits near the downstream turbine. (Author)

A80-28804 * # **Numerical calculation of steady inviscid full potential compressible flow about wind turbine blades.** D. S. Dulikravich (NASA, Lewis Research Center, Cleveland, Ohio). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 14-19. 9 refs. Research sponsored by the National Research Council. (AIAA 80-0607)

The air flow through a propeller-type wind turbine rotor is characterized by three-dimensional rotating cascade effects about the inner portions of the rotor blades and compressibility effects about the tip regions of the blades. In the case of large rotor diameter and/or increased rotor angular speed, the existence of small supersonic zones terminated by weak shocks is possible. An exact

nonlinear mathematical model (called a steady Full Potential Equation - FPE) that accounts for the above phenomena has been rederived. An artificially time dependent version of FPE was iteratively solved by a finite volume technique involving an artificial viscosity and a three-level consecutive mesh refinement. The exact boundary conditions were applied by generating a boundary conforming periodic computation mesh. (Author)

A80-28805 # **Numerical solution of the flow near the rotor of a horizontal-axis wind turbine and comparisons with data.** J. A. Schetz (Virginia Polytechnic Institute and State University, Blacksburg, Va.) and R. L. Figard (Rockwell International Corp., Downey, Calif.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 20-28. 19 refs. Research supported by the U.S. Department of Agriculture. (AIAA 80-0608)

A numerical procedure based on the full Navier-Stokes equations as applied to the flow near a wind turbine rotor is developed. The flow is assumed axisymmetric, and the unsteady equations of motion are cast in terms of a stream function, one vorticity component and the peripheral velocity. The vorticity equation and the peripheral momentum equation are solved by an Alternating Difference Implicit technique, and the Poisson equation for the stream function is solved by Direct Matrix Reduction. The rotor is modeled as an actuator disk, and the direct simulation of a given actual wind turbine rotor is considered in detail. Turbulent transport is modeled by an integrated Turbulent Kinetic Energy equation with a simple extension to represent the effects of swirl. Comparison with field measurements on a horizontal-axis, three-bladed Elektro 10 kw machine at a station right behind the rotor shows that a good prediction of the radial distribution of the axial velocity was obtained. (Author)

A80-28806 # **Wind energy conversion system simulation program.** R. J. Assarabowski and J. J. Mankauskas (United Technologies Research Center, East Hartford, Conn.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 29-36. (AIAA 80-0609)

The paper deals with a simulation program developed to evaluate the operation and performance of a Wind Energy Conversion System (WECS) and to perform a life-cycle economic analysis. To demonstrate the use of the program, a hypothetical system is described and analyzed. V.T.

A80-28807 # **Wind loading definition for the structural design of wind turbine generators.** A. Kareem, P. B. S. Lissaman, and T. G. Zambrano (AeroVironment, Inc., Pasadena, Calif.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 37-43. 21 refs. (AIAA 80-0610)

The stochastic nature of atmospheric wind plays an important role in the design of a wind turbine generator and the supporting structure. This paper is concerned with the identification of important statistical parameters of fluctuating wind such as turbulence intensity, power spectral density, and coherence functions. This information also provides an insight to the importance of turbulence characteristics for the practical design of wind turbine generators and is used as a guide for obtaining representative wind flow measurements in an area of Southern California currently being developed for large scale wind energy generation. For the practical design of wind turbine generators, short-term extreme wind loading descriptions for the stressing of structural systems and long-term loading for the fatigue analysis are discussed in time and frequency domains. (Author)

A80-28808 # **Dynamic rotor loads of a wind turbine via hand-held calculations.** W. Stoddard (U.S. Windpower, Inc., Burlington, Mass.). In: Wind Energy Conference, Boulder, Colo., April 9-11,

1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 44-49. 9 refs. (AIAA 80-0611)

A straightforward method has been developed for the calculation of wind turbine dynamic loads using a closed-form analytical model. This paper describes the model and provides an example calculation. Blade natural frequencies are used to identify an analytical blade model to represent the complex, flexible rotor blade. The rotor and wind parameters are identified and calculated, and the equations giving collective and cyclic blade trajectories are described. The corresponding root bending moments are calculated for the example set of conditions. The inplane coupling due to Coriolis force and flapping velocity is then assessed. Limitations of the theory and method are described, with simple procedures to assess their effects. (Author)

A80-28810 # Markets for wind energy systems - When, where and at what price. E. E. Johanson, M. Goldenblatt, R. Marshall, and M. Tennis (JBF Scientific Corp., Wilmington, Mass.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 55-60. 11 refs. Research supported by the U.S. Department of Energy and Electric Power Research Institute. (AIAA 80-0613)

The paper considers the resources, machines, loads, rate structures, and potential users' buy, no-buy criteria of a wind energy conversion system (WECS) economic analysis. Based upon these criteria, a market emergence picture is presented indicating where WECS penetration should begin and under what conditions. V.T.

A80-28811 # Economic incentives to wind systems commercialization. M. Lotker (Synetics Group, Inc., Bethesda, Md.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 61-72. Contract No. EG-77-C-01-4053. (AIAA 80-0617)

The paper reports on a study of economic incentives to commercialization of wind systems. The study analyzes the quantitative and qualitative impacts of government funded economic incentives on Wind Energy Conversion Systems (WECS). The uncertainties of WECS and WECS user economics required the development of analysis methodologies which are capable of parametrically analyzing a (1) broad range of incentives, (2) a variety of WECS cost and performance assumptions, and (3) various classes of WECS users. To develop these methods assumptions were made to produce a 'rational man' model for each market sector's decision process; WECS incentives were evaluated for WECS manufacturers, the utility market for WECS, and the residential market for WECS. A.T.

A80-28812 # Economics of selected WECS dispersed applications. S. Krawiec (Solar Energy Research Institute, Golden, Colo.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 73-79. (AIAA 80-0618)

The breakeven cost/market relationship and other economic indices of Wind Energy Conversion Systems (WECS) are analyzed with reference to various markets. It is shown that the economics of WECS varies widely by location depending on the availability of wind resources, the fluctuation of fuel prices and electricity rates, and the effects of seasonal changes on load profiles, even within the same application. The breakeven cost under the best market conditions should not exceed \$1,200/installed kW (1979 \$) in order to enable these systems to compete effectively with conventional energy systems. The capital cost of the wind systems has to be reduced to \$600-\$800 for broad market applications. V.L.

A80-28813 # The wingmill - An oscillating-wing windmill. W. McKinney and J. DeLaurier (Toronto, University, Toronto, Canada). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American

Institute of Aeronautics and Astronautics, Inc., 1980, p. 80-87. 12 refs. Research supported by the National Research Council of Canada and University of Toronto. (AIAA 80-0621)

This paper describes an analytical and experimental investigation of a windmill which utilizes a harmonically-oscillating wing to extract wind energy. In particular, the wing's span is horizontally aligned and the airfoil is a chordwise-rigid symmetrical section. The whole wing oscillates in vertical translation and angle-of-attack, with prescribed phasing between the two motions. A theoretical analysis was developed utilizing unsteady-wing aerodynamics from aeroelasticity and the results guided the design of a working model for wind-tunnel experiments. For the cases tested, theory and experiment compared favorably, and showed the wingmill to be capable of efficiencies comparable to those of the best rotary designs. (Author)

A80-28814 # Tension-field wind machine - A new concept in large-scale energy production. D. Z. Bailey (Bailey Engineering, East Greenwich, R.I.; Aerospace Systems, Inc., Burlington, Mass.) and R. B. Noll (Aerospace Systems, Inc., Burlington, Mass.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 88-98. 9 refs. (AIAA 80-0622)

A unique wind energy conversion system (WECS) is described for large-scale (megawatt range) energy production. The uniqueness of the system is the application of the well-proven tension-field concept of suspension bridges to provide the required structural strength not only for the WECS support but also for the airfoil section. The machine typically has parallel, horizontal tensioned blades, spreaders to maintain rotational radius, and anchored end-bearings to accept the large axial tension. The basic configuration is called a horizontal cross-axis tension-field WECS or HCATF-WECS. Typical configurations, performance, cost effectiveness, and preliminary tests are discussed. (Author)

A80-28815 # Model wind rotors in wind tunnels - Performance and the effect of Reynolds number. L. W. Slager and D. E. Cromack (Massachusetts, University, Amherst, Mass.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 99-104. 15 refs. (AIAA 80-0623)

Small-scale wind rotors have been tested in a four-foot by four-foot open-throat wind tunnel. A variety of operation conditions are considered to evaluate design and off-design performance. It is noted that lifting line theory provides improved predictions when compared to experimental data over a broad range of operating conditions. V.T.

A80-28816 # Experiments on an oscillating aerofoil and applications to wind energy converters. K. H. Ly and V. A. L. Chasteau (Auckland, University, Auckland, New Zealand). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 105-111. 14 refs. (AIAA 80-0624)

Forces measured on a two-dimensional NACA 0012 aerofoil oscillating in pitch and combined pitch-heave are presented. The application of this data to the prediction of Darrieus turbine performance, by approximating blade-wind interaction to a pure pitch oscillation, showed some significant differences from steady aerofoil predictions. The use of an aerofoil oscillating in combined heave-pitch as a WEC is treated briefly. (Author)

A80-28817 # Further studies on wind turbine generator wakes. P. M. Sforza, P. Sheerin, and M. Smorto (New York, Polytechnic Institute, Farmingdale, N.Y.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 112-122. 58 refs. (AIAA 80-0626)

An experimental and theoretical investigation of the wake

behind a simulated wind turbine is presented. Modeling of wake in an environmental wind tunnel is described and experimental results for the three-dimensional model wake flow field are presented. A three-dimensional turbulent flow analysis is developed to deal with prediction of the wake characteristics. The theoretical results are shown to display the experimentally observed features of the wake, and may be used to predict the behavior of full-scale wind turbines under conditions of practical importance. (Author)

A80-28818 # Preliminary work concerning the near wake structure of the Darrieus turbine. J. H. Strickland and A. L. Goldman (Texas Tech University, Lubbock, Tex.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 123-129. 26 refs. Research supported by the U.S. Department of Energy. (AIAA 80-0627)

The potential of a vortex analytical model in making near wake predictions is analyzed. The near wake predictions using this model are compared with a full-scale Darrieus turbine operating in a natural wind environment. Consideration is given to predicted velocity profiles, and corrections for wind direction fluctuations. V.T.

A80-28819 # Wind-turbine power improvement with modern airfoil sections and multiple-speed generators. B. F. Habron (Westinghouse Research and Development Center, Pittsburgh, Pa.), F. R. Goldschmied, and H. S. Kirschbaum. In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 130-147. 11 refs. (AIAA 80-0633)

A brief study was conducted on the power improvement of horizontal-axis wind turbines with modern airfoil sections and multiple-speed PAM generators. On the basis of a reference single-speed variable-pitch wind turbine with NACA 23018 blades, the following improvements can be made with a three-speed PAM generator and NASA LS(1)-0417 blades: (1) 15% gain of plant factor, i.e., average annual energy generation, (2) 17% gain of power output at a rated wind speed of 25 mph, and (3) 70% gain of power output at a higher wind speed of 32 mph. (Author)

A80-28820 # Low cost composite blades for large wind turbines. D. J. Peery and O. Weingart (Structural Composites Industries, Inc., Azusa, Calif.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 148-154. 7 refs. Research sponsored by the U.S. Department of Energy. (AIAA 80-0634)

The paper discusses results of the studies of a low-cost composite blade being designed to meet NASA requirements. The proposed composite blade is a one-piece reliable design that can be fabricated in a continuous operation on automatic machinery. Consideration is given to design requirements, material, and blade structural properties. V.T.

A80-28821 # Multi-speed electrical generator application to wind turbines. T. S. Andersen (Westinghouse Electric Corp., Advanced Energy Systems Div., Pittsburgh, Pa.) and H. S. Kirschbaum. In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 155-162. (AIAA 80-0635)

A cost-effective method to achieve increased energy conversion from wind turbine generators is presented. Most large wind turbines designed to supply electricity to a power have been optimized at a single rotor speed to maintain synchronism with the grid. Suboptimal performance results from spatial and temporal variation in actual wind speeds. Use of mechanical or electrical devices to allow variable or multiple rotor speeds in operation to obtain more efficient aerodynamic performance offer a wider range of wind speeds can improve annual energy capture from 10-30%. The Pole Amplitude Modulated multi-speed induction generator is shown to achieve such

benefits without introduction of adverse costs or inefficiencies associated with other conventional approaches. (Author)

A80-28822 # Wind turbines for irrigation pumping. R. N. Clark (Conservation and Production Laboratory, Bushland, Tex.), V. Nelson, and R. E. Barieau (West Texas State University, Canyon, Tex.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 163-169. (AIAA 80-0639)

A80-28823 # Technical and economic feasibility of wind-powered systems for dairy farms. J. G. McGowan (Massachusetts University, Amherst, Mass.) and P. F. Wendelgass (New York State, Energy Office, Albany, N.Y.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 170-178. 18 refs. (AIAA 80-0641)

A80-28824 # Demonstration and analysis of a combined wind-solar energy conversion system. L. Icerman, A. Swift (Washington University, St. Louis, Mo.), and W. Cargal (Solar Building Corp., St. Louis, Mo.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 179-184. 10 refs. Contract No. EW-79-G-47-1025. (AIAA 80-0643)

The current proof-of-concept demonstration project consists of two integrated components: (i) an experimental program to construct and operate a model combined wind-solar energy conversion system and (ii) an analytical program to model the performance of full-sized combined wind-solar system designs. The experimental program is designed to: (i) investigate systems integration problems; (ii) test the concept of combined wind-solar systems; (iii) monitor the operation of a scale-model system; and (iv) provide empirical data to validate performance simulations. The analytical phase is developing a computer simulation model to: (i) compare combined wind-solar system operation with solar- and wind-only designs; (ii) analyze the impact of a combined wind-solar system on optimal storage capacities; and (iii) translate the empirical results of the system model testing program into useful general design information and performance evaluations of full-scale combined wind-solar system designs. (Author)

A80-28825 # Wind characteristics over complex terrain relative to WECS siting. W. Frost (FWG Associates, Inc.; Tennessee University, Tullahoma, Tenn.) and C. F. Shieh (FWG Associates, Inc., Tullahoma, Tenn.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 185-193. 23 refs. Contract No. E(45-1)-2443. (AIAA 80-0645)

The phenomenon of atmospheric flow over various surface features relative to WECS siting in complex terrain has been analyzed systematically. Although the information presented cannot be utilized to compute highly accurate values of the wind power at a site nor to identify the exact optimum location for a WECS (wind energy conversion system), the wind prospector can use it to select locations where the wind field will be potentially higher and certainly not less than the synoptic wind. Moreover, siting personnel will have the background knowledge needed to identify and to avoid regions of low wind speed and of highly turbulent and periodic flow. This knowledge is provided under the considerations of the effects of the geometries of terrain features, their surface conditions and atmosphere stratifications, as well as the history of wind approaching the WECS site. The application of this information will provide the basic guidance in practical WECS siting. (Author)

A80-28827 # Project windsheet - An interim report. E. X. Berry (Atmospheric Research and Technology, Inc., Sacramento, Calif.), R. K. Hauser, and W. G. Lane (California State University, Chico, Calif.). In: Wind Energy Conference, Boulder, Colo., April

9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 197-199. (AIAA 80-0647)

The paper deals with a wind-energy prospecting project Windesert being conducted over approximately a 90,000-sq-km area including the southern California desert. Twenty-five anemometer stations have been installed which give hourly resolution of wind run, north-south and east-west wind-run components, wind energy, and wind-energy weighted run. Field operations, equipment and system design are considered. V.T.

A80-28828 # Measurements of wind shear at the Mod-1 Site, Boone, N.C. M. Garstang, J. W. Snow, and G. D. Emmitt (Virginia, University, Charlottesville, Va.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 200-204. Contract No. EY-76-C-06-1830. (AIAA 80-0648)

Three components of the wind field, temperature and pressure were measured by means of tethered balloon-borne sondes from the surface to 175 meters over a ten day period at the Mod-1 Site in Boone, N.C. Composite wind profiles are presented for different flow and stability regimes. The most extreme shears, on the order of 0.3/sec, were found between 10 meters and hub height. Individual profiles of wind and temperature show the effect of nocturnal cooling and accompanying surface stratification on the intensity of the wind shear. The variations of gustiness with height and of the wind shear itself are discussed. (Author)

A80-28829 # SWECS qualifications criteria for state tax incentive programs. J. V. Guerrero and C. Alford (Rockwell International Corp., Golden, Colo.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 205-208. 9 refs. (AIAA 80-0650)

The paper considers Small Wind Energy Conversion Systems (SWECS) qualifications criteria for state tax incentive programs. The high initial cost of SWECS require state and federal financial incentives to promote its public acceptance; several prototype qualification documents are being prepared to guide the states in formulating their specific criteria. The formulation of a comprehensive range of qualification documents enables each state to select one as a model representative of its needs, modify the prototype qualification to satisfy its requirements, or change its own qualification requirements based on inputs provided by a range of documents. A.T.

A80-28830 # An integrated approach to energy supply for small communities. F. K. Manasse (New Hampshire, University, Durham, N.H.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York,

American Institute of Aeronautics and Astronautics, Inc., 1980, p. 209-217. 6 refs. (AIAA 80-0651)

The use of hybrid or integrated systems in which wind power is combined with such renewable energy sources as hydro, biomass, and solar technologies is proposed for remote community applications, as for instance in New England. Attention is given to generic applications and methods to overcome their temporal, seasonal, and geographic limitations through multiple source integration, showing that the integrated schemes can replace the fossil-fueled electric generating systems and encourage the use of locally available resources. L.M.

A80-28831 # UTRC 8 kW wind turbine tests. M. C. Cheney (United Technologies Research Center, East Hartford, Conn.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 218-226. 5 refs. (AIAA 80-0657)

The various features of a bearingless wind turbine, which were

conceived and wind tunnel tested over three years, were demonstrated in full scale during the field testing reported in this paper. The tests also demonstrated the predicted performances of 9 kW at 20 mph and the high speed stall control feature. V.T.

A80-28832 # Aerodynamic tests of Darrieus turbine blades. P. G. Migliore, W. P. Wolfe, and R. E. Walters (West Virginia University, Morgantown, W. Va.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 227-237. 20 refs. Contract No. DE-AC05-76ET05135. (AIAA 80-0625)

An indoor facility was developed for aerodynamic testing of Darrieus wind turbine blades. A three component strain gage balance was used to determine lift, drag, and moment coefficients of blades whose angle of attack, chord-to-radius ratio and Reynolds number could be systematically varied. Two blades were tested, each having an aspect ratio of 6, a chord of 0.3 meters and a span of 1.8 meters. The first blade was of NACA 0015 airfoil section while the second was a 15% elliptical section with a modified rounded trailing edge. This second blade was tested without and with (circulation control) high energy air tangentially injected into the boundary layer at approximately 98% chord. Maximum lift coefficients of 0.92, 0.98 and 2.30 were measured respectively. The elliptical blade tested was not of optimum shape and much greater lift augmentation is possible. Wind turbine performance calculations indicate that net power coefficient increases of 50% might be achieved with circulation control. The effects of flow curvature on blade aerodynamics were experimentally verified. Both blades demonstrated virtual camber and incidence as evidenced by non-zero moment coefficients and angles of zero lift. Boundary layer centrifugal effects were also demonstrated. (Author)

A80-28833 # Gust models for design and performance analyses of wind turbines. J. C. Doran and D. C. Powell (Battelle Pacific Northwest Laboratories, Richland, Wash.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 238-243. 6 refs. Contract No. EY-76-C-06-1830. (AIAA 80-0644)

This paper presents an analysis of discrete gusts that are characterized by the amplitude and duration of departures of the fluctuating wind speed from some mean value. The data were recorded using a circular array of anemometers, 49 m in diameter, mounted in a vertical plane. The observed gust characteristics at a fixed point are related to features of gusts that would be experienced by wind turbines. Spatial averaging of gusts is derived from low-pass filtering, and the frequency of occurrence of gust amplitudes and times as a function of filter length is shown. The relationship between gust times and amplitudes is also given in terms of curves that allow determination of the range of gust times associated with a given amplitude. Finally, comparisons are made between the gust environment at a fixed point and that felt by a rotating blade element. (Author)

A80-28834 # An assessment of utility-related test data from large wind turbine generator tests. W. A. Vachon (Arthur D. Little, Inc., Cambridge, Mass.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York,

American Institute of Aeronautics and Astronautics, Inc., 1980, p. 244-248. 9 refs. Research supported by the Electric Power Research Institute. (AIAA 80-0631)

An ongoing project sponsored by the Electric Power Research Institute (EPRI) is described in which performance and test data emanating from the U.S. Department of Energy (DOE) large wind turbine generator (WT) tests is examined as an aid to electric utilities contemplating the use of WT's. It is shown that if the lost operating time of DOE large wind turbine tests is analyzed in detail, it is possible to derive a higher estimated machine availability by eliminating downtime associated with the research and engineering nature of the machine tests. Recommendations are made on the

performance parameters which should be measured during WT tests to make the resulting information of greater value to utilities. Lastly, estimates of the annual average capacity factor from both federally and privately funded large WT's are derived for a wind speed distribution at a site with a 6.3 m/s (14 mph) annual average wind speed. (Author)

A80-28835 * # Installation and checkout of the DOE/NASA Mod-1 2000-kW wind turbine generator. R. L. Puthoff, J. L. Collins, and R. A. Wolf (NASA, Lewis Research Center, Cleveland, Ohio). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 249-260. 5 refs. (AIAA 80-0638)

The paper describes the DOE/NASA Mod-1 wind turbine generator, its assembly and testing, and its installation at Boone, North Carolina. The paper concludes with performance data taken during the initial tests conducted on the machine. The successful installation and initial operation of the Mod-1 wind turbine generator has had the following results: (1) megawatt-size wind turbines can be operated satisfactorily on utility grids; (2) the structural loads can be predicted by existing codes; (3) assembly of the machine on top of the tower presents no major problem; (4) large blades 100 ft long can be transported long distances and over mountain roads; and (5) operating experience and performance data will contribute substantially to the design of future low-cost wind turbines. S.D.

A80-28836 * # Teetered, tip-controlled rotor - Preliminary test results from Mod-O 100-kW experimental wind turbine. J. C. Glasgow and D. R. Miller (NASA, Lewis Research Center, Cleveland, Ohio). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 261-268. 5 refs. (AIAA 80-0642)

A series of tests is currently being conducted using the DOE/NASA 100 kW Experimental Wind Turbine with a two-bladed, teetered rotor with 30% span tip control. Preliminary evaluation test results indicate that the teetered rotor significantly decreases loads on the yaw drive mechanism and reduces blade cyclic flapwise bending moments by 25% at the 20% span location when compared to rigid hub rotor. The teetered hub performed well but did impact the teeter stops on occasion as wind speed and/or direction varied rapidly. The tip-controlled rotor performed satisfactorily with some expected loss of control when compared to the full span pitchable blade. The performance results indicate that a review of techniques used to calculate rotor power is in order. (Author)

A80-28837 # Economic assessment of the Darrieus wind turbine. R. O. Nellums (Sandia Laboratories, Albuquerque, N. Mex.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 269-274. 8 refs. Contract No. DE-AC04-76DP00789. (AIAA 80-0614)

Development of a second-generation vertical axis wind turbine (VAWT) is currently in progress. This paper assesses second-generation economic progress to date in relation to first-generation experience. Cost performance of first-generation VAWTs in production is established to be 5 to 6 cents/kWh using a combination of economic projections, experimental performance data, and prototype fabrication cost experience. Economic methods and design guidelines are discussed as they are applied to second-generation analysis of foundation volume, drive train efficiency, guy cable tiedown configuration, and improved control of aerodynamic power regulation. Reference is also made to preliminary work on aerodynamic efficiency, blade structural tailoring, and installation procedures. Potential for energy cost reduction in the second-generation is concluded to be 35 to 50% under the assumptions contained in the paper. (Author)

A80-28838 # The potential for optimizing the economics of wind energy utilization on a dairy farm through load management. E.

B. Kear (Clarkson College of Technology, Potsdam, N.Y.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 275-279. 7 refs. (AIAA 80-0640)

A80-28839 # Offshore wind energy conversion systems. L. A. Kilar, P. H. Stiller (Westinghouse Electric Corp., East Pittsburgh, Pa.), and D. F. Anaconda (U.S. Department of Energy, Washington, D.C.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 280-285. Research supported by the U.S. Department of Energy. (AIAA 80-0619)

The paper summarizes the findings of a comprehensive assessment of off-shore wind energy conversion systems. Eight generic types of support platforms are discussed, and their conceptual designs are given. Attention is given to the economics of such systems, emphasizing the busbar energy cost measures. Onshore energy costs are developed in terms of controlling environmental parameters, distance from shore and equipment type. C.F.W.

A80-28840 # New concepts in vertical axis wind turbines /VAWT/ and applications to large multi-MW size, off-shore wind turbine systems. O. Ljungstrom (Flygtekniska Forsoksanstalten, Bromma, Sweden). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 286-298. 24 refs. Research supported by the Styrelsen for Tekniskutveckling and NE. (AIAA 80-0620)

The basic characteristics of three selected vertical axis wind turbine (VAWT) subsystems in Sweden are discussed. Results of preliminary small-scale rotor experiments are outlined. An example of application of these subsystems to a 20-MW VAWT, the L-180 Poseidon is presented. V.T.

A80-28841 # A refined windmill rotor model. J. A. C. Bugge (Danmarks Tekniske Højskole, Lyngby, Denmark). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 299-303. (AIAA 80-0628)

A model for calculating performance and aerodynamic blade loads under various working conditions including fully stalled rotor and instationary inflow, is presently being developed. The theory used is a further development of the lifting line theory. In order to be able to handle the stall case, the usual condition of no flow across the meanline at the three quarter point is relaxed, and a certain amount of cross flow is allowed for. The bound circulation on the blade is calculated iteratively within each step of a simulation scheme. The induced velocities at the blades and the self-induced distortion of the rotor wake is calculated using three types of wake representation: vortex sheet, discrete vortex filaments and dipoles each enclosing a given number of vortex filaments. (Author)

A80-28842 # Aerodynamic performance of the DOE/Sandia 17-m vertical axis wind turbine in the two-bladed configuration. M. H. Worstell (Sandia Laboratories, Albuquerque, N. Mex.). In: Wind Energy Conference, Boulder, Colo., April 9-11, 1980, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 304-306. Contract No. DE-AC04-76DP00789. (AIAA 80-0655)

The aerodynamic performance of the DOE/Sandia 17-m Darrieus wind turbine is presented in the two-bladed configuration for two-blade constructions: (1) strutted composite NACA 0012, 21.0 inch chord, (2) unstrutted aluminum extrusion NACA 0015, 24.0 inch chord. Significant increases in overall performance were obtained for the extruded blade which represents a currently viable low-cost blade construction technique for the Darrieus wind turbine. (Author)

A80-28858 # Solar water heating in the Midwest - An economic assessment based on measured performance. W. P.

Corcoran (Solar Energy Research Institute, Golden, Colo.), R. C. Foote (Citizens Gas and Coke Utility, Indianapolis, Ind.), R. E. Henderson, G. D. Huffman, and J. I. Kaplan (Indianapolis Center for Advanced Research; Purdue University, Indianapolis, Ind.). *Journal of Energy*, vol. 4, Jan.-Feb. 1980, p. 39-43. 24 refs. Research supported by the Citizens Gas and Coke Utility.

Solar hot water heaters using both natural and forced flow have been used for many years. Both experimental and theoretical investigations have been conducted recently. The bulk of the experimental studies have been carried out over short periods of time, but assessments of maintainability, upkeep, and the related cost have not been addressed. In the present study, performance data have been obtained for a 12-mo period. Maintenance problems are documented, and the long-term measured performance is used as the basis for an economic evaluation of solar hot water systems. Substantial reductions in installed systems costs are required before the solar units can compete economically with natural gas in the Midwest. (Author)

A80-28859 # Condensation of aluminum when used as a fuel additive in MHD power generation. A. S. Myerson (Dayton, University, Dayton, Ohio). *Journal of Energy*, vol. 4, Jan.-Feb. 1980, p. 44-46. 12 refs.

An analytic study of alumina nucleation and growth is undertaken to determine whether metal oxides will condense as predicted by equilibrium calculations in the short time they are present in an MHD channel. Attention is given to the method employed to calculate condensation times, where finite time intervals are chosen during which particles are added to the system at an instantaneous nucleation rate. It is found that alumina condensation time increased rapidly with decreasing initial supersaturation at a given initial temperature. C.F.W.

A80-28892 PESC '79; Power Electronics Specialists Conference, San Diego, Calif., June 18-22, 1979, Record. Conference sponsored by the Institute of Electrical and Electronics Engineers. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979. 495 p. Members, \$21.; nonmembers, \$28.

The papers deal with such fields as power electronics, power converters, switching regulators, and electromagnetic devices and circuits. Among the topics covered are: the general theory of switching power converters, modeling and analysis of power processing systems; a switching amplifier for capacitive loads, using incremental resonant charging; the general topological properties of switching structures; a peak power tracking technique for photovoltaic arrays; a unified derivation of switching dc-dc converter technologies; a new current-fed converter technology; a high-reliability control circuit of PWM inverter for electric car drive; a microcomputer-based controller for a single phase 2-HP dc motor drive; and a method of designing switching power supplies for improved reliability and maintainability. V.P.

A80-28908 Peak power tracking technique for photovoltaic arrays. D. A. Fox, K. C. Shuey, and D. L. Stechschulte (Westinghouse Electric Corp., Lima, Ohio). In: PESC '79; Power Electronics Specialists Conference, San Diego, Calif., June 18-22, 1979, Record. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 219-227.

A new method of peak power tracking for photovoltaic arrays is presented. The method utilizes ripple inherent in the system to determine the correct operating point for maximum power from the array. Peak power tracking is important for efficient operation of photovoltaic power systems. Operation of a microprocessor controlled 50KVA power conditioning unit utilizing the new peak power tracking method is described. The unit features automatic start up and parallel operation with the utility grid. (Author)

A80-28953 Coal liquefaction processes. P. Nowacki. Park Ridge, N.J., Noyes Data Corp. (Chemical Technology Review, No.

131; Energy Technology Review, No. 45), 1979. 349 p. 107 refs. \$48.

The book describes the latest available technologies pertaining to the liquefaction of coal, thereby forming liquid fuel products that are equivalent to petroleum products. Attention is focused on recent developments in coal liquefaction processes based on pyrolysis, solvent extraction, catalytic liquefaction, and indirect liquefaction. In particular, the basic concept and chemistry of main process variants are discussed along with the special problems inherent in coal processing. Process economics, status, history, environmental impact and scheduling are also discussed. All the important domestic and foreign processes are covered; each approach is illustrated by reference to existing process development units, pilot units or large installations. S.D.

A80-28954 Wind power: Recent developments. Edited by D. J. De Renzo. Park Ridge, N.J., Noyes Data Corp. (Energy Technology Review, No. 46), 1979. 357 p. \$36.

The work presents the most important developments which have occurred in wind power technology in the U.S. in the last five years. New useful devices and constructions are interpreted and explained by actual case histories, which provide a sound background for action toward combating the energy shortage. Special attention is given to rotor development, wind turbines, and the application of wind power to electric utilities. C.F.W.

A80-29006 A microprocessor-based system for the monitoring and control of a solar installation. S. A. Tyuluman, D. C. Schroder, and M. E. Austin (Texas, University, El Paso, Tex.). *IEEE Transactions on Industrial Electronics and Control Instrumentation*, vol. IECI-27, Feb. 1980, p. 1-4. 6 refs.

This paper describes the microcomputer hardware and software used to instrument and control a flat plate solar energy collection system. The procured data is transferred to a minicomputer for further signal processing and analysis. The system utilizes micro-electronic circuits to digitize and store data on magnetic tape as well as use that data for control decisions. The scheme described was found to be inexpensive yet effective. (Author)

A80-29007 Processing of solid fossil-fuel deposits by electrical induction heating. S. T. Fisher. *IEEE Transactions on Industrial Electronics and Control Instrumentation*, vol. IECI-27, Feb. 1980, p. 19-26. 8 refs.

A study has been made to determine the feasibility of extracting the energy commodities electricity, gas, petroleum, chemical feedstocks, and coke from the solid fossil fuels coal, oil shale, oil sand, and heavy oil by the electrical induction heating of the deposits. Available electrical, physical, and chemical data indicate that this process may be technically and economically feasible. Some basic data are missing, and it has been necessary to indicate possible ranges of values for some parameters. The tentative conclusions drawn are the following. All four solid fossil fuels can be processed successfully underground. All five energy commodities can be produced economically in adequate quantities for a period of a century or more in North America, without recourse to any other major energy source. The development and construction time required is short enough to permit an uninterrupted supply of all energy commodities as present sources decline. (Author)

A80-29008 A battery-run pulsed motor with inherent dynamic electronic switch control. K. C. Tripathi, P. Lal, P. R. Sarma, A. K. Sharma, and V. Prakash (Bhabha Atomic Research Centre, Nuclear Research Laboratory, Srinagar, India). *IEEE Transactions on Industrial Electronics and Control Instrumentation*, vol. IECI-27, Feb. 1980, p. 29-34. 7 refs.

A new type of battery-run brushless ferrite-magnet dc motor system is described. Its rotor part consists of a few permanent ceramic (ferrite) magnets uniformly spread on the rim of a disk (wheel) and the stator part consists of electromagnets placed in such a way that when energized, they always form a repulsive couple to

rotate the disk. A sensor coil is placed to give an induced pulse signal, which acts as an inherent dynamic switching time control for the automatic electronic control system. Control of speed, brake system, and safety measures are also discussed. Experimental values for the present system are given. Some possible applications are suggested.

(Author)

A80-29037 Going with the wind. W. Nesbit, E. DeMeo, and F. Goodman, Jr. (Electric Power Research Institute, Palo Alto, Calif.). *EPRI Journal*, vol. 5, Mar. 1980, p. 6-17.

The current status of wind generation of electricity is surveyed, noting that extracting electric power from such an abundant and inconsistent source requires the correct size, a reliable machine, and power system flexibility to adapt to the air stream. Attention is given to currently operating installations in New Mexico, North Carolina, Puerto Rico, and Rhode Island. Also discussed is the breadth of the federal program including NASA work for the DOE such as the 2.5 MW MOD-2, as well as Sandia work on Darreius design of vertical axis turbines. Other topics examined include siting considerations, private efforts, the depth of analysis required, and the establishing of utility requirements.

M.E.P.

A80-29038 DOE moves ahead with geothermal. *EPRI Journal*, vol. 5, Mar. 1980, p. 28-32.

Various forms of geothermal energy, such as: dry steam and hot water (hydrothermal resources), geopressed water with dissolved methane gas, and dry, hot rock are surveyed. A federal program under the Department of Energy for the development of hydrothermal resources in the near term (around 1985), geopressed resources in the midterm (1990-1995), and dry, hot rock in the long term (2000) is proposed, stressing the integral role in it for the private industry. Resource finding, drilling and production testing for heat and electricity of temperatures below 400 F are discussed. The flash technology and the binary cycle for lower cost power are also discussed and environmental problems (water salinity) are analyzed.

O.L.

A80-29051 Solar energy: Chemical conversion and storage. Edited by R. R. Hautala, R. B. King, and C. Kutal (Georgia, University, Athens, Ga.). Clifton, N.J., Humana Press, Inc., 1979, 432 p. \$34.

Papers are presented on solar energy conversion in photosynthesis, the chlorophyll A water-splitting light reaction, light-induced electron-transfer reactions in solution, effect of the micellar phase on photo-induced reactions, and on reversible excited-state electron-transfer reactions of transition metal complexes. Individual topics include solar cell technology, and photocyclization.

C.F.W.

A80-29052 Petroleum plantations. M. Calvin (California, University, Berkeley, Calif.). In: Solar energy: Chemical conversion and storage. Clifton, N.J., Humana Press, Inc., 1979, p. 1-30. 54 refs. Research sponsored by the U.S. Department of Energy.

Photosynthesis is examined as an annually renewable resource for material and energy. The production of fermentation alcohol from sugar cane as a major source of materials for chemical feedstocks is examined as well as the direct photosynthetic production of hydrocarbons from known plant sources. Experiments are underway to analyze the hydrocarbons from Euphorbias and other hydrocarbon containing plants with a view toward determining their various chemical components. In addition, experimental plantings of several species of Euphorbias have begun to obtain data on which species would be most successful. Using Euphorbia lathyris, there are indications that we may expect a yield of approximately ten barrels of hydrocarbon material per acre in a seven-month growing period on semiarid land.

(Author)

A80-29053 Solar energy conversion in photosynthesis - Features relevant to artificial systems for the photochemical conversion of solar energy. J. R. Bolton (Western Ontario, University, London, Canada). In: Solar energy: Chemical conversion and storage.

Clifton, N.J., Humana Press, Inc., 1979, p. 31-50. 46 refs.

The mechanism and efficiency of photosynthesis as a solar energy converter is examined and the features that are most relevant to the design of artificial systems are presented. A brief review of the thermodynamic and kinetic limitations on any photochemical conversion and storage process is discussed. A wavelength threshold relation is derived for a general photochemical solar energy process, and it is shown that if photosynthesis were to proceed with one photosystem, then the threshold wavelength would be about 610 nm.

C.F.W.

A80-29054 The 'tandem photoelectrolysis plant' concept - A strategy for fuel production via biomass conversion wastes. R. E. Schwerzel, E. W. Brooman, R. A. Craig, D. D. Levy, F. R. Moore, L. E. Vaaler, and V. E. Wood (Battelle Columbus Laboratories, Columbus, Ohio). In: Solar energy: Chemical conversion and storage. Clifton, N.J., Humana Press, Inc., 1979, p. 83-115. 28 refs. Contract No. W-7405-eng-92. DOE Task 95.

The paper presents an approach, based on the photoelectrolysis of water, by which the conversion of biomass materials to gaseous fuels can be accomplished. A review of the photoelectrolysis technique is presented, and the results on which the tandem photoelectrolysis plant concept is based, are studied. Attention is given to the concept of a photochemical diode, for the production of hydrogen and oxygen, which has evolved as an extension of the development of p-n heterotype photoelectrolysis cells.

C.F.W.

A80-29055 Light-induced electron transfer reactions in solution, organized assemblies and at interfaces - Scope and potential applications. D. G. Whitten, P. J. DeLaive, T. K. Foreman, J. A. Mercer-Smith, R. H. Schmehl (North Carolina, University, Chapel Hill, N.C.), and C. Giannotti (North Carolina, University, Chapel Hill, N.C.; CNRS, Institut de Chimie des Substances Naturelles, Gif-sur-Yvette, Essonne, France). In: Solar energy: Chemical conversion and storage. Clifton, N.J., Humana Press, Inc., 1979, p. 117-140. 87 refs. Research supported by the W. R. Grace Co. and NATO; NSF Grant No. CHE-76-01074; Grants No. DAAG29-77-G-0063; No. NIH-GM-15238-11.

The paper presents a review of some investigations of light-induced electron transfer reactions and redox chemistry resulting from these processes that occur in solutions and in various molecular organizes. The first section presents solution-phase photoredox processes that will focus on ways to prevent energy wasting back reactions, such that the high energy products produced in reactions, such as 1 and 3, can be diverted to provide useable and/or energy storage. The second section deals with recent studies of electron transfer reactions in organizes and at interfaces that suggest an expanded scope and possible new applications for these products.

C.F.W.

A80-29056 Photochemical determinants of the efficiency of photogalvanic conversion of solar energy. M. Z. Hoffman and N. N. Lichtin (Boston University, Boston, Mass.). In: Solar energy: Chemical conversion and storage. Clifton, N.J., Humana Press, Inc., 1979, p. 153-187. 76 refs. Contract No. EY-76-S-02-2889.

The photochemical determinants of the efficiency of photogalvanic cell operation are examined, which include: the absorption spectral characteristics of the cell solution, the efficiency of formation of separated charge carriers, and the lifetimes of the carriers toward back electron transfer. Modulation of bulk solution dynamics can be achieved by variation of the solution medium. The photochemical determinants are discussed with particular reference to the use of thionine or Ru(bpy)₂/3(+) as the light absorbing species.

(Author)

A80-29057 Photogalvanovoltaic cells and photovoltaic cells using glassy carbon electrodes. H. T. Tien, J. Higgins, and J. Mountz (Michigan State University, East Lansing, Mich.). In: Solar

energy: Chemical conversion and storage. Clifton, N.J., Humana Press, Inc., 1979, p. 203-235. 30 refs. Research supported by the Michigan State University.

Numerous electrochemical photocells have been proposed for the direct conversion of solar energy to electricity or chemical fuel. These cells, on the basis of two well established photoelectric effects, can be classified as either photovoltaic (PV) or photogalvanic (PG). The operation of a PV cell depends on the generation of an EMF as a result of the absorption of light, whereas the operation of a PG cell relies on the excitation by light of photoactive species in solution which induces a Faradaic process at the electrode. This paper describes a new type of electrochemical photocell, the operation of which is based on the combined principles of the PV and PG phenomena. This system, having the advantages of both the PV and PG cell, is therefore called the photogalvanovoltaic (PGV) cell. The key element of the cell responsible for the PV effect is a porphyrin-coated glassy carbon electrode. Either Pt or glassy carbon can serve as the counter electrode. The results of an electrochemical PV cell using porphyrin-coated glassy carbon electrodes are also described. (Author)

A80-29058 Growth and characterization of thin film III-V compound semiconductor material for solar cell applications. W. D. Johnston, Jr. (Bell Telephone Laboratories, Inc., Holmdel, N.J.). In: Solar energy: Chemical conversion and storage. Clifton, N.J., Humana Press, Inc., 1979, p. 237-260. 10 refs.

The paper presents an overview of the growth and characterization of thin film III-V compound semiconductor materials for solar cell applications. Attention is given to the cost analysis of GaAs or InP solar cells prepared on single crystal substrates, and to the basic properties of polycrystalline thin films. Growth techniques of GaAs solar cells are discussed, including reversible reactions, the open-tube chloride VPE process, and metallorganic growth. The electrical characteristics of thin GaAs and InP films are also discussed. It is concluded that any photovoltaic array for practical terrestrial use will have to be provided with a complete hermetic seal, to ensure stability at differing temperatures. C.F.W.

A80-29059 Nitrogen reducing solar cells. G. N. Schrauzer, T. D. Guth, M. R. Palmer, and J. Salehi (California, University, La Jolla, Calif.). In: Solar energy: Chemical conversion and storage. Clifton, N.J., Humana Press, Inc., 1979, p. 261-269. 15 refs. Research supported by the University of California; NSF Grant No. CHE-76-10890.

An alternative approach to the use of a natural gas for existing methods of industrial ammonia synthesis is presented based on biological nitrogen fixation. The main purpose of this research is to establish the fundamental chemical aspects of the mechanism and to develop functional models of the nitrogen fixing enzyme that could become the basis of new catalytic processes. Attention is given to photooxidation of: mercury to mercuric oxide, cyanide to cyanate, and of iodide to iodine. Several experiments are conducted to determine whether minerals other than those containing titanium could possess nitrogen photoreducing activity. C.F.W.

A80-29060 Photosensitization mechanisms for energy storing isomerizations. G. Jones, II, P. T. Xuan, and S. H. Chiang (Boston University, Boston, Mass.). In: Solar energy: Chemical conversion and storage. Clifton, N.J., Humana Press, Inc., 1979, p. 271-298. 50 refs. Research supported by the U.S. Department of Energy and U.S. Navy.

The prospects for driving endoergic reactions of simple, relatively abundant, organic chemicals by photochemical means have been examined. Photoisomerization reactions which have some potential for storage of solar energy as latent heat in kinetically stable products are surveyed. Emphasis is placed on methods for the photosensitization of storage chemicals to visible light. Mechanisms include excited state complexation of isomerizable substrates through electron donor-acceptor attraction and conventional energy transfer photosensitization. Efficient isomerization of a norborna-

diene derivative using the latter technique and photosensitizers absorbing past 500 nm is described. Factors controlling the efficiency of endothermic triplet energy transfer are outlined. The concept of 'thermal upconversion' of the excitation energies of visible absorbing sensitizers is introduced, including a demonstration of improved quantum efficiency as a function of temperature for an isomerization which utilizes a very low energy sensitizer. (Author)

A80-29061 The norbornadiene-quadracyclene energy storage system. R. R. Hautala, R. B. King, and C. Kotal (Georgia, University, Athens, Ga.). In: Solar energy: Chemical conversion and storage. Clifton, N.J., Humana Press, Inc., 1979, p. 333-369. 42 refs. Research supported by the U.S. Department of Energy and NSF.

It is noted that the potential applicability of endoergic photochemical transformations of organic molecules to the storage of solar energy is currently receiving considerable attention. The paper examines norbornadiene-quadracyclene interconversion, which is reported to be one of the most promising systems currently available. Attention is given to several practical problems. Discussion covers an assessment of these problems, an overview of the objectives, and a summary of the most recent efforts. M.E.P.

A80-29152 Electrochemical gasification of coal - Simultaneous production of hydrogen and carbon dioxide by a single reaction involving coal, water, and electrons. R. W. Coughlin and M. Farooque (Connecticut, University, Storrs, Conn.). *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 19, Apr. 1980, p. 211-219. 22 refs. Research supported by the University of Connecticut Research Foundation and U.S. Department of Energy.

Coals and other forms of solid carbonaceous fossil fuel are oxidized to oxides of carbon at the anode of an electrochemical cell and hydrogen is produced at the cathode. These gases are thereby produced in relatively pure states. The reaction proceeds at very mild temperatures and at operating electrical potentials lower than 1 V, i.e., significantly lower than the thermodynamic potential of water electrolysis. The process may be viewed as driven simultaneously by energy supplied at low temperatures in approximately equal proportions by the coal and by an external electrical source. It is expected that coal can supply a larger proportion of the energy if the process is operated at higher temperature for which the required electrical potential will be lower. (Author)

A80-29154 Wood gasification in a fluidized bed. S. R. Beck and M. J. Wang (Texas Tech University, Lubbock, Tex.). *I & EC - Industrial and Engineering Chemistry, Process Design and Development*, vol. 19, Apr. 1980, p. 312-317. 21 refs. Research supported by the Texas Cattle Feeders Association, Pioneer Corp., and U.S. Environmental Protection Agency; Contract No. EY-76-S-04-3779.

Gasification of oak sawdust in the Synthesis Gas From Manure (SGFM) pilot plant at Texas Tech University has been evaluated. The SGFM reactor operates as a countercurrent fluidized bed in which a biomass feedstock is fed to the top of the reactor and is fluidized by an air-steam mixture fed to the bottom of the reactor. Using oak sawdust from Missouri as the feedstock, the gas yields were 1.1 to 1.4 L/g daf feed when the average reactor temperature was 600 to 800 C. The gas contained about 4% C₂H₄ and 11% CH₄. The gross heating value of the gas exceeded 11.2 MJ/cu m in all cases. The gasification of wood is compared to previous results obtained for cattle manure. The differences are due to the relative amounts of cellulose, hemicellulose, and lignin in the feedstock. (Author)

A80-29280 Arabs turn their eyes to the sun. J. Perera. *New Scientist*, vol. 85, Feb. 14, 1980, p. 474-477.

The present status of solar energy development in the Arab world is discussed. The Arab world receives solar energy equivalent to an average of 275 W/sq m. A total of 30 million MW is potentially available, which could be converted to usable electricity at an efficiency of at least 10% to produce over 3 million MW or the

equivalent of the output of 3000 large power stations generating 1 GW each. Attention is given to the solar projects undertaken by Saudi Arabia as the most deeply involved and perhaps the most important country. The joint SOLERAS program with the U.S.A. is briefly outlined. Of the other Arab states, Kuwait, Jordan, Egypt and Algeria are also backing solar research. Work done in these countries is examined. At present the various research projects are uncoordinated and there is much duplication between states. S.D.

A80-29334 Laser 79 opto-electronics; Proceedings of the Fourth Conference, Munich, West Germany, July 2-6, 1979. Edited by W. Waidelich (München, Universität, Munich, West Germany). Guildford, Surrey, England, IPC Science and Technology Press, Ltd., 1979. 673 p. In English and German. \$78.

Papers are presented on optoelectronic components, laser systems, optoelectronic signal transmission, materials processing with laser emission, lasers in environmental measuring techniques, and optoelectronic solar technology. Individual topics presented include: blue-light emitting diodes, results and perspectives of hollow cathode gas lasers, digital fiber-optic communications link for 1 Gbit/s, programming laser marking systems, and new semiconductor laser technology for cloud altimeters. C.F.W.

A80-29370 Helios, a 20 TW CO₂ laser fusion facility. J. S. Ladish (California, University, Los Alamos, N. Mex.). In: Laser 79 opto-electronics; Proceedings of the Fourth Conference, Munich, West Germany, July 2-6, 1979. Guildford, Surrey, England, IPC Science and Technology Press, Ltd., 1979, p. 294-301. 5 refs. Research sponsored by the U.S. Department of Energy.

It is noted that since June 1978, the Los Alamos scientific laboratory's Helios CO₂ laser fusion facility has been committed to an experimental target program to investigate the feasibility of laser produced inertial confinement fusion. A brief description is given of the system, and preliminary experimental results are reported. It is shown that the development of fusion energy depends on the success of the research being carried out in inertial and magnetic confinement. It is concluded that while the recent high density results obtained must be regarded with cautious optimism, the significance of these results should not be underestimated. M.E.P.

A80-29384 Solar generators for terrestrial use (Solar-generatoren für den terrestrischen Einsatz). R. Buhs (Telefunken AG, Wedel, West Germany). In: Laser 79 opto-electronics; Proceedings of the Fourth Conference, Munich, West Germany, July 2-6, 1979. Guildford, Surrey, England, IPC Science and Technology Press, Ltd., 1979, p. 471-485. 18 refs. In German.

The paper presents an overview of the technological status of photovoltaic converters for terrestrial use. Attention is given to solar cells and solar generators, and production techniques. Further, a survey is made of the applications of terrestrial solar generators presently possible. Finally, discussion covers the research programs underway in the Western world as well as the largest German programs. M.E.P.

A80-29393 Heterojunction for thin-film solar cells (Hetero-übergänge als Dünnschichtsolarellen). G. H. Hewig (Stuttgart, Universität, Stuttgart, West Germany). In: Laser 79 opto-electronics; Proceedings of the Fourth Conference, Munich, West Germany, July 2-6, 1979. Guildford, Surrey, England, IPC Science and Technology Press, Ltd., 1979, p. 533-538. 26 refs. In German.

The paper examines the developments in solar technology with regard to heterojunction of thin-film solar cells. Attention is given to experimental results of various layer combinations. A specific example of a Cu₂S-CdS thin-film cell is examined and analyzed, listing film densities and various possible crystal combinations. C.F.W.

A80-29394 Silicon ribbon for photovoltaic cells. A. Baghdadi, R. W. Gurtler, R. J. Ellis, and I. A. Lesk. In: Laser 79 opto-electronics; Proceedings of the Fourth Conference, Munich, West Germany, July 2-6, 1979. Guildford, Surrey, England, IPC Science and Technology Press, Ltd., 1979, p. 539-543.

The ribbon-to-ribbon method (RTR) for silicon ribbon growth is presented, in which a pair of scanned, focused CO₂ laser beams is used to establish a molten zone in a preformed polycrystalline ribbon. Large-grained silicon ribbon is then drawn from the zone at growth rates up to 13.3 cm/min and the silicon ribbon purity is maintained by purging gases used to protect the molten zone during growth. The efficiency of RTR solar cells is found to average 9% with the best cell reaching the 12% conversion efficiency needed for economic viability. It is shown that RTR has achieved the highest growth rates reported for silicon ribbon growth and has great promise as a low-cost photovoltaic substrate. L.M.

A80-29395 Thin film solar cells based on amorphous silicon. G. Winterling (Messerschmitt-Bölkow-Blohm GmbH, Ottonbrunn, West Germany). In: Laser 79 opto-electronics; Proceedings of the Fourth Conference, Munich, West Germany, July 2-6, 1979. Guildford, Surrey, England, IPC Science and Technology Press, Ltd., 1979, p. 544-548. 11 refs.

Thin film solar cells can be produced in a much cheaper way than conventional cells based on bulk crystalline silicon. The advantages of the amorphous silicon technology is illustrated by comparing the production process for polycrystalline and amorphous silicon cells. The state of art of the present laboratory cells with amorphous silicon is reviewed. The experimental conversion efficiency is relatively low since the mobilities of charge carriers are much smaller in amorphous silicon than in crystalline silicon. Possibilities to enhance the collection efficiency of the optically induced charge carriers are discussed. (Author)

A80-29396 Photovoltaic hybrid collectors (Photovoltaischer Hybridkollektor). H. Karl (Stuttgart, Universität, Stuttgart, West Germany). In: Laser 79 opto-electronics; Proceedings of the Fourth Conference, Munich, West Germany, July 2-6, 1979.

Guildford, Surrey, England, IPC Science and Technology Press, Ltd., 1979, p. 549-558. In German. Research sponsored by the Bundesministerium für Forschung und Technologie.

The performance of a combined collector has been studied. The collector produces low grade thermal energy and electrical power. It contains 4 poly-silicon solar cell arrays instead of the usual absorber surface. The efficiency of the solar cell arrays are around 6% at 60°C, where the thermal efficiency is about 40%, at normal conditions. Experiments and analysis characterizing electrical and thermal performance are discussed. A water type combined collector and a usual solar collector of the same design have been simultaneously tested. Thermal performance is measured under open voltage conditions, varying inlet temperature and meteorological conditions. (Author)

A80-29406 A heat penalty and economic analysis of the hybrid sulfuric acid process. R. H. Carty and W. L. Conger (Kentucky, University, Lexington, Ky.). *International Journal of Hydrogen Energy*, vol. 5, no. 1, 1980, p. 7-20. 10 refs. Contract No. EC-77-S-05-5522.

A heat penalty and economic analysis of the Westinghouse hydrogen process is made showing that the process efficiency is about 50.9% and the production cost of hydrogen based on 1976 cost figures is \$8.20/GJ. A breakdown of the equipment in the process with the enthalpy change, entropy change, heat and work requirements, and heat penalty for each piece is given. (Author)

A80-29407 The oxidation of sulphur dioxide by bromine and water. D. van Velzen and H. Langenkamp (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune Di

Ricerche, Ispra, Italy). *International Journal of Hydrogen Energy*, vol. 5, no. 1, 1980, p. 85-96.

The reaction of SO₂, Br₂ and H₂O, forming HBr and H₂SO₄, is one of the reactions of the hybrid cycle for thermochemical decomposition of water, the Mark-13 cycle. Experimental work on this reaction is described. Equilibrium measurements show that high sulfuric acid concentrations (higher than 80 wt%) are attainable. At low sulfuric acid concentrations only traces of Br₂ and/or SO₂ remain in the gaseous phase. Besides the equilibrium determinations, development work by dynamic experiments has also been carried out. A simple mathematical model for the reaction rate in packed columns has been developed which satisfactorily fits the available experimental data. (Author)

A80-29448 * # Space disposal of nuclear wastes. C. C. Priest, R. F. Nixon (NASA, Marshall Space Flight Center, Program Development Directorate, Huntsville, Ala.), and E. E. Rice (Battelle Columbus Laboratories, Columbus, Ohio). *Astronautics and Aeronautics*, vol. 18, Apr. 1980, p. 26-35. 37 refs. Contract No. NAS8-32391.

The DOE has been studying several options for nuclear waste disposal, among them space disposal, which NASA has been assessing. Attention is given to space disposal destinations noting that a circular heliocentric orbit about halfway between Earth and Venus is the reference option in space disposal studies. Discussion also covers the waste form, showing that parameters to be considered include high waste loading, high thermal conductivity, thermochemical stability, resistance to leaching, fabrication, resistance to oxidation and to thermal shock. Finally, the Space Shuttle nuclear waste disposal mission profile is presented. M.E.P.

A80-29474 Optimizing a regional energy provision system for multi-task achievement (Optimierung eines regionalen Energieversorgungssystems bei mehrfacher Zielsetzung). B. Fürniss, D. Hoch, V. Schulz, and H. Stehfest (Karlsruhe, Kernforschungszentrum, Karlsruhe, West Germany). *Energiewirtschaftliche Tagesfragen*, vol. 30, Mar. 1980, p. 155, 156, 158 (3 ff.). 19 refs. In German.

The purpose of the paper is to present an optimization model for energy provision systems and their possible application. A comparison is made between this model and various previous ones with regard to the existing oil/energy crisis. The main function of the proposed system is to (1) enable the optimization of many goals, including minimization of costs and primary energy consumption, and (2) be functional on a regional scale. C.F.W.

A80-29475 Energy politics (Energiepolitik). B. Börner (Köln, Universität, Cologne, West Germany). *Energiewirtschaftliche Tagesfragen*, vol. 30, Mar. 1980, p. 179-183. In German.

The paper examines the basis and principles of energy politics, emphasizing the flow of goods and capital. Attention is given to the peculiarities of forecasts, including probability, freedom, and conclusions. The predicted development of energy is discussed with respect to supply and demand, and economic growth. Nuclear power and the fuel cycle are examined as viable means for dealing with the rising lack of oil. C.F.W.

A80-29662 # Power units for mini RPV's. D. P. Short (Westlake Aeromarine Engines, Ltd., England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 16.1-16.7.

Production engines suitable for mini-remotely piloted vehicles (RPVs), having minimum bulk and weight for a given power output are discussed, including engines designed for chain saws, snowmobiles, and go-carts. Attention is given to the carburetor, exhaust and fuel systems, and the alternator. Typical specifications for such future mini-RPV engines include: rated output at 6500-8000 rpm, BMEP at rating 75-80 psi, specific fuel consumption at cruise

condition better than 0.75 lb/bhp hr, and specific weight of a running engine, not including exhaust system, better than 1 lb/bhp. J.P.B.

A80-29725 Hysteresis in metal/hydrogen systems. T. B. Flanagan, B. S. Bowerman, and G. E. Biehl (Vermont, University, Burlington, Vt.). *Scripta Metallurgica*, vol. 14, Apr. 1980, p. 443-447. 22 refs. NSF-supported research.

The paper considers hysteresis in metal/hydrogen systems. It was shown that the hysteresis in the solvus behavior of Nb/H which consists of unequal values of relative partial enthalpy of solution for heating and cooling is due to the occurrence of plastic deformation during both processes, and that it may be applied to pressure hysteresis in the Pd/H system. Evidence based on H₂ solubility suggests that dislocation densities of the same order of magnitude are generated by the beta to alpha phase transition in Pd which already contains a large dislocation density from the alpha to beta change; hysteresis scans have been measured with Pd samples which have been previously subjected to the phase changes, with the H₂ removed by evacuation at low temperature. Finally, the free energy loss for a scan is computed suggesting that beta-phase can be formed or decomposed with a smaller energy loss within the hysteresis gap than along the plateau pressure branches. A.T.

A80-29742 Graded metal carbide solar selective surfaces coated onto glass tubes by a magnetron sputtering system. G. L. Harding and B. Window (Sydney, University, Sydney, Australia). *Journal of Vacuum Science and Technology*, vol. 16, Nov.-Dec. 1979, p. 2101-2104. 10 refs. Research supported by the University of Sydney.

A solar selective absorbing surface consisting of mixed iron, chromium, and nickel carbides on copper has been deposited onto 1.5 m long, 22 mm o.d. glass tubes by reactive and nonreactive dc sputtering. Grading the properties of the metal carbide from metal rich at the copper substrate to dielectric at the surface results in solar absorptances approximately 93% and emittances approximately 4% at 300 K (both properties averaged along the length of a tube). Aging experiments show that absorptances deteriorate slowly at 300 C in vacuum due to diffusion in the graded film. Emittances at elevated temperature for copper and for the selective surfaces deposited onto tubes have been determined using a calorimetric technique. (Author)

A80-29743 Cylindrical magnetron sputtering system for coating solar selective surfaces onto batches of tubes. G. L. Harding, B. Window, D. R. McKenzie, A. R. Collins, and C. M. Horwitz (Sydney, University, Sydney, Australia). *Journal of Vacuum Science and Technology*, vol. 16, Nov.-Dec. 1979, p. 2105-2108. 12 refs. Research supported by the University of Sydney.

Construction and operation of a cylindrical magnetron sputtering system for coating glass tubes with solar selective surfaces is described. A metal carbide on copper selective surface produced in the coater is discussed in terms of uniformity of coating thickness, electrical and optical properties. Short pumpdown times and high deposition rates make this a medium volume productive system. (Author)

A80-29744 Alternative grading profile for sputtered solar selective surfaces. G. L. Harding (Sydney, University, Sydney, Australia). *Journal of Vacuum Science and Technology*, vol. 16, Nov.-Dec. 1979, p. 2111-2113. 15 refs. Research supported by the University of Sydney.

Metal carbide selective surfaces of DMD structure produced by dc reactive sputtering in a cylindrical magnetron are discussed with reference to the deposition conditions and film properties. The experimental data indicate that absorptance and emittance of three-layer surfaces decrease as total thickness is reduced. The five-layer surfaces exhibit the same trend in absorptance, but emittance values are found to be independent of thickness in the range studied. Since the three-layer surfaces appear equivalent in

selective properties to five-layer surfaces, it is suggested that little improvement will be observed for continuously graded surfaces.

V.L.

A80-29795 Possible direct conversion of chemical energy into electrical energy in a semiconductor. A. E. Kabanskii, V. V. Styrov, and Iu. I. Tiurin (Tomsk Institute of Automated Control Systems and Electronics, Tomsk, USSR). (*Pis'ma v Zhurnal Tekhnicheskoi Fiziki*, vol. 5, July 26, 1979, p. 833-837.) *Soviet Technical Physics Letters*, vol. 5, July 1979, p. 343, 344. 8 refs. Translation.

The direct conversion of the chemical energy released by a simple heterogeneous reaction in the surface of a semiconductor into electrical energy is investigated. The requirements of high exothermicity, efficient energy conversion into an electron-hole pair and product desorption from the surface for the reaction are discussed. The peak efficiency of a H + Ge reaction system is estimated to be 0.1% in a strong magnetic field and with a high excitation level, while when a rectification chemoeffect is utilized, the maximum efficiency is calculated to be 0.04, which is of practical interest. It is pointed out that the efficiency can be increased by using a wide-gap semiconductor, a system with a more favorable energy ratio, or a system with less surface recombination. A.L.W.

A80-29800 Oil shale processing technology. G. L. Baughman (Colorado School of Mines, Golden, Colo.). *ISA Transactions*, vol. 19, no. 1, 1980, p. 21-28.

The paper presents the technical details of oil shale retorting technologies and describes the types of instrumentation and control problems. The underground and above ground retorting processes of direct and indirect heated types are discussed along with in-situ methods which involve the fracturing of the oil shale zone with explosives. Direct-heated above ground processes include the Gas Combustion Process, the Soviet Kiviter Process, a Paraho Process, and the Union Oil Retorting Process which have been developed to a potential commercial stage; seven methods including Lurgi-Ruhrgas and Union Oil Co. are designed for indirect-heating retorting. Finally, instrumentation for control of injected air and recycle gas, product gas monitoring and analysis of the product gas stream, and control of balance between recycle gas temperature and flow rate are examined. A.T.

A80-29812 The open-circuit voltage of back-surface-field/BSF/p-n junction solar cells in concentrated sunlight. C.-Y. Wu and W.-Z. Shen (National Chiao Tung University, Hsinchu, Nationalist China). *Solid-State Electronics*, vol. 23, Mar. 1980, p. 209-216. 8 refs. National Science Council of Nationalist China Contract No. 68E-0404(O2).

A80-29815 The barrier height change and current transport phenomena with the presence of interfacial layer in MIS Schottky barrier solar cells. J. T. Lue (National Tsinghua University, Hsinchu, Nationalist China). *Solid-State Electronics*, vol. 23, Mar. 1980, p. 263-268. 15 refs. Research supported by the National Science Council of Nationalist China.

A80-29817 * The influence of a voltage ramp on the measurement of I-V characteristics of a solar cell. O. von Roos (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Solid-State Electronics*, vol. 23, Mar. 1980, p. 285-288. 7 refs.

For efficiency and convenience the voltage applied to a Si solar cell is often fairly rapidly driven from zero to the open circuit value typically at a common rate of 1 V per millisecond. During this time the values of current are determined as a function of the instantaneous voltage thus producing an I-V characteristic. The present paper shows that the customary expressions for the current as a function of cell parameters still remain valid provided that the diffusion length in the expression for the dark current is changed from its steady state value L to the effective diffusion length L1 given by $L1 = L(1 + qV/kT.\tau)$ to the $-1/2$, where V is the ramp rate considered constant

and tau is the lifetime of minority carriers. This result is true to a very good approximation provided that low level injection prevails. B.J.

A80-29894 Safety studies on Li/SO₂ cells. II - Kinetics of lithium-organic solvent exothermic reactions. A. N. Dey and R. W. Holmes (P. R. Mallory Laboratory for Physical Science, Burlington, Mass.). *Electrochemical Society, Journal*, vol. 127, Apr. 1980, p. 775-778. 9 refs. Grant No. DAAB07-78-C-0563.

An isothermal DTA technique was developed for studying the kinetics of the heterogeneous exothermic reactions involving lithium metal and organic solvents used in the Li/SO₂ batteries. The results showed that while film forming agents such as SO₂ and PC retard the Li + AN exothermic reaction, the organic solvents such as MF, DME, DG, and THF enhance the Li + AN exothermic reaction most probably due to an enhanced solubilizing effect on the Li film.

(Author)

A80-29895 Electrochemistry of amorphous V₂S₅ in lithium cells. A. J. Jacobson and S. M. Rich (Exxon Research and Engineering Co., Linden, N.J.). *Electrochemical Society, Journal*, vol. 127, Apr. 1980, p. 779-781. 28 refs.

Amorphous V₂S₅ prepared by thermal decomposition of (NH₄)₃VS₄ has been found to react readily with n-butyl lithium to give amorphous compositions Li(x)V₂S₅. In lithium electrochemical cells, V₂S₅ cathodes react with 2.5 Li per vanadium above 1.40V on primary discharge. On subsequent cycling the capacity eventually falls to 30% of the initial value with an accompanying change in the voltage composition profile.

(Author)

A80-29897 Simultaneous determination of quantum efficiency and energy efficiency of semiconductor photoelectrochemical cells by photothermal spectroscopy. A. Fujishima, Y. Maeda, K. Honda (Tokyo, University, Tokyo, Japan), G. H. Brilmyer, and A. J. Bard (Texas, University, Austin, Tex.). *Electrochemical Society, Journal*, vol. 127, Apr. 1980, p. 840-846. 20 refs. NSF-Army-supported research.

During a photoelectrochemical reaction only a portion of the light energy absorbed by the semiconductor is utilized in the electrode reaction. By monitoring temperature changes within the photoanode as a function of electrode potential and light intensity, information concerning the efficiency of the process can be obtained. Experimental results are interpreted using a model for the energy balance within the system which permits the determination of the quantum and energy efficiencies simultaneously without the need to calibrate the light source.

(Author)

A80-29898 Mixed electrolyte solutions of propylene carbonate and dimethoxyethane for high energy density batteries. Y. Matsuda and H. Satake (Yamaguchi University, Ube, Japan). *Electrochemical Society, Journal*, vol. 127, Apr. 1980, p. 877-879. 25 refs.

The effects of mixing propylene carbonate (PC) and dimethoxyethane (DME), containing some perchlorates, are investigated with reference to the electric conductance, dielectric constant, and viscosity. It is found that the viscosity of the mixed solvents increases when PC is added into DME, and the experimental values tend to be lower than the predictions based on the ideal solution theory. The dielectric constants of the mixed solvents increase when PC is added into DME; the measured values are almost linear. The conductance of the mixed electrolytes is found to be higher than that of each solvent with NaClO₄, and the maximum value of the equivalent conductance is obtained at the mixing ratio of about one to one. V.L.

A80-29920 Photobiological production of hydrogen. P. F. Weaver, S. Lien, and M. Seibert (Solar Energy Research Institute, Golden, Colo.). *Solar Energy*, vol. 24, no. 1, 1980, p. 3-45. 412 refs. Contract No. EG-77-C-01-4042.

This literature survey of photobiological hydrogen production covers the period from its discovery in relatively pure cultures during the early 1930s through 1978. The focus is hydrogen production by

phototrophic organisms (and their components) which occurs at the expense of light energy and electron-donating substrates. The survey covers the major contributions in the area; however, in many cases, space has limited the degree of detail provided. Among the topics included is a brief historical overview of hydrogen metabolism in photosynthetic bacteria, eucaryotic algae, and cyanobacteria (blue-green algae). The primary enzyme systems, including hydrogenase and nitrogenase, are discussed along with the manner in which they are coupled to electron transport and the primary photochemistry of photosynthesis. A number of *in vivo* and *in vitro* photobiological hydrogen evolving schemes including photosynthetic bacterial, green algal, cyanobacterial, two-stage, and cell-free systems are examined in some detail. The remainder of the review discusses specific technical problem areas that currently limit the yield and duration of many of the systems and research that might lead to progress in these specific areas. The final section outlines, in broadest terms, future research directions necessary to these specific areas. The final section outlines, in broadest terms, future research directions necessary to develop practical photobiological hydrogen-producing systems. Both whole cell (near- to mid-term) and cell-free (long-term) systems should be emphasized. Photosynthetic bacteria currently show the most promise for near-term applied systems. (Author)

A80-29921 **The prospects for solar energy use in industry within the United Kingdom.** C. W. Lewis (International Institute for Environment and Development, London, England). *Solar Energy*, vol. 24, no. 1, 1980, p. 47-53. 15 refs. Research supported by the Ford Foundation.

An assessment of the potential for solar energy applications within U.K. industry has been made, using a disaggregated breakdown of energy consumption in the eight industrial sectors by fuel and end-use, and taking account of solar collector performance under U.K. climatic conditions. Solar contributions of 35 per cent of process boiler heat up to a temperature of 80 C and 10 per cent in the 80-120 C range are considered feasible, along with 35 per cent of non-industrial water heating. After employing energy conservation techniques currently more cost-effective than solar systems, an additional 3.5 per cent of U.K. primary energy expended in manufacturing industry (excluding iron and steel production) could be contributed by solar. This represents 1 per cent of the U.K. national primary energy demand. (Author)

A80-29922 **Transient response of thermosyphon solar collectors.** G. L. Morrison (New South Wales, University, Kensington, Australia) and D. B. J. Ranatunga (National Engineering Research and Development Centre, Solar Energy Div., Colombo, Sri Lanka). *Solar Energy*, vol. 24, no. 1, 1980, p. 55-61. 8 refs.

The response of thermosyphon solar water heaters to step changes of insolation is investigated. Measurements of the transient flow development in a thermosyphon circuit were obtained using a laser doppler anemometer and a mathematical model was developed to simulate the transient performance. The results show that although there are long time delays associated with the development of the thermosyphon flow the energy collection capability is not affected by thermosyphon time delays. (Author)

A80-29923 **Estimation and prediction of global solar radiation over Greece.** A. A. Flocas (Salonica, University, Salonica, Greece). *Solar Energy*, vol. 24, no. 1, 1980, p. 63-70. 18 refs.

A regression analysis of the relative monthly values of global solar radiation and the corresponding values of sunshine, for the period 1961-75, was performed to determine the constants a and b of the Angstrom formula, for Athens. The geographical distribution of the annual totals of global solar radiation over Greece was mapped and some types and sub-types were identified. Further, a stepwise multiple regression analysis of the annual total amounts of global solar radiation and the three factors (latitude, longitude and altitude) was carried out; the validity of the assumption of the linear relationship between the annual totals of global solar radiation and the three factors was examined. (Author)

A80-29924 **Performance calculations of tubular cover collectors.** Y. Bayazitoglu and S. Asgarpour (Rice University, Houston, Tex.). *Solar Energy*, vol. 24, no. 1, 1980, p. 105-109. 11 refs.

The transmittance of the tubular cover system is calculated by treating interactive problems of the array of tubular units. The thermal analysis of the tubular cover system with a plane absorber surface underneath is studied. It is assumed that the tube wall is composed of an infinitely long nodal structure. The energy balance and radiosity equations for each element of the node is evaluated and solved. The effectiveness of convection suppression is determined by the magnitude of imposed heat transfer through the tube walls. (Author)

A80-29925 **Instantaneous collector thermal efficiencies in less time.** S. J. Kleis, R. T. Chen, and R. B. Bannerot (Houston, University, Houston, Tex.). *Solar Energy*, vol. 24, no. 1, 1980, p. 111, 112.

A modification of the 'standard' flow loop, based on the removal of thermal feedback due to the solar heating in the collector and on significant reduction in the transient behavior or time constant for the flow loop is discussed. The time constant is defined as the time required for the collector fluid temperature to achieve 63.2% of its final steady state value, and data on chill water flow rate are plotted. It is shown that the time constant can be changed by redesigning the chill water heat exchanger, that in the present design the response lag is essentially a function of time of residence of the collection fluid within the exchanger, and that faster time responses can be achieved by reducing the length of the coil. L.M.

A80-29938 **The global carbon dioxide problem - Impacts of U.S. synthetic fuel- and coal-fired electricity generating plants.** P. D. Moskowitz, S. C. Morris, and A. S. Albanese (Brookhaven National Laboratory, Upton, N.Y.). *Air Pollution Control Association, Journal*, vol. 30, Apr. 1980, p. 353-357. 11 refs. Contract No. EY-76-C-02-0016.

The possible impacts of future U.S. solvent-refined coal (SRC-II) and coal-fired electricity generating plants on global CO₂ emissions and growth rates are assessed. Analyses of carbon flows in an SRC-II electricity generation fuel cycle and a coal-fired electricity generation fuel cycle indicate that 81-88% and 98% of all carbon is ultimately vented to the atmosphere, respectively; however, the CO₂ emissions from the synfuels process are 20 to 30% greater for the amount of energy produced. It is estimated that the proposed U.S. synthetic fuels programs could increase the global CO₂ growth rate by less than 0.1% annually, resulting in an increase from 2.9 to 2.95% in the annual CO₂ growth rate between 1976 and 1990. It is concluded that while the increased emission of CO₂ from U.S. synthetic fuel combustion would exacerbate the global CO₂ problem, it is less than one tenth of the projected impact of alternative fuel sources. A.L.W.

A80-29946 **The energy impacts of solar heating.** C. Whipple (Electric Power Research Institute, Palo Alto, Calif.). *Science*, vol. 208, Apr. 18, 1980, p. 262-266. 17 refs.

The purpose of the paper is to examine the impact of a rapid implementation of active solar space heating and water heating on the U.S. energy supply. The net energy analysis for an expanding supply system is discussed, together with several estimates of the energy requirements of solar heating equipment, and two solar heating integration paths to represent low and high growth rate scenarios. It is concluded that the cumulative energy invested to the year 2000 will be 1/2 to 1.5 times the amount saved. C.F.W.

A80-29975 **Microtearing modes and anomalous transport in tokamaks.** J. F. Drake, N. T. Gladd, C. S. Liu, and C. L. Chang (Maryland, University, College Park, Md.). *Physical Review Letters*, vol. 44, Apr. 14, 1980, p. 994-997. 15 refs.

The stability of microtearing modes and the associated electron thermal transport are investigated. It is shown that these modes are driven unstable by the electron temperature gradient in present tokamaks, even in the absence of toroidal effects. The unstable

modes produce magnetic islands which saturate by transferring energy to stable long-wavelength modes. The associated crossfield electron thermal conductivity is found to be inversely proportional to density, consistent with Alcator scaling, and comparable in magnitude to that inferred from experiments. V.L.

A80-30241 Cesium vapor source with a gas-controlled heat pipe for thermionic energy converters. I. G. Gverdtsiteli, A. G. Kalandarishvili, and P. D. Chilingarishvili. (*Zhurnal Tekhnicheskoi Fiziki*, vol. 49, Aug. 1979, p. 1764, 1765.) *Soviet Physics - Technical Physics*, vol. 24, Aug. 1979, p. 988, 989. 7 refs. Translation.

A80-30242 Low-temperature thermionic converter with an expanded-area collector. I. G. Gverdtsiteli, N. E. Menabde, V. K. Tskhakaia, and L. M. Tsakadze. (*Zhurnal Tekhnicheskoi Fiziki*, vol. 49, Aug. 1979, p. 1766, 1767.) *Soviet Physics - Technical Physics*, vol. 24, Aug. 1979, p. 990. Translation.

A80-30465 Plant power fuels hydrogen production. D. Hall, M. Adams, P. Gisby, and K. Rao (King's College, London, England). *New Scientist*, vol. 86, Apr. 10, 1980, p. 72-75.

Photolysis has unique attributes that are unmatched by any other known energy systems: the substrate (water) is abundant; the energy source (sunlight) is effectively unlimited; the product (hydrogen) can be stored and is nonpolluting; and the process is completely renewable because when hydrogen is 'consumed', the substrate (water) is regenerated. Another attraction of this system is that it operates at normal ambient temperatures and does not involve toxic intermediates. Researchers in the U.S. have shown that upon irradiation with visible light in the absence of added electron donors, spinach chloroplasts and bacterial extracts containing hydrogenase would evolve hydrogen if either ferredoxin or viologen dyes were added as electron carriers. Photobiological hydrogen production from water by intact organisms such as algae is also discussed. By mimicking natural processes one may be able to split water into hydrogen and oxygen using sunlight as the energy source. S.D.

A80-30474 Pitting resistance of engineering materials in geothermal brines. I - Low salinity brine. B. C. Syrett (Electric Power Research Institute, Palo Alto, Calif.), D. D. Macdonald (Ohio State University, Columbus, Ohio), and H. Shih (National Tsinghua University, Hsinchu, Nationalist China). *Corrosion*, vol. 36, Mar. 1980, p. 130-139. 15 refs.

A80-30521 Mechanochemical effects on coal conversion. I - Coal hydrogenation in gaseous hydrogen aided by mechanical energy. R. T. Yang (Brookhaven National Laboratory, Upton, N.Y.). *Fuel*, vol. 58, Apr. 1979, p. 242-246. 23 refs. Contract No. EY-76-C-02-0016.

Hydrogenation experiments with a Pennsylvania anthracite coal were carried out in H₂ under the following conditions: with simultaneous grinding; with grinding and the addition of 1% tin; without simultaneous grinding; and without grinding but with the addition of SnCl₂ (1% Sn). Temperature was maintained at 442 C and pressure at about 6.8 MPa gage (1000 psig). By eliminating or minimizing the effects of heating that were due to grinding, and of size and mass transfer, the net effects on hydrogenation of the above conditions were examined. SnCl₂, as expected, increased the light products, both gaseous and liquid. Grinding substantially increased the heavy oil products (MW about 280), but not the light fractions. The effect of grinding in combination with the addition of tin was very similar to the effect of SnCl₂. A simple mechanistic scheme is postulated to represent these effects. Rationale of the mechanochemical effects is presented. Some preliminary results of the ESR measurements regarding these effects are also included. (Author)

A80-30522 Coal gasification in steam at very high temperatures. D. B. Northam and C. W. von Rosenberg, Jr. (Avco Everett Research Laboratory, Inc., Everett, Mass.). *Fuel*, vol. 58, Apr. 1979,

p. 264-268. 16 refs. Research supported by the Gas Research Institute.

Gasification of pulverized coal in steam has been investigated at heating rates of one-million K/s and peak gas temperatures of 3300 K. These severe conditions were achieved in a batch process reactor by igniting a stoichiometric hydrogen-oxygen mixture in which the coal had been blown into turbulent suspension. Subsequent gas-phase combustion was followed by heat conduction from the nascent steam to the coal. Variable solids/gas mass ratios were investigated. Stabilized carbon gasification yields as high as 80% were achieved. (Author)

A80-30523 Hydrogenation of brown coal. I - The effects of additional quantities of the inorganic constituents. W. R. Jackson, F. P. Larkins, M. Marshall, D. Rash (Monash University, Clayton, Victoria, Australia), and N. White (Broken-Hill-Proprietary Co., Ltd., Melbourne Research Laboratories, Clayton, Victoria, Australia). *Fuel*, vol. 58, Apr. 1979, p. 281-284. 21 refs. Research supported by the Victorian Brown Coal Research and Development Committee.

The effect of adding additional amounts of the inorganic constituents normally found in a Morwell coal on the hydrogenation reactions of the coal has been studied. Of the principal inorganic constituents, only iron has a major effect on conversion yields. Addition of iron as haematite led to an increase in coal conversion similar to that obtained by addition of a crushed cobalt molybdate catalyst. Generally, little inorganic matter, even in the case of iron, entered the chloroform-soluble fraction. The variation of conversion yield with the particle size of the coal was examined and found to be small. (Author)

A80-30524 Reaction kinetics between CO₂ and oil-shale residual carbon. I - Effect of heating rate on reactivity. A. K. Burnham (California University, Livermore, Calif.). *Fuel*, vol. 58, Apr. 1979, p. 285-292. 33 refs. Contract No. W-7405-eng-48.

The reaction kinetics between CO₂ and residual carbon from Colorado oil shale (Mahogany Zone) have been investigated using both isothermal and nonisothermal methods. It was found that oil-shale residual carbon is approximately an order of magnitude more reactive than subbituminous-coal char, although the surface areas are similar. The reactivity of the residual carbon was found to vary by a factor of two for samples prepared by retorting the shale at heating rates between 0.033 and 12 C/min. Since the surface area of the residual carbon is approximately independent of the amount of oil coking, the heating-rate effect cannot be explained by pore filling. Surface areas of the residual organic carbon in shale were estimated by comparing the surface area of retorted shale (about 3% carbon) with that of retorted shale which had been decharred by oxidation at 400 C. Surface areas of 250-400 sq m/g and 100-200 sq m/g were obtained using CO₂ and N₂ respectively as the adsorbed gases. Mercury porosimetry results are also presented. (Author)

A80-30525 Application of Fourier-transform infrared spectroscopy to the characterization of fractionated coal liquids. P. C. Painter and M. M. Coleman (Pennsylvania State University, University Park, Pa.). *Fuel*, vol. 58, Apr. 1979, p. 301-308. 22 refs. Research supported by the Electric Power Research Institute.

Fourier-transform infrared spectroscopy offers considerable advantages over conventional dispersive methods for the characterization of highly absorbing materials such as coal. This technique has been applied to the determination of the functional groups present in three solvent-refined-coal samples, all of which were obtained from the same parent coal but under different processing conditions. Both the benzene-soluble and pyridine-soluble portions are subjected to chromatographic fractionation by sequential elution from a silica-gel column using a specific sequence of solvents. The functional groups present in each fraction were identified from their infrared spectrum, using the group-frequency approach. (Author)

A80-30526 Electrochemical gasification of coal - Investigation of operating conditions and variables. M. Farooque and R. W.

Coughlin (Connecticut, University, Storrs, Conn.). *Fuel*, vol. 58, Oct. 1979, p. 705-712. 11 refs. Research supported by the University of Connecticut and U.S. Department of Energy.

Experimental results are reported for this new process where coal is consumed within an aqueous electrolyte to produce gaseous oxides of carbon at the anode and hydrogen at the cathode. Data are reported on the effect of coal particle size and concentration, activation energy and temperature effects, behaviour of the supporting electrolyte, and changes in morphology and reactivity of the coal during the process. The gas liberated at the anode is almost pure CO₂ with a small percentage of CO. When the process is conducted galvanostatically, the potential gradually rises in parallel with accumulation of reaction intermediates on the coal and a corresponding decline in its reactivity. Moreover an abrupt and reproducible jump in potential is observed which suggests at least two different mechanisms for the overall process. (Author)

A80-30527 Reaction kinetics between CO₂ and oil-shale residual carbon. II - Partial-pressure and catalytic-mineral effects. A. K. Burnham (California, University, Livermore, Calif.). *Fuel*, vol. 58, Oct. 1979, p. 713-718. 31 refs. Contract No. W-7405-eng-48.

A80-30528 Reaction kinetics between steam and oil-shale residual carbon. A. K. Burnham (California, University, Livermore, Calif.). *Fuel*, vol. 58, Oct. 1979, p. 719-723. 11 refs.

The reaction kinetics between steam and the residual organic carbon in retorted Colorado oil shale (Mahogany Zone) have been investigated using both isothermal and nonisothermal methods. The reaction was found to depend on the 0.5-power of the steam partial pressure. The H₂O-C reaction was found to be approximately three times as fast as the CO₂-C reaction at atmospheric pressure and temperatures near 700 C. The reactivity of the residual carbon depended on both the heating rate used to generate the carbon and the subsequent thermal treatment. Surface area and mercury porosimetry results are also discussed. (Author)

A80-30552 Interchange stability of axisymmetric field reversed equilibria. L. Sparks, J. M. Finn, and R. N. Sudan (Cornell University, Ithaca, N.Y.). *Physics of Fluids*, vol. 23, Mar. 1980, p. 611-613. 12 refs. Contract No. EY-76-S-02-3170.

Axisymmetric field reversed equilibria are obtained by solving the Grad-Shafranov equation, with pressure on the magnetic axis and pressure on the separatrix specified as independent parameters. A stability criterion assuming unfavorable curvature is evaluated for various pressure profiles. (Author)

A80-30554 Ideal magnetohydrodynamic stability of tokamak plasmas. C. Copenhaver (Tennessee, University, Knoxville; Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Physics of Fluids*, vol. 23, Mar. 1980, p. 624-635. 18 refs. Contract No. AT-(40-1)-2598.

Variational theory is used to derive a generalized Euler equation and a new energy functional which are convenient for analytical studies of ideal magnetohydrodynamic stability in tokamaks. This generalized Euler equation, which is an explicit function of the magnetic surface coordinate ψ only, represents an infinite set of equations coupled together by poloidal m mode coupling. In the infinite aspect ratio limit, the toroidal curvature and mode coupling terms disappear and an infinite set of uncoupled Euler equations for the diffuse linear pinch (Hain-Lüst equation) for each m value results. The continuous spectra are discussed for the circular toroidal case. In this case, the equations are further specialized to three modes (m , $m-1$, $m+1$) and in the marginal stability limit reduce to known results. Analytically eliminating the $m-1$ and $m+1$ modes for arbitrary current profiles provides results on limiting beta poloidal for tokamaks. (Author)

A80-30597 Balancing the process of hydrating gasification of brown coal (Bilanzierung des Verfahrens zur hydrierenden Vergasung von Braunkohle). G. Tsatsaronis, P. Schuster (Aachen,

Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany), and H. Rörtgen (Rheinische Braunkohlenwerke AG, Cologne, West Germany). *Brennstoff-Wärme-Kraft*, vol. 32, Mar. 1980, p. 105-111. 23 refs. In German.

A method is presented for the hydrating gasification of brown coal to synthetic natural gas by employing heat from a nuclear reactor. Attention is given to the layout and flow scheme of the gasification plant as well as to graphs of gasification percentages versus gasification temperatures and pressure. The irreversibilities of various plant components are determined by using detailed exergy balance sheets, and the thermal and exergy efficiencies of the entire plant are noted. C.F.W.

A80-30614 # Turbulent flows through annular spaces (Miscari turbulente prin spatii inelare). A. D. Stan (Institutul de Petrol si Gaze, Ploiesti, Rumania). *Studii si Cercetari de Mecanica Aplicata*, vol. 38, Nov.-Dec. 1979, p. 825-837. 9 refs. In Rumanian.

Engineering conditions in the oil industry are considered, where pressure drop and shearing stress situations are involved. Numerical calculations show that in petroleum engineering, the pressure drop in an annular space of common tubular material is comparable to the pressure drop realized in a tube with a circular section. J.P.B.

A80-30656 Coal combustion fly ash characterization - Adsorption of nitrogen and water. S. J. Rothenberg (Lovelace Biomedical and Environmental Research Institute, Albuquerque, N. Mex.). *Atmospheric Environment*, vol. 14, no. 4, 1980, p. 445-456. 45 refs.

A80-30668 Grown junction GaAs solar cells with a thin graded band-gap Al_xGa_{1-x}As surface layer. P. Kordos and G. L. Pearson (Stanford University, Stanford, Calif.). *Solid-State Electronics*, vol. 23, Apr. 1980, p. 399, 400. 6 refs.

A80-30772 # Incidence-angle modifier and average optical efficiency of parabolic trough collectors. H. Gaul and A. Rabi (Solar Energy Research Institute, Golden, Colo.). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 102, Feb. 1980, p. 16-21. 11 refs. Contract No. EG-77-C-01-4042.

The incidence-angle modifier for parabolic troughs is investigated in order to clarify the connection between collector tests and the prediction of long-term energy delivery by collector arrays. The optical efficiency of a parabolic trough collector decreases with incidence angle for several reasons: the decreased transmission of the glazing and the absorption of the absorber; the increased width of the solar image on the receiver; and the spillover of the radiation from troughs of finite length. In order to be able to apply test results from a short collector module to collector arrays of arbitrary length, it is necessary to separate analytically the end loss from the first two effects. This analysis is applied to several collectors that have been tested at low temperature with an open water test loop for improved accuracy. The results are presented in two forms: as a polynomial fit to the data; and as a single number, the all-day average optical efficiency for typical operating conditions. (Author)

A80-30773 # Measurement of heliostat performance characteristics. J. P. Thornton and D. Waddington (Solar Energy Research Institute, Golden, Colo.). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 102, Feb. 1980, p. 22-33. Contract No. EY-76-C-03-1110.

A key milestone in the development of any solar collector is the comparison of actual performance data with predicted data. During a series of tests at the Martin Marietta solar test facility during 1976 and 1977, the performance of four full-size, prototype heliostats with different types and sizes of glass mirrors were measured and subsequently shown to compare closely with the predicted performances. (Author)

A80-30774 # The sensitivity of solar transmittance, reflectance and absorptance to selected averaging procedures and solar irradiance distributions. M. A. Lind (Battelle Pacific Northwest Laboratories, Richland, Wash.), R. B. Pettit (Sandia Laboratories, Albuquerque, N. Mex.), and K. D. Masterson (Solar Energy Research Institute, Golden, Colo.). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 102, Feb. 1980, p. 34-40. 19 refs. Contracts No. EY-76-C-06-1830; No. DE-AC04-76-DP00789; No. EG-77-C-01-4042.

The sensitivity of the solar weighted optical properties of selected materials to different terrestrial solar spectral irradiance distributions and computational techniques has been investigated. The spectral transmittance, reflectance, and absorptance of typical materials employed in solar thermal conversion systems were used for the calculations. The values obtained for several different solar irradiance distributions and calculational methods show only small differences. A single terrestrial solar irradiance distribution is recommended for use as a standard. (Author)

A80-30775 # Operating thresholds of solar collection systems. D. S. Ward (Colorado State University, Fort Collins, Colo.). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 102, Feb. 1980, p. 66-72. 9 refs. Research supported by the U.S. Department of Energy.

A solar collector subsystem operating threshold is defined as the minimum solar insolation rate at which useful heat can be collected when collector loop piping heat losses and parasitic power requirements are considered. This paper discusses the quantitative effect of these energy flows on the operating threshold of the solar subsystem (and thus on the overall system efficiency), and briefly considers the effects of different installation and design procedures. (Author)

A80-30801 Submerged cylinder wave energy device - Theory and experiment. D. V. Evans (Bristol, University, Bristol, England), D. C. Jeffrey, S. H. Salter, and J. R. M. Taylor (Edinburgh, University, Edinburgh, Scotland). *Applied Ocean Research*, vol. 1, Jan. 1979, p. 3-12. 11 refs. Research supported by the Science Research Council.

Linearized water wave theory is used to show that a submerged long circular cylinder suitably constrained by springs and dampers to make small harmonic oscillations, can be extremely efficient in absorbing the energy in an incident regular wave whose crests are parallel to the axis of the cylinder. Experimental results are described which confirm the theory for small amplitude waves and which suggest that the device can still be fairly efficient in waves of moderate amplitude. (Author)

A80-30802 Characteristics of Salter's cam for extracting energy from ocean waves. A. E. Mynett, D. D. Serman, and C. C. Mei (MIT, Cambridge, Mass.). *Applied Ocean Research*, vol. 1, Jan. 1979, p. 13-20. 13 refs. Research supported by the Massachusetts Institute of Technology, U.S. Navy, and NOAA.

The performance characteristics of Salter's cam with fixed or moveable support as an energy extractor from ocean waves are studied numerically. Linear theory of surface waves and floating bodies is employed in the study. Effects of varying geometrical parameters such as shape, submergence, and water depth are discussed along with the effects of nonrigid support. V.T.

A80-30804 Wave power extraction by a train of rafts - Hydrodynamic theory and optimum design. P. Haren and C. C. Mei (MIT, Cambridge, Mass.). *Applied Ocean Research*, vol. 1, July 1979, p. 147-157. 19 refs. NR Project 062-228.

A theory is given for a two-dimensional wave power device which consists of a train of floating rafts whose wave-induced rotation about the hinges is used to generate energy. Ideal efficiency, wave forces and raft movements are studied by a linearized shallow water theory which is sufficiently simple to enable an investigation for optimum designs under a variety of criteria of efficiency and cost-effectiveness. For a sample raft train, a numerical theory for

arbitrary wavelength is also applied, yielding results which are not essentially different from those by the long wave approximation.

(Author)

A80-30805 Absorption of wave energy by elongated bodies. J. N. Newman (MIT, Cambridge, Mass.). *Applied Ocean Research*, vol. 1, Oct. 1979, p. 189-196. 7 refs. Navy-NSF-supported research.

Slender-body approximations are used to predict the maximum rate of energy absorption by an elongated floating vessel which performs vertical motions of varying amplitude and phase along its length. Simple estimates are derived for the amplitude and phase of particular mode shapes, and for the corresponding power absorption. Specific mode shapes considered include polynomials, trigonometric functions, and piecewise-linear functions intended to represent an articulated raft. An articulated raft with two hinges appears to be optimum from the engineering standpoint. (Author)

A80-30939 The current-voltage characteristics of semiconductor-electrolyte junction photovoltaic cells. J. Reichman (Grumman Aerospace Corp., Research Dept., Bethpage, N.Y.). *Applied Physics Letters*, vol. 36, Apr. 1, 1980, p. 574-577. 13 refs.

Equations are derived giving the current-voltage characteristics of photovoltaic cells based on the semiconductor-electrolyte junction. Recombinations in the neutral region and space-charge region are included. It is shown that the rate-limiting effect of charge transfer across the interface enhances the recombination rate in these regions with increasing voltage, thereby reducing the fill factor. Significant differences in the behavior of these cells and other photovoltaic cells are pointed out. (Author)

A80-30940 Amorphous Si-F-H solar cells prepared by dc glow discharge. M. Konagai and K. Takahashi (Tokyo Institute of Technology, Tokyo, Japan). *Applied Physics Letters*, vol. 36, Apr. 1, 1980, p. 599-601. 9 refs.

Amorphous Si-F-H films were prepared by dc glow discharge in an atmosphere of SiF₄ + H₂. Optical and electrical measurements have been performed to evaluate the film quality. The photoconductivity of amorphous Si-F-H solar cell showed the efficiency of 1.3% under simulated AM1, 100-mW/sq cm insolation. (Author)

A80-30942 Field-dependent quantum efficiency in hydrogenated amorphous silicon. R. Crandall (RCA Laboratories, Princeton, N.J.). *Applied Physics Letters*, vol. 36, Apr. 1, 1980, p. 607, 608. 11 refs. Research sponsored by RCA; Contract No. AC-03-78ET21074.

A model calculation of the electric field dependence of the quantum efficiency for electron-hole pair production in hydrogenated amorphous silicon is presented and compared with recent measurements of the electric field dependence of the solar-cell collection efficiency. The theory, based on electric field reduction of geminate recombination of the excited electron-hole pair, agrees well with experiment. (Author)

A80-31042 An underground coal gasification experiment - Hoe Creek II. W. R. Aiman, C. B. Thorsness, R. W. Hill, and D. R. Stephens (California, University, Livermore, Calif.). *Combustion Science and Technology*, vol. 21, no. 3-4, 1980, p. 97-107. 17 refs. Contract No. W-7405-eng-48.

In this experiment the scheme of linked vertical wells for in-situ coal gasification was used with an 18.3-m well spacing. The experiment took 100 days for air-flow testing, reverse-combustion linking, forward-combustion gasification, and postburn steam flow. Air was used for gasification except for a 2-day test with oxygen and steam flow. Reverse-combustion linking took 14 days at 1.6 m/day and used 0.40 Mgmol of air per meter of link. At least two linkage paths were formed. The detected links stayed below the 3 m level in the 7.6 m coal seam; however, the product flow from the forward-burn gasification probably followed the coal-overburden interface, rather than the reverse-burn links at the 3-m level.

Forward-burn gasification took 58 days and produced a total of 232 Mg/mol (194 Mscf) of gas with an average heating value of 96 kJ/gmol (108 Btu/scf). During the oxygen-steam test, the heating value averaged 235 kJ/gmol (265 Btu/scf). The coal recovery was 1310 cu m (1950 ton). Gasification was terminated because of decreasing product quality, not because the burn had reached the production well. Product quality decreased as a result of increasing heat loss to inert materials underground. (Author)

A80-31200 # Satellite solar power plants (Satelitarne elektrownie sloneczne). K. Wiewiorowska. *Astronautyka*, vol. 22, no. 6, 1979, p. 20, 21. In Polish.

An international survey revealed that serious effort directed to the construction of orbiting solar power plants cannot be expected earlier than in two decades. The formidable technical and economical problems involved in this venture are examined, along with some legal aspects arising from the current formulation of the international space law. V.P.

A80-31357 # Explosive-driven magnetic generator with a plasma load (Vzryvomagnitnyi generator s plazmennoi nagruzkoi). I. I. Divnov, N. I. Zotov, O. P. Karpov, B. G. Klokov, and B. D. Khristoforov. *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, Nov.-Dec. 1979, p. 46-52. 9 refs. In Russian.

The paper deals with an experimental study of the energy transfer from an explosive-driven magnetic generator to an active inductive load in the form of a high-current discharge in air at normal pressure. The highest energy value (340 kJ) was obtained at a close to optimal (calculated) resistance of 0.1 ohm. V.P.

A80-31501 # Analysis of losses in a high-frequency converter with low-cosine capacitance load (Analiz poter' v preobrazovatele povyshennoi chastoty pri emkostnoi nizkokosinusnoi nagruzke). I. M. Chizhenko, I. A. Kurilo, and O. S. Iakimov (Akademiia Nauk Ukrainiskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR). *Problemy Tekhnicheskoi Elektrodinamiki*, no. 71, 1979, p. 3-6. 5 refs. In Russian.

The paper evaluates the losses and efficiency of high-frequency thyristor converters with low-cosine capacitance load both for the case of reactive-power compensation and the case without such compensation. The redistribution of losses in components of the converter circuit is analyzed, and computational results are compared with experimental data. B.J.

A80-31507 # Effective thermal and electrical resistances of stabilized layered superconductors with nonideal phase contact (Ob effektivnom teplovom i elektricheskom soprotivlenii sloistykh stabilizirovannykh sverkhprovodnikov s neideal'nym kontaktom faz). Iu. V. Boiko, Iu. G. Golubenko, F. A. Kotenev, and V. F. Reztsov (Akademiia Nauk Ukrainiskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR). *Problemy Tekhnicheskoi Elektrodinamiki*, no. 71, 1979, p. 71-77. 8 refs. In Russian.

A80-31509 # Electrical processes in the interaction of a magnetic field wave with an ionized-gas stream (Elektricheskie protsessy pri vzaimodeistvii volny magnitnogo polia s potokom ionizovannogo gaza). A. P. Rashchepkin and A. E. Vuginshtein (Akademiia Nauk Ukrainiskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR). *Problemy Tekhnicheskoi Elektrodinamiki*, no. 71, 1979, p. 97-102. In Russian.

The interaction of a plasma stream with a nonuniform magnetic field is studied by numerically solving the electrodynamic Maxwell equations with allowance for the anisotropy of plasma conductivity. The study is applicable to conditions in a Hall-effect MHD generator with sign-variable magnetic field. B.J.

A80-31626 International tokamak reactor - Executive summary of the IAEA Workshop, 1979. G. Grieger, F. Engelmann, R. Hancox, D. Leger, P. Reynolds, S. Mori, T. Hiraoka, K. Sako, T.

Tazima, and B. B. Kadomtsev (EURATOM, Brussels, Belgium). *Nuclear Fusion*, vol. 20, Mar. 1980, p. 349-388.

The paper describes the efforts of the international fusion community to define the objectives and characteristics of the next fusion device beyond the next generation of large tokamaks in the world to operate in 1990. The technical and scientific feasibility of the device is assessed together with an analysis of the advantages in international cooperation. Programmatic and technical objectives are defined, the plasma physics and technical data bases are evaluated, and major research and development needs are identified. The physical parameters of a device that would be consistent with the objectives and the data base estimates are discussed. C.F.W.

A80-31750 Promising fuels for MHD power stations. N. A. Kruzhilin, A. G. Rotinov, S. A. Tager, and I. T. Iakubov (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR). (*Teploenergetika*, vol. 26, July 1979, p. 28-34.) *Thermal Engineering*, vol. 26, July 1979, p. 408-413. 5 refs. Translation.

The influence of hydrocarbon fuel characteristics on the properties of the plasma generated in an open-cycle magnetohydrodynamic power station is examined in order to investigate the feasibility and efficiency of various fuels. Plasma electrical conductivity was determined from plasma pressure and temperature, fuel hydrocarbon ratio, oxidant oxygen content and potassium carbonate seed concentration in the combustion chamber, as a function of the chemical properties of various types of coals, natural gas and oil. Results indicate that coals with a high reactivity, low moisture content, low ash content, high carbon-hydrogen ratio and arbitrary sulfur content are most suitable for MHD power station use, with only the semicoke of brown coals having acceptable values of all parameters. While the clean fuels, natural gas and oil, are also found to satisfy these requirements, it is concluded that due to its relative abundance coal will most likely represent the major MHD generator fuel. A.L.W.

A80-31770 Light rail transit in the United States. S. F. Taylor (Sanders and Thomas, Inc., Pottstown, Pa.). *Transportation*, vol. 9, Mar. 1980, p. 67-74.

In recent years interest in light rail transit has grown substantially in the United States. The concept of LRT is increasingly viewed as a possible answer to the search for a less costly rail transit technology that could reduce America's dependency on the private automobile and put the country on the road to a more secure, self-sufficient energy future. The paper reviews recent LRT developments in four American cities, two of which have undertaken to rehabilitate and upgrade their existing surface street railway systems, and the other two have embarked upon construction of entirely new light rail systems. (Author)

A80-31775 # A study on plasma plug. T. Taniyama and T. Masutani (Nihon University, Tokyo, Japan). *Nihon University, Research Institute of Science and Technology, Report*, Sept. 1979, p. 13-33.

The paper examines fundamental experiments on high energy ignition plugs which are employed in solving problems on how to reduce the exhaust gas pollution and decrease specific fuel consumption. Wave forms of voltage, current, and light energy are observed by changing electrode materials, forms and gaps with discharge generated by impulse voltage of high pressure hydrogen. It is noted that energy transfer conditions are greatly affected by an oxide film covering the electrode surface and contents of the alloy elements that are used for electrodes. C.F.W.

A80-31791 The industrialisation of space. G. K. C. Pardoe (General Technology Systems, Ltd., London, England). *British Interplanetary Society, Journal (Space and Education)*, vol. 33, May 1980, p. 195-200.

It is noted that the industrialization of space has rested and will continue to rest to a major extent on the support and stimulus of defense programs. The present paper examines the more publicly

visible activities in space. Discussion covers the progressive use of space to date, noting the introduction of commercially based communications satellites in the 1960s. Also examined is the growth of industrialization and the commercial implications of earth observation satellites, in-orbit material processing, orbital antenna farm, and space power system. Finally, it is concluded that the current reluctance of sectors of industry to innovate must be reversed since the solving of future problems will require a more revolutionary approach. M.E.P.

A80-31856 # Design and testing of a cavity-type, steam-generating, central receiver for a solar thermal power plant. R. J. Zoschak, S. F. Wu (Foster Wheeler Development Corp., Livingston, N.J.), and D. N. Gorman (Martin Marietta Aerospace, Denver, Colo.). *ASME, Transactions, Journal of Engineering for Power*, vol. 102, Apr. 1980, p. 486-494.

This paper focuses on the design and operating aspects of a 10-MWe cavity-type, natural-circulation, steam-generating receiver for a central-receiver thermal power plant. The development of the receiver concept and the basic design features are described. The solar energy input analysis, thermal/hydraulic performance, and structural design of the receiver are discussed along with its control concept and transient operation. The design, construction, and testing of a 5-MWt scaled-down version of the 10-MWe receiver are summarized with emphasis on test objectives, scaling criteria, and design similarities to the full-scale receiver. (Author)

A80-31857 # The effect of material properties on the thermal efficiency of the Minto solar wheel. S. Lin (Concordia University, Montreal, Canada) and R. Bhardwaj. *ASME, Transactions, Journal of Engineering for Power*, vol. 102, Apr. 1980, p. 504-507.

The characteristic of the thermal performance of the Minto solar wheel is that its thermal efficiency is strongly dependent on the material properties of the working fluid. For a specified working fluid, the thermal efficiency of the ideal cycle of the Minto solar wheel is dependent only on the mean diameter of the wheel. To study the effect of the material properties of the working fluid on the ideal thermal efficiency, 14 working fluids are selected, and their thermal efficiencies as functions of the mean diameter of the wheel are calculated and compared with each other. Among these fluids, R-12, R-115, R-500, R-22 and R-13B1 achieve better thermal performance than the others. (Author)

A80-31900 Solar cells for photovoltaic generation of electricity: Materials, devices and applications. M. Sittig. Park Ridge, N.J., Noyes Data Corp. (Energy Technology Review, No. 48), 1979. 358 p. 11 refs. \$48.

The book provides detailed, descriptive information that is based on U.S. patents issued since January 1970 dealing with solar cells suitable for the photovoltaic generation of electricity. In this book, solar energy is restricted to the proposition of producing useful energy directly from sunlight only. The discussion covers the fundamentals of solar cells, future development prospects, application areas for solar cells, materials for solar cells, materials availability, toxic hazards of solar cell materials, solar cell fabrication, solar cell testing, solar cell enhancement, solar cell mountings, photovoltaic cogeneration - hybrid systems, photoemissive cell devices, solar cell energy storage, photoelectrochemical energy conversion, and economics of solar cells. S.D.

A80-31966 The characteristics of high current amorphous silicon diodes. R. A. Gibson, P. G. Le Comber, and W. E. Spear (Dundee, University, Dundee, Scotland). *Applied Physics*, vol. 21, Apr. 1980, p. 307-311. 7 refs. Research supported by the Science Research Council and the Lucas Group.

Amorphous silicon p-n junctions with various doping profiles have been prepared by the glow discharge technique and the effect of the barrier profile on electrical properties investigated. Current densities of up to 40 A sq cm with rectification ratios of 10 to the 4th to 10 to the 5th were obtained with n(+)-v-p(t) structures. The

diode quality factor has also been investigated, both in the dark and under illumination. (Author)

A80-31999 Gas turbines for automotive use. Edited by J. P. O'Brien. Park Ridge, N.J., Noyes Data Corp. (Energy Technology Review, No. 54), 1980. 350 p. \$42.

Gas turbine engines for automotive use are discussed with regard to technology, engine concepts, materials, and costs. The characteristics of complete engines and vehicles powered by state-of-the-art and advanced gas turbines are considered, and attention is given to the manufacture and costs of metallic materials. In addition, recent ceramic material and fabrication developments are discussed, and major ceramic technology problem areas related to the metallic and advanced Brayton engine configurations are outlined. Emphasis is placed on ceramic components capable of operating at temperatures hundreds of degrees above metallic components. The potential of advanced alternative heat engine power systems (Brayton and Stirling) is compared with that of the evolving conventional power systems, considering fuel economy, exhaust emissions, multifuel capability, use of advanced materials, and cost/manufacturability. J.P.B.

A80-32021 * Design of nonimaging concentrators as second stages in tandem with image-forming first-stage concentrators. R. Winston (Chicago, University, Chicago, Ill.) and W. T. Welford (Imperial College of Science and Technology, London, England). *Applied Optics*, vol. 19, Feb. 1, 1980, p. 347-351. Research supported by the California Institute of Technology; Contract No. JPL-955565.

The paper discusses the paraboloidal mirror as a tracking solar concentrator, fitting a nonimaging second stage to the paraboloidal mirror, other image-forming systems as first stages, and tracking systems in two-dimensional geometry. Because of inherent aberrations, the paraboloidal mirror cannot achieve the thermodynamic limit. It is shown how paraboloidal mirrors of short focal ratio and similar systems can have their flux concentration enhanced to near the thermodynamic limit by the addition of nonimaging compound elliptical concentrators. S.D.

A80-32055 Oils and rubber from arid land plants. J. D. Johnson (Arizona, University, Tucson, Ariz.) and C. W. Hinman (Diamond Shamrock Corp., Tucson, Ariz.). *Science*, vol. 208, May 2, 1980, p. 460-464. 17 refs. Research sponsored by the Diamond Shamrock Corp.

In this article the economic development potentials of *Cucurbita* species (buffalo gourd and others), *Simmondsia chinensis* (jojoba), *Euphorbia lathyris* (gopher plant), and *Parthenium argentatum* (guayule) are discussed. All of these plants may become important sources of oils or rubber. (Author)

A80-32056 Radiant heat for energy conservation. R. V. Pound (Harvard University, Cambridge, Mass.). *Science*, vol. 208, May 2, 1980, p. 494, 495.

It is proposed that human comfort could be provided in otherwise chilly surroundings by filling the occupied space with electromagnetic energy of centimeter wavelength. Very considerable reductions in the consumption of energy required for the heating of buildings should result from the lowering of interior temperatures thereby permitted. (Author)

A80-32074 # Low cost composite blades for large wind turbines. O. Weingart (Structural Composite Industries, Inc., Azusa, Calif.). In: Rising to the challenge of the '80s; Annual Conference and Exhibit, 35th, New Orleans, La., February 4-8, 1980, Preprints. New York, Society of the Plastics Industry, Inc., 1980, p. 17-A 1 to 17-A 4.

The TFT process developed to fabricate a filament-wound spar for a composite wind turbine blade is discussed, as well as the preliminary design review for the rotor blade and plans for a 4 kW small wind energy conversion system. The TFT process utilizes a low cost E-glass fabric called transverse-filament tape, in which the major

reinforcing fibers are transverse to the length of the tape, whose circumferential winding results in axial fiber orientation. It is indicated that the TFT manufacturing process will allow the blades to be fabricated from low cost materials, in a continuous operation, on automatic machinery with low labor intensity. J.P.B.

A80-32201 # The energy problem - Its effect on aircraft design. II - The effects of fuel cost. W. Tye. *Aircraft Engineering*, vol. 52, Apr. 1980, p. 2-4.

The paper examines the factors of the energy problem's effect on aircraft design beginning with a discussion of what decides cost and price. Attention is given to the effect of energy costs on the pattern of living and on air transport. Consideration is then given to fuel prices and aircraft operating costs. Finally, the effect of design advances on fuel use and DOC is studied. M.E.P.

A80-32220 # End zone of a channel with segmented electrodes, carrying nonuniform flow (O kontsevoi zone ramochnogo kanala s neodnorodnym potokom). V. L. Bobrov, V. Iu. Konoplev, and Iu. V. Makarov. *Magnitnaia Gidrodinamika*, Oct.-Dec. 1979, p. 69-72. In Russian.

In the present paper, a modification of the Lax-Wendroff method is applied to the numerical analysis of the potential and current fields in the end zone of a channel with segmented electrodes and nonuniform flow. It is shown that in order to determine the position of the first electrode, one must know both the mean values and the spatial distribution of the plasma parameters. V.P.

A80-32221 # A magnetohydrodynamic piston engine (Porshnevoi magnitogidrodinamicheskii dvigatel'). A. I. Khozhainov. *Magnitnaia Gidrodinamika*, Oct.-Dec. 1979, p. 111-116. In Russian.

The paper deals with the theory of a conduction-type MHD piston engine with a reciprocating motion of the liquid metal. Relations for the piston rate, the apparent mass, and engine efficiency are derived under the assumption of a linear dependence of the effective resistance on the piston rate. It is assumed that the flow is laminar and that edge effects are negligible. V.P.

A80-32276 # The use of different-scale multispectral space photographs of the earth for the geological study of lands with oil and natural gas (Primenenie raznomasshtabnykh mnogozonal'nykh kosmicheskikh snimkov zemli pri geologicheskoi izuchenii neftegazonosnykh territorii). S. V. Atanasian and V. D. Skariatin. In: Space photography and thematic mapping: A method for processing multichannel photography. Moscow, Izdatel'stvo Moskovskogo Universiteta, 1979, p. 115-122. In Russian.

The paper considers the application of photogeological interpretation methods to the exploration of areas with oil and natural gas reserves; the use of multispectral (including IR scanner) satellite photographs of different scales is examined. Geological interpretations of the Persian Gulf area and of the Caucasus Mountains area are considered as examples. B.J.

A80-32287 # Electrical purifiers for dielectric fluids (Elektricheskie ochistiteli dielektricheskikh zhidkostei). G. A. Nikitin (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR). *Khimiia i Tekhnologiya Topliv i Masel*, no. 4, 1980, p. 21-24. In Russian.

Electrical devices for the separation of charged particle contaminants from dielectric working fluids such as fuels, motor oils and hydraulic fluids are discussed. The operating principles and design of an electrical purifier, which acts to create a nonuniform electric field within the dielectric fluid which causes the contaminant particles to settle on the electrodes, are considered. Experimental measurements of the effectiveness of various electrical purifiers in removing contaminant particles from aviation motor oil MK-8 and the hydraulic fluid AMG-10 are presented, and 92.3- and 743-fold reductions in impurity content are pointed out. It is also found that the operating conditions, fire safety and the cost effectiveness of the

device are compatible for use in conjunction with filters for fuel purification. A.L.W.

A80-32318 MHD electrical potentials - Uniqueness of solutions to an extended class of elliptic boundary value problems. R. A. Sacks (Science Applications, Inc., Oak Brook; Argonne National Laboratory, Argonne, Ill.). *Journal of Applied Physics*, vol. 51, Mar. 1980, p. 1407-1409. 5 refs.

The electrostatic potential describing the fields interior to a magnetohydrodynamic (MHD) power generating channel obeys a linear uniformly elliptic partial differential equation. The physically natural boundary conditions, however, do not fall within a class for which the solution has previously been shown to be unique. We discuss the boundary conditions appropriate to this situation and then generalize the discussion in Courant and Hilbert to demonstrate the uniqueness of the solution to an extended class of boundary value problems which includes the MHD channel as a special case. (Author)

A80-32325 Black a-Si solar selective absorber surfaces. R. Messier, S. V. Krishnaswamy, L. R. Gilbert, and P. Swab (Pennsylvania State University, University Park, Pa.). *Journal of Applied Physics*, vol. 51, Mar. 1980, p. 1611-1614. 23 refs. Contracts No. EM-78-C-04-5302; No. DE-AC03-79ET23038.

Amorphous Si films display a unique anisotropic etching phenomenon in which a columnar microstructure results. The alignment of the anisotropic microstructure is related to the average angle of the depositing material. Since cross-sectional spacing of the columns is less than the wavelength of light, a continuous grading of the refractive index occurs and results in a drastic reduction in the total reflectance from 40 to 50% in the as-deposited film to less than 2% in the etched film. The etchant, HF/HNO₃, apparently oxidizes rapidly down aligned void networks followed by an equally rapid dissolution and removal step. Such a semiconductor film on a low IR emissivity metallic substrate is a potentially efficient photothermal selective absorber surface. (Author)

A80-32330 Electrical conductivity of a seeded H₂/O₂ system. B. K. Sawhney, S. Q. Hussain (Indian Institute of Technology, New Delhi, India), and J. Swithenbank (Sheffield, University, Sheffield, England). *Journal of Applied Physics*, vol. 51, Mar. 1980, p. 1831, 1832. 12 refs.

The feasibility of using a H₂/O₂ system as a working fluid in an open-cycle MHD generator is considered. The variation of the electrical conductivity of the seeded combustion products of a H₂/O₂ system with temperature has been determined and the results have been compared with the available data for acetylene-oxygen and water-gas-oxygen systems. Although the conductivity of a H₂/O₂ system is smaller than that of hydrocarbon fuels, it is sufficient at higher temperatures for MHD application. V.L.

A80-32331 * The spectral response of a front surface field solar cell. O. von Roos (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Journal of Applied Physics*, vol. 51, Mar. 1980, p. 1852, 1853. Contract No. NAS7-100.

A calculation of the short-circuit current as a function of wavelength of the incident light, induced in a front surface field solar cell, is presented. The cell consists of a P(+)-P-N(+) junction. The electric field present in the P(+) layer situated at the front surface (the surface exposed to the sun) boosts the minority carrier collection at the P-N(+) junction sufficiently to make this structure a viable alternative to ordinary solar cells. A distinct advantage derives from the placement of all ohmic contacts on the back-surface facilitating array assemblage. (Author)

A80-32371 Filtration in coal liquefaction - Influence of filtration conditions in non-hydrogenated systems. J. W. Clarke and T. D. Rantell (Coal Research Establishment, Cheltenham, Glos., England). *Fuel*, vol. 59, Jan. 1980, p. 35-41. 10 refs.

A series of experiments has been carried out to study the effects

of filtration conditions upon the rate of filtration of non-hydrogenated coal digests. The results show the dependence of cake resistivity on both the filtration temperature and pressure. Filter cakes were found to be compressible, resulting in smaller increases in rate with increasing pressure than with incompressible cakes. The filtration temperature determines the packing of residual solids in the cake which in turn affects the cake resistivity. An empirical relation has been derived between filtration temperature and resistivity. With increasing temperature there is an increase in filtration rate due to the reduced viscosity, but a reduction owing to a higher packing density of solids in the filter cake. (Author)

A80-32372 Filtration in coal liquefaction - Influence of digestion conditions in the filtration of non-hydrogenated coal digests. J. W. Clarke and T. D. Rantell (Coal Research Establishment, Cheltenham, Glos., England). *Fuel*, vol. 59, Mar. 1980, p. 208-212. 8 refs.

A80-32396 Coal processing and utilization (Kohlenveredlung und Kohlenverwendung). H.-D. Schilling (Bergbau-Forschung GmbH, Essen, West Germany). *Brennstoff-Wärme-Kraft*, vol. 32, Apr. 1980, p. 125-129. 98 refs. In German.

It is noted that the rising price of oil as well as supply concerns have lead to an increase in the use of coal. It is shown that in order for coal to take a greater role in energy supply, work must commence now in the areas of coal extraction and processing. Attention is given to new technologies such as coke production, electricity and heat generation, coal gasification, and coal liquifaction. Also covered are a separator for nitrogen oxides and active coal regeneration. Finally, the upgrading of coal is examined.

M.E.P.

A80-32397 Regenerative energy sources (Regenerative Energiequellen). M. Meliss (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Brennstoff-Wärme-Kraft*, vol. 32, Apr. 1980, p. 140-146. 51 refs. In German.

The paper examines the impact of regenerative energy sources on the Federal Republic of Germany. Attention is given to passive systems, including a discussion of 'clearview', 'freeflow', 'sunrise' and 'sky view' systems. Also discussed are low temperature collector installations and heat pumps. Further, consideration is given to high temperature collector systems and solar cells, as well as wind energy converters. Finally, the utilization possibilities of other energy sources are surveyed.

M.E.P.

A80-32398 Energy storage (Energiespeicherung). U. Kaier (Kraftanlagen AG, Heidelberg, West Germany). *Brennstoff-Wärme-Kraft*, vol. 32, Apr. 1980, p. 163-165. 37 refs. In German.

Attention is given to R&D in three areas: (1) storage in systems for electricity and power generation, (2) central heat storage in remote heating systems, and (3) decentralized heat and low temperature thermal energy storage. Further, discussion covers development tendencies including differences in European and U.S. approaches. It is shown that European development tends to integrate the energy storage as a supporting component in the heating system whereas in the U.S. research has primarily concentrated on short term storage.

M.E.P.

A80-32399 Gas turbines (Gasturbinen). A. Eiermann and F. Pötz (Brown, Boveri et Cie. AG, Mannheim, West Germany). *Brennstoff-Wärme-Kraft*, vol. 32, Apr. 1980, p. 170-177. 258 refs. In German.

The article examines the world market for power generating gas turbines, noting that in many cases it is economically feasible to convert steam turbine generating plants and to combine them with gas turbines. Attention is given to the use of gas turbines on oil drilling platforms to generate electricity for pumps, compressors, lighting and ventilation. Consideration is given to the technical status of gas turbines including discussion of developments regarding components such as the compressor, turbine, and combustion chamber. Also discussed are operating experiences with gas turbine

installations. Finally, development trends and the future outlook are covered.

M.E.P.

A80-32410 Sweden beyond oil - Nuclear commitments and solar options. M. Lonnroth (Swedish Secretariat for Futures Studies, Stockholm, Sweden), T. B. Johansson (Lund, Universitet, Lund, Sweden), and P. Steen (Forsvarets Forskningsanstalt, Stockholm, Sweden). *Science*, vol. 208, May 9, 1980, p. 557-563. 6 refs. Research sponsored by the Swedish Secretariat for Futures Studies.

A study of indigenous energy sources as alternatives to imported oil in Sweden is presented. Nuclear energy and renewable energy were considered, showing that large uncertainties were associated with both alternatives. The principal characteristics of an energy policy that does not rule out these two options were identified; such a policy will be based on an understanding of similarities and differences between the alternatives. A nuclear and solar energy systems were outlined as a basis for an analysis of technical, economic, and institutional issues.

A.T.

A80-32412 Cogeneration of electric energy and nitric oxide. C. G. Vayenas and R. D. Farr (MIT, Cambridge, Mass.). *Science*, vol. 208, May 9, 1980, p. 593, 594. 8 refs. Research supported by the Massachusetts Institute of Technology; NSF Grant No. ENG-77-27500.

A solid electrolyte fuel cell operating on ammonia fuel has been constructed and tested. The yield of nitric oxide can exceed 60 percent with simultaneous electric energy production. Two dimensionless numbers have been identified which govern the product selectivity and power output of this fuel cell. The cell appears to be a promising candidate for nitric acid and electric energy cogeneration.

(Author)

A80-32499 Geothermal heating in Creil (Le chauffage géothermique de Creil). P. Jaud (Gaz du France, Direction des Etudes et Techniques Nouvelles, Paris, France). *Revue de l'Energie*, vol. 31, Mar. 1980, p. 125-130. In French.

The geothermal heating system in operation in the city of Creil near Paris since 1976 is presented. The system makes use of three heat pumps linked to three titanium plate heat exchangers at the source in order to extract the maximum amount of heat from the saline aquifer prior to its reinjection into the ground at 21 C. Measurements have shown the system to operate at a flow rate of 270 sq m/h with an entrance water temperature of 56 C, however not to provide sufficient heat for all of the buildings to which it was connected during the heating seasons from 1976-1978. Fossil fuel energy savings during the 1977-1978 season are found to amount to 46 percent annually, with a total geothermal/backup cost of 22.25 francs/sq m space heated. It is noted that the costs of geothermal heating have declined in 1978, and, assuming that maintenance and operating costs remain low, further cost reductions are expected.

A.L.W.

A80-32500 Study of a French national energy system based on coal and nuclear energy (Etude d'un système énergétique français utilisant le charbon et l'énergie nucléaire). Mr. Henry, Mr. Pottier, and Mr. Le Penhuizic (Gaz du France, Direction des Etudes et Techniques Nouvelles, Paris, France). *Revue de l'Energie*, vol. 31, Mar. 1980, p. 131-143. In French.

Models of a future French national energy economy based on energy derived from coal and nuclear energy are examined. The concept of the energy vector, the form in which energy is transported and transmitted, is considered, and models of transportable energy production by electrolysis and coal gasification and of energy consumption are presented. The integration of the production, transport and storage model with the consumption model is discussed, and the utility of the models in the evaluation of connections between various factors for the planning of future energy policies is noted.

A.L.W.

A80-32501 Mixed potential analysis of sulfation of molten carbonate fuel cells. D. Townley, J. Winnick (Georgia Institute of

Technology, Atlanta, Ga.), and H. S. Huang (Argonne National Laboratory, Argonne, Ill.). *Electrochemical Society, Journal*, vol. 127, May 1980, p. 1104-1106.

A simple thermodynamic model is used to estimate the effect of hydrogen sulfide on molten carbonate fuel cells. A linear Henry's law relation between the activity and the partial pressure is assumed, and the effect of hydrogen sulfide pressure on overvoltage is plotted. The calculations show that the effect of hydrogen sulfide is progressively greater from the inlet to the outlet of the anode. Theoretical predictions are compared with experimental data from two independent laboratories, showing good agreement. L.M.

A80-32503 * **The effects of titanium impurities in N/+//P silicon solar cells.** A. M. Salama and L. J. Cheng (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Electrochemical Society, Journal*, vol. 127, May 1980, p. 1164-1167. 8 refs. Research supported by the U.S. Department of Energy.

Microscopic and electrical measurements were performed to explain the degradation mechanisms associated with the presence of titanium impurities in silicon. The measurements included X-ray topography, transmission electron microscopy, and deep level transient spectroscopy, before and after processing. The results indicated the presence of TiO₂ precipitates, the density of which increased after phosphorus diffusion. A majority carrier trapping level was observed in the wafers before processing. It was concluded that 10% of the Ti in the N(+)/P silicon solar cells formed electrically active centers which caused degradation of the cell junction. 14% of the remaining Ti precipitated out as TiO₂, forming electrically active defects, which also caused junction degradation. (Author)

A80-32511 * # **Just over the horizon in space.** I. Bekey (NASA, Washington, D.C.) and J. E. Naugle. *Astronautics and Aeronautics*, vol. 18, May 1980, p. 64-76.

The article surveys some of the concepts introduced and examined by a New Concepts Symposium convened by the NASA Advisory Council recently. Results are reported from the symposium's eight working groups: astrophysics, climate, communications and navigation, energy, large structures, planetary exploration, propulsion and transportation, and telefactories. M.E.P.

STAR ENTRIES

N80-16111 California Univ., Berkeley.
HEAVY HYDROCARBONS FROM COAL GASIFICATION VAPOR PRESSURES AND DEW POINT Ph.D. Thesis

Albert Brian Macknick 1979 110 p
 Avail: Univ. Microfilms Order No. 8000429

Experimental vapor pressure data at near-ambient temperatures were measured for seven heavy hydrocarbons. Semitheoretical methods are recommended for extrapolating the data to higher temperatures. Because it is not always feasible economically to determine experimentally all vapor pressure data required, a group contribution method is presented which gives parameters for a vapor pressure equation, where all parameters are obtained from molecular structure only. Techniques are presented which allow classification of heavy hydrocarbon mixtures so that vapor pressures and molecular weights needed for dew point calculations can be estimated with a minimum amount of experiment effort. A computer program is used to predict conditions for two tars obtained from coal gasification pilot plants. Dissert. Abstr.

N80-16126# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.

COMBUSTION OF MULTICOMPONENT FUEL DROPLETS Final Report

H. S. Homan Jul. 1979 28 p refs
 (Contract EC-77-S-02-4449)

(COO-4449-2) Avail: NTIS HC A03/MF A01

The vaporization and burning of liquid fuel droplets which contain more than one chemical component were investigated. The prediction of the transient rate of changes in chemical composition of multi-component liquid fuel droplets during vaporization and burning in convective flow was considered. A model is provided of droplet burning which is more relevant to droplet vaporization and combustion in fuel sprays than the droplet combustion models which assume spherical symmetry, single-component fuel, and constant droplet properties. The model is expected to impact the models of combustion in diesel engines, gas turbines, and furnaces especially for the heavy shale and coal-derived fuels. DOE

N80-16129# Department of Energy, Pittsburgh, Pa. Energy Technology Center.

STABILITY STUDIES OF COAL LIQUIDS

F. R. Brown and F. S. Karn Aug. 1979 23 p refs
 (PETC/TR-79/5) Avail: NTIS HC A02/MF A01

The aging characteristics of liquid products derived from the hydrogenation of coal were studied. Viscometric, spectrometric, ultimate analysis, solvent separations, and oxygen consumption measurements were employed to monitor the storage properties of the coal liquids under a variety of environmental conditions. Using viscosity measurements as the primary probe of changes in the stored samples, the rate of product degradation was found to be related to the initial viscosity of the sample, the storage temperature and the concentration of oxygen in the gaseous environment over the samples. Fractions of gross coal liquid samples obtained by solvent separation methods were monitored for their rates of oxygen consumption in order to more accurately determine those materials most susceptible to oxidation, and concurrent degradation of the product. The results show that coal liquids are very susceptible to oxidative degradation. DOE

N80-16130# Department of Energy, Bartlesville, Okla.
DEVELOPMENT OF HIGH TEMPERATURE SUBTRACTIVE COLUMN AND CHROMATOGRAPHIC ANALYSIS OF HYDROCARBONS PRESENT IN DIESEL EXHAUST

Clarence J. Raible and D. E. Seizinger Dec. 1978 11 p refs
 (BETC/RI-78/12) Avail: NTIS HC A02/MF A01

A high-temperature subtractive column was developed for distinguishing diesel fuel and exhaust hydrocarbons into two classifications, i.e., saturated and unsaturated hydrocarbons. Duplicate samples were collected with and without a subtractive column and subsequently analyzed by gas liquid chromatography to determine boiling range distribution of exhaust hydrocarbons. Comparison of the resulting chromatographic data permitted determination of hydrocarbon class as well as boiling range distribution. The analytical procedure was developed for classification of hydrocarbons in the range C7 to C22. The loss of saturated compounds within the subtractive column was a reproducible 6 percent over the analyzed hydrocarbon range. Compensation for losses during sample transfer was accomplished by including the transfer steps in the calibration procedure. DOE

N80-16131# Versar, Inc., Springfield, Va.
SURVEY OF POTENTIAL CHLORINE PRODUCTION PROCESSES Final Report

Apr. 1979 196 p refs Prepared for Argonne Natl. Lab., Ill.
 (Contract W-31-109-eng-38)

(ANL/OEPM-79-1) Avail: NTIS HC A09/MF A01

A computerized literature search of past and current chlorine generation methods was performed to identify basic chlorine production processes. Over 200 pertinent references are cited involving 20 separate and distinct chlorine processes. Each basic process is evaluated for its engineering and economic viability and energy efficiency in terms of raw material availability, type and amount of energy required, by-product demand/disposal, and status of development. The most promising processes are the membrane process (with and without catalytic electrodes), Kel-Chlor, Mobay (direct electrolysis of hydrogen chloride), the Shell process (catalytic oxidation of hydrogen chloride), and oxidation of ammonium chloride. DOE

N80-16172# Case Western Reserve Univ., Cleveland, Ohio.
POLYMER MATERIALS BASIC RESEARCH NEEDS FOR ENERGY APPLICATIONS. PROCEEDINGS OF A WORKSHOP RECOMMENDING FUTURE DIRECTIONS IN ENERGY-RELATED POLYMER RESEARCH

W. J. Macknight, E. Baer, and R. D. Nelson Aug. 1979 205 p refs
 Workshop held at Cleveland, 27-29 Jun. 1978 Sponsored by DOE and Massachusetts Univ.

(CONF-780643) Avail: NTIS HC A10/MF A01

The larger field covered in the workshop consists of (1) synthesis and characterization, (2) physical chemistry, (3) physics, and (4) engineering. The basic research needs in polymer materials related to energy are reported. The development of sophisticated instrumentation makes the task of molecular characterization possible on a level hitherto unattainable. Many of these instruments because of their size and complexity must of necessity be located at the DOE National Laboratories. The importance of personnel trained in the polymer field located at these facilities is emphasized. In the past there has been relatively little concerted polymer research within the energy community. This report attempts to describe the present situation and point out some needs and future research directions. DOE

N80-16177# National Academy of Sciences - National Research Council, Washington, D. C. Energy Engineering Board.

HYDROGEN AS A FUEL

1979 86 p refs
 (Contract EY-76-C-02-2708)

Avail: NTIS HC A05/MF A01

A panel of the Committee on Advanced Energy Storage Systems of the Assembly of Engineering examined the status and problems of hydrogen manufacturing methods, hydrogen transmission and distribution networks, and hydrogen storage

systems Suitable criteria for establishing the pace, timing, and technical content of appropriate federally sponsored hydrogen R&D programs was considered. It was concluded the increasing urgency to develop new sources and forms of fuel and energy may well impact on the scale and timing of potential future hydrogen uses. M.M.M.

N80-16178# California Univ., Berkeley. Lawrence Berkeley Lab.

AGGREGATED VECTORIAL MODEL OF PETROLEUM FLOW IN THE UNITED STATES

V. V. Krishnan and D. F. Cahn Mar. 1979 90 p refs (Contract W-7405-eng-48) (LBL-8874) Avail: NTIS HC A05/MF A01

An aggregated material-flow model is proposed for crude oil and its derivative products. Stages in petroleum flow where material conservation is expected are isolated from those where volumetric or identity changes can occur, and generic properties of petroleum and petroleum products that would assist in effective data validation are identified. The model provides a structural framework for organization and consolidation of the various data bases related to petroleum, and serves as a guide for analysis and enumeration of explicit semantic data interrelationships. The model is amenable to expansion into both transactional and more disaggregated representations. The material-flow model is intended as a preliminary step toward a coherent and comprehensive data structure to support monitoring, forecasting, and regulatory efforts in the energy field. The model is developed in the abstract; no attempt is made to test it using explicit data. DOE

N80-16179# Brookhaven National Lab., Upton, N. Y. **PRELIMINARY ASSESSMENT OF THE PROSPECTS FOR USE OF REFUSE-DERIVED FUEL IN MARYLAND**

W. C. Metz and J. Shyer Feb. 1979 82 p refs (Contract EY-76-C-02-0016) (BNL-51065) Avail: NTIS HC A05/MF A01

The deployment problems of refuse derived fuel (RDF) production in Maryland are examined. Problems experienced by the pyrolysis plant in Baltimore City and the resource recovery plant in Baltimore County are cited. Maryland's municipal solid waste problems are discussed with emphasis on the major components of the municipal solid waste stream, e.g., volume, composition, and location; collection methods used; present and long-range disposal methods; and regulations and ordinances. The generic social and legal constraints to RDF production are described. The problems of RDF technology deployment in Maryland, i.e., county and state RDF energy potential, institutional barriers to RDF production and use, remitting requirements for new RDF production and use facilities, water quality issues of RDF production and use, air quality issues of RDF production and use, and recommendations for initiating RDF production and use are discussed. DOE

N80-16180# California Univ., Livermore. Lawrence Livermore Lab.

CHEMICAL KINETICS IN LNG DETONATIONS

C. K. Westbrook and L. C. Haselman 14 Sep. 1979 27 p refs Presented at 7th Intern. Colloq. on Gas-Dynamics of Explosions and Reactive Systems, Gottingen, West Germany, 20 Aug. 1979 Revised (Contract W-7405-eng-48) (UCRL-82293-Rev-1; CONF-790828-1-Rev-1) Avail: NTIS HC A03/MF A01

The problem of detonability of vaporized mixtures of liquified natural gas and air is addressed, using a characteristic time analysis. Separate numerical models are used to treat the evolution of the blast wave produced by a charge of high explosive and the chemical ignition delay of the fuel-air mixture. These models are combined with experimental data to predict the amount of high explosive required to initiate a detonation of a stoichiometric mixture of methane and air, giving an estimate of 50 to 100 kg of high explosive in spherical geometry. The effects of minor constituents such as ethane and propane on methane-air detonability are examined, and the mechanism by which these minor constituents kinetically sensitize the fuel is discussed. DOE

N80-16181# Department of Energy, Morgantown, W. Va. Energy Technology Center.

UNCONVENTIONAL GAS RECOVERY PROGRAM Semianual Report, 31 Mar. 1979

R. L. Wise, ed. Aug. 1979 375 p (METC/SP-79/8) Avail: NTIS HC A16/MF A01

Progress of projects directed at gas recovery from unconventional sources is reported. Methane recovery from coalbeds, eastern gas shales, western gas sand, and geopressed aquifers are among the topics covered. DOE

N80-16182# Badger Plants, Inc., Cambridge, Mass. **CONCEPTUAL DESIGN OF A COAL-TO-METHANOL-TO-GASOLINE COMMERCIAL PLANT: EXECUTIVE SUMMARY Interim Final Report, 31 Aug. 1977 - 31 Mar. 1979**

Mar. 1979 53 p (Contract EX-76-C-02-2416) (FE-2416-43; IFR-2) Avail: NTIS HC A04/MF A01

An engineering and economic assessment of a conceptual design for a commercial facility to convert coal-to-methanol-to-gasoline is presented. This design is conceptual and, therefore, is considered to be a prediction of the development of the technology in question and thus appropriate for comparative economic evaluation purposes. DOE

N80-16183# Department of Energy, Washington, D. C. Div. of Coal Conversion.

COAL LIQUEFACTION Quarterly Report, Jul. - Sep. 1978

May 1979 65 p (Contract EX-76-C-01-2297) (DOE/ET-0068/3) Avail: NTIS HC A04/MF A01

Several conversion processes that are currently in the pilot plant stage are described briefly and information is given as to contractor, contract, funding, site, and current progress. Several support projects are also described. DOE

N80-16184# Department of Energy, Washington, D. C. Div. of Coal Conversion.

COAL GASIFICATION Quarterly Report, Jul. - Sep. 1978

May 1979 77 p (Contract EY-76-C-01-2297) (DOE/ET-0067/3) Avail: NTIS HC A05/MF A01

A number of processes for making high Btu gas and for making low Btu gas are described with the contractor identification, contract, site, funding, and current progress. Projects on mathematical modeling and preparation of a coal conversion systems technical data book are also described. DOE

N80-16185# Brookhaven National Lab., Upton, N. Y. **FLASH HYDROPYROLYSIS OF COAL Progress Report, 1 Jul. - 31 Dec. 1978**

M. Steinberg and P. Fallon Feb. 1979 156 p (Contract EY-76-C-02-0016) (BNL-51010; PR-7) Avail: NTIS HC A08/MF A01

The data generated by the parametric study of lignite was correlated and activation energies for a first approximation of the reaction scheme are presented. These range from 88 Kcal/mol for the formation of ethane and 62 Kcal/mol for the formation of benzene to 29 Kcal/mol for the formation of methane, all from the feed coal. The mechanism appears to be largely chemical reaction rate controlled as opposed to diffusion controlled. DOE

N80-16187# 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 112 p Sponsored by DOE (DOE/TIC-10078) Avail: NTIS HC A06/MF A01

Oil and Gas Development and production costs are projected by region and depth interval for the benchmark years 1980, 1985 and 1990. Twenty-four geographical regions were specified and six depth classes defined under historical development costs. Direct operating costs are also covered. DOE

N80-16189# Gorham International, Inc., Maine. **ASSESSMENT OF THE TECHNICAL AND ECONOMIC**

FEASIBILITY OF CONVERTING WOOD RESIDUES TO LIQUID AND GASEOUS FUEL PRODUCTS USING STATE-OF-THE-ART AND ADVANCED COAL CONVERSION TECHNOLOGY Quarterly Report, 1 Dec. 1978 - 28 Feb. 1979

May 1979 15 p refs

(Contract ET-78-C-02-4862)

(COO-4862-3; QR-3) Avail: NTIS HC A02/MF A01

The approach to be used in evaluating coal gasification technologies for gasification of wood is outlined. The coal gasification technologies to be evaluated and their status are tabulated. The parameters critical to the development of wood gasification (technical risk, economics, institutional factors, and environmental impacts) are briefly discussed. DOE

N80-16190# Mobil Research and Development Corp., Paulsboro, N. J.

DEVELOPMENT STUDIES ON SELECTED CONVERSION OF SYNTHESIS GAS FROM COAL TO HIGH OCTANE GASOLINE Final Report

J. A. Brennan Oct. 1978 383 p refs

(Contract EX-76-C-01-2276)

(FE-2276-27) Avail: NTIS HC A17/MF A01

An exploratory, experimental process study was conducted on the direct conversion of coal derived synthesis gas to gasoline. Novel, proprietary catalysts were used; (these unique catalysts do not yield oxygenates and the hydrocarbons formed are limited in size to about C sub 11.) This new technology was compared with conventional Fischer-Tropsch. The experiments were conducted in micro reactor (10 cc catalyst capacity) and in bench-scale units (150 cc catalyst capacity). The bench-scale unit was used in both a fixed and fluid bed mode. The studies included effects of temperature, pressure and space velocity on catalyst performance, and catalyst activation, aging and regeneration. DOE

N80-16192# Battelle Columbus Labs., Ohio.

PROCEEDINGS: SYMPOSIUM ON COAL CLEANING TO ACHIEVE ENERGY AND ENVIRONMENTAL GOALS HELD AT HOLLYWOOD, FLORIDA ON SEPTEMBER 1978, VOLUME 1 Final Report, Apr. 1977 - Mar. 1979

S. E. Rogers, ed. and A. W. Lemmon, Jr., ed. Apr. 1979 647 p refs

(Contract EPA-68-02-2163)

(PB-299383/0; EPA-600/7-79-098A)

Avail: NTIS HC A99/MF A01 CSCL 07A

The physical and chemical coal cleaning programs of EPA, DOE, the Electric Power Research Institute, and numerous industrial organizations; European and Soviet plans for the future; and problems of ongoing operations are discussed. Topics are presented: coal characteristics, coal cleaning overview, and physical coal cleaning technology. GRA

N80-16193# Battelle Columbus Labs., Ohio.

PROCEEDINGS: SYMPOSIUM ON COAL CLEANING TO ACHIEVE ENERGY AND ENVIRONMENTAL GOALS HELD AT HOLLYWOOD, FLORIDA ON SEPTEMBER 1978, VOLUME 2 Final Report, Apr. 1977 - Mar. 1979

S. E. Rogers and A. W. Lemmon, Jr. Apr. 1979 595 p refs

(Contract EPA-68-02-2163)

(PB-299384/8; EPA-600/7-79-098B)

Avail: NTIS HC A25/MF A01 CSCL 07A

A review and discussion is reported on: the physical and chemical coal cleaning programs of EPA, DOE, the Electric Power Research Institute, and numerous industrial organizations; European and Soviet plans for the future; and problems of ongoing operations. The following included are: environmental assessment and pollution control technology, and chemical coal cleaning technology. GRA

N80-16194# Office of Technology Assessment, Washington, D. C.

GASOHOL: A TECHNICAL MEMORANDUM

Sep. 1979 89 p refs

(PB80-105885; OTA/TM/E-1) Avail: NTIS HC A05/MF A01 CSCL 21D

The technical and non technical issues surrounding the development of gasohol are discussed including the resource base, production technologies, and economics of gasohol, and its use as a transportation fuel. The environmental problems and benefits of producing and using gasohol, and the social and institutional issues about using agricultural products for energy are covered. Policy options about gasohol as well as other bioenergy technologies such as wood and methanol production are considered. GRA

N80-16195# National Technical Information Service, Springfield, Va.

ALCOHOL FUELS. CITATIONS FROM THE AMERICAN PETROLEUM INSTITUTE DATA BASE Progress Report, 1973 - Jul. 1979

Diane M. Cavagnaro Sep. 1979 194 p

(NTIS/PS-79/0911/2) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 21D

Research on alcohol fuels are cited. The citations cover synthesis, chemical analysis, performance testing, processing, pollution, economics, environmental effects, and feasibility. (Contains 178 abstracts). GRA

N80-16215*# Oklahoma Univ., Norman. School of Aerospace, Mechanical and Nuclear Engineering.

LATERAL AND TILT WHIRL MODES OF FLEXIBLY MOUNTED FLYWHEEL SYSTEMS

C. W. Bert and T. L. C. Chen /In Shock and Vibration Inform. Center The Shock and Vibration Bull., Pt. 2 Sep. 1979 p 35-46 refs Sponsored by DOE

Avail: NTIS HC A10/MF A01 CSCL 10B

An axisymmetric energy storage flywheel system with four degrees of freedom, two associated with lateral translation and two with tilting, was driven by an air turbine which added two more degrees of freedom. A six degree-of-freedom analysis was performed and applied to two versions of a specific design. K.L.

N80-16236# Los Alamos Scientific Lab., N. Mex. Cryogenics Group.

SAFETY OF LIQUID HYDROGEN IN AIR TRANSPORTATION

F. J. Edeskuty 1979 18 p refs Presented at the Hydrogen in Air Transportation Conf., Stuttgart, 10 Sep. 1979

(Contract W-7405-eng-36)

(LA-UR-79-1416; CONF-790942-1)

Avail: NTIS HC A02/MF A01

The safety factors and problems associated with the use of liquid hydrogen as an aircraft fuel are discussed. The properties of liquid hydrogen are reviewed and their effect upon airline operations is reported. The effects include safety requirements for storage and refueling systems and safety devices for aircraft hangars and buildings in the close vicinity. Safety problems which need further research are addressed. These include the consequences of a hydrogen spill and dispersion, hydrogen combustion, and hydrogen disposal.

N80-16284# United Technologies Corp., South Windsor, Conn. Power Systems Div.

AN ac/dc POWER CONVERTER FOR BATTERIES AND FUEL CELLS Annual Report

Ramon W. Rosati, ed. Aug. 1978 98 p refs Sponsored by Elec. Power Res. Inst.

(EPRI-EM-662) Avail: NTIS HC A05/MF A01

The overall objective of the EPRI program is the design of an advanced power converter for use in both battery energy storage and fuel cell generation systems. This will be accomplished by expansion of the existing FCG-1 fuel cell power conditioning inverter into a high-efficiency inverter-rectifier system employing improved commutation circuits and advanced semiconductor devices capable of operating over wider dc voltage ranges. A separate but concurrent program for the U. S. Department of Energy (DOE) is examining augmentation of the present FCG-1 inverter for operation as an inverter-rectifier with battery systems; feasibility and operating characteristics were demonstra-

ted. Activities and accomplishments in the EPRI program include revision of the preliminary specification for ac/dc conversion equipment, survey of seven semiconductor manufacturers to project characteristics of thyristors, screening of fifteen commutation concepts and selection of the two most promising options for experimental evaluation, and modifications of existing experimental power pole hardware to evaluate the selected advanced commutation circuits. DOE

N80-16293 Utah Univ., Salt Lake City.
THE EFFECT OF SUPERHEATING ON THE PERFORMANCE OF FLOATING DROPLET DIRECT CONTACT HEAT EXCHANGERS Ph.D. Thesis

Calvin Albert Kodres, Jr. 1979 174 p
 Avail: Univ. Microfilms Order No. 8000972

A mathematical model of a single evaporating, superheated droplet is formulated and studied numerically to determine instantaneous and average heat transfer rates to the droplet at various stages of evaporation. An explicit procedure for analyzing the entire heat exchanger is then developed based upon the application of a dimensional analysis derivation of a relationship for the heat flux from the single evaporating droplet. The results of the numerical model are used to define the parameters and determine the required constants. Two operating geothermal heat exchangers are designed using this procedure. The two sites both have a moderate temperature brine and both systems utilize pentane as the working fluid. The heat exchanger vessel pressures are varied, providing a range of superheats from 19 to 52 C. The average difference between the calculated and measured total heat flux is about 16%. Dissert. Abstr.

N80-16347# Sandia Labs., Livermore, Calif. Combustion Applications Div.

ENGINE COMBUSTION TECHNOLOGY OVERVIEW

C. W. Robinson and S. C. Keeton Oct. 1978 6 p Presented at the Highway Vehicle Systems Contractors Meeting, Dearborn, Mich., 17 Oct. 1978
 (Contract EY-76-C-04-0789)
 (SAND-78-8801; CONF-781050-1) Avail: NTIS HC A02/MF A01

A five-year program to develop technology for increasing the efficiency of automotive, truck, and stationary engines and for switching to modified or alternate fuels is discussed. The plan calls for a coordinated program involving DOE/Fossil Fuel Utilization, universities, DOE laboratories, private research organizations, and the engine manufacturing industry. The program plan is complementary to existing programs in the DOE/TEC, DOD, and DOT, and is coordinated with those efforts. DOE

N80-16409# Juniata Coll., Huntingdon, Pa.
STUDY OF HYDROCARBON-SHALE INTERACTION
 Progress Report, 1 Apr. - 30 Jun. 1979

P. D. Schettler, Jr. and D. L. Wampler 1979 50 p refs
 (Contract EY-76-S-05-5197)
 (ORO-5197-14; PR-14) Avail: NTIS HC A03/MF A01

Construction of an apparatus for degasibility/isotherm measurements up to 1000 psi is complete. Results of chromatographic analysis of off-gassing from wells KY No. 4-, PA No. 1-, PA No. 2-, OH No. 3-, and IL No. 4-EGSP are tabulated. Temperature coefficients of degasibility and isotherm parameters in Devonian shales were determined. A summary of degasibility/isotherm data is presented. A computer simulation of a matrix diffusion/fracture flow model in the radial case is discussed. A small infrared/X-ray diffraction study is proceeding on selected samples. DOE

N80-16410# Department of Energy, Morgantown, W. Va. Energy Technology Center.

GAS PRODUCTION OF DEVONIAN SHALE WELLS RELATIVE TO PHOTO LINEAMENT LOCATIONS: A STATISTICAL ANALYSIS

J. F. Howard (Howard and Associates, Owensboro, Ky.), S. J. Lahoda (West Virginia Univ., Morgantown), W. E. Zirk (West Virginia Univ., Morgantown), and C. A. Komar Apr. 1979 19 p refs
 (METC/CR-79/28) Avail: NTIS HC A02/MF A01

A pilot study was made to relate Devonian shale gas well production to distance from photo lineaments that were mapped at two different scales, namely low altitude (1:24,000) and intermediate altitude (1:62,500). Cumulative production after 5 years for 41 wells located in the Vicco quadrangle of Perry Co., Kentucky, was used in the study. A statistical two-way analysis of variance design was used to group the data into four classes depending on whether the producing wells were within or beyond 300 feet of a photo lineament derived from both scales. Results indicate that cumulative 5 year production is higher for wells sited within 300 feet of a low-altitude photo lineament. The correlations indicate a narrow zone of influence or effect for the geologic feature represented by the photo lineament. Moreover, the most consistently effective features are derived from low-altitude (1:24,000) scale photography, well below the detail commonly utilized in studies to date. DOE

N80-16411# Department of Energy, Washington, D. C.
ENVIRONMENTAL DEVELOPMENT PLAN: UNDERGROUND COAL GASIFICATION

Sep. 1979 76 p Sponsored by DOE, Washington, D.C.
 (DOE/EDP-0047) Avail: NTIS HC A05/MF A01

Early tests indicate that some of the groundwater pollution due to underground coal gasification (UCG) is confined to an area adjacent to the gasified zone and the cleansing properties of the surrounding coal may serve as a natural contaminant control system. Ground subsidence is another major concern. Subsidence could cause disruption of aquifers, surface disturbance, and loss of product gas through cracks to the surface. Degradation of air quality is also a significant concern particularly with respect to emissions through cracks and fissures resulting from anticipated subsidence. Potential hazards to the worker exist, including the inadvertent release of gas through cracks in the ground surface and worker safety associated with the sudden collapse through subsidence. Environmental regulations which will most directly affect the UCG program include the Federal Water Pollution Control Act, the Safe Drinking Water Act, and the Clean Air Act. These regulations will impact upon pollution control requirements, and potential siting of facilities. DOE

N80-16452* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

ALUMINIUM OR COPPER SUBSTRATE PANEL FOR SELECTIVE ABSORPTION OF SOLAR ENERGY Patent

Marion L. Roberts, Max H. Sharpe, and Albert C. Krupnick, inventors (to NASA) Issued 4 Dec. 1979 6 p Filed 30 May 1978 Supersedes N78-25557 (16 - 16, p 2137) Division of US Patent Appl. SN-829390, Filed 31 Aug. 1977, US Patent 4,104,134

(NASA-Case-MFS-23518-3; US-Patent-4,177,325; US-Patent-Appl-SN-910793; US-Patent-Class-428-629; US-Patent-Class-428-650; US-Patent-Class-428-658; US-Patent-Class-428-675; US-Patent-Class-428-680; US-Patent-Class-126-417; US-Patent-Class-126-901; US-Patent-Appl-SN-829390; US-Patent-4,104,134) Avail: US Patent and Trademark Office CSCL 10A

A method for making panels which selectively absorb solar energy is disclosed. The panels are comprised of an aluminum substrate, a layer of zinc thereon, a layer of nickel over the zinc layer and an outer layer of solar energy absorbing nickel oxide or a copper substrate with a layer of nickel thereon and a layer of solar energy absorbing nickel oxide distal from the copper substrate.

Official Gazette of the U.S. Patent and Trademark Office

N80-16453# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

LARGE WIND TURBINE DESIGN CHARACTERISTICS AND R AND D REQUIREMENTS

Seymour Lieblein, ed. (Technical Report Services, Rocky River, Ohio) Dec. 1979 459 p refs Conf. held at Cleveland, 24-26 Apr. 1979; sponsored in part by DOE
 (NASA-CP-2106; CONF-7904111) Avail: NTIS HC A20/MF A01 CSCL 10B

Detailed technical presentations on large wind turbine research and development activities sponsored by public and private

organizations are presented. Both horizontal and vertical axis machines are considered with emphasis on their structural design.

N80-16454*# Department of Energy, Washington, D. C.

OVERVIEW OF FEDERAL WIND ENERGY PROGRAM

Daniel F. Ancona *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 1-24 ref

Avail: NTIS HC A20/MF A01 CSCL 10B

The objectives and strategies of the Federal wind energy program are described. Changes in the program structure and some of the additions to the program are included. Upcoming organizational changes and some budget items are discussed, with particular emphasis on recent significant events regarding new approvals. R.E.S.

N80-16455*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

DESIGN EVOLUTION OF LARGE WIND TURBINE GENERATORS

David A. Spera *In its* Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 25-33 ref

Avail: NTIS HC A20/MF A01 CSCL 10B

During the past five years, the goals of economy and reliability have led to a significant evolution in the basic design--both external and internal--of large wind turbine systems. To show the scope and nature of recent changes in wind turbine designs, development of three types are described: (1) system configuration developments; (2) computer code developments; and (3) blade technology developments. R.E.S.

N80-16456*# General Electric Co., Philadelphia, Pa. Space Div.

THE GENERAL ELECTRIC MOD-1 WIND TURBINE GENERATOR PROGRAM

Richard H. Poor and R. B. Hobbs *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 35-59

Avail: NTIS HC A20/MF A01 CSCL 10B

The design, fabrication, installation and checkout of MOD-1, a megawatt class wind turbine generator which generates utility grade electrical power, is described. A MOD-1/MOD-1A tradeoff study is discussed. R.E.S.

N80-16457*# Boeing Engineering and Construction, Seattle, Wash.

THE BOEING MOD-2 WIND TUNNEL SYSTEM RATED AT 2.5 MW

Richard R. Douglas *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 61-78

Avail: NTIS HC A20/MF A01 CSCL 10B

A summary description of MOD-2 development and the resulting system hardware is presented. R.E.S.

N80-16458*# WTG Energy Systems, Inc., Buffalo, N.Y.

WTG ENERGY SYSTEMS' MP1-200 200 KILOWATT WIND TURBINE GENERATOR

Allen P. Spaulding, Jr. *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 79-88

Avail: NTIS HC A20/MF A01 CSCL 10B

The preliminary design criteria of the MP1-200 wind turbine are given along with a brief description of the wind turbine generator. Performance and operational experience and cost factors are included. Recommendations for additional research are listed. J.M.S.

N80-16459*# National Swedish Board for Energy Source Development, Spanga.

SPECIFICATION, SITING AND SELECTION OF LARGE WECS PROTOTYPES

Sven Hugosor *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 89-102

Avail: NTIS HC A20/MF A01 CSCL 10B

The development of large-scale windpowered systems is outlined. Topics discussed include: prototype specifications development, site selection process, and selection of prototype contractor. J.M.S.

N80-16460*# Technical Univ. of Denmark, Lyngby.

THE DANISH LARGE WIND TURBINE PROGRAM

B. Maribo Pederson *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 103-120

Avail: NTIS HC A20/MF A01 CSCL 10B

A brief description of the Danish wind energy program and its present status is given. Results and experiences from tests on the Gedser windmill (200 kW) are presented. The key results are presented from the preliminary design study and detailed design of two new WECS (630 kW each) is described. J.M.S.

N80-16461*# Maschinenfabrik Augsburg-Nuernberg A.G., Augsburg (West Germany).

LARGE WIND ENERGY CONVERTER: GROWIAN 3 MW

F. Koerber and Hans A. Thiele *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 121-132

Avail: NTIS HC A20/MF A01 CSCL 10B

The main features of the Growian wind energy converter are presented. Energy yield, environmental impact, and construction of the energy converter are discussed. Reliability of the windpowered system is assessed. J.M.S.

N80-16462*# Sandia Labs., Albuquerque, N. Mex.

CHARACTERISTICS OF FUTURE VERTICAL AXIS WIND TURBINES (VAWTs)

Emil G. Kadlec *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 133-141 refs

(Contract DE-AC04-76DP-00789)

Avail: NTIS HC A20/MF A01 CSCL 10B

The developing Darrieus VAWT technology whose ultimate objective is economically feasible, industry-produced, commercially marketed wind energy systems is reviewed. First-level aerodynamic, structural, and system analyses capabilities which support and evaluate the system designs are discussed. The characteristics of current technology designs are presented and their cost effectiveness is assessed. Potential improvements identified are also presented along with their cost benefits. J.M.S.

N80-16463*# National Research Council of Canada, Ottawa (Ontario).

DESIGN CHARACTERISTICS OF THE 224 kW MAGDALEN ISLANDS VAWT

R. J. Templin *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 143-154 refs

Avail: NTIS HC A20/MF A01 CSCL 10A

The evolution of the main design features of the Magdalen Islands vertical axis wind turbine (VAWT) is described. The turbine has a rotor height of 120 ft (36.58 m) and diameter 80 ft (24.38 m). It was operated as a joint project between NRC and Hydro-Quebec in grid-coupled mode from July 1977 to July 1978 when the rotor was destroyed in an accident. The accident, although unfortunate, tested the basic integrity of the design in a gross overspeed condition, and the rotor is being rebuilt with minor modifications. Some directions for future VAWT research are suggested. M.M.M.

N80-16464*# Aluminum Co. of America, Alcoa Center, Pa.

ALCOA WIND TURBINES

N80-16465

Daniel K. Ai *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 155-171 refs

Avail. NTIS HC A20/MF A01 CSCL 10A

An overview of Alcoa's wind energy program is given with emphasis on the the development of a low cost, reliable Darrieus Vertical Axis Wind Turbine System. The design layouts and drawings for fabrication are now complete, while fabrication and installation to utilize the design are expected to begin shortly.

M.M.M.

N80-16465*# Sandia Labs., Albuquerque, N. Mex.
TEST RESULTS OF THE DOE/SANDIA 17 METER VAWT
Robert O. Nellums and M. H. Worstell *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 173-184 refs

(Contract DE-AC04-76-DP00789)

Avail: NTIS HC A20/MF A01 CSCL 10B

A review is given of the practices of a 17 meter Vertical Axis Wind Turbine VAWT. Performance test results are discussed including difficulties encountered during the VAWT operation along with ways of solving these problems.

M.M.M.

N80-16466*# Sandia Labs., Albuquerque, N. Mex.
OVERVIEW OF VERTICAL AXIS WIND TURBINE (VAWT)
William N. Sullivan *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics R and D Requirements Dec. 1979 p 185-192 refs

(Contract DE-AC04-76-DP00789)

Avail: NTIS HC A20/MF A01 CSCL 10B

A survey is presented of the practices which were applied for designing VAWT blades. An attempt is made to discuss strengths and weaknesses of the existing procedures. Discussion is provided on planned or suggested future work in developing improved design tools.

M.M.M.

N80-16467*# Aluminum Co. of America, Alcoa Center, Pa.
Technical Marketing Div.
FABRICATION OF EXTRUDED VERTICAL AXIS TURBINE BLADES

Arthur G. Craig, Jr. *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 193-204 refs

Avail: NTIS HC A20/MF A01 CSCL 10B

Important characteristics of the extruded aluminum blade for the Vertical Axis Wind Turbine are presented. Their weight, structural strength, shape, and maintainability are pointed out.

M.M.M.

N80-16468*# Sandia Labs., Albuquerque, N. Mex.
OPERATIONAL EXPERIENCE WITH VAWT BLADES
William N. Sullivan *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 205-210 ref

(Contract DE-AC04-76-DP00789)

Avail: NTIS HC A20/MF A01 CSCL 10B

The structural performance of 17 meter diameter wind turbine rotors is discussed. Test results for typical steady and vibratory stress measurements are summarized along with predicted values of stress based on a quasi-static finite element model.

K.L.

N80-16469*# National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, Ohio.
STRUCTURAL ANALYSIS CONSIDERATIONS FOR WIND TURBINE BLADES

David A. Spera *In* its Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 211-224 refs

Avail: NTIS HC A20/MF A01 CSCL 10B

Approaches to the structural analysis of wind turbine blade designs are reviewed. Specifications and materials data are

discussed along with the analysis of vibrations, loads, stresses, and failure modes.

K.L.

N80-16470*# National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, Ohio.
BLADE DESIGN AND OPERATING EXPERIENCE ON THE MOD-OA 200 kW WIND TURBINE AT CLAYTON, NEW MEXICO

Bradford S. Linscott and Richard K. Shaltens *In* its Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 225-238 refs

Avail: NTIS HC A20/MF A01 CSCL 10B

Two 60 foot long aluminum wind turbine blades were operated for over 3000 hours on the MOD-OA wind turbine. The first signs of blade structural damage were observed after 400 hours of operation. Details of the blade design, loads, cost, structural damage, and repair are discussed.

K.L.

N80-16471*# Lockheed Aircraft Service, Inc., Ontario, Calif.
EVALUATION OF AN OPERATING MOD-OA 200 kW WIND TURBINE BLADE

Robert E. Donham *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 239-265 refs

Avail: NTIS HC A20/MF A01 CSCL 10B

Operating loads and structural damage were monitored during operation of the MOD-OA electric generating system. The turbine was damaged locally between stations 48 and 125 after 2.8 million rotations. Loads due to degraded yaw stiffness and fretting at rib station 48 were identified as primary to this distress. The repaired blades operated an additional 4.8 million rotations without problems.

K.L.

N80-16472*# National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, Ohio.
DESIGN, FABRICATION, AND TEST OF A STEEL SPAR WIND TURBINE BLADE

Timothy L. Sullivan, Paul J. Sirocky, Jr., and Larry A. Viterna *In* its Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 267-284 refs

Avail: NTIS HC A20/MF A01 CSCL 10B

The design and fabrication of wind turbine blades based on 60 foot steel spars are discussed. Performance and blade load information is given and compared to analytical prediction. In addition, performance is compared to that of the original MOD-O aluminum blades. Costs for building the two blades are given, and a projection is made for the cost in mass production. Design improvements to reduce weight and improve fatigue life are suggested.

K.L.

N80-16473*# WTG Energy Systems, Inc., Buffalo, N.Y.
WTG ENERGY SYSTEMS' ROTOR: STEEL AT 80 FEET
Robert E. Barrows *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 285-292

Avail: NTIS HC A20/MF A01 CSCL 10B

The design, specifications, and performance of the 80 foot diameter fixed pitch rotor operating on the MP1-200 wind turbine generator installed as part of the Island of Cuttyhunk's electric power utility grid system are described. This synchronous generating system rated 200 kilowatts at 28 mph wind velocity, and produces constant 60 Hz, 480 VAC current at +/- 1 percent accuracy throughout the machine's operating range. Future R & D requirements and suggestions are included with cost data.

A.R.H.

N80-16474*# Gougeon Bros., Inc., Bay City, Mich.
THE USE OF WOOD FOR WIND TURBINE BLADE CONSTRUCTION

Meade Gougeon and Mike Zuteck *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 293-308

Avail: NTIS HC A20/MF A01 CSCL 10B

The interrelationships between moisture and wood, conditions for dry rot spore activity, the protection of wood fibers from moisture, wood resin composites, wood laminating, quality control, and the mechanical properties of wood are discussed. The laminated veneer and the bonded sawn stock fabrication techniques, used in the construction of a turbine blade with a monocoque 'D' section forming the leading edge and a built up trailing edge section, are described. A 20 foot root end sample complete with 24 bonded-in studs was successfully subjected to large onetime loads in both the flatwise and edgewise directions, and to fatigue tests. Results indicate that wood is both a viable and advantageous material for use in wind turbine blades. The basic material is reasonably priced, domestically available, ecologically sound, and easily fabricated with low energy consumption. A.R.H.

N80-16475*# Kaman Aerospace Corp., Bloomfield, Conn.
LARGE, LOW COST COMPOSITE WIND TURBINE BLADES

Herbert W. Gewehr *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 309-324 refs

Avail: NTIS HC A20/MF A01 CSCL 10B

A woven roving E-glass tape, having all of its structural fibers oriented across the tape width was used in the manufacture of the spar for a wind turbine blade. Tests of a 150 ft composite blade show that the transverse filament tape is capable of meeting structural design requirements for wind turbine blades. Composite blades can be designed for interchangeability with steel blades in the MOD-1 wind generator system. The design, analysis, fabrication, and testing of the 150 ft blade are discussed. A.R.H.

N80-16476*# Boeing Engineering and Construction, Seattle, Wash.

THE MOD-1 STEEL BLADE

John VanBronkhorst *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 325-342

Avail: NTIS HC A20/MF A01 CSCL 10B

The design, development, fabrication, testing, and transport of two 100 foot metal blades for the MOD-1 WTS are summarized. Because the metal blade design was started late in the MOD-1 system development, many of the design requirements (allocations) were restrictive for the metal blade concept, particularly the maximum weight requirement. The design solutions required to achieve the weight goal resulted in a labor intensive (expensive) fabrication, particularly for a quantity of only two blades manufactured using minimal tooling. A.R.H.

N80-16477*# Boeing Engineering and Construction, Seattle, Wash.

THE BOEING MOD-2 WIND TURBINE SYSTEM ROTOR

Gordon N. Davison *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 343-354

Avail: NTIS HC A20/MF A01 CSCL 10B

External configuration, environmental, and internal design requirements for the 300 foot diameter MOD-2 rotor are discussed, with emphasis on design details, significance of fatigue strength, design development test results, and conclusions of the preliminary design efforts. A.R.H.

N80-16478*# Southern California Edison Co., Rosemead.
STATUS OF THE SOUTHERN CALIFORNIA EDISON COMPANY 3 MW WIND TURBINE GENERATOR (WTG) DEMONSTRATION PROJECT

Robert L. Scheffler *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 355-362

Avail: NTIS HC A20/MF A01 CSCL 10B

To demonstrate the concept of utility scale electricity production from a high wind energy resource, a program was initiated to construct and test a 3 megawatt (3,000 kW) Schachle wind turbine generator near Palm Springs, California. The

background and current status of this program are presented along with a summary of future planned program activities.

A.R.H.

N80-16479*# Institut de Recherche de l'Hydro-Quebec. Varennes (Canada).

RESULTS OF A UTILITY SURVEY OF THE STATUS OF LARGE WIND TURBINE DEVELOPMENT

A. Watts, S. Quraeshi (Shawinigan Eng. Co. Ltd., Montreal), and L. P. Rowley (Canadair Ltd., Montreal) *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 363-374

Avail: NTIS HC A20/MF A01 CSCL 10B

Wind energy conversion systems were surveyed from a utility viewpoint to establish the state of the art with regard to: (1) availability of the type of machines; (2) quality of power generation; (3) suitability for electrical grid; (4) reliability; and (5) economics. Of the 23 designs discussed, 7 have vertical axis wind turbines, 9 have upwind horizontal axis turbines, and 7 have downwind horizontal axis turbines. A.R.H.

N80-16480*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SIMULATION STUDIES OF MULTIPLE LARGE WIND TURBINE GENERATORS ON A UTILITY NETWORK

Leonard J. Gilbert and David M. Triesenberg (Purdue Univ.) *In* its Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 375-384 refs

Avail: NTIS HC A20/MF A01 CSCL 10B

The potential electrical problems that may be inherent in the inertia of clusters of wind turbine generators and an electric utility network were investigated. Preliminary and limited results of an analog simulation of two MOD-2 wind generators tied to an infinite bus indicate little interaction between the generators and between the generators and the bus. The system demonstrated transient stability for the conditions considered. A.R.H.

N80-16481*# Hamilton Standard, Windsor Locks, Conn.

SYSTEM CONFIGURATION IMPROVEMENT

Glidden S. Doman *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 385-396

Avail: NTIS HC A20/MF A01 CSCL 10B

Factors involved in the choice of the system configuration for the wind turbine generator are listed. It was found that choices among the many configuration options can be based strictly upon the resulting cost of energy results. Choices made on that basis also lead to reduced analytical complexity, less hardware complexity and reduced program risk. It was also found that many seemingly minor details turn out to have important impacts that are seen only after design, performance and cost-finding were thoroughly probed. M.M.M.

N80-16482*# Hamilton Standard, Windsor Locks, Conn.

COST OF ENERGY EVALUATION

Thad M. Hasbrouck *In* NASA. Lewis Res. Center Large Wind Turbine Design Characteristics and R and D Requirements Dec. 1979 p 397-402

Avail: NTIS HC A20/MF A01 CSCL 10B

The estimated cost per kilowatt hour, the wind resources in the utilities service area, and the reliability of the units are considered in computing the cost of energy of the wind turbine generator system. M.M.M.

N80-16483*# Energy Technology, Inc., Cleveland, Ohio.

STUDY OF ADVANCED RADIAL OUTFLOW TURBINE FOR SOLAR STEAM RANKINE ENGINES

Cecil Martin and Terry Kolenc Dec. 1979 74 p refs (Contract DEN3-86)

(NASA-CR-159695; DOE/NASA/0086-79/1; ETI-1279) Avail: NTIS HC A04/MF A01 CSCL 10B

The performance characteristics of various steam Rankine engine configurations for solar electric power generation were

investigated. A radial outflow steam turbine was investigated to determine: (1) a method for predicting performance from experimental data; (2) the flexibility of a single design with regard to power output and pressure ratio; and (3) the effect of varying the number of turbine stages. All turbine designs were restricted to be compatible with commercially available gearboxes and generators. A study of several operating methods and control schemes for the steam Rankine engine shows that from an efficiency and control simplicity standpoint, the best approach is to hold turbine inlet temperature constant, vary turbine inlet pressure to match load, and allow condenser temperature to float maintaining constant heat rejection load. A.R.H.

N80-16485*# General Electric Co., Philadelphia, Pa. Space Div.

PROTOTYPE SOLAR HEATING AND COMBINED HEATING COOLING SYSTEMS

DOE 2 Oct. 1978 44 p Sponsored in part by DOE (Contract NAS8-32092) (NASA-CR-161340; QR-9) Avail: NTIS HC A03/MF A01 CSCL 10A

The design and development of eight prototype solar heating and combined heating and cooling systems is discussed. The program management and systems engineering are reported, and operational test sites are identified. A.W.H.

N80-16487*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

EVALUATION OF CONCENTRATED SPACE SOLAR ARRAYS USING COMPUTER MODELING

D. E. Rockey 1 Nov. 1979 54 p refs (Contract NAS7-100) (NASA-CR-162681; JPL-PUB-79-87) Avail: NTIS HC A04/MF A01 CSCL 10A

A general approach is developed for predicting the power output of a concentrator enhanced photovoltaic space array. A ray trace routine determines the concentrator intensity arriving at each solar cell. An iterative calculation determines the cell's operating temperature since cell temperature and cell efficiency are functions of one another. The end result of the iterative calculation is that the individual cell's power output is determined as a function of temperature and intensity. Circuit output is predicted by combining the individual cell outputs using the single diode model of a solar cell. Concentrated array characteristics such as uniformity of intensity and operating temperature at various points across the array are examined using computer modeling techniques. An illustrative example is given showing how the output of an array can be enhanced using solar concentration techniques. Author

N80-16491*# Foster-Miller Associates, Inc., Waltham, Mass. **A 15kW_e (NOMINAL) SOLAR THERMAL ELECTRIC POWER CONVERSION CONCEPT DEFINITION STUDY: STEAM RANKINE REHEAT RECIPROCATOR SYSTEM Final Report**

H. Fuller, R. Demler, E. Poulin, and P. Dantowitz Jun. 1979 63 p refs (Contracts DEN3-62; EX-76-A-29-1060) (NASA-CR-159590; DOE/NASA/0062-79/1; NAS-7845) Avail: NTIS HC A04/MF A01 CSCL 10B

An evaluation was made of the potential of a steam Rankine reheat reciprocator engine to operate at high efficiency in a point-focusing distributed receiver solar thermal-electric power system. The scope of the study included the engine system and electric generator; not included was the solar collector/mirror or the steam generator/receiver. A parametric analysis of steam conditions was completed leading to the selection of 973 K 12.1 MPa as the steam temperature/pressure for a conceptual design. A conceptual design was completed for a two cylinder/opposed engine operating at 1800 rpm directly coupled to a commercially available induction generator. A unique part of the expander design is the use of carbon/graphite piston rings to eliminate the need for using oil as an upper cylinder lubricant. The evaluation included a system weight estimate of 230 kg at the mirror focal point with the condenser mounted separately on the ground. The estimated cost of the overall system is \$1932 or \$90/kW for the maximum 26 kW output. R.E.S.

N80-16492*# Wyle Labs., Inc., Huntsville, Ala.

OUTDOOR TEST FOR THERMAL PERFORMANCE EVALUATION OF THE OWENS-ILLINOIS SUNPACK SEC-601 (AIR) SOLAR COLLECTOR

Dec. 1979 28 p Sponsored in part by DOE Prepared for IBM Federal Systems Div., Huntsville, Ala. (Contract NAS8-32036) (NASA-CR-161339; WYLE-TR-531-37R) Avail: NTIS HC A03/MF A01 CSCL 10A

The test procedures used and the test results obtained during the performance of an evaluation test program on the Owens-Illinois Sunpak, model SEC-601, air solar collector under natural outdoor weather conditions are presented. All testing activities were performed on a single module. The test was performed and the data evaluated as applicable to outdoor testing of solar collectors. J.M.S.

N80-16493*# Sundstrand Corp., Rockford, Ill.

THE 15 kW SUB_e (NOMINAL) SOLAR THERMAL ELECTRIC POWER CONVERSION CONCEPT DEFINITION STUDY: STEAM RANKINE TURBINE SYSTEM Final Report

Timothy J. Bland Oct. 1979 63 p refs (Contracts DEN3-61; EX-76-A-29-1060) (NASA-CR-159589; AER-1713; DOE/NASA/0061-79/1) Avail: NTIS HC A04/MF A01 CSCL 10A

A study to define the performance and cost characteristics of a solar powered, steam Rankine turbine system located at the focal point of a solar concentrator is presented. A two stage re-entry turbine with reheat between stages, which has an efficiency of 27% at a turbine inlet temperature of 732 C was used. System efficiency was defined as 60 Hertz electrical output divided by absorbed thermal input in the working fluid. Mass production costs were found to be approximately 364 dollars/KW. R.E.S.

N80-16494*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PRELIMINARY ANALYSIS OF PERFORMANCE AND LOADS DATA FROM THE 2-MEGAWATT MOD-1 WIND TURBINE GENERATOR

D. A. Spera, L. A. Viterna, T. R. Richards, and H. E. Neustadter 1979 16 p refs Presented at 4th Biennial Conf. and Workshop on Wind Energy Conversion Systems, Washington, D.C., 29-31 Oct. 1979; sponsored by DOE (Contract EX-77-A-29-1010) (NASA-TM-81408; DOE/NASA/1010-79/5; E-322) Avail: NTIS HC A02/MF A01 CSCL 10A

Preliminary test data on output power versus wind speed, rotor blade loads, system dynamic behavior, and start-stop characteristics on the Mod-1 wind turbine generator are presented. These data were analyzed statistically and are compared with design predictions of system performance and loads. To date, the Mod-1 wind turbine generator has produced up to 1.5 MW of power, with a measured power versus wind speed curve which agrees closely with design. Blade loads were measured at wind speeds up to 14 m/s and also during rapid shutdowns. Peak transient loads during the most severe shutdowns are less than the design limit loads. On the inboard blade sections, fatigue loads are approximately equal to the design cyclic loads. On the outboard blade sections, however, measured cyclic loads are significantly larger than design values, but they do not appear to exceed fatigue allowable loads as yet. R.E.S.

N80-16495*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Semiconductor Group.

SEMICONDUCTOR GRADE, SOLAR SILICON PURIFICATION PROJECT Final Report

W. M. Ingle, R. R. Rosler, S. W. Thompson, and R. E. Chaney 10 Dec. 1979 173 p (Contract JPL-954442) (NASA-CR-162746; DOE/JPL-954442-78/12; Motorola-2257/12) Avail: NTIS HC A08/MF A01 CSCL 10A

Experimental apparatus and procedures used in the development of a 3-step SiF₂(x) polymer transport purification process are described. Both S.S.M.S. and E.S. analysis demonstrated

that major purification had occurred and some samples were indistinguishable from semiconductor grade silicon (except possibly for phosphorus). Recent electrical analysis via crystal growth reveals that the product contains compensated phosphorus and boron. The low projected product cost and short energy payback time suggest that the economics of this process will result in a cost less than the goal of \$10/Kg(1975 dollars). The process appears to be readily scalable to a major silicon purification facility. A.R.H.

N80-16497# University of Southeastern Massachusetts, North Dartmouth.

ECONOMICS OF GEOTHERMAL POWER

R. DiPippo Feb. 1979 13 p Transl. into ENGLISH from Nucl. Elec. Power Generation (Japan), v. 26, no. 9, Sep. 1975 p 1039-1043

(Contract EY-76-S-02-4051)

(COO-4051-43) Avail: NTIS HC A02/MF A01

Geothermal, steam, nuclear, and hydraulic construction costs, power generating costs, and utilization rate are compared. The risk factor in exploratory geothermal wells is discussed. DOE

N80-16498# Los Alamos Scientific Lab., N. Mex.

CHARACTERIZATION OF CRUSHED GLASS AS A TRANSPIRED AIR HEATING SOLAR COLLECTOR MATERIAL

R. K. Collier 1979 6 p refs Presented at the Intern. Solar Energy Soc. Meeting, Atlanta, 28 May 1979

(Contract W-7405-eng-36)

(LA-UR-79-1336; CONF-790541-7)

Avail: NTIS

HC A02/MF A01

The use of crushed glass matrices as the heat absorbing media in air heating solar collectors was investigated. The most likely candidate glass types and sizes were characterized by measuring pressure drops, optical extinction coefficients, and volumetric heat transfer coefficients. Bed efficiencies were also measured and found to be similar to those expected for screen matrices unless critical amounts of clear glass were used as a top layer, which results in lower efficiency. DOE

N80-16499# Technical Translation Service, Albuquerque, N. Mex.
USE OF SOLAR ENERGY FOR THE PRODUCTION OF ELECTRICITY IN THE ALPS

Jan. 1979 48 p Transl. into ENGLISH from Serie de Publications de la Commission Federale de la Conception Globale de l'Energie (Geneva), etude no. 7 Oct. 1976 48 p Prepared in cooperation with Battelle Memorial Inst., Geneva, Switzerland (SAND-79-6000) Avail: NTIS HC A03/MF A01

Means of converting solar energy into electricity are reviewed. Applications of solar energy technology to meet the increasing demand for electricity in Switzerland are considered. A description and discussion of central tower and heliostat field systems is presented. Details concerning steam cycles and solar boilers, turboalternator units and heat exhaust systems, daily and seasonal power variations of a solar plant, and effects on energy output due to cloudiness are considered. Meteorological data for the evaluation of possible solar generating sites is discussed and the solar potential of the Alps is analyzed. Integration of solar plants into the existing power grid is discussed. The economic and environmental impacts of solar power plants are considered in detail and a development program is suggested. DOE

N80-16500# Department of Energy, Washington, D. C. Energy Information Administration.

SOLAR COLLECTOR MANUFACTURING ACTIVITY Energy Data Report, Jul. - Dec. 1978

Sep. 1979 45 p

(DOE/EIA-0174/78) Avail: NTIS HC A03/MF A01

Results from a survey of solar collector manufacturing and importing activity are presented. Manufacturers of medium temperature liquid collectors, used primarily for hot water and space heating, low temperature nonmetallic collectors used for pool heating, and special collectors (evacuated tube collector or a concentrating collector), used for pool heating and for air conditioning and specialized industrial processes are included. J.M.S.

N80-16501# Lincoln Lab., Mass. Inst. of Tech., Lexington.

FLYWHEEL ENERGY STORAGE AND CONVERSION SYSTEM FOR PHOTOVOLTAIC APPLICATIONS

A. R. Millner 1979 7 p refs Presented at the Mech. and Magnetic Energy Storage Conductor Ann. Rev., Washington, D.C., 19-22 Aug. 1979

(Contract EY-76-C-02-4094)

(COO-4094-57; CONF-790854-3)

Avail: NTIS

HC A02/MF A01

A project to develop a flywheel energy storage unit for use with photovoltaics in residential or load center applications is described. The unit employs a high efficiency permanent-magnet motor-generator and cycloconverter electronics to convert dc input to regulated ac output. The fabrication of a scale model unit, scaling laws for residential and intermediate load center sizes, and worth and cost estimation are discussed. DOE

N80-16502# Brookhaven National Lab., Upton, N. Y.

DECENTRALIZED ENERGY: TECHNOLOGY ASSESSMENT AND SYSTEMS DESCRIPTION

M. K. Reckard Jun. 1979 206 p refs

(Contract EY-76-C-02-0016)

(BNL-50987) Avail: NTIS HC A10/MF A01

Decentralized energy systems and their characteristic features are examined. These systems are divided into six groups for the purpose of analysis: solar, wind, hydro, biomass, geothermal, and coproduction (total energy). The technical and economic potential for the implementation of these systems is discussed for the years 2000 and 2025. The results of a comparison of base-case and decentralized scenarios for the year 2000, using a computer systems model, are presented. Social and institutional factors are also addressed, both as motivations for and results of energy system decentralization. Appendices are included with more detailed technical information on each of the systems groups. DOE

N80-16503# Department of Energy, Washington, D. C.

ENVIRONMENTAL DEVELOPMENT PLAN: SOLAR THERMAL POWER SYSTEMS

Aug. 1979 45 p refs

(DOE/EDP-0035) Avail: NTIS HC A03/MF A01

The goals of the program and potential environmental, health, safety, and socioeconomic impacts relevant to solar thermal power systems (STPS), particularly those sited in the Southwest are discussed. These impacts are screened for key issues, i.e., those issues considered to be the most serious in nature, that have near-term importance to the program, and for which current knowledge of effects and control is inadequate. A management plan is then presented for conducting and coordinating environmental research in concert with the technology development effort to ensure that identified environmental issues are resolved prior to significant public deployment of the technology. Key environmental concerns associated with the development and deployment of STPS were identified in the following subject areas: (1) site selection (including the question of water availability); (2) ecological and microclimatic effects; (3) working fluid handling and release modes; and (4) misdirected solar radiation. DOE

N80-16504# National Climatic Center, Asheville, N. C.

INPUT DATA FOR SOLAR SYSTEMS

V. Cinquemani, J. R. Owenby, Jr., and R. G. Baldwin Aug. 1979 203 p refs

(Contract EX-76-A-29-1041)

(DOE/TIC-10193-Rev-1) Avail: NTIS HC A10/MF A01

Normals (30-year mean values) of maximum, minimum, and average temperatures for a month or year, and of heating and cooling degree days are provided for 248 U.S. stations. Average daily values of total hemispheric (global) solar radiation on a horizontal surface were based on corrected hourly measurements for 25 stations, derived values from corrected measurements for 25 stations, and derived values from the corrected measurements for the remaining 222 stations. DOE

N80-16505# Sandia Labs., Albuquerque, N. Mex.

WORKSHOP ON POWER CONDITIONING FOR ALTERNATIVE ENERGY TECHNOLOGIES, EXECUTIVE SUMMARY

N80-16506

D. R. Smith 1979 139 p Workshop held at Denver, 9-11 May 1979

(Contracts EY-76-C-04-0789; EG-77-C-01-4042)
(SERI-TP-35-217-Pt-2) Avail: NTIS HC A07/MF A01

The development of power conditioners for alternative energy technologies is presented. Topics discussed include: (1) assessments of current technology; (2) identification of operational requirements with a comparison of requirements for each source technology; (3) the identification of future technology trends; (4) the determination of mass production and marketing requirements; and (5) recommendations for program direction.

DOE

N80-16506# Oak Ridge National Lab., Tenn.
FOSSIL ENERGY PROGRAM Quarterly Progress Report, period ending 30 Sep. 1978

L. E. McNeese Jan. 1979 287 p refs
(Contract W-7405-eng-26)

(ORNL-5487) Avail: NTIS HC A13/MF A01

Research and development projects that are carried out in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy are reviewed. These projects include: coal conversion techniques, coal gasification processes, fossil energy environmental studies, materials technology development for coal conversion, and a life sciences synthetic fuel program for biological research of health hazards in coal conversion.

DOE

N80-16507# Brookhaven National Lab., Upton, N. Y.
COMPUTER SIMULATION OF GROUND COUPLED STORAGE IN A SERIES SOLAR ASSISTED HEAT PUMP SYSTEM

J. W. Andrews and Philip D. Metz 1979 5 p refs Presented at the 1979 Intern. Solar Energy Soc. Congr., Atlanta, 28 May - 1 Jun. 1979

(Contract EY-76-C-02-0016)

(BNL-26216; CONF-790541-25) Avail: NTIS HC A02/MF A01

The effect of thermal coupling between the ground and the heat storage element of a series solar assisted heat pump system is studied quantitatively. The transient simulation computer program TRNSYS is used to simulate the solar portion of this system. A program to simulate the thermal interaction of the storage element with the ground is incorporated into TRNSYS as a subroutine. This program calculates heat flow through the ground in discrete steps over space and time. Boundary conditions are established. The ground coupled storage is driven by thermal inputs from the solar portion of the system and from the changing ambient and ground temperatures.

DOE

N80-16508# General Atomic Co., San Diego, Calif.
FIXED MIRROR SOLAR CONCENTRATOR FOR APPLICATION TO A 100 MW(e) ELECTRIC GENERATING PLANT

J. R. Schuster, J. M. Neill, and J. Bass May 1979 6 p refs Presented at the 14th Intersoc. Energy Conf., Boston, 5-10 Aug. 1979

(Contract ET-78-C-03-2240)

(GA-A-15340; CONF-790803-10) Avail: NTIS HC A02/MF A01

A design study was performed of a 100 MW(e) power plant that uses a fixed mirror solar concentrator (FMSC) to supply energy for steam generation. Various heat transport fluids were considered and draw salt was selected over Therminol 88 and sodium. The complete plant was modeled in a cost performance optimization code which automatically performed tradeoffs such as reduced blocking vs increased piping costs, field piping heat loss vs pumping power, and fluid outlet temperature vs overall system efficiency. Various collector and receiver designs were studied and evaluated for their cost effectiveness. Operational requirements impacting the component designs were identified.

DOE

N80-16509# Brookhaven National Lab., Upton, N. Y.
EXPERIMENTAL RESULTS FROM THE SOLAR GROUND COUPLING RESEARCH FACILITY AT BROOKHAVEN NATIONAL LABORATORY

P. D. Metz 1979 5 p refs Presented at the Intern. Solar Energy Soc. Meeting, Atlanta, 28 May - 1 Jun. 1979

(Contract EY-76-C-02-0016)

(BNL-26219; CONF-790541-27) Avail: NTIS HC A02/MF A01

The results of the first half year of operation of the solar ground coupling research facility are presented. The data from the eight original experiments are analyzed. A computer model of the heat transfer between first generation ground coupled heat transfer and storage devices for a solar source heat pump system and the Earth is discussed.

DOE

N80-16510# Massachusetts Inst. of Tech., Cambridge.
INDEPENDENT ASSESSMENT OF ENERGY POLICY MODELS Final Report

E. Kuh and D. O. Wood May 1979 273 p refs Sponsored by EPRI

(EPRI Proj. 1015-1)

(EPRI-EA-1071) Avail: NTIS HC A12/MF A01

Energy policy models are reviewed and analyzed. Two energy system models, the Baughman-Joskow regionalized electricity model and the Wharton annual energy model are assessed and the organizational and procedural issues in the model assessment process are identified.

DOE

N80-16511# Midwest Research Inst., Golden, Colo.
SOIL FERTILITY AND SOIL LOSS CONSTRAINTS ON CROP RESIDUE REMOVAL FOR ENERGY PRODUCTION

S. Flaim Jul. 1979 38 p refs

(Contract EG-77-C-01-4042)

(SERI/RR-52-324) Avail: NTIS HC A03/MF A01

A summary of the methodologies used to estimate the soil fertility and soil loss constraints on crop residue removal for energy production is presented. Estimates of excess residue are developed for wheat in north central Oklahoma and for corn and soybeans in central Iowa. The sample farming situations are analyzed.

DOE

N80-16512# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLAR PHOTOVOLTAIC FIELD TESTS AND APPLICATIONS PROJECT Quarterly Technical Report, 1 Apr. - 30 Jun. 1978

1978 58 p refs

(Contract EY-76-C-02-4094)

(COO-4094-26) Avail: NTIS HC A04/MF A01

Field tests for a variety of both large and small experimental photovoltaic systems are summarized. Support activities in the areas of power conditioning, control, and storage; materials, processes, testing, and data acquisition are reviewed.

DOE

N80-16513# Midwest Research Inst., Golden, Colo.
OBJECTIVES AND STRATEGIES OF THE INTERNATIONAL PHOTOVOLTAIC PROGRAM PLAN

D. Costello, D. Posner, R. Koontz, P. Heiferling, P. Carpenter (JPL), and L. Perelman (JPL) Jul. 1979 45 p refs

(Contract EG-77-C-01-4042)

(SERI/TR-52-250) Avail: NTIS HC A03/MF A01

The objective of the International Photovoltaic Program Plan, the strategies that will be used in the plan, and the approach that is being taken to prepare the plan are described. Background on photovoltaic technology and markets and the DOE domestic photovoltaic effort is also presented.

DOE

N80-16514# Midwest Research Inst., Golden, Colo.
PROCEEDINGS: PHOTOVOLTAICS USER REVIEW PANEL
S. Carroll Aug. 1979 26 p refs Proc. held at Golden, Colo., 6-7 Mar. 1979

(Contract EG-77-C-01-4042)

(SERI/TP-69-276) Avail: NTIS HC A03/MF A01

The discussions, recommendations, and conclusions of the photovoltaics user review panel are presented. The purpose of the panel discussion was to determine the technical information dissemination (TID) needs for target audiences, to reach agreement on what informational products could fill these needs and who should produce the materials, and to establish priorities for the

need for the TID products. Technological areas discussed include photovoltaics, solar thermal power, biomass, wind energy conversion, and ocean thermal energy conversion. DOE

N80-16515# Kaiser Aluminum and Chemical Corp., Pleasanton, Calif.

ENERGY SAVINGS THROUGH USE OF AN IMPROVED REDUCTION CELL CATHODE

W. H. Goodnow 1979 19 p refs
(Contract EC-76-C-03-1257)

(SAN-1257-T2) Avail: NTIS HC A02/MF A01

Material characterization for a wettable and rained Hall cell cathode was expanded to include inspection of TiB₂ components for the 15KA cell restart. The cell was restarted and went through a shutdown and performance monitoring period. An engineering and economic study of TiB₂ retrofit into existing cells was carried to the point where a sensitivity type cost analysis was done. DOE

N80-16516# Sandia Labs., Albuquerque, N. Mex. Thermal and Fluid Sciences Dept.

COMPARATIVE ANALYSIS OF SOLAR ENERGY STORAGE CYCLES

C. E. Hackett 1979 25 p refs Presented at the Intern. Conf. on Solar Energy, Milan, 23 Sep. 1979

(SAND-79-1803C; CONF-790954-1) Avail: NTIS HC A02/MF A01

A thermodynamic technique is presented which will enable the assessment of the overall performance of various storage options on an absolute basis so that cost effective designs can be developed to obtain the full thermodynamic and system advantages of energy storage. First the underlying thermodynamic principles of entropy production analysis are examined. The various energy storage schemes are classified. Detailed analyses were developed to cover the various generic types of energy storage which are appropriate for solar power systems. DOE

N80-16517# Sandia Labs., Albuquerque, N. Mex.

PREPARATION OF THIN FILMS FOR SOLAR ENERGY UTILIZATION

D. M. Mattox 1979 17 p refs Presented at the National Vacuum Symp., New York, N.Y., 2 Oct. 1979

(Contract EY-76-C-04-0789)
(SAND-79-1754C; CONF-791013-2) Avail: NTIS HC A02/MF A01

A technology assessment of thin film deposition techniques is presented. Commercial applications of thin films include photothermal selective absorbers formed by electroplating, chemical conversion and vacuum processing; solar reflectors formed by vacuum processes; heat reflectors formed by vacuum processes and spray pyrolysis; antireflection coatings formed by vacuum processes and chemical leaching and the metallization of photovoltaic cells. CdS/Cu₂S photovoltaics formed by vacuum processes and spray pyrolysis are also close to commercial utilization. Principle concerns in thin films applications include economics of fabrication and environmental stability of the thin film materials. One of the major problems with thin film evaluation is the lack of acceptable testing procedures particularly as related to lifetime. The status of thin films in solar energy utilization is reviewed. DOE

N80-16520# Idaho National Engineering Lab., Idaho Falls.

COMMERCIAL PROTOTYPE DESIGN OF A SOLAR HEATING/COOLING SYSTEM FOR A MANUFACTURED HOME

M. P. Scofield (EG&G Idaho, Inc., Idaho Falls), A. S. Lau (EG&G Idaho, Inc., Idaho Falls), K. H. Liebelt (EG&G Idaho, Inc., Idaho Falls), N. R. Shinn (Boise Cascade Corp., Idaho), and T. L. Schafer (Boise Cascade Corp., Idaho) Sep. 1979 140 p refs Prepared jointly with Boise Cascade Corp., Idaho
(Contract EY-76-C-07-1570)

(TREE-1384) Avail: NTIS HC A07/MF A01

A prototype design is presented for a solar heating and cooling system for a manufactured modular home. The objective was to develop an active solar system for space heating that would be competitive with conventional energy sources; that is, the increase in the mortgage payment would be completely and

simultaneously recovered from energy savings. The heating and cooling system features air collectors that are structurally part of the south facing rear wall, rock storage that is in the basement, and a heat exchanger that preheats domestic hot water. Summer cooling is achieved by cooling rock storage at night and circulating house air through the storage during the day as required. Two nearly identical homes were designed and built incorporating the prototype system. Both in Idaho, one house is located in Boise, the other in Idaho Falls, placing the homes in distinctly different climates. Both homes are being monitored for a two-year period to obtain dynamics and long-term performance data. The results of the monitoring will be the subjects of further reports. DOE

N80-16521# Solar Environmental Engineering Co., Inc., Fort Collins, Colo.

CONTINUING REGIONAL SOLAR ENERGY INFORMATION MINI-CENTER ACTIVITIES AND UPDATING THE SOLCOST PROGRAM Quarterly Report

L. J. Lantz Jul. 1979 69 p

(Contract EG-77-C-02-4643)

(COO-4643-T2) Avail: NTIS HC A04/MF A01

Progress in the various tasks in the program to develop SOLCOST is reviewed. Several SOLCOST examples are included. DOE

N80-16522# Institute of Gas Technology, Chicago, Ill.

SOLAR-MEC DEVELOPMENT PROGRAM, PROJECT 9103 Semiannual Progress Report, 1 Sep. 1977 - 28 Feb. 1978

J. Wurm, S. A. Weil, and L. R. Wright Jan. 1979 44 p

(Contract EG-77-C-02-4495)

(COO-4495-7) Avail: NTIS HC A03/MF A01

The dynamic performance of a supported molecular-sieve, regenerative, heat and mass exchanger is reported, under input conditions typical of the operation of a solar-power open desiccant cooling system. The experimental data are compared with a computer model describing the dynamic processes of air drying and desiccant regeneration of the Solar-MEC desiccant cooling system. The test setup, the experimental program, and the results of diagnostic steps to evaluate and minimize air leakage rates within the Solar-MEC system are described. The test design and experimental approach to verify the performance of the rotary regenerative (sensible) heat exchanger are reported. DOE

N80-16524# Sandia Labs., Albuquerque, N. Mex.

SOLAR CENTRAL TEST FACILITY

G. E. Brandvold and John T. Holmes 1979 18 p Presented at the Frontiers of Power Generation Conf., Stillwater, Okla., 24 Sep. 1979

(Contract EY-76-C-04-0789)

(SAND-79-1730C; CONF-790924-1) Avail: NTIS HC A02/MF A01

The central receiver test facility capable of delivering 5 million watts of thermal power to experimental equipment is described. The primary CRTF testing programs which involve prototype components (receivers and heliostats) for central receiver solar electric power plants are discussed and the high solar flux and high temperature research and development work is reported. DOE

N80-16525# Department of Energy, Washington, D. C.

FEDERAL PHOTOVOLTAICS UTILIZATION PROGRAM

Jun. 1979 40 p refs

(DOE/EA-0087) Avail: NTIS HC A03/MF A01

The potential environmental effects of silicon cell technology are analyzed. It is noted that any potential environmental impacts of this technology occur in connection with manufacturing of silicon cells and proposed applications of photovoltaic systems. However, it was found that there are no known adverse environmental effects associated with the federal photovoltaics utilization program which cannot be mitigated or avoided. DOE

N80-16527# Boston Univ., Mass. Dept. of Chemistry.

ORGANIC PHOTO-CHEMICAL STORAGE OF SOLAR ENERGY Progress Report, 1 Mar. 1978 - 31 Jan. 1979

G. Jones, II Feb. 1979 24 p refs

(Contract EG-77-S-02-4380)

(COO-4380-2) Avail: NTIS HC A02/MF A01

N80-16528

Photosensitization mechanisms for driving energy storing reactions of readily available organic compounds were studied. Aromatic sensitizers were used as complexing agents for a series of non-conjugated dienes which are capable of valence isomerization. Diene exciplexes, shown to be stabilized by electron donor-acceptor interaction, led to photoisomers with chemical and quantum efficiency in two of the cases studied. With triplet photosensitizers visible light (to 520 nm) was used to bring about an energy storing valence isomerization of a diester derivative of norbornadiene. High quantum yields (0.6) were measured at the longest wavelengths yet utilized for this type of isomerization. The quantum efficiency for isomerization using a very low energy triplet sensitizer was significantly enhanced at slightly elevated temperatures, suggesting that thermal energy (in amounts present in solar collector media) can be an aid in driving energy storing photo-reactions. DOE

N80-16528# Sandia Labs., Albuquerque, N. Mex. MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY EXPERIMENT MANUAL AND TEST PLAN

Aug. 1979 52 p refs
(Contract EY-76-C-04-0789)
(SAND-79-0379) Avail: NTIS HC A04/MF A01

The midtemperature solar systems test facility is described and the procedures for selecting items to be evaluated there are outlined. The prerequisites for installing such items are defined, the typical tests performed are described, and the reports generated and disseminated from the facility are discussed. DOE

**N80-16529# Midwest Research Inst., Golden, Colo.
PERFORMANCE CHARACTERISTICS OF A COM-
MERCIALLY AVAILABLE POINT-FOCUS SOLAR POWER**
M. Bohn Apr. 1979 12 p refs Presented at the ASME/AICHE
Natl. Heat Transfer Conf., San Diego, Calif., Aug. 1979
(Contract EG-76-C-01-4042)
(SERI/TP-34-169; CONF-790808-17) Avail: NTIS
HC A02/MF A01

The performance of a commercially available solar electric power system is described in terms of instantaneous electrical power output for a given insolation and electrical energy production per day. Receiver thermal loss coefficient and concentrator optical efficiency are measured and system performance is given using steam cycle efficiency and electrical generator efficiency as parameters. DOE

**N80-16532# Argonne National Lab., Ill. Energy and Environmen-
tal Systems Div.
SOLAR AVAILABILITY FOR WINTER SPACE HEATING: AN
ANALYSIS OF THE CALENDAR PERIOD 1953-1975**
J. G. Asbury, C. Maslowski, and R. O. Mueller Apr. 1979
20 p refs
(Contract W-31-109-eng-38)
(ANL/SPG-14) Avail: NTIS HC A02/MF A01

Data tapes for eight US sites containing hourly readings of insolation and ambient temperature for the period 1953-1975 were analyzed. Scatter-diagrams of insolation versus heating degree-days, compiled on a daily basis, indicate a wide variation in insolation levels, even during periods of coldest weather. For seven of the eight sites, the peak-day backup energy required by a solar space heating system exceeded 85 percent of the peak-day energy requirement of a conventional (nonsolar) heating system. The cities considered are Albuquerque (NM), Bismark (ND), Boston (MA), Caribou (ME), Columbia (MO), Madison (WI), Seattle (WA), and Sterling (VA). DOE

N80-16535# Delaware Univ., Newark. PHOTOVOLTAIC EFFECT, ITS PRESENT UNDERSTANDING AND REMAINING MYSTERIES

K. W. Boer 1979 5 p refs Presented at the Intern. Solar
Energy Society Meeting, Atlanta, 28 May 1979 Prepared jointly
by SES, Inc., Newark, Del.
(Contract EX-76-C-23-1030)
(DOE/ET/23103-6; CONF-790541-44) Avail: NTIS
HC A02/MF A01

The present phenomenological understanding of the photo-
voltaic effect and solar cells is discussed. Unexplained questions

and problems with the effects of various device parameters on the current-voltage characteristics are discussed, and the need for more sophisticated theoretical analyses of photovoltaic cells is stressed. DOE

**N80-16537# Motorola, Inc., Phoenix, Ariz. Semiconductor
Group.**

LOW-COST STRUCTURES FOR PHOTOVOLTAIC ARRAYS Final Report

P. Masser Aug. 1979 204 p refs
(Contract EY-76-C-04-0789)
(SAND-79-7006) Avail: NTIS HC A10/MF A01

Designs of photovoltaic array support structures, which encourage life cycle cost reduction through mass production techniques, material cost reduction, and simplified installation methods, are presented. Nontracking collectors with a low concentration ratio (one to about two suns) are considered primarily for commercial and utility applications. The results are applicable to both thermal and photovoltaic flat plate collectors. A value analysis approach was used, starting with a survey of the current state-of-the-art which found an absence of pertinent references on array support structures. Also, realistic load criteria were not found, and this was determined to be a key area for future cost reduction. Heights above the ground, array geometry, and wind direction all have important effects on loads. Foundation design was also found to be a key area for future cost reduction. A generic concept study was conducted, aimed at life cycle cost reduction, and representative examples were chosen. DOE

N80-16538# Midwest Research Inst., Golden, Colo. PHOTOVOLTAIC MATERIALS AND DEVICE MEASURE- MENTS WORKSHOP: FOCUS ON POLYCRYSTALLINE THIN FILM CELLS

1979 190 p refs Workshop, held at Arlington, Va., 11 Jun.
1979
(Contract EG-77-C-01-4042)
(SERI/TP-49-185; CONF-790601) Avail: NTIS
HC A09/MF A01

Papers on the development of thin film solar cells by improving the versatility and reliability of material and device measurement techniques are presented. Structural/chemical aspects, electro-optics, and charge transport techniques are emphasized. DOE

N80-16539# Sandia Labs., Albuquerque, N. Mex. ECONOMIC ANALYSIS OF DARRIEUS VERTICAL AXIS WIND TURBINE SYSTEMS FOR THE GENERATION OF UTILITY GRID ELECTRICAL POWER. VOLUME 1: EXECU- TIVE SUMMARY

W. N. Sullivan Aug. 1979 28 p 4 Vol.
(Contract EY-76-C-04-0789)
(SAND-78-0962-Vol-1) Avail: NTIS HC A03/MF A01

The economic analysis of the Darrieus vertical axis wind turbine is discussed. A description of the technical approach used, key results, and major conclusions is presented along with a summary of the study. DOE

N80-16540# Sandia Labs., Albuquerque, N. Mex. ECONOMIC ANALYSIS OF DARRIEUS VERTICAL AXIS WIND TURBINE SYSTEMS FOR THE GENERATION OF UTILITY GRID ELECTRICAL POWER. VOLUME 2: ECO- NOMIC OPTIMIZATION MODEL

W. N. Sullivan Aug. 1979 100 p refs 4 Vol.
(Contract EY-76-C-04-0789)
(SAND-78-0962-Vol-2) Avail: NTIS HC A05/MF A01

An economic study of the Darrieus vertical axis wind turbine (VAWT) economics is reported. A computer model of VAWT cost and performance factors useful for system design and optimization is presented. The content and limitations of the model are outlined. Output data are presented to demonstrate selection of optima and to indicate sensitivity of energy cost to design parameter variations. Optimized specifications generated by this model for six point designs are summarized. An appendix is included with a FORTRAN IV listing of the model and a description of the input/output characteristics. DOE

N80-16541# Sandia Labs., Albuquerque, N. Mex.
ECONOMIC ANALYSIS OF DARRIEUS VERTICAL AXIS WIND TURBINE SYSTEMS FOR THE GENERATION OF UTILITY GRID ELECTRICAL POWER. VOLUME 3: POINT DESIGNS

R. D. Grover and E. G. Kadlec Aug. 1979 99 p refs 4 Vol.
 (Contract EY-76-C-04-0789)

(SAND-78-0962-Vol-3) Avail: NTIS HC A05/MF A01

Features of the Darrieus vertical axis wind turbine design including the blades, the speed increaser, guy cables and cable anchors, transmission, clutch, brakes, and the electrical system are discussed. System weight characteristics are tabulated. The operation and maintenance costs, and requirements reported and detailed descriptions of point designs for 120, 200, 500, and 1600 kW Darrieus vertical axis wind energy system are examined. DOE

N80-16542# Sandia Labs., Albuquerque, N. Mex.
ECONOMIC ANALYSIS OF DARRIEUS AXIS WIND TURBINE SYSTEMS FOR THE GENERATION OF UTILITY GRID ELECTRICAL POWER. VOLUME 4: SUMMARY AND ANALYSIS OF THE A. T. KEARNEY AND ALCOA LABORATORIES POINT DESIGN ECONOMIC STUDIES

W. N. Sullivan Aug. 1979 250 p refs 4 Vol.
 (Contract EY-76-C-04-0789)

(SAND-78-0962-Vol-4) Avail: NTIS HC A11/MF A01

Two independent economic studies to assess the installed costs of a series six Darrieus vertical axis wind turbine designs are summarized. The designs cover a range of sizes with peak outputs from 10 to 1600 kW. And are designed produce utility grid electrical power. A comparison and analysis of the studies is presented. DOE

N80-16543# Illinois Univ., Urbana. Fusion Studies Lab.
DIRECT ENERGY CONVERSION SYSTEMS

G. H. Miley 1978 11 p refs Presented at the Meeting on the Technology of Controlled Thermonuclear Fusion, Santa Fe, N. Mex., 9 May 1978

(Contract EY-76-S-02-2218)

(COO-2218-117; CONF-780508-73) Avail: NTIS HC A02/MF A01

The potential importance of direct energy conversion to the long-term development of fusion power is discussed with stress on the possibility of alleviating waste heat problems. Two approaches to direct conversion, i.e., direct collection and magnetic expansion are reviewed. DOE

N80-16545# Department of Energy, Washington, D. C. Div. of Technology Assessment.
HYDROTHERMAL ELECTRIC AND DIRECT HEAT. COMMERCIALIZATION PHASE 3 PLANNING

R. C. Clusen Sep. 1978 38 p

(DOE/ERD-0005) Avail: NTIS HC A03/MF A01

A technology program for the development of hydrothermal electric and direct heat energy is discussed. Environmental concerns identified over the commercialization of hydrothermal energy are examined. They include: airborne effluents, waterborne effluents, noise, subsidence, enhanced seismicity, water use conflicts, land use, socioeconomic impacts, and system safety and occupational health. A.W.H.

N80-16546# Delta Research Corp., Arlington, Va.
WORLDWIDE TRANSPORTATION/ENERGY DEMAND FORECAST, 1975 - 2000

R. U. Ayres Oct. 1978 103 p refs

(Contract W-7405-eng-26)

(ORNL/SUB-78/13536/1) Avail: NTIS HC A06/MF A01

Worldwide transportation energy demand for both commodities and passengers are forecast for 1975 - 2000. The long-range forecast methodology is described. Regional aggregation and economic/demographic projects are discussed. Transportation projections and transportation energy projections are presented. DOE

N80-16547# Department of Energy, Washington, D. C.
ADVANCED ELECTRIC GENERATION. COMMERCIALIZATION IN PHASE 3 PLANNING

Sep. 1978 46 p

(DOE/ERD-0014) Avail: NTIS HC A03/MF A01

Two basic technologies are under consideration for advanced electrical generation: fluidized-bed combustion (FBC) and phosphoric acid fuel cells. FBC consists of two major subtypes: atmospheric and pressurized fluidized-bed combustion. The fuel-cell power plant produces electricity by electrochemical conversion. The commercial readiness of these technologies with respect to environmental issues was investigated. Characteristics of the technologies and status information on the technical and environmental R and D programs are discussed. A milestone chart representing a relationship between a considered commercialization schedule and relevant environmental R and D is presented. Environmental concerns significant to the technologies were reviewed. The likelihood and consequences of adverse findings, the problems and uncertainties stemming from current or anticipated environmental regulation, and potential costs of environmental control are examined. DOE

N80-16549# Argonne National Lab., Ill.
PEAK-LOAD PROBLEM WITH STORAGE TECHNOLOGY

J. G. Asbury and R. O. Mueller Aug. 1978 23 p refs

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

(ANL/SPG-8) Avail: NTIS HC A02/MF A01

The pricing and welfare implications of storage in a utility supply is examined. The method of analysis, which separates the load into storage and non-storable components, is described. DOE

N80-16550# Research Triangle Inst., Research Triangle Park, N. C.

APPLICATION ANALYSIS AND PHOTOVOLTAIC SYSTEM CONCEPTUAL DESIGN FOR SERVICE/COMMERCIAL/ INSTITUTIONAL AND INDUSTRIAL SECTORS. TASK 1 REPORT

R. A. Whisnant, R. D. Alberts, R. M. Burger, R. P. Gardner, C. B. Morrison, and N. G. Staffa Jul. 1978 155 p refs

(Contract EY-76-C-04-0789)

(SAND-78-7032) Avail: NTIS HC A08/MF A01

The approach used to identify applications in the defined sectors for photovoltaic conversion are: (1) The Standard Industrial Classification Codes and to describe the applications that must be considered and data on the attributes of these applications germane to solar photovoltaic systems application. (2) The expected profitability of photovoltaic applications was determined from the discounted future costs of conventional energy sources, capital costs, and projected operating and maintenance costs over the life of the system. This was combined with the energy consumption of the application to obtain an estimate of the energy market potential. (3) The application ranking and subjective evaluations of market size, diversity, and public exposure were used to select five applications and their locations for design of a suitable photovoltaic system. (4) For each of the selected applications, the various relevant characteristics were identified, potential photovoltaic system configurations were defined, and performance and economic models were used to design a representative system. The design of the selected system is described. DOE

N80-16552# Battelle Pacific Northwest Labs., Richland, Wash.
FACTORS AFFECTING POTENTIAL MARKET PENETRATION OF LASER FUSION POWER PLANTS

D. E. Deonigi and D. W. Fraley Aug. 1979 43 p refs

(Contract EY-76-C-06-1830)

(PNL-2803) Avail: NTIS HC A03/MF A01

A mini model constructed to estimate the optimal size of laser fusion power plants and to estimate the allowable cost of the first such plant in relation to the next best alternative is described. The mini model incorporates such factors as market penetration, learning, economies of scale, system size, transmission costs, reserve requirements, development and licensing costs and site costs. The results of the mini model simulations are discussed. DOE

N80-16554# Resources for the Future, Inc., Washington, D. C.
CONTRIBUTIONS TO THE FOUNDATIONS OF SUPPLY FOR ENERGY AND TRANSPORTATION: CONCEPTS, ECONOMICS, AND TECHNOLOGIES

James W. Sawyer, Jr. Mar. 1979 224 p refs
 (Grant NSF AER-75-16163)
 (PB-300541/0; NSF/RA-790116) Avail: NTIS
 HC A10/MF A01

The energy problem and its possible effects on transportation, interaction between energy issues and policies, and transportation issues and policies is emphasized. The development of the energy crisis is reviewed and the transition to new energy sources is discussed. Following sections include: discussions of energy resource reserves; the characterization of likely future pricing of energy resources; engineering and economic descriptions of actual and potential synfuel processes; energy as a transportation fuel and as a commodity to be transported; descriptions of the energy and transportation models used; descriptions of the model runs and projections; impacts, emerging issues, and brief discussions of some of the policy options open in both transportation and energy areas. GRA

N80-16555# General Accounting Office, Washington, D. C. Energy and Minerals Div.

FEDERAL DEMONSTRATIONS OF SOLAR HEATING AND COOLING ON PRIVATE RESIDENCES: ONLY LIMITED SUCCESS Report to the Congress

9 Oct. 1979 65 p refs
 (PB-301123/6; EMD-79-55) Avail: NTIS HC A04/MF A01
 CSCL 10A

The residential solar heating and cooling demonstration program implemented by the Department of Housing and Urban Development for the Department of Energy is analyzed. A perspective on the program, an evaluation of its success in demonstrating solar heating systems, and a discussion of the prospects for demonstrating solar cooling technologies are included. GRA

N80-16556# Berg (Charles A.), Buckfield, Maine.
ENERGY CONSERVATION IN INDUSTRY: THE PRESENT APPROACH, THE FUTURE OPPORTUNITIES Final Report
 Charles A. Berg May 1979 96 p refs
 (Contract EQ7AD505)
 (PB-301244/0) Avail: NTIS HC A05/MF A01 CSCL 10A

Possible opportunities for industry to conserve energy through the introduction of new technology are considered. It is indicated that these technology options offer far greater savings of energy and of all other resources required in production than modifying the operation of existing plants, toward which present energy conservation efforts are directed. GRA

N80-16557# National Technical Information Service, Springfield, Va.

SOLAR ENERGY CONCENTRATOR DESIGN AND OPERATIONS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Jul. 1979

Audrey S. Hundemann Sep. 1979 183 p Supersedes NTIS/PS-78/0838 Updates NTIS/PS-77/0458 2 Vol.
 (NTIS/PS-79/0926/0; NTIS/PS-78/0838) Avail: NTIS
 HC \$28.00/MF \$28.00 CSCL 10A

Government-funded research on the design and operation of various types of solar energy concentrators is discussed. Abstracts cover the efficiency and optimization of Fresnel lenses, V-trough concentrators, flat plate and parabolic reflectors, compound parabolic concentrators used in solar photovoltaic conversion, and heliostat systems. A few abstracts deal with heat loss and cost studies. (This updated bibliography contains 177 abstracts, 80 of which are new entries to the previous edition.) GRA

N80-16558# National Technical Information Service, Springfield, Va.

SOLAR ENERGY CONCENTRATOR DESIGN AND OPERATIONS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Jul. 1979

Audrey S. Hundemann Sep. 1979 225 p Supersedes NTIS/PS-78/0839 Updates NTIS/PS-77/0459 2 Vol.
 (NTIS/PS-79/0927/8; NTIS/PS-78/0839) Avail: NTIS
 HC \$28.00/MF \$28.00 CSCL 10A

Worldwide research on the design and operation of various types of solar energy concentrators is discussed. Topic areas cover thermal and optical performance of Fresnel lenses, compound parabolic concentrators, fixed mirror concentrators, and planar reflector enhancement of flat plate collector systems. A few abstracts deal with V-trough concentrators and methods to calculate performance of concentrators. A separate Published Search on heliostat systems is available. This updated bibliography contains 220 abstracts, 53 of which are new entries to the previous edition. GRA

N80-16559# Michigan Univ., Ann Arbor. Highway Safety Research Inst.

COPING WITH ENERGY LIMITATIONS IN TRANSPORTATION: PROPOSALS FOR MICHIGAN

Robert Kaufman and Herman Koenig Apr. 1979 49 p refs
 Sponsored by Michigan Dept. of Transportation
 (PB-299737/7; UM-HSRI-79-13) Avail: NTIS
 HC A03/MF A01 CSCL 10B

The transportation energy dependence of Michigan's economy and major industries is discussed and quantified. Alternative energy forms and automotive propulsion systems are surveyed and assessed. Probable economic impacts on Michigan are discussed and the dual pressures of rising transport energy costs and federal regulations on the auto industry are outlined. State action for managing the economic transition which Michigan faces is recommended, and a mechanism for managing change is proposed. GRA

N80-16560# National Bureau of Standards, Washington, D.C. National Engineering Lab.

AN INVESTIGATION OF PREFERENCES FOR VARIOUS TYPES OF ENERGY COST FEEDBACK Final Report

Ann Rammey-Smith and Jennifer L. Gagnon Aug. 1979 73 p refs
 Sponsored by DOE
 (PB-300314/2; NBSIR-79-1771) Avail: NTIS
 HC A04/MF A01 CSCL 10B

The issue of consumer preferences for various types of energy cost feedback for individual consumers is addressed. Recommendations related to the performance characteristics of energy cost feedback devices for use in testing energy cost feedback meters are examined. GRA

N80-16561# Old West Regional Commission, Billings, Mont.
ENERGY RESEARCH INFORMATION SYSTEM (ERIS) PROJECTS REPORT, VOLUME 4, NUMBER 1 Progress Report, Dec. 1978 - Jun. 1979

Catherine A. Boyd, comp. and Janet Jelinek, comp. Jun. 1979 88 p Prepared in cooperation with Geological Survey, Reston, Va. and Argonne National Lab., Ill.
 (PB-300338/1; OWRC/ERIS-7906) Avail: NTIS
 HC A05/MF A01 CSCL 10B

An inventory of the energy related programs and research activities from 1974 to the present in the states of Montana, Nebraska, North Dakota, South Dakota, and Wyoming is presented. Areas of research include: coal, petroleum, oil shales, fission fuels, synthetic fuels, hydro-energy, renewable energy, resources, energy policy, reclamation, socioeconomic impacts, environmental impacts, and land use. Each project description lists title, investigator(s), research institution, sponsor, funding, time frame, location, a descriptive abstract of the research, and the titles of reports and/or publications generated by the research. GRA

N80-16562# New Mexico Energy Inst., Las Cruces.
ADDITION OF AN AIR-COOLED COLLECTOR TEST CAPABILITY TO THE SOLAR COLLECTOR TEST FACILITY Final Report, 1 Jan. 1977 - 30 Jun. 1978

H. L. Connell Jun. 1979 41 p refs Sponsored in part by the New Mexico Energy and Minerals Dept.
 (Contract ERB-76-259)
 (PB-300482/7; NMEI-43) Avail: NTIS HC A03/MF A01 CSCL 10A

The design and fabrication of test stands with adjustable-tilt collector mounting frames is discussed. The air flow and conditioning circuits, and the integration of the required temperature and pressure instrumentation are also discussed. GRA

N80-16563# National Technical Information Service, Springfield, Va.

ENERGY POLICY AND RESEARCH PLANNING, VOLUME 3. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, Oct. 1977 - Sep. 1979

Andrey S. Hundemann Sep. 1979 184 p Supersedes NTIS/PS-78/0962; NTIS/PS-77/0839; NTIS/PS-76/0710 (NTIS/PS-79/1069/8; NTIS/PS-78/0962; NTIS/PS-77/0839; NTIS/PS-76/0710) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10A

Citations relative to planning for future U.S. energy needs on both national and state government levels are presented. The history and development of national and state legislation and regulations, Project Independence studies, and assessment of the effects of deregulation are included. Technical, economic, and environmental considerations in energy planning are also covered. GRA

N80-16564# SRI International Corp., Menlo Park, Calif.
COMPARATIVE ASSESSMENT OF RESIDENTIAL ENERGY SUPPLY SYSTEMS THAT USE FUEL CELLS: EXECUTIVE SUMMARY Final Report, Sep. 1976 - Jan. 1979

R. V. Steele, D. C. Bomberger, K. M. Clark, R. F. Goldstein, R. L. Hays, M. E. Gray, and G. Ciprios Apr. 1979 15 p (Contract EPA-68-02-2180) (PB-299207/1; EPA-600/7-79-105A) Avail: NTIS HC A02/MF A01 CSCL 10B

A comparison of residential energy supply systems using fuel cells is presented. All systems used coal as the primary energy source, and all residences were assumed to have identical heating and cooling demands. Five systems were analyzed in detail and the entire energy cycle, from coal mine to end use, was examined for costs, efficiency, environmental impact, and applicability. The five energy systems are: (1) a coal fired power plant supplying electricity and a coal gasification plant supplying SNG; (2) a 26 MW fuel cell power plant fueled by coal derived SNG supplying electricity; (3) a 26 MW fuel cell power plant fueled by coal derived naphtha supplying electricity; (4) a combined cycle power plant fueled by coal derived fuel oil supplying electricity; and (5) a 100 kW fuel cell power plant fueled by coal derived SNG. GRA

N80-16565# SRI International Corp., Menlo Park, Calif.
COMPARATIVE ASSESSMENT OF RESIDENTIAL ENERGY SUPPLY SYSTEMS THAT USE FUEL CELLS Final Report, Sep. 1976 - Jan. 1979

R. V. Steele, D. C. Bomberger, K. M. Clark, R. F. Goldstein, R. L. Hays, M. E. Gray, and G. Ciprios Apr. 1979 505 p refs (Contract EPA-68-02-2180) (PB-299208/9; EPA-600/7-79-105B) Avail: NTIS HC A22/MF A01 CSCL 10B

A comparison of residential energy supply systems using fuel cells is presented. Twelve energy systems, able to provide residential heating and cooling using technologies projected to be available toward the end of this century, were designed conceptually. Five systems were analyzed in detail. The entire energy cycle, from coal mine to end use, was examined for costs, efficiency, environmental impact, and applicability. The five energy systems were: (1) a coal fired power plant supplying electricity and a coal gasification plant supplying SNG; (2) a 26 MW fuel cell power plant fueled by coal derived SNG supplying electricity; (3) a 26 MW fuel cell power plant fueled by coal derived naphtha supplying electricity; (4) a combined cycle power plant fueled by coal derived fuel oil supplying electricity; and (5) a 100 kW fuel cell power plant fueled by coal derived SNG, sited in a housing complex, supplying electricity to heat pumps, with heat recovered from the fuel cell supplying supplemental space heating and hot water. GRA

N80-16566# National Technical Information Service, Springfield, Va.

FLAT PLATE SOLAR COLLECTOR DESIGN AND PERFORMANCE. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Jul. 1979

Audrey S. Hundemann Sep. 1979 168 p Supersedes NTIS/PS-78/0840 (NTIS/PS-79/0928/6; NTIS/PS-78/0840) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10A

Federally-funded research on the design and thermal efficiency of air- and liquid-type flat plate collectors is discussed. Topic areas cover convection characteristics, methods to reduce heat loss, optical coatings, and corrosion control. Emphasis of the bibliography is on basic research studies. (This updated bibliography contains 160 abstracts, 63 of which are new entries to the previous edition.) GRA

N80-16567# National Technical Information Service, Springfield, Va.

FLAT PLATE SOLAR COLLECTOR DESIGN AND PERFORMANCE. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Jul. 1979

Audrey S. Hundemann Sep. 1979 180 p Supersedes NTIS/PS-78/0841 (NTIS/PS-79/0929/4; NTIS/PS-78/0841) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10A

Citations from worldwide literature on the design, thermal performance, and optimization of air- and liquid-type flat plate collectors are covered. Topic areas include heat loss and heat transfer, effect of orientation, corrosion protection, optical coatings, enhancement of performance through the use of planar reflectors, and the effect of honeycomb layers on collector performance. A few studies pertain to grooved, corrugated, or V-trough collectors. Abstracts dealing with methods of measuring the performance of flat plate collectors and computer optimization studies are included. This bibliography contains 174 abstracts, 30 of which are new entries to the previous edition. GRA

N80-16568# Economics, Statistics and Cooperatives Service, Washington, D. C. National Economics Div.

SOLAR ENERGY FOR AGRICULTURE: REVIEW OF RESEARCH Final Report

W. K. Trotter, W. G. Heid, Jr., and R. G. McElroy Aug. 1979 29 p refs (PB-298688/3; ESCS-67) Avail: NTIS HC A03/MF A01 CSCL 02B

Solar energy use in various agricultural applications is summarized. Grain drying, heating and cooling of greenhouses and rural residences, heating livestock shelters, drying crops other than grain, food processing, and irrigation are discussed. An exploratory economic assessment of solar energy technologies is given. GRA

N80-16569# New Mexico Energy Inst., Las Cruces.
FEASIBILITY STUDY OF GEOTHERMAL ENERGY FOR HEATING GREENHOUSES Final Report, 1 Jan. - 31 Aug. 1977

Leo J. LaFrance Jun. 1979 24 p refs Sponsored in part by New Mexico Energy and Minerals Dept. (PB-299517/3; NMEI-41) Avail: NTIS HC A02/MF A01 CSCL 02C

The technical feasibility of heating greenhouses with low temperature, 212 F (100 C) and below, geothermal sources is established. The economic feasibility of using geothermal energy to heat greenhouses is summarized. Candidate greenhouse facilities in New Mexico were determined for conversion to geothermal energy as well as sites favorable for new greenhouse construction. GRA

N80-16571# National Technical Information Service, Springfield, Va.

HELIOSTAT SYSTEM DESIGN AND OPERATION. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Jul. 1979

Audrey S. Hundemann Sep. 1979 61 p Supersedes NTIS/PS-78/0842 (NTIS/PS-79/0930/2; NTIS/PS-78/0842) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10A

The design and use of heliostats in solar central receiver thermal power systems are discussed in abstracts from worldwide

N80-16572

literature. Topic areas include heliostat systems performance, efficiency, and optimization. Emphasis of the bibliography is on basic research. (This updated bibliography contains 55 abstracts, 17 of which are new entries to the previous edition.) GRA

N80-16572# National Bureau of Standards, Washington, D.C. National Engineering Lab.

PERFORMANCE OF A PACKAGED SOLAR SPACE-HEATING SYSTEM USED WITH A MOBILE HOME

Dennis E. Jones and James A. Hill Aug. 1979 45 p refs
Sponsored in part by HUD, Washington, D.C. Div. of Energy, Building Technol. and Standards
(PB-300890/1; NBSIR-79-1799) Avail: NTIS HC A03/MF A01 CSCL 13A

A mobile home was equipped with a packaged solar space-heating system using air heating collectors and pebble bed shortage. The system was fully instrumented and data were collected. The performance of the system was determined and various methods of correlating performance were explored. GRA

N80-16580# Brookhaven National Lab., Upton, N. Y. Atmospheric Sciences Div.

STATUS OF POLLUTANT REMOVAL TECHNOLOGY FOR COAL FIRED PLANTS IN THE NORTHEASTERN U.S.

E. N. Ziegler (Polytechnic Inst. of N.Y., Brooklyn) and Ronald E. Meyers Feb. 1979 44 p refs
(Contract EY-76-C-02-0016)

(BNL-51004) Avail: NTIS HC A03/MF A01

The status of air pollution control technology for coal fired industrial and power plant boilers is surveyed. Lime and limestone based scrubbers, the Wellman-Lord, thiosorbic, and citrate processes, electrostatic precipitators, fabric filtration, and modification of the combustion system to reduce nitrogen oxide concentrations are among the technology items covered. Various process capital and annualized costs are reported for SO₂ and particulate removal systems. The status of fluidized bed combustion, fuel desulfurization, conversion of coal to gaseous and liquid fuels, and flue gas denitrification is also discussed. DOE

N80-16581# Department of Energy, Washington, D. C.
PETROLEUM PRODUCTION AT MAXIMUM EFFICIENT RATE, NAVAL PETROLEUM RESERVE NO. 1 (ELK HILLS), KERN COUNTY, CALIFORNIA Final Environmental Impact Statement

Aug. 1979 525 p refs

(DOE/EIS-0012) Avail: NTIS HC A22/MF A01

The Naval Petroleum Reserves were opened up for production at maximum efficient rates consistent with sound engineering practices, for a period of 6 years. Production for Naval Petroleum Reserve No. 1 is expected to peak at between 205,000 and 240,000 bbl/d of crude oil in 1982. Positive impacts of the project are increased employment, use of vacant housing, increased local spending on goods and services, and the potential for increased domestic petroleum production with a commensurate decrease in the US balance of payment deficit. Adverse effects of the project include increased air pollution emissions, increased noise levels, reduction in vegetation, loss of the Petroleum Reserve for use in emergency situations, increased traffic levels, and decreased visual quality. DOE

N80-16596# Resources for the Future, Inc., Washington, D. C.
ENVIRONMENTAL SYSTEM STUDY ON THE DEVELOPMENT OF FOSSIL FUEL RESOURCES IN THE SOUTHWEST

James W. Sawyer May 1979 18 p refs

(Grant NSF AER-75-16163)

(PB-300526/1; NSF/RA-790117) Avail: NTIS

HC A02/MF A01 CSCL 13B

Various outcomes of a project designed to study energy and synfuels technologies appropriate to the Southwest are described. The topics investigated include air pollution control for electric power plants in the Southwest, use of coal for electricity generation in California, and energy/transportation concepts, economics, and technologies. Navajo resource problems and economic considerations for the continued care of uranium mill sites are also discussed. GRA

N80-16600# Tennessee Valley Authority, Chattanooga. Office of Natural Resources.

REMOTE SENSING OF SULFUR DIOXIDE EFFECTS ON VEGETATION - PHOTOMETRIC ANALYSIS OF AERIAL PHOTOGRAPHS

C. Daniel Sapp Jun. 1979 42 p refs

(PB-300460/3; TVA/ONR-79/01; EPA-600/7-79-138) Avail: NTIS HC A03/MF A01 CSCL 13B

Spectral reflectances were measured by tri band densitometry of aerial color infrared photographs of soybean Glycine mass fields that had been affected by sulfur dioxide (SO₂) emissions from large, coal fired power plants in northwestern Alabama and western Tennessee. The photographs were photometrically calibrated. Results indicate that, at very light levels of foliar injury, the infrared to red reflectance ratio decreased with increasing injury. This behavior was in accordance with theory. At moderate and severe levels of injury, the ratio increased with injury. The best indicator of crop yield was green band reflectance, but the red and infrared bands were nearly as good. The yield variable actually increased with the level of injury, apparently because of field to field variations in canopy density. GRA

N80-16601# Acurex Corp., Mountain View, Calif. Aerotherm Div.

ENVIRONMENTAL ASSESSMENT OF STATIONARY SOURCE NO_x CONTROL TECHNOLOGIES Annual Report, Jun. 1977 - Jun. 1978

L. R. Waterland, K. J. Lim, K. G. Salvesen, R. M. Evans, E. G. Higginbotham, and H. B. Mason Jun. 1979 203 p refs

(Contract EPA-68-02-2160)

(PB-300469/4; EPA-600/7-79-147; AR-2) Avail: NTIS HC A10/MF A01 CSCL 13B

Program results are summarized for: (1) developing fuel consumption and NO_x emission inventories; (2) field testing selected stationary combustion sources; (3) performing process engineering and environmental assessment studies of NO_x controls applied to utility and industrial boilers and gas turbines; and (4) developing reactive air quality and source analysis models. Preliminary NO_x control technology analysis for utility boilers indicates that off-stoichiometric combustion and low NO_x burners (LNB) are the preferred techniques for both retrofit and new applications. For coal firing, overfire air operation and LNB are both cost effective; LNB is preferred for new wall-fired boilers. For oil and gas firing, staged combustion with burners out of service is recommended. GRA

N80-16602# Mitre Corp., McLean, Va.

A REVIEW OF STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES: PETROLEUM REFINERIES

Kris Barrett and Alan Goldfarb Jan. 1979 93 p refs

(Contract EPA-68-02-2526)

(PB-300480/1; EPA-450/3-79-008; MTR-7825) Avail: NTIS HC A05/MF A01 CSCL 13B

The current standards of performance for petroleum refineries are presented. The status of current applicable control technology is reviewed and the ability of refineries to meet the current standards is discussed. Compliance test results are analyzed and recommendations are made for possible modifications and additions to the standard, including future studies needed for unresolved issues. GRA

N80-16623# General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.

GROUNDWATER QUALITY MONITORING OF WESTERN OIL SHALE DEVELOPMENT. IDENTIFICATION AND PRIORITY RANKING OF POTENTIAL POLLUTION SOURCES

Guenton C. Slawson, Jr. Jan. 1979 241 p refs

(Contract EPA-68-03-2449)

(PB-300536/0; GE77TMP-51; EPA-600/7-79-023) Avail: NTIS HC A11/MF A01 CSCL 08I

Oil shale operations such as those proposed for eastern Utah are assessed as potential pollution sources. A priority ranking of pollutants is presented based on the magnitude of the source and the toxicity, persistence, and mobility of the pollutants. K.L.

N80-16625# Mitre Corp., McLean, Va. METREK Div.
OUTER CONTINENTAL SHELF ENVIRONMENT MONITORING CONCERNS Final Report

J. Slaughter Jul. 1979 78 p refs

(Contract EQ8AC020)

(PB-299861/5; MTR-79W00192)

Avail: NTIS

HC A05/MF A01 CSCL 13B

Information is presented on existing and proposed Federal environmental monitoring programs applicable to oil and gas exploration, development, and production on the outer continental shelves (OCS). An analysis of the relevance of these programs to the needs of state and local governments affected by OCS activities is given. Discussion of significant unmet monitoring needs is included. GRA

N80-16628 West Virginia Univ., Morgantown.
SUBSURFACE STRATIGRAPHY OF THE MIDDLE AND UPPER DEVONIAN CLASTIC SEQUENCE IN SOUTHERN WEST VIRGINIA AND ITS RELATION TO GAS PRODUCTION Ph.D. Thesis

Donald Wade Neal 1979 305 p

Avail: Univ. Microfilms Order No. 8000226

A stratigraphic framework for the Middle and Upper Devonian clastic sequence in the subsurface of southern West Virginia was established using gamma-ray logs, drillers' logs, and sample descriptions. The Devonian shale within the study area is submature with respect to hydrocarbon generation yet produces a high quality gas. An interconnected fracture system is postulated to be the reservoir in which gas accumulates where there is the complimentary presence of both thick intervals of black shale and broad flexures which produce fractures. New areas of potential shale gas exploration for both the Huron Member of the Ohio Shale and the Rhinestreet Shale-Marcellus Shale interval are located east of the Warfield Anticline in Boone, Logan, Mingo, McDowell, Wyoming, and Raleigh Counties, West Virginia. Dissert. Abstr.

N80-16632 Colorado State Univ., Fort Collins.
THE YALLAHS FAN DELTA, SOUTHEASTERN JAMAICA: A DEPOSITIONAL MODEL FOR ACTIVE TECTONIC COASTLINES Ph.D. Thesis

William Albert Wescott 1979 189 p

Avail: Univ. Microfilms Order No. 7928557

The vertical and lateral succession of specific subaerial, transitional, and submarine environments associated with the Yallahs fan delta system provides the data for the development of a stratigraphic model for truncated, coarse-grained, humid region fans that build directly onto relatively steep submarine slopes. This model should prove useful in the recognition of fan delta deposits in the rock record and for the paleogeographic reconstruction of ancient, tectonically active continental and island-arc plate margins. It may also serve as a valuable tool in the search for economic deposits and fossil fuels. Dissert. Abstr.

N80-16652# California Univ., Berkeley. Earth Sciences Div.
VERTICAL MOVEMENT ALONG THE CERRO PRIETO TRANSFORM FAULT, BAJA CALIFORNIA, MEXICO - A MECHANISM FOR GEOTHERMAL ENERGY RENEWAL

S. VonderHaar, J. E. Noble, and I. Puente Cruz Mar. 1979 8 p refs Prepared jointly by Comision Federal de Electricidad, Mexico City

(Contract W-7405-eng-48)

(LBL-8905) Avail: NTIS HC A02/MF A01

Data from 53 geothermal wells to depths of 1 to 3 km on either side of the right-lateral Cerro Prieto fault, as well as geophysical data, indicate vertical displacements of this fault of 400 to 600 m. This episodic vertical movement has offset deltaic sandstone reservoirs that are primarily at 1200 m and 1800 m depth and contain 250 to 345 C water. A major fracture system for convective fluid movement has been thus maintained, with production at 150 MW. DOE

N80-16653# Brookhaven National Lab., Upton, N. Y.
NORMAL INCIDENT SOLAR RADIATION MEASUREMENTS AT UPTON, NEW YORK

J. G. Cottingham 24 Oct. 1978 15 p

(Contract EY-76-C-02-0016)

(BNL-50939) Avail: NTIS HC A02/MF A01

Normal incident solar energy measurements made at Upton, L.I., New York are reported and analyzed relative to the total energy received on a horizontal surface. A method for computing normal incident solar radiation is developed and used to study long term variations in this energy source at Upton and to estimate average values for other east coast locations. DOE

N80-16663# Geological Survey, Albuquerque, N. Mex. Water Resources Div.

BIBLIOGRAPHY OF GEOLOGY AND HYDROLOGY, EASTERN NEW MEXICO Final Water Resources Investigation

Ann Finley Wright Mar. 1979 175 p

(PB-300832/3; USGS/WRI-79/76; USGS/WRD/WRI-79/060)

Avail: NTIS HC A08/MF A01 CSCL 08G

The high plains of the eastern New Mexico region and its natural resources are examined. The bibliography contains 1,900 references concerned with the geology, hydrology, chemistry, and geography of the region. GRA

N80-16885# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMMENTS ON TEC TRENDS

James F. Morris 1979 28 p refs Presented at Intern. Conf. on Plasma Sci., Montreal, 4-6 Jun. 1979; sponsored by IEEE (NASA-TM-79317; E-273) Avail: NTIS HC A03/MF A01 CSCL 20I

A technology assessment of thermionic energy conversion research and technology is presented. R.E.S.

N80-16886# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTS ON H2-O2MHD POWER GENERATION

J. Marlin Smith 1980 18 p refs Proposed for presentation at the 3d World Hydrogen Energy Conf., Tokyo, 23 - 26 Jun. 1980

(NASA-TM-81424) Avail: NTIS HCA02/MF A01 CSCL 20I

Magneto-hydrodynamic power generation experiments utilizing a cesium-seeded H2-O2 working fluid were carried out using a diverging area Hall duct having an entrance Mach number of 2. The experiments were conducted in a high-field strength cryomagnets facility at field strengths up to 5 tesla. The effects of power takeoff location, axial duct location within the magnetic field, generator loading, B-field strength, and electrode breakdown voltage were investigated. For the operating conditions of these experiments, it is found that the power output increases with the square of the B-field and can be limited by choking of the channel or interelectrode voltage breakdown which occurs at Hall fields greater than 50 volts/insulator. Peak power densities of greater than 100 MW/cu M were achieved. A.R.H.

N80-16926 California Univ., Berkeley.
MOLECULAR THERMODYNAMICS OF DEW-POINT CALCULATIONS IN COAL GASIFICATION PROCESSES Ph.D. Thesis

Abdalla Ibrahim El-Twaty 1979 205 p

Avail: Univ. Microfilms Order No. 8000333

A flow apparatus for dew point measurements suitable for highly asymmetric mixtures at high temperatures is described. The apparatus was used to measure the vapor pressure of anthracene in the temperature range 145-165 C and the solubility of n-hexadecane in methane at 125 C near 600 psig. A molecular thermodynamic model was developed to predict condensation conditions for coal gases. Fugacity coefficients are calculated from the virial equation for the gas-phase. The model is implemented in the form of a computer program which requires as input: the total pressure, weight fractions of all components of the feed and, for each tar cut, one vapor pressure datum, fraction aromaticity, and hydrogen-to-carbon ratio. The program calculates the initial dew point as well as the mole and weight percent of tar and/or water condensed as the temperature falls along the heat exchanger. Dissert. Abstr.

N80-16932# Bureau of Mines, Pittsburgh, Pa. Mining and Safety Research Center.

THERMAL, MECHANICAL, AND PHYSICAL PROPERTIES OF SELECTED BITUMINOUS COALS AND COKES

N80-16950

J. M. Singer and R. P. Tye 1979 44 p refs
(PB-300398/5; BM-RI-8364) Avail: NTIS HC A03/MF A01
CSCL 081

Thermal, mechanical, and physical properties, of virgin and heat-treated seam coal were determined. Measured properties include thermal conductivity, specific heat, thermal expansion, density, compressive and tensile strength, porosity, and permeability. Interdependence among all properties is discussed. GRA

N80-16950* Denver Univ., Colo. Industrial Economics Div. SPACE BENEFITS: THE SECONDARY APPLICATION OF AEROSPACE TECHNOLOGY IN OTHER SECTORS OF THE ECONOMY

Jan. 1980 236 p
(Contract NASw-3113)
(NASA-CR-162697) Avail: NASA Scientific and Technical
Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240
CSCL 05A

Over 580 examples of the beneficial use of NASA aerospace technology by public and private organizations are described to demonstrate the effects of mission-oriented programs on technological progress in the United States. General observations regarding technology transfer activity are presented. Benefit cases are listed in 20 categories along with pertinent information such as communication link with NASA; the DRI transfer example file number and individual case numbers associated with the technology and examples used; and the date of the latest contract with user organizations. Subject, organization, geographic, and field center indexes are included. A.R.H.

N80-16974# DeLeuw, Cather and Co., Chicago, Ill. AGT GUIDEWAY AND STATION TECHNOLOGY. VOLUME 8: WEATHER PROTECTION CONCEPTS Final Report

R. D. Stevens, T. J. Nicario, T. J. McGean, S. M. Easley, and T. L. Easley Aug. 1979 249 p refs Prepared jointly with ABAM Engineers Inc.
(Contract DOT-UT-70066)
(PB-299746/8; UMTA-IT-06-0152-79-7) Avail: NTIS
HC A11/MF A01 CSCL 13F

Guideway, station, and weather protection concepts which will reduce the cost and implementation time associated with AGT systems as well as to improve performance are considered. Weather protection concepts are presented for guideways associated with AGT systems, with emphasis on minimizing costs and energy consumption while maximizing system operability/reliability during winter weather. The concepts include a comparison of embedded pipe and electric heating systems with varied heated widths, heating densities, and amount of utilization. GRA

N80-16976# National Technical Information Service, Springfield, Va.

ELECTRIC AUTOMOBILES. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Aug. 1979

Audrey S. Hundemann Sep. 1979 276 p Supersedes
NTIS/PS-78/0880, NTIS/PS-77/0635, NTIS/PS-76/0560 and
NTIS/PS-75/490
(NTIS/PS-79/0990/6; NTIS/PS-78/0880; NTIS/PS-77/0635;
NTIS/PS-76/0560; NTIS/PS-75/490) Avail: NTIS
HC \$28.00/MF \$28.00 CSCL 13F

The research pertaining to battery systems, costs, and evaluations of electric vehicles are presented. Nickel zinc and lead acid batteries are studied and various types of lithium cells and hybrid heat engine/electric systems are reported. This bibliography contains 271 abstracts, 58 of which are new entries to the previous edition. GRA

N80-17014*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala. FISCAL YEAR 1979 SCIENTIFIC AND TECHNICAL RE- PORTS, ARTICLES, PAPERS AND PRESENTATIONS

O. L. White, comp. Oct. 1979 62 p
(NASA-TM-78250) Avail: NTIS HC A04/MF A01 CSCL
05B

This bibliography lists approximately 590 formal NASA technical reports, papers published in technical journals, presentations by MSFC personnel, and reports of MSFC contractors introduced into the NASA scientific and technical information system in 1979. J.M.S.

N80-17243# Sandia Labs., Albuquerque, N. Mex. Process
Research Div.

APPLICATION OF RADIOGRAPHY TO COAL LIQUEFAC- TION

D. G. Sample and M. G. Thomas 1979 16 p refs Presented
at the ASNT Fall Conf., St. Louis
(Contract EY-76-C-04-0789)
(SAND-79-1226C; CONF-791008-2) Avail: NTIS
HC A02/MF A01

The application of X-radiographic techniques to the investigation of coal and coal liquefaction systems is discussed. The analysis of catalysts used in coal liquefaction by wavelength and energy dispersive analyses, identification and isolation of tagged catalysts using film radiography, and measuring mineral matter in coal with a radiation gage are among the topics covered. DOE

N80-17244# Los Alamos Scientific Lab., N. Mex. PRODUCTION OF SYNTHETIC GAS FROM NUCLEAR ENERGY SOURCES

C. A. Anderson, J. C. Biery, and L. A. Booth Apr. 1979 235 p
refs
(Contract EW-78-Y-04-4183)
(LA-7592-MS) Avail: NTIS HC A11/MF A01

A survey of nuclear energy sources and their potential application to the production of synthetic gas is documented. The state-of-the-art in commercial nuclear fission reactors and on-going research and development in advanced reactors is described. The status of fusion energy research and estimated timing of commercial availability are reported. Surveys of high temperature electrolysis and thermochemical cycles as means for producing synthetic gas from process heat are given. Synthetic gas production from radiolysis is discussed. A description of the nuclear fuel cycle and uranium reserve and resource estimates are presented. DOE

N80-17246# Institut Francais du Petrole, Rueil-Malmaison. Lab
Recherches Chimiques de Base.

STORING HYDROGEN IN THE FORM OF LIGHT ALLOY HYDRIDES Final Report [STOCKAGE DE L'HYDROGENE SOUS FORME D'HYDRURES D'ALLIAGES DE METAUX LEGERES]

Edouard Freund and Christine Guillermin Jul. 1978 58 p refs
In FRENCH
(IFP-26-209) Avail: NTIS HC A04/MF A01

Different hydrides are investigated to find a system with a sufficiently high storage density ($>$ or $=$ 3 percent). The formation of hydrides with light alloys is examined. Reaction kinetics for hydride formation were defined and applied to the systems Mg-Al-H, Mg-Al-Cu-H, Ti-Al-Hi, Ti-Al-Cu-H, and Ti-Al-Ni-H. Results indicate that the addition of Al destabilizes MgH₂ and TiH₂ hydrides while having only a limited effect on the storage density. Author (ESA)

N80-17467*# National Aeronautics and Space Administration,
Lewis Research Center, Cleveland, Ohio.

PERFORMANCE SENSITIVITY ANALYSIS OF DEPARTMENT OF ENERGY-CHRYSLER UPGRADED AUTOMOTIVE GAS TURBINE ENGINE, S/N 5-4 Final Report

Roy L. Johnson Dec. 1979 37 p refs
(Contract EC-77-A-31-1040)
(NASA-TM-79242; DOE/NASA/1040-79/9; E-147) Avail:
NTIS HC A03/MF A01 CSCL 21A

The performance sensitivity of a two-shaft automotive gas turbine engine to changes in component performance and cycle operating parameters was examined. Sensitivities were determined for changes in turbomachinery efficiency, compressor inlet temperature, power turbine discharge temperature, regenerator effectiveness, regenerator pressure drop, and several gas flow and heat leaks. Compressor efficiency was found to have the greatest effect on system performance. K.L.

N80-17470* Chrysler Corp., Detroit, Mich.

MATERIALS REVIEW FOR IMPROVED AUTOMOTIVE GAS TURBINE ENGINE Final Report

C. Belleau, W. L. Ehlers, and F. A. Hagen Apr. 1978 101 p refs Sponsored by NASA

(Contract EY-76-C-02-2749-A011)
(NASA-CR-159673; DOE/NASA/2749-79/4-Vol-4) Avail:
NTIS HC A06/MF A01 CSCL 21A

The potential role of superalloys, refractory alloys, and ceramics in the hottest sections of engines operating with turbine inlet temperatures as high as 1370 C is examined. The conventional superalloys, directionally solidified eutectics, oxide dispersion strengthened alloys, and tungsten fiber reinforced superalloys are reviewed and compared on the basis of maximum turbine blade temperature capability. Improved high temperature protective coatings and special fabrication techniques for these advanced alloys are discussed. Chromium, columbium, molybdenum, tantalum, and tungsten alloys are also reviewed. Molybdenum alloys are found to be the most suitable for mass produced turbine wheels. Various forms and fabrication processes for silicon nitride, silicon carbide, and SIALON's are investigated for use in highstress and medium stress high temperature environments.

K.L.

N80-17484# Transportation Systems Center, Cambridge, Mass.
COMPARISON OF FUEL ECONOMY AND EMISSIONS FOR DIESEL AND GASOLINE POWERED TAXICABS Final Report, Jun. 1976 - Apr. 1979

K. M. Hergenrother Washington Jul. 1979 30 p

(PB-298609/9; DOT-TSC-UMTA-79-30;

UMTA-MA-06-0066-79-1) Avail: NTIS HC A03/MF A01 CSCL 21D

Potential improvements in fuel economy and exhaust emissions by dieselization of the taxi fleet in a large urban area was assessed. Sixty-six diesel powered taxicabs and an equal number of gasoline powered cabs were operated for 120,000 miles each in three taxicab fleets in New York City. Identical cabs were powered with either 198 CID diesel engines or 225 CID gasoline engines. Test results from all cabs were used to determine fuel economy and exhaust emissions. On the road, the diesel cabs had 50 percent better fuel economy than the gasoline cabs; the diesel exhaust emissions (HC, CO, NOx) were lower than the gasoline exhaust emissions over the life of the test. Emission from the diesels did not appreciably degrade with vehicle age; emission from the gasoline cabs increased appreciably.

GRA

N80-17539 Miami Univ., Coral Gables, Fla.
INFORMATION THEORY APPLIED TO SOLAR RADIATION CONCENTRATORS Ph.D. Thesis

Russell Paul Patera 1979 179 p

Avail: Univ. Microfilms Order No. 8001674

A solar collector is treated as a communication channel with the input being the directional distribution of radiation at the aperture and the output being the spatial distribution of the radiation at the absorber. The channel structure and information measure are found. The information measure is used to obtain a general figure of merit which is useful for collector comparisons over wide ranges of operating conditions. The findings of the theory indicate that for an isotropic distribution of radiation at the input, a single absorber segment is sufficient for optimum collector performance. For a nonisotropic distribution, many thermally separated absorber segments are necessary for optimum performance. The heat transfer fluid is first passed through the warm segments, and then passed sequentially through the progressively hotter segments. Three practical examples are given.

Dissert. Abstr.

N80-17541 Georgia Inst. of Tech., Atlanta.

OPTICAL AND THERMAL EFFECTS IN LINEAR SOLAR CONCENTRATING COLLECTORS Ph.D. Thesis

Sheldon Moseley Jeter 1979 430 p

Avail: Univ. Microfilms Order No. 8000828

Procedures for the analysis and evaluation of optical and thermal effects in concentrating solar collectors employing reflector optical systems are presented. Particular emphasis is placed on the consideration of cylindrical, single-axis suntracking concentra-

tors and collectors. The optical analysis is based on fundamental concepts of geometrical optics augmented by limited simplifications generally applicable to solar energy utilization and leading to representations of the source as a finite disc emitter and of the concentrating surface as an array of differential reflective elements. The optical characteristics of several ideal concentrators are evaluated and detailed. Coupling the results of the optical analysis with standard heat transfer and hydraulic analysis yields a model for the thermal collector suitable for performance projections and dynamic simulations. Elementary examples of the application of the model are presented.

Dissert. Abstr.

N80-17543* Electro-Mechanical Research, Inc., Sarasota, Fla.
DOE/NASA WIND TURBINE DATA ACQUISITION. PART 1: EQUIPMENT

O. J. Strock Jan. 1980 56 p

(Contract DEN3-98)

(NASA-CR-159779; EMR-827053)

Avail: NTIS

HC A04/MF A01 CSCL 10B

Large quantities of data were collected, stored, and analyzed in connection with research and development programs on wind turbines. The hardware configuration of the wind energy remote data acquisition system is described along with its use on the NASA/DOE Wind Energy Program.

R.C.T.

N80-17544* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

SOLAR ENERGY CONTROL SYSTEM Patent Application

James R. Currie, inventor (to NASA) Filed 29 Nov. 1979 18 p

(NASA-Case-MFS-25287-1; US-Patent-Appl-SN-098570) Avail: NTIS HC A02/MF A01 CSCL 10A

A solar energy control system for a hot air type solar energy heating system wherein thermocouples are arranged to sense the temperature of a solar collector, a space to be heated, and a top and bottom of a heat storage unit is described. Pertinent thermocouples are differentially connected together, and these are employed to effect the operation of dampers, a fan, and an auxiliary heat source. In accomplishing this, the differential outputs from the thermocouples are amplified by a single amplifier by multiplexing techniques. Additionally, the amplifier is corrected as to offset by including as one multiplex channel a common reference signal.

NASA

N80-17545* National Aeronautics and Space Administration, Earth Resources Labs., Bay St. Louis, Miss.

ENERGY FROM AQUATIC PLANT WASTEWATER TREATMENT SYSTEMS

B. C. Wolverton and Rebecca C. McDonald Sep. 1979 18 p refs

(NASA-TM-X-72733) Avail: NTIS HC A02/MF A01 CSCL 10A

Water hyacinth (*Eichhornia crassipes*), duckweed (*Spirodela* sp. and *Lemna* sp.), water pennywort (*Hydrocotyle ranunculoides*), and kudzu (*Pueraria lobata*) were anaerobically fermented using an anaerobic filter technique that reduced the total digestion time from 90 days to an average of 23 days and produced 0.14-0.28 cu m CH₄/kg (dry weight) (2.3-4.5 cu ft/lb) from mature filters. The anaerobic filter provided a large surface area for the anaerobic bacteria to establish and maintain an optimum balance of facultative, acid-forming, and methane-producing bacteria. Consequently the efficiency of the process was greatly improved over prior batch fermentations.

Author

N80-17547* Institute of Gas Technology, Chicago, Ill.
HIGH-TEMPERATURE MOLTEN SALT THERMAL ENERGY STORAGE SYSTEMS Final Report, 14 Sep. 1977 - 14 Dec. 1978

Randy J. Petri, Terry D. Claar, Ray R. Tison, and Leonard G. Marianowski Feb. 1980 175 p refs

(Contract NAS3-20806)

(NASA-CR-159663; DOE/NASA/0806-79/1) Avail: NTIS

HC A08/MF A01 CSCL 10A

The results of comparative screening studies of candidate molten carbonate salts as phase change materials (PCM) for advanced solar thermal energy storage applications at 540 to 870 C (1004 to 1600 F) and steam Rankine electric generation at 400 to 540 C (752 to 1004 F) are presented. Alkali carbonates

are attractive as latent heat storage materials because of their relatively high storage capacity and thermal conductivity, low corrosivity, moderate cost, and safe and simple handling requirements. Salts were tested in 0.1 kWhr lab scale modules and evaluated on the basis of discharge heat flux, solidification temperature range, thermal cycling stability, and compatibility with containment materials. The feasibility of using a distributed network of high conductivity material to increase the heat flux through the layer of solidified salt was evaluated. The thermal performance of an 8 kWhr thermal energy storage (TES) module containing LiKCO₃ remained very stable throughout 5650 hours and 130 charge/discharge cycles at 480 to 535 C (896 to 995 F). A TES utilization concept of an electrical generation peaking subsystem composed of a multistage condensing steam turbine and a TES subsystem with a separate power conversion loop was defined. Conceptual designs for a 100 MW sub e TES peaking system providing steam at 316 C, 427 C, and 454 C (600 F, 800 F, and 850 F) at 3.79 million Pa (550 psia) were developed and evaluated. Areas requiring further investigation have also been identified. Author

N80-17548*# Kaman Aerospace Corp., Bloomfield, Conn.
DESIGN, FABRICATION, TEST, AND EVALUATION OF A PROTOTYPE 150-FOOT LONG COMPOSITE WIND TURBINE BLADE Final Report

Herbert W. Gewehr Sep. 1979 135 p refs
 (Contracts NAS3-20600; EX-76-I-01-1028)
 (NASA-CR-159775; DOE/NASA/O600-79/1; R-1575) Avail:
 NTIS HC A07/MF A01 CSCL 10B

The design, fabrication, testing, and evaluation of a prototype 150 foot long composite wind turbine blade is described. The design approach and material selection, compatible with low cost fabrication methods and objectives, are highlighted. The operating characteristics of the blade during rotating and nonrotating conditions are presented. The tensile, compression, and shear properties of the blade are reported. The blade fabrication, tooling, and quality assurance are discussed. A.W.H.

N80-17549*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PROCEEDINGS OF THE 13TH PROJECT INTEGRATION MEETING Progress Report, Apr. 1979 - Aug. 1979

R. R. McDonald Aug. 1979 465 p Presented at 13th Project Integration Meeting, 22-23 1979
 (Contract NAS7-100)

(NASA-CR-162787; JPL-Pub-79-88; DOE/JPL-1012-29;
 PR-13) Avail: NTIS HC A20/MF A01 CSCL 10A

Progress made by the Low Cost Solar Array Project during the period April through August 1979 is presented. Reports are given on project analysis and integration; technology development in silicon material, large area sheet silicon, and encapsulation; production process and equipment development; engineering and operations, and a discussion of the steps taken to integrate these efforts. A report on, and copies of viewgraphs presented at the Project Integration Meeting held August 22-23, 1979 are presented. M.M.M.

N80-17551*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CHARACTERIZATION OF DELIBERATELY NICKEL-DOPED SILICON WAFERS AND SOLAR CELLS

A. M. Salama 1 Nov. 1980 24 p refs
 (Contract NAS7-100)
 (NASA-CR-162790; JPL-Pub-79-116; DOE/JPL-1012-34)
 Avail: NTIS HC A02/MF A01 CSCL 10A

Microstructural and electrical evaluation tests were performed on nickel-doped p-type silicon wafers before and after solar cell fabrication. The concentration levels of nickel in silicon were 5 x 10 to the 14th power, 4 x 10 to the 15th power, and 8 x 10 to the 15th power atoms/cu cm. It was found that nickel precipitated out during the growth process in all three ingots. Clumps of precipitates, some of which exhibited star shape, were present at different depths. If the clumps are distributed at depths approximately 20 micron apart and if they are larger than 10 micron in diameter, degradation occurs in solar cell electrical properties and cell conversion efficiency. The larger the size of the precipitate clump, the greater the degradation in solar cell efficiency. A large grain boundary around the cell effective area acted as a gettering center for the precipitates and impurities

and caused improvement in solar cell efficiency. Details of the evaluation test results are given. Author

N80-17553# Army Electronics Technology and Devices Lab., Fort Monmouth, N. J.

REGENERATIVE BURNER SYSTEM FOR THERMOELECTRIC POWER SOURCES

G. Guazzoni, J. Angello, and A. Herchakowski Jul. 1979 9 p refs

(DA Proj. 1L1-62705-AH-94)
 (AD-A075955; DELET-TR-79-16) Avail: NTIS
 HC A02/MF A01 CSCL 10/2

A thermoelectric power source is being developed to provide a multifuel, silent, maintenance free tactical power generator for forward area and unattended-operation applications. An experimental study of a regenerative burner system for the 500-Watt Thermoelectric Power Source has resulted in significant reduction in fuel consumption and infrared signature of the power source. GRA

N80-17554# KDI Score, Inc., Cockeysville, Md.

IMPROVED THERMAL BATTERY Final Report, Jun. 1976 - Dec. 1978

Praful V. Dand and Khushrow K. Press Apr. 1979 38 p
 (Contract F33615-76-C-2144; AF Proj. 3145)
 (AD-A075835; AFAPL-TR-79-2027) Avail: NTIS
 HC A03/MF A01 CSCL 10/3

Under U.S.A.F. Contract F33615-76-C-2144, KDI SCORE undertook a study to advance state-of-the-art technology of thermal batteries for military applications, so that they might meet the requirements of some systems now using more complicated and expensive reserve batteries. An exhaustive study of the calcium/calcium chromate system and investigation of many new electrochemical systems showed lithium/iron disulfide to be a superior system got thermal batteries, with longer life at high current densities, and greater energy density. Based on battery tests, it was concluded that calcium/calcium chrome thermal batteries could not achieve the goal of 30 minutes life at 30 volts and 30 amperes, and that the lithium-aluminum/iron disulfide system, which achieved approximately 80% of the goal, could, with further development reach and possibly surpass this goal. Author (GRA)

N80-17555# Brookhaven National Lab., Upton, N. Y.

THERMAL MATS FOR SPACE HEATING AND COOLING

F. P. Szydlak and A. L. Berlad Mar. 1979 19 p refs
 (Contract EY-76-C-02-0016)
 (BNL-51019) Avail: NTIS HC A02/MF A01

A single solar-powered device to accomplish both direct-gain heating and space cooling or water heating was studied. In the former operating mode, heating load reductions of 10 to 30 percent were achieved for small structures under cold, sunny midwinter weather conditions. With water flowing, cooling load reductions of 25 percent were obtained with the mats attached to only one large surface of similar structures. The mats also possess significant water heating capability which is a function of flow rate and solar flux. When operated simultaneously as space cooling devices, they serve as efficient water preheaters. For lower flow rates, temperature rises are sufficiently high for direct coupling to domestic hot water supplies. DOE

N80-17556# Franklin Research Center, Philadelphia, Pa.

FIRST PASSIVE SOLAR HOME AWARDS

Jan. 1979 229 p refs
 (Contract EX-76-A-29-1020)
 (DSE-1020-T17) Avail: NTIS HC A11/MF A01

One hundred and sixty two solar home projects are listed and described. The projects are divided into three general categories: direct solar gain, indirect solar gain, and solarium. Discussions on selecting the best type of solar project for a given area, issues involved in marketing passive solar homes, and calculating the solar gain from passive systems are included. A.W.H.

N80-17557# Bechtel National, Inc., San Francisco, Calif.

COMBINED CYCLE FOR SOLAR-FOSSIL HYBRID POWER GENERATION

E. Y. Lam and J. H. Westsik 1979 5 p refs Presented at 14th Intersoc. Energy Conversion Conf., Boston Mass., 5 Aug. 1979

(Contract ET-78-C-03-2051)

(CONF-790803-43) Avail: NTIS HC A02/MF A01

Parametric studies were conducted on a near term and an advanced version of a nominal 100 MWe commercial power system. The combined cycle hybrid system consists of an air operated open Brayton cycle with a steam Rankine bottoming cycle utilizing the gas turbine waste heat. Solar energy is used to preheat the air in the gas turbine cycle with the air cooled receiver located upstream from the combustor in a series arrangement. Cycle efficiencies of 43.5 and 47.7 percent and average annual solar fractions of .312 and .408 were predicted for the near term and advanced versions respectively. DOE

N80-17558# Idaho National Engineering Lab., Idaho Falls.
TODAY'S GEOTHERMAL POWER ECONOMICS AND RISKS

T. W. Lawford 1979 6 p refs Presented at 14th Intersoc. Energy Conversion Conf., Boston, 5 Aug. 1979
(Contract EY-76-C-07-1570)

(CONF-790803-44) Avail: NTIS HC A02/MF A01

Capital and power generation costs are developed as a parameterized composite of a number of ongoing geothermal power projects. Several of the most commonly accepted risks of geothermal power are evaluated in terms of cost penalties to a basic cost of power. The status of geothermal power in the U.S. is reviewed. DOE

N80-17560# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.

METAL FOILS FOR DIRECT APPLICATION OF ABSORBER COATINGS ON SOLAR COLLECTORS

C. M. Lampert Aug. 1979 18 p refs Presented at the Am. Electroplaters Soc. Symp. on Coatings for Solar Collectors, St. Louis, 16-17 Oct. 1979

(Contract W-7405-eng-48)

(LBL-9324; CONF-791021-1) Avail: NTIS HC A02/MF A01

The basic materials and processing associated with the production of coated metal foils for solar collector absorber surfaces are discussed. Also covered are details of heavier metal strips for direct fabrication of solar collectors. Techniques including bonding methods and the use of adhesives are surveyed. Commercial solar foil manufacturers are covered, along with the new research efforts in this area. In conclusion, advantages and disadvantages are outlined, with specific recommendations. DOE

N80-17561# Arizona Univ., Tucson. Dept. of Electrical Engineering.

SEGMENTED DISH CONCENTRATOR DESIGN PROJECT

R. L. Call Jul. 1979 89 p refs

(Contract EY-76-C-04-0789)

(SAND-79-7024) Avail: NTIS HC A05/MF A01

A description of the segmented dish concentrator is presented in two parts: (1) the design and fabrication of the optical module concentrator with heat sink and solar cell receiver; and (2) the design and procedure of mounting the solar cells. The optical module consists of tiers of conical reflecting surfaces accumulating light on a central hexagonal shaped cylindrical receiver. The solar cells are mounted on the faces of the hexagon. Complete units were assembled and tested. Various reflecting materials were tested. An overall maximum of 7.6 percent was obtained for the module using a silver reflector. R.E.S.

N80-17562# Midwest Research Inst., Golden, Colo.
STATE-OF-THE-ART OF SOLAR CONTROL SYSTEMS IN INDUSTRIAL PROCESS HEAT APPLICATIONS

W. S. Su and J. N. Castle Jul. 1979 26 p refs Presented at the ISA Natl. Conf., Chicago, 22-25 Oct. 1979

(Contract EG-77-C-01-4042)

(SERI/TP-39-240; CONF-791005-5) Avail: NTIS HC A02/MF A01

Solar system configurations currently being used or proposed are presented. Parameters and functions deemed essential in solar system controls are identified. Operating deficiencies and possible future improvements are discussed. DOE

N80-17563# Sandia Labs., Albuquerque, N. Mex.
SUNTECH SOLAR LINEAR ARRAY THERMAL SYSTEM (SLATS) TEST RESULTS Summary Report

H. J. Gerwin Aug. 1979 58 p refs

(Contract EY-76-C-04-0789)

(SAND-79-0658) Avail: NTIS HC A04/MF A01

A fixed-receiver, movable-reflector solar collector system was tested. The collector included 260 sq m of reflector area. Thermal energy was transferred from the linear receiver to a heat exchanger by water and from the heat exchanger to the thermal storage tanks by Therminol 66. The collector system start-up and operation over a period of 16 months is described. Several data tables and many graphical displays show the performance characteristics under various operating parameters. DOE

N80-17564# Sandia Labs., Albuquerque, N. Mex.
RECEIVER ASSEMBLY DESIGN STUDIES FOR 2-m 90 DEG PARABOLIC-CYLINDRICAL SOLAR COLLECTORS

A. C. Ratzel Sep. 1979 87 p refs

(Contract EY-76-C-04-0789)

(SAND-79-1026) Avail: NTIS HC A05/MF A01

A computer simulation was developed to provide cumulative all day performance results or instantaneous solar noon results for three annular solar receiver assemblies: 2.223, 2.54, and 3.175 cm o.d. tubes with concentric glass jackets. Representative clear spring, summer, and winter conditions for Albuquerque, N.M. were modeled. Design problems considered in the analysis included misalignment of the receiver assembly from the focal line, reflector trough tracking bias, variation in receiver tube operating temperature, and variation in the reflector trough one-dimensional slope errors and two-dimensional mirror errors. Summarized performance results for all studies are provided graphically. For operating receiver-tube temperatures < 475 K, the 3.175 cm receiver tube provides the best overall collector performance results. For higher operating temperatures where detrimental receiver heat losses become more significant, the smaller 2.54 cm tube is more effective for solar energy collection. DOE

N80-17565# Sandia Labs., Albuquerque, N. Mex.
PERFORMANCE OF LINEAR SOLAR CONCENTRATING COLLECTORS

R. P. Stromberg 1979 21 p refs Presented at the First Intern. Symp. on Non-conventional Energy, Trieste, Italy, 27 Aug. - 7 Sep. 1979

(Contract EY-76-C-04-0789)

(SAND-79-1378C; CONF-790850-1) Avail: NTIS HC A02/MF A01

Performance equations and performance as a function of intensity are discussed. Progress over the past five years and current linear concentrating collector performance are reviewed. The design and development of a low technology linear concentrator are described. DOE

N80-17566# Sandia Labs., Albuquerque, N. Mex.
PERFORMANCE OF SOLAR PASSIVE BUILDINGS

R. P. Stromberg 1979 20 p refs Presented at the First Intern. Symp. on Non-conventional Energy, Trieste, Italy, 27 Aug. - 7 Sep. 1979

(Contract EY-76-C-04-0789)

(SAND-79-1574C; CONF-790850-2) Avail: NTIS HC A02/MF A01

Test data are presented for five different homes during the same winter days. Trombe wall, waterwall, greenhouse, and direct gain features of the buildings display their differing responses to the same climate conditions. DOE

N80-17567# Battelle Pacific Northwest Labs., Richland, Wash.
GUST-RISE EXCEEDANCE STATISTICS FOR WIND TURBINE DESIGN

C. H. Huang and G. H. Fichtl Jul. 1979 31 p refs

(Contract EY-76-C-06-1830)

(PNL-2530) Avail: NTIS HC A03/MF A01

A method of obtaining the velocity change for the design life of a wind energy conversion system is presented. The turbulence spectra, variation of the length scale, turbulence intensity, and surface roughness that are needed to compute the total number of gust rises from the formula are also described. K.L.

N80-17568# Sandia Labs., Albuquerque, N. Mex.
MAGMA ENERGY RESEARCH, 79-1 Semiannual Report, Oct. 1 - 31 Mar. 1979

N80-17569

R. K. Traeger, ed., J. L. Colp, ed., and R. R. Neel, ed. Jul. 1979 59 p refs

(Contract EY-76-C-04-0789)

(SAND-79-1344) Avail: NTIS HC A04/MF A01

The Kilavea Iki lava lake was evaluated. Mathematical models of the cooling of the lake and the state of solidification of the liquid lens were verified by thermal profile and permeability measurements. Jet-augmented drilling concepts successfully penetrated the viscous, multiphase molten rock region in some locations where conventional drilling failed. Heat transfer studies in the lake suggest that injection of fluids to enhance convection may be useful to extract energy from magma chamber margins. An 800 cc simulation facility for evaluating simulated magma properties at temperatures to 1500 C and pressures to 4 kbar was completed and tested. Thermodynamic stability diagrams were developed for 15 pure metals in basaltic magma systems and compatibility tests were completed. Results are to be used to define simple alloy systems which may be compatible with magmas and to identify other superalloy material candidates.

DOE

N80-17569# Midwest Research Inst., Golden, Colo.

OVERVIEW OF DEVELOPING PROGRAMS IN SOLAR DESICCANT COOLING FOR RESIDENTIAL BUILDINGS

1979 18 p Presented at the ASHRAE Soc. Meeting, Detroit, 24 Jun. 1979

(Contract EG-77-C-01-4042)

(SERI/TP-34-187; CONF-790678-3)

Avail: NTIS

HC A02/MF A01

Open cycle adsorption and absorption systems are examined. The different dehumidifier bed configurations are the distinguishing features of these systems. The basic operating principles of each dehumidifier concept are explained along with some discussion of their comparative features. Performance predictions developed by SERI for a solar desiccant solar system employing an axial flow desiccant wheel dehumidifier are presented. In terms of life cycle cost and displaced fossil fuel energy, the results indicate that it should be beneficial to use solar desiccant coolers in residential applications.

DOE

N80-17570# Battelle Pacific Northwest Labs., Richland, Wash. **SOME POTENTIAL MATERIAL SUPPLY CONSTRAINTS IN SOLAR SYSTEMS FOR HEATING AND COOLING OF BUILDINGS AND PROCESS HEAT. A PRELIMINARY SCREENING TO IDENTIFY CRITICAL MATERIALS**

R. L. Watts, W. E. Gurwell, T. A. Nelson, and S. A. Smith Jun. 1979 137 p refs

(Contract EY-76-C-06-1830)

(PNL-2972) Avail: NTIS HC A07/MF A01

Nine solar heating and cooling of buildings designs and three agricultural and industrial process heat designs were studied to identify potential future material constraints to their large scale installation and use. The systems were screened and found to be free of serious future material constraints. The screening was carried out for each individual system design assuming 500 million sq m of collector area installed by the year 2000. Also, two mixed designed scenarios, containing equal portions of each system design, were screened. Three materials were identified that could possibly restrain the deployment of solar systems in the specific scenarios investigated. They are iron and steel, soda lime glass and polyvinyl fluoride. All three of these materials are bulk materials. No raw material supply constraints were found.

DOE

N80-17571# Solar Environmental Engineering Co., Inc., Fort Collins, Colo.

CONTINUING REGIONAL SOLAR ENERGY INFORMATION MINI-CENTER ACTIVITIES AND UPDATING THE SOLCOST PROGRAM Quarterly Report, Nov. 1978 - Jan. 1979

L. J. Lantz Jan. 1979 31 p

(Contract EG-77-C-02-4643)

(COO-4643-T1) Avail: NTIS HC A03/MF A01

Contents: interactive SOLCOST interface; energy conversion - solar system optimization; detailed duct sizing; extension of the SOLCOST data base; portable FORTRAN version; automatic

collector parameter subroutine; the SOLAR INDEX; and the operation of the SOLCOST Mini-Center. DOE

N80-17572# Research Triangle Inst., Research Triangle Park, N. C.

DEVELOPMENT OF HIGH EFFICIENCY, LOW COST ZnSiAs2 SOLAR CELLS. Quarterly Progress Report, 9 Apr. - 30 Jun. 1979

J. E. Andrews 1979 7 p

(Contract DE-AC04-79ET-23001)

(DOE/ET-23001-T1; QPR-1) Avail: NTIS HC A02/MF A01

Three critical goals are identified that must be achieved before ZnSiAs2 can be realistically assessed: (1) hole concentrations must be reduced the 1018 to 1019/cu cm range to the 1016 to 1017/cu cm range (2) n-type ZnSiAs2 must be demonstrated; and (3) ZnSiAs2 pn junctions must be demonstrated. The approach taken and the progress made toward achieving these goals are described. DOE

N80-17573# Midwest Research Inst., Golden, Colo.

AEROSOLS AND SOLAR ENERGY

R. E. Bird and R. L. Hulstrom 1979 11 p refs Presented at

the Workshop on Artificial Aerosols: Vail, Colo., 19 Jun. 1979

(Contract EG-77-C-01-4042)

(SERI/TP-36-309; CONF-7906108-1)

Avail: NTIS

HC A02/MF A01

A brief description is presented of the involvement of the Solar Energy Research Institute (SERI) in atmospheric research, including aerosol characterization and modeling. The use of both rigorous and simple models for radiation transport is described. Modeled broadband solar irradiance data are shown to illustrate the important influence that aerosols have on the energy available to solar systems and the economics of solar systems design. Standard aerosol measurement methods for solar applications are discussed along with the need for improved instrumentation and methods. DOE

N80-17574# Battelle Pacific Northwest Labs., Richland, Wash. **ENERGY MATERIAL TRANSPORT, NOW THROUGH 2000, SYSTEM CHARACTERISTICS AND POTENTIAL PROBLEMS. TASK 3: PETROLEUM TRANSPORTATION Final Report**

J. G. DeSteele Mar. 1979 291 p

(Contract EY-76-C-06-1830)

(PNL-2421) Avail: NTIS HC A13/MF A01

A summary characterization of the petroleum transportation system and an assessment of some potential problems that may impact petroleum transportation in the United States during the balance of the century are presented. The system characterization includes a review of petroleum product movements, modal operations and comparisons, and transportation regulations and safety. A median scenario based on published projections shows that the US will probably rely on foreign oil to supply between 40 and 50 percent of domestic petroleum needs throughout the balance of the century. DOE

N80-17575*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ASSESSMENT OF LOW-COST MANUFACTURING PROCESS SEQUENCES

Robert G. Chamberlain 1979 11 p refs Presented at the

European Congr. on Operations Res., Amsterdam, 9 Apr. 1979

(Contract EY-76-A-29-1012)

(NASA-CR-162745; CONF-790451-1)

Avail: NTIS

HC A02/MF A01 CSCL 10A

An extensive research and development activity to reduce the cost of manufacturing photovoltaic solar arrays by a factor of approximately one hundred is discussed. Proposed and actual manufacturing process descriptions were compared to manufacturing costs. An overview of this methodology is presented. DOE

N80-17576# Dow Chemical Co., Midland, Mich. Hydrocarbons and Energy Research Dept.

ENERGY FROM THE SITU PROCESSING OF ANTRIM OIL SHALE Quarterly Technical Progress Report, Jan. - Mar. 1979

L. J. Washington, Jr. 20 Mar. 1979 45 p refs
(Contract EX-76-C-01-2346)
(FE-2346-44) Avail: NTIS HC A03/MF A01

The 100 series wells, which had been hydraulically and then explosively fractured, are shown to have much greater permeability than had been present in the wells on the existing site during the 1978 extraction trials. Well 301, which is the central well in the explosive underreaming series, was cleaned out. Two wells were drilled and cored nearby. Extensive fracturing due to the use of explosives in Well 301 was evident in the well located 15 feet from the site of the explosive treatment. Communication between these wells is also evident. A downhole methane burner of Tejas Petroleum Engineers was successfully tested under realistic operating conditions in an existing well. DOE

N80-17577# Wizard Research and Development Group, Inc., Washington, D.C.

CRITERIA FOR AN IDEAL SOLAR PHOTOVOLTAIC POWERED INDUSTRY

Jun. 1979 74 p refs
(Contract ET-78-X-01-5433)
(HCP/T5433-01) Avail: NTIS HC A04/MF A01

The application of solar photovoltaic energy and the use of energy in the Primary Metals Industries were surveyed in literature and used to outline criteria for an ideal solar photovoltaic powered industry. Some of the major findings include: (1) the most important requirements of an ideal solar photovoltaic powered industry are the ability to use dc electrical power, ability to be located in Southern California or the Southwestern US and ability to do without power for extended periods of time, (2) the costs of varying from the ideal are most severe with respect to the loss of power element of the criteria, (3) although most of the industries in the Primary Metals group use tremendous amounts of electrical energy, the general requirements of an uninterrupted power source makes them less than ideal users of photovoltaic energy, (4) it appears to be both technologically and economically feasible to develop processes which would make at least four of the seven members of the Primary Metals Industries ideal solar photovoltaic powered industries. DOE

N80-17578# Brookhaven National Lab., Upton, N. Y.
REGIONAL ENVIRONMENT-ENERGY DATA BOOK: NORTHEAST REGION

Dec. 1978 714 p refs
(Contract EY-76-C-02-0016)
(DOE/TIC-10114/3; BNL-24867) Avail: NTIS HC A99/MF A01

A compilation of regional data relating to the energy, environmental, socioeconomic, and institutional characteristics of the Northeast is presented. The document discusses: current and historic data on energy supply, demand, and production; sector fuel demands, fuel consumption, transmission, and transportation; location of energy production and conversion; water quality and quantity; air quality and air quality control areas; natural and induced climatic conditions; waste disposal; land and coast conditions, use, and management; managed and endangered species; demographic and socioeconomic conditions; and health and mortality data. DOE

N80-17582# Badische Anilin- und Soda-Fabrik A. G., Ludwigshafen am Rhein (West Germany).

DEVELOPMENT OF ELECTROCHEMICAL STORAGE BATTERIES WITH IMPROVED ENERGY DENSITY Final Report

Fritz Beck and Wolfram Treptow Bonn Bundesmin. fuer Forsch. u. Technol. Dec. 1977 209 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol. (BMFT-FB-T-77-88) Avail: NTIS HC A10/MF A01; Fachinformationzentrum, Karlsruhe, DM 43.45

The development of secondary batteries containing metals and metal oxides as nonporous electrodes was investigated. Of the systems examined Zn/MnO₂ has the most favorable theoretical stored energy density (up to 360 Whr/kg). Acid corrosion of active masses and the poor load capacity of MnO₂ impeded practical applications. The Pb/PbO₂ system did not have these problems with an energy yield of 35 to 40 Whr for

a theoretical stored energy density of 107 Whr/kg. The limiting value was about 50 Wh/kg. These values were valid for HBF₄ as an electrolyte, which was found to be optimal. Power density was high as well. Results indicate that polypropylene filled with natural graphite is feasible as material for base electrodes. It leads to an essentially metal free bipolar battery design and an improved manufacturing technique. Data on cycle life as well as suggestions for the transformation of these results into improved battery design are also presented. Author (ESA)

N80-17583# Royal Aircraft Establishment, Farnborough (England). Space Dept.

PHOTOVOLTAIC CONVERSION RESEARCH AND DEVELOPMENT IN THE UNITED KINGDOM

F C Treble London HMSO 9 Mar. 1977 14 p refs Presented at 1st Solar Energy R and D Workshop. Bldg Res. Estab., 24 Mar. 1977

(RAE-TM-SPACE-247; BR57075) Avail: NTIS HC A02/MF A01

Research and development, aimed at reducing the cost and increasing the efficiency of photovoltaic solar cells and modules for terrestrial applications in the United Kingdom is discussed. The cell types involved include crystalline and amorphous silicon, thin film and ceramic cadmium sulfide, cadmium sulfide/indium phosphide, gallium arsenide, and Schottky barrier. These activities are reviewed, with some background information on the general topic of photovoltaic conversion and the merits of the various approaches. Recommendations for future action are made. Author (ESA)

N80-17584# National Technical Information Service, Springfield, Va.

THERMAL ENERGY STORAGE, VOLUME 2. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1978 - Jul. 1979

Diane M. Cavagnaro Sep. 1979 117 p
(NTIS/PS-79/0952/6) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10C

The cited reports of Federally funded research concern thermal energy storage. The 112 citations cover the design of equipment, performance evaluation, theory, materials used, and experimental design. GRA

N80-17585# National Technical Information Service, Springfield, Va.

THERMAL ENERGY STORAGE, VOLUME 1. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - 1977

Diane M. Cavagnaro Sep. 1979 203 p
(NTIS/PS-79/0951/8) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10C

Studies on thermal energy storage are cited. The 197 citations discuss the materials used, design, theory, performance evaluation, experimental design and applications. GRA

N80-17586# National Technical Information Service, Springfield, Va.

THERMAL ENERGY STORAGE, VOLUME 1. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - 1977

Diane M. Cavagnaro Sep. 1977 211 p
(NTIS/PS-79/0953/4) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10C

Research from worldwide journal literature on thermal energy storage is cited in the bibliography. The 205 citations cover the materials used, equipment design, theory, industries, performance evaluation, and the problems faced. GRA

N80-17587# National Technical Information Service, Springfield, Va.

THERMAL ENERGY STORAGE, VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1977 - Jul. 1979

Diane M. Cavagnaro Sep. 1979 116 p
(NTIS/PS-79/0954/2) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 10C

N80-17588

Reports from worldwide research are cited covering thermal energy storage. The 110 citations cover many aspects such as the materials used, theory, applications, performance evaluation, design, and problems and advantages. GRA

N80-17588# National Technical Information Service, Springfield, Va.

SILICON SOLAR CELLS, VOLUME 3. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, Nov. 1978 - Oct. 1979

Brian Carrigan Nov. 1979 176 p Supersedes NTIS/PS-1116; NTIS/PS-77/0958; NTIS/PS-76/0801 (PB80-800717; NTIS/PS-78/1116; NTIS/PS-77/0958; NTIS/PS-76/0801) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

Worldwide research on the development of solar energy conversion devices using silicon ribbons, sheets, films, crystals, and wafers is cited. The preparation, purity, crystal defects, and efficiency of these cells are covered. The economics of solar cell development is discussed. The effects of radiation and weathering on performance are included. This updated bibliography contains 171 abstracts, all of which are new entries to the previous edition. GRA

N80-17589# National Technical Information Service, Springfield, Va.

SILICON SOLAR CELLS, VOLUME 3. CITATIONS FROM THE NTIS DATA BASE Progress Report, Dec. 1977 - Oct. 1979

Brian Carrigan Nov. 1979 290 p Supersedes NTIS/PS-1115; NTIS/PS-77/0956; NTIS/PS-76/0800; NTIS/PS-75/628 (PB80-800691; NTIS/PS-78/1115; NTIS/PS-77/0956; NTIS/PS-76/0800; NTIS/PS-75/628) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

Citations of Government sponsored research reports on silicon solar cell growth and fabrication are presented. Processes covered include chemical vapor deposition, the Czochralski method, dendritic growth, ribbon growth, epitaxial growth, and silicon sheet fabrication on substrates. Silicon compound synthesis, purification, and reduction are discussed. Casting, cutting, and shaping of silicon solar cells are included. Solar energy conversion efficiency and performance are described. Abstracts on costs and production of these cells are covered. This updated bibliography contains 209 abstracts, 75 of which are new entries to the previous edition. GRA

N80-17590# National Technical Information Service, Springfield, Va.

SILICON SOLAR CELLS, VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1976 - Oct. 1978

Brian Carrigan Nov. 1979 201 p (PB80-800709) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

Worldwide research pertaining to solar energy conversion devices using silicon ribbons, sheets, films, crystals, and wafers is cited. The preparation, purity, crystal defects, and efficiency of these cells are covered. Solar cell development costs are discussed. The effects of radiation and weathering on performance are described. This updated bibliography contains 196 abstracts, none of which are new entries to the previous edition. GRA

N80-17591# National Technical Information Service, Springfield, Va.

DESIGN AND APPLICATIONS OF FLYWHEELS, VOLUME 1. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Aug. 1978

Guy E. Habercom, Jr. Oct. 1979 264 p (PB80-800303) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 131

The design and varied applications of flywheels and reaction wheels are investigated in these Government-sponsored research reports. Such diversified applications as satellite stabilization, surface vehicle propulsion, energy transfer devices, and inertia

or friction welding are reviewed. This updated bibliography contains 258 abstracts, none of which is new to the previous edition.

GRA

N80-17592# National Technical Information Service, Springfield, Va.

DESIGN AND APPLICATIONS OF FLYWHEELS, VOLUME 2. CITATIONS FROM THE NTIS DATA BASE Progress Report, Sep. 1978 - Sep. 1979

Guy E. Habercom, Jr. Oct. 1979 99 p Supersedes NTIS/PS-78/0997; NTIS/PS-77/0882; NTIS/PS-76/0767; NTIS/PS-75/743; NTIS/PS-75/070 (PB80-800311; NTIS/PS-78/0997; NTIS/PS-77/0882; NTIS/PS-76/0767; NTIS/PS-75/743; NTIS/PS-75/070) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 131

Federally funded research in the design and use of flywheels and reaction vehicles is cited in 93 abstracts, all of which are new to the previous edition. Applications considered include energy storage for surface vehicle propulsion, inertia or friction welding, and satellite attitude control. A.R.H.

N80-17593# National Technical Information Service, Springfield, Va.

DESIGN AND APPLICATIONS OF FLYWHEELS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Oct. 1979

Guy E. Habercom, Jr. Oct. 1979 271 p Supersedes NTIS/PS-78/0998; NTIS/PS-77/0883; NTIS/PS-76/0768 (PB80-800329; NTIS/PS-78/0998; NTIS/PS-77/0883; NTIS/PS-76/0768) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 131

This bibliography cites 266 reports from world literature relating to the design and use of flywheels and reaction wheels for such applications as satellite attitude control, surface vehicle propulsion, energy transfer devices, and inertia or friction welding. Of the entries, 44 are new to the previous edition. A.R.H.

N80-17594# National Technical Information Service, Springfield, Va.

COMBINED CYCLE POWER GENERATION. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Oct. 1979

Audrey S. Hundemann Nov. 1979 158 p Supersedes NTIS/PS-78/1156; NTIS/PS-77/0991 (PB80-800915; NTIS/PS-78/1156; NTIS/PS-77/0991) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

Federally-funded research pertaining to design, efficiency, cost, resource requirements, and environmental aspects of combined cycle power plants is discussed. Abstracts primarily deal with use of coal gasification in conjunction with combined gas and steam turbine generation, including subsystems development studies. This updated bibliography contains 151 abstracts, 45 of which are new entries to the previous edition. GRA

N80-17595# National Technical Information Service, Springfield, Va.

COMBINED CYCLE POWER GENERATION. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Oct. 1979

Audrey S. Hundemann Nov. 1979 195 p Supersedes NTIS/PS-78/1157; NTIS/PS-77/0992 (PB80-800923; NTIS/PS-78/1157; NTIS/PS-77/0992) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

Design, performance, efficiency, economics, and environmental aspects of combined cycle power plants are discussed. Abstracts of worldwide research cover the use of waste heat from gas turbines to drive steam turbines and the thermal efficiency of integrated gasification combined cycle plants using low or intermediate Btu gas. A few abstracts pertain to control and instrumentation used in the plants. This updated bibliography contains 189 abstracts, 36 of which are new entries to the previous edition. GRA

N80-17597# California Univ., Berkeley. Lawrence Berkeley Lab.

REGIONAL ENVIRONMENT-ENERGY DATA BOOK: WESTERN REGION

Dec. 1978 435 p refs
(Contract W-7405-eng-48)
(DOE/TIC-10114/2; LBL-7821) Avail: NTIS
HC A19/MF A01

This document provides a compilation of regional data relating to the energy, environmental, socioeconomic, and institutional characteristics of the West. The document is divided into four chapters. Chapter one includes current and historic data on energy supply, demand, and production; sector fuel demands, fuel consumption, transmission, and transportation; location of energy production and conversion; and energy prices by sector and state. Chapter two shows a variety of natural and preternatural characteristics including water quality and quantity; air quality and air quality control areas; natural and induced climatic conditions; waste disposal; land and coast conditions, use, and management; managed and endangered species; demographic and socioeconomic conditions; and health and mortality data. Included in Chapter three are a variety of organizational, legislative, and regulatory data. Chapter four provides energy equivalents, metric conversions, an index, and a glossary. DOE

N80-17598# California Univ., Berkeley. Lawrence Berkeley Lab.

REGIONAL ENVIRONMENT-ENERGY DATA BOOK: SOUTHERN REGION

Dec. 1978 832 p refs
(Contract W-7405-eng-26)
(DOE/TIC-10114/4; ORNL-5443) Avail: NTIS
HC A99/MF A01

Regional data relating to the energy, environmental, socioeconomic, and institutional characteristics of the South is compiled. Chapter one includes current and historic data on energy supply, demand, and production; sector fuel demands, fuel consumption, transmission, and transportation; location of energy production and conversion; and energy prices by sector and state. Chapter two shows a variety of natural and preternatural characteristics including water quality and quantity; air quality and air quality control areas; natural and induced climatic conditions; waste disposal; land and coast conditions, use, and management; managed and endangered species; demographic and socioeconomic conditions; and health and mortality data. Included in Chapter three are a variety of organizational, legislative, and regulatory data. Chapter four provides energy equivalents, metric conversions, an index, and a glossary. DOE

N80-17599# Battelle Pacific Northwest Labs., Richland, Wash.

REGIONAL ENVIRONMENT-ENERGY DATA BOOK: NORTHWEST REGION

Dec. 1978 864 p refs
(Contract W-7405-eng-36)
(DOE/TIC-10114/5; PNL-RAP-28) Avail: NTIS
HC A99/MF A01

A compilation of regional data relating to the energy, environmental, socioeconomic, and institutional characteristics of the Northwest is presented. The document is divided into four chapters and includes data on the following: energy supply, demand, and production; environmental quality; natural and induced climatic conditions; waste disposal; land and coast conditions, use, and management; managed and endangered species; demographic and socioeconomic conditions; and health and mortality. DOE

N80-17635 Deutscher Wetterdienst, Offenbach am Main (West Germany).

WIND FORCE ANALYSIS FOR THE FEDERAL REPUBLIC OF GERMANY TO DETERMINE THE USEFULNESS OF WIND POWER [DIE WINDVERHAELTNISSE IN DER BUNDESREPUBLIK DEUTSCHLAND IM HINBLICK AUF DIE NUTZUNG DER WINDKRAFT]

W. Benesch, G. Duensing, G. Jurksch, and R. Zoellner 1978 145 p refs In GERMAN; ENGLISH summary Original contains color illustrations
(ISBN-3-88148-164-8) Avail: NTIS HC A07

The utilization of wind force in inland areas is investigated on the basis of data sets from 74 stations from the period

1969 to 1974. The dependence of the annual means and average annual cumulative frequencies of wind velocity on elevation is evaluated. Analyses on the duration of threshold values of wind velocity are also made. A number of sites suitable for wind power utilization are identified. Author (ESA)

N80-17863# Westinghouse Electric Corp., Pittsburgh, Pa. Fusion Power Systems Dept.

DESIGN STUDY OF A FUSION-DRIVEN TOKAMAK HYBRID REACTOR FOR FISSILE FUEL PRODUCTION, VOLUME 1 Final Report

R. P. Rose May 1979 284 p refs
(EPRI-ER-1083-Vol-1) Avail: NTIS HC A13/MF A01

Conceptual approaches for a Tokamak fusion driven fuel producing reactor were evaluated. The conceptual design of the hybrid reactor was based on using projected state of the art technology for the late 1980s. The conceptual definitions of two alternatives for the fusion driver were assessed. A two component Tokamak (TCT) concept, based on the TFTR plasma physics parameters, was compared to a beam driven thermonuclear (BDTN) concept, based on the USSR T-20 plasma physics parameters. DOE

N80-17864# Westinghouse Electric Corp., Pittsburgh, Pa. Fusion Power Systems Dept.

DESIGN STUDY OF A FUSION-DRIVEN TOKAMAK HYBRID REACTOR FOR FISSILE FUEL PRODUCTION, VOLUME 2 Final Report

R. P. Rose May 1979 268 p refs
(EPRI-NP-1083-Vol-2) Avail: NTIS HC A12/MF A01

Conceptual approaches for a Tokamak fusion driven fuel producing reactor are discussed. The conceptual design of the hybrid reactor was based on using projected state of the art technology for the late 1980s. Considerations such as reactor materials and safety are included. The conceptual definitions of two alternatives for the fusion driver were evaluated. A two component Tokamak (TCT) concept, based on the TFTR plasma physics parameters, was compared to a beam driven thermonuclear (BDTN) concept, based on the USSR T-20 plasma physics parameters. DOE

N80-17909# Planco, Inc., Dallas, Tex.

SURVEY OF THE RESEARCH INTO ENERGY-ECONOMIC INTERACTIONS. VOLUME 2: ANNOTATED BIBLIOGRAPHY

R. Coates, D. Hanson, S. Tuenger, and J. Kennington Apr. 1979 423 p
(Contract EI-78-C-01-6346)

(DOE/TIC-10134-Vol-2) Avail: NTIS HC A18/MF A01
Abstracts of about 400 articles, books, and reports cited in Planco's 'Survey of the Research into Energy-Economy Interactions: Volume I are reported'. It represents the end result of a search for recent (1960 to present) and ongoing research into energy-economy interactions. Only the research directly related to macroeconomic energy-economy interactions was selected for inclusion in the annotated bibliography. Abstracts are provided. DOE

N80-17913# Committee on Science and Technology (U. S. House).

NASA AUTHORIZATION, 1981, PROGRAM REVIEW, VOLUME 1

Washington GPO 1979 649 p refs Hearings before the Subcomm. on Space Sci. and Applications of the Comm. on Sci. and Technol., 96th Congr., 1st Sess., 16-18 Oct. 1979
(GPO-53-814) Avail: Subcomm. on Space Sci. and Applications

The status of NASA programs is reviewed as a preliminary to fiscal 1981 authorization hearings. Problems of cost, performance, and scheduling which can affect the budget program performance are examined. Particular emphasis is given to advanced research and development, technology utilization, and aerospace technology transfer in communications, space processing, energy conversion, electric propulsion systems, life sciences, planetary exploration, astrophysics, solar terrestrial interactions, and Earth resources observation. A.R.H.

N80-17916*# Garrett Corp., Torrance, Calif.
ADVANCED ELECTRIC PROPULSION SYSTEM CONCEPT FOR ELECTRIC VEHICLES

A. E. Raynard and F. E. Forbes Aug. 1979 157 p refs
 (Contracts EC-77-A-31-1044; DEN3-81)
 (NASA-CR-159651; DOE/NASA/0081-79/1;
 AiResearch-79-16182) Avail: NTIS HC A08/MF A01 CSCL 13F

Seventeen propulsion system concepts for electric vehicles were compared to determine the differences in components and battery pack to achieve the basic performance level. Design tradeoffs were made for selected configurations to find the optimum component characteristics required to meet all performance goals. The anticipated performance when using nickel-zinc batteries rather than the standard lead-acid batteries was also evaluated. The two systems selected for the final conceptual design studies included a system with a flywheel energy storage unit and a basic system that did not have a flywheel. The flywheel system meets the range requirement with either lead-acid or nickel-zinc batteries and also the acceleration of zero to 89 km/hr in 15 s. The basic system can also meet the required performance with a fully charged battery, but, when the battery approaches 20 to 30 percent depth of discharge, maximum acceleration capability gradually degrades. The flywheel system has an estimated life-cycle cost of \$0.041/km using lead-acid batteries. The basic system has a life-cycle cost of \$0.06/km. The basic system, using batteries meeting ISOA goals, would have a life-cycle cost of \$0.043/km. A.R.H.

N80-17918# EIC, Inc., Newton, Mass.
SURVEY ON METALLURGICAL RECYCLING PROCESSES Final Report

J. P. Pemsler Mar. 1979 197 p refs
 (Contract W-31-109-eng-38)
 (ANL/OEPM-79-2) Avail: NTIS HC A09/MF A01

Major opportunities for increasing the extent of recycle of nonferrous scrap metals and thereby increasing the energy savings are discussed. Preliminary flowsheets are presented for the recovery of value metals from batteries considered for use in vehicular propulsion and load leveling applications. A flow sheet was outlined for an integrated hydrometallurgical process to treat low-grade copper scrap. A fully integrated hydrometallurgical process is outlined, and costs and energy consumption are derived for recovering zinc metal from electric furnace flue dusts. Costs and energy are high and the process does not appear to warrant development at this time. Improvement in the recycle of magnesium is associated primarily with improved recycle in the Al industry where Mg is an important alloy additive. Ni and Ti recycle are associated with improved collection and sorting of stainless steel and specialty alloys. DOE

N80-17922# Transportation Systems Center, Cambridge, Mass.
ANALYSIS OF LIFE-CYCLE COSTS AND MARKET APPLICATIONS OF FLYWHEEL ENERGY-STORAGE TRANSIT VEHICLES Final Report, Fall 1977 - Summer 1978

D. L. Goeddel and G. Ploetz Jul. 1979 191 p
 (PB-300289/6; DOT-TSC-UMTA-78-77;
 UMTA-MA-06-0044-78-2) Avail: NTIS HC A09/MF A01 CSCL 13F

The operational requirements and conceptual design of flywheel energy storage vehicles for transit service are analyzed along with the economic viability and potential market applications of these proposed concepts within urban transit operations. The design characteristics, system capital costs, and annual recurring operations/maintenance costs associated with the conventional diesel bus, the trolley bus, and the flywheel-powered vehicle systems are defined. The results of the life cycle analysis and the sensitivity of these results due to variations of key assumed input variables are described. GRA

N80-17923# Transportation Systems Center, Cambridge, Mass.
SIMULATION OF AN URBAN BATTERY BUS VEHICLE Final Report, Jun. - Dec. 1978

John J. Stickler Jul. 1979 90 p
 (PB-300306/8; DOT-TSC-UMTA-79-15;

UMTA-MA-06-0093-79-1) Avail: NTIS HC A05/MF A01 CSCL 13F

The computer simulation of a battery-powered bus as it traverse an arbitrary mission profile of specified acceleration, roadway grade, and headwind is described. The battery-bus system components comprise a DC shunt motor, solidstate power conditioning unit with regeneration capability, and a battery source consisting of a multiunit lead acid battery. The computer model determines vehicle tractive effort and power consumption and computes actual vehicle speed for a given mission profile. The computer model uses a 'modularization' format which facilitates the simulation of alternate propulsion systems involving the interchange of one system component for another. GRA

N80-18098*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ECONOMIC ANALYSIS OF THE DESIGN AND FABRICATION OF A SPACE QUALIFIED POWER SYSTEM

Gregory Ruselowski Jan. 1980 25 p refs
 (NASA-TM-81418; E-339) Avail: NTIS HC A02/MF A01 CSCL 10B

An economic analysis was performed to determine the cost of the design and fabrication of a low Earth orbit, 2 kW photovoltaic/battery, space qualified power system. A commercially available computer program called PRICE (programmed review of information for costing and evaluation) was used to conduct the analysis. The sensitivity of the various cost factors to the assumptions used is discussed. Total cost of the power system was found to be \$2.46 million with the solar array accounting for 70.5%. Using the assumption that the prototype becomes the flight system, 77.3% of the total cost is associated with manufacturing. Results will be used to establish whether the cost of space qualified hardware can be reduced by the incorporation of commercial design, fabrication, and quality assurance methods. J.M.S.

N80-18125 Massachusetts Univ., Amherst.
THE APPLICATION OF CHROMATOGRAPHY AND ANCILLARY TECHNIQUES TO THE CHARACTERIZATION OF SHALE OIL/OIL SHALE COMPOUND CLASSES AND OF ORGANOMETALLICS Ph.D. Thesis

Frank Patrick DiSanzo 1979 203 p
 Avail: Univ. Microfilms Order No. 8004916

Chromatography and Ancillary techniques (specific detectors and mass spectrometry) were applied to the characterization of shale oil and oil shale compound classes and of organometallics. An inexpensive and simple preparative low pressure high performance liquid chromatographic scheme was developed for shale oil hydrocarbon analysis. Activated silica and silver nitrate impregnated 32-63 micron silica was employed for the isolation of alkanes, alkenes, and aromatics. Evidence for the presence of prist-1-ene in the alkene fraction is presented. Application of on-line reactors to aid in the discrimination between various classes of hydrocarbons is also described. Dissert. Abstr.

N80-18156*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PRELIMINARY STUDY OF A SOLAR SELECTIVE COATING SYSTEM USING BLACK COBALT OXIDE FOR HIGH TEMPERATURE SOLAR COLLECTORS

G. McDonald 1980 16 p refs Proposed for presentation at Intern. Conf. on Metal Coatings, San Diego, Calif., 21-25 Apr. 1980; Sponsored by Am. Vacuum Soc.
 (NASA-TM-81385; E-293) Avail: NTIS HC A02/MF A01 CSCL 10A

Black cobalt oxide coatings (high solar absorptance layer) were deposited on thin layers of silver or gold (low emittance layer) which had been previously deposited on oxidized (diffusion barrier layer) stainless steel substrates. The reflectance properties of these coatings were measured at various thicknesses of cobalt for integrated values of the solar and infrared spectrum. The values of absorptance and emittance were calculated from the measured reflectance values, before and after exposure in air at 650 C for approximately 1000 hours. Absorptance and emittance were interdependent functions of the weight of cobalt oxide. Also, these cobalt oxide/noble metal/oxide diffusion barrier

coatings have absorptances greater than 0.90 and emittances of approximately 0.20 even after about 1000 hours at 650 C.

Author

N80-18157* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EFFECTS OF IMPURITIES IN COAL-DERIVED LIQUIDS ON ACCELERATED HOT CORROSION OF SUPERALLOYS Final Report

Daniel L. Deadmore and Carl E. Lowell Mar. 1980 30 p refs (Contract EF-77-A-01-2593)

(NASA-TM-81384; DOE/NASA/2593-79/13; E-292) Avail: NTIS HC A03/MF A01 CSCL 11F

A Mach 0.3 burner rig was used to determine the effects of potential coal derived liquid fuel impurity combustion of products on hot corrosion in IN-100, IN-792, IN-738, U-700, Mar M-509, and 304 stainless steel. The impurities, added as aqueous solutions to the combustor, were salts of sodium, potassium, vanadium, molybdenum, tungsten, phosphorus, and lead. Extent of attack was determined by metal consumption and compared to the effects of sodium alone. Vanadium, molybdenum, tungsten, phosphorous, and lead in combination with sodium all resulted in increased attack as compared with sodium alone at some temperatures, apparently due in large part to the extension of the formation of liquid deposits. Varying the sodium-potassium ratio had little effect for ratios less than 1:3 for which reduced, but measurable, attack was observed. K.L.

N80-18202 Oklahoma State Univ., Stillwater.

PHOTOCHEMICAL CONVERSION OF COAL TO GASOLINE IN AN ENTRAINED BED REACTOR Ph.D. Thesis

Muthu Subramanian Sundaram 1979 246 p

Avail: Univ. Microfilms Order No. 8003606

The interaction of photochemically produced hydrogen atoms with a variety of coal dusts under various reaction conditions was investigated. The existence of correlations between coal types and their relative hydrogen atom reactivities as a function of temperature, extent of conversion, particle size, and hydrogen atom concentration was explored. Dissert. Abstr.

N80-18203# Department of the Treasury, Washington, D.C. Bureau of Alcohol, Tobacco and Firearms.

EXPERIMENTAL ALCOHOL FUEL PLANTS

Dec. 1979 27 p

(ATF-P-5000-2) Avail: NTIS HC A03/MF A01

Information on experimental alcohol fuel plants for personal fuel use is presented. Pertinent laws and regulations for the prospective alcohol producers and users are described. R.E.S.

N80-18204# Department of the Treasury, Washington, D.C. Bureau of Alcohol, Tobacco and Firearms.

ALCOHOL FUELS INFORMATION DIRECTORY

Feb. 1980 8 p

(ATF-P-5000-3) Avail: NTIS HC A02/MF A01

Information on renewable energy sources, particularly alcohol fuels, is presented. Permit information is discussed. R.E.S.

N80-18205* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

INITIAL CHARACTERIZATION OF AN EXPERIMENTAL REFEREE BROADENED-SPECIFICATION (ERBS) AVIATION TURBINE FUEL

George M. Prok and Gary T. Seng Jan. 1980 10 p refs

(NASA-TM-81440; E-206) Avail: NTIS HC A02/MF A01 CSCL 21D

Characterization data and a hydrocarbon compositional analysis are presented for a research test fuel designated as an experimental referee broadened-specification aviation turbine fuel. This research fuel, which is a special blend of kerosene and hydrotreated catalytic gas oil, is a hypothetical representation of a future fuel should it become necessary to broaden current kerojet specifications. It is used as a reference fuel in research investigations into the effects of fuel property variations on the performance and durability of jet aircraft components, including combustors and fuel systems. J.M.S.

N80-18212# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

HYDROGEN AS A FUEL

L. W. Richards Jul. 1979 35 p refs

(TT-7903; ISSN-0140-9751) Avail: NTIS HC A03/MF A01

Research on the storage of hydrogen in automobiles is reviewed. Metal hydride storage, encapsulation of hydrogen in molecular sieve zeolites, and the reaction of saline hydrides with water are considered in detail. After a brief comparison of hydrogen energy yield with gasoline energy yield per weight, hydrogen fuel storage in motor vehicles is considered. Safety factors of different storage schemes (high pressure gas, cryogenic tanks, metal hydrides) are emphasized along with volume and weight considerations. Results show two basic systems as feasible, namely that of a saline hydride reacting with water inside the vehicle, or a system involving a combination of calcium - mischmetal and magnesium, with nickel to act as a catalyst.

Author (ESA)

N80-18261* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

A FLUORESCENT RADIATION CONVERTER Patent Application

Walter Viehmann, inventor (to NASA) Filed 11 Jan. 1980 19 p

(NASA-Case-GSC-12528-1; US-Patent-Appl-SN-111439) Avail: NTIS HC A02/MF A01 CSCL 20N

A fluorescent radiation converter having a substantially undoped optically transparent substrate and a waveshifter coating deposited on at least one portion of substrate for absorption of radiation and conversion thereof to fluorescent radiation is described. The coating is formed of substantially 1000 g/liter of a solvent, 70 to 200 q/liter of an organic polymer, and .2 to 25 g/liter of at least one organic fluorescent dye. The incoming incident radiation impinges on the coating and enters therein. Radiation is absorbed by the fluorescent dye and is reemitted as a longer wavelength radiation. Advantages of the fluorescent radiation converter in the areas of liquid crystal displays, scintillation counters, and in photovoltaic conversion techniques are discussed. NASA

N80-18287* National Aeronautics and Space Administration, Pasadena Office, Calif.

MICROWAVE POWER TRANSMISSION BEAM SAFETY SYSTEM Patent

Richard M. Dickinson, inventor (to NASA) (JPL) Issued 5 Feb. 1980 8 p Filed 16 Oct. 1978 Supersedes N79-10271 (17 - 01, p 0036) Sponsored by NASA

(NASA-Case-NPO-14224-1; US-Patent-4,187,506;

US-Patent-Appl-SN-951829; US-Patent-Class-343-100R;

US-Patent-Class-310-306; US-Patent-Class-343-100ST) Avail: US Patent and Trademark Office CSCL 09C

A system in which the characteristics of a microwave power transmission beam are controlled in accordance with power distribution profiles altered due to the detected presence or entrance of an object into the beam which causes changes that are perceived in various received, reflected and scattered power distribution profiles resulting over various receiving elements of the system is presented. The system comprises a microwave power beam radiator array, a microwave power beam receiving antenna array, the radiator array in one embodiment being located on an orbiting spacecraft and the receiving array being located at a ground station. Another embodiment provides a ground based transmitting array and a receiving array aboard an aircraft or airship.

Official Gazette of the U.S. Patent and Trademark Office

N80-18307# Naval Postgraduate School, Monterey, Calif. **PERFORMANCE ANALYSIS OF A TYPE OF ELECTROHYDRODYNAMIC POWER GENERATOR**

T. H. Gawain and Oscar Biblarz Apr. 1979 91 p

(AFOSR MIPR 78-0002)

(AD-A076115; NPS67-79-006)

Avail: NTIS

HC A05/MF A01 CSCL 10/2

This report develops a detailed analysis of a type of electrohydrodynamic power generator which employs an ejector and a so-called 'fluid flywheel' as essential components. The medium is steam containing electrically charged water droplets. The analysis takes into account the experimentally established facts that the maximum strength of the electrical field that can be sustained at incipient breakdown at the most critical location is proportional to the fluid density at that location. It is shown that as a consequence of this fact, the electrical output can be maximized by designing the primary jet for an exit Mach number of 0.71. Estimates are made of the pump work required, of mixing losses in the ejector and of friction and secondary flow losses. The mathematical analysis is reduced to a fully non-dimensional form and the key dimensionless parameters that govern performance are clearly identified. A preliminary estimate is made of the numerical values of these parameters and the overall performance of the system is estimated on this basis.

GRA

N80-18311# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

PERMANENT MAGNET AND SUPERCONDUCTING GENERATORS IN AIRBORNE, HIGH POWER SYSTEMS
Interim Report, 1 Feb. 1978 - 31 Mar. 1979

Hugh L. Southall and Frederick C. Brockhurst Aug. 1979 99 p refs

(AF Proj. 3145)

(AD-A078424; AFAPL-TR-79-2073)

Avail: NTIS

HC A05/MF A01 CSCL 10/2

This report presents results of a study performed to compare airborne, high power supplies at power levels of 10 and 20 MW utilizing permanent magnet and superconducting generators. Algorithms for the weight and volume of these electrical generators are presented and algorithms for the other power supply components are used to predict total system weights for seven point designs at the two power levels.

GRA

N80-18345# Brussels Univ. (Belgium). Inst. de Mecanique Appliquee.

THEORETICAL STUDY OF THERMAL LOSSES: THE USE OF HYBRID AND COMBINED DRY COOLANTS [ETUDE DE BASE DES REJETS THERMIQUES: UTILISATION DE REFRIGERANTS SECS, HYBRIDES ET COMBINES]

Andre L. Jaumotte, Pierre Decock, Bernard Leduc, and Philippe Nagel 1978 67 p refs In FRENCH Sponsored by Groupement Ecologique Belge (GEBEG)

(NT-44-1978) Avail: NTIS HC A04/MF A01

After a brief review of techniques used in the disposal of waste heat from electrical power plants, dry coolant systems are cited as a promising solution. Emphasis is placed on the size reduction of cooling towers, on further limiting heat exchanger surfaces by using special cooling fin profiles, and on the introduction of an intermediary cold cycle between the condenser and the coolant (ammonia cycle). Results show that a combined wet tower/dry tower system has short term advantages, especially from a cost effectiveness point of view (reduced ecological impact). Three regions in Belgium are taken as examples of areas that might benefit from this scheme. As a long term solution the use of a condensable fluid (ammonia) with a cold cycle for recuperating thermal energy is suggested.

Author (ESA)

N80-18406*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EFFECT OF GEOMETRY AND OPERATING CONDITIONS ON SPUR GEAR SYSTEM POWER LOSS

Neil E. Anderson and Stuart H. Loewenthal 1980 31 p refs Proposed for presentation at 3d Intern. Power Transmission and Gearing Conf., San Francisco, Calif., 18-22 Aug. 1980; sponsored by Am. Soc. of Mech. Engr.

(NASA-TM-81426; E-350; AVRADCOM-TR-80-C-2) Avail: NTIS HC A03/MF A01 CSCL 20I

The results of an analysis of the effects of spur gear size, pitch, width, and ratio on total mesh power loss for a wide range of speeds, torques, and oil viscosities are presented. The analysis uses simple algebraic expressions to determine gear sliding, rolling, and windage losses and also incorporates an

approximate ball bearing power loss expression. The analysis shows good agreement with published data. Large diameter and fine pitched gears had higher peak efficiencies but low part load efficiency. Gear efficiencies were generally greater than 98 percent except at very low torque levels. Tare (no-load) losses are generally a significant percentage of the full load loss except at low speeds.

Author

N80-18411# Engineering Development Establishment, Maribyrnong (Australia).

LABORATORY INVESTIGATION OF THE PERFORMANCE OF A HOLDEN ENGINE OPERATING ON LIQUIFIED PETROLEUM GAS

N. Webb Aug. 1979 49 p

(AD-A076145; EDE-28/79) Avail: NTIS HC A03/MF A01 CSCL 14/2

A laboratory investigation into the relative performances of an engine when operated on both liquified petroleum gas (LPG) and petrol showed that the engine operated at higher terminal efficiency on LPG and also that it would operate satisfactorily at leaner air-fuel mixtures on this fuel. Engine performance was less affected by retarded ignition for LPG than for petrol. Furthermore, a large increase in dwell angle from the recommended setting had no significant effect on LPG performance. The LPG carburettor when installed in its normal configuration maintained an essentially constant mixture strength with no part throttle leaning of mixtures to give better efficiency nor corresponding full throttle enrichment to give best engine torque.

GRA

N80-18415# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

FLUTTER ANALYSIS OF SMALL WINDTURBINE, DESIGNED FOR MANUFACTURE AND USE IN DEVELOPING COUNTRIES

P. C. Hensing Aug. 1978 29 p refs

(UTH-LR-272) Avail: NTIS HC A03/MF A01

The flutter behavior of a wind turborotor designed for manufacture and use in developing countries was investigated. Possible improvements are discussed. The effect of scaling is considered. Results show that the addition of small tip-masses has a curative influence on flutter sensitive rotor designs.

Author (ESA)

N80-18446*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

AEROELASTIC EQUATIONS OF MOTION OF A DARRIEUS VERTICAL-AXIS WIND-TURBINE BLADE

Krishna Rao V. Kaza (Toledo Univ.) and Raymond G. Kvaternik Dec. 1979 57 p refs

(Contract E(49-26)-1028)

(NASA-TM-79295; DOE/NASA/1028-79/25; E-238) Avail: NTIS HC A04/MF A01 CSCL 20K

The second-degree nonlinear aeroelastic equations of motion for a slender, flexible, nonuniform, Darrieus vertical-axis wind turbine blade which is undergoing combined flatwise bending, edgewise bending, torsion, and extension are developed using Hamilton's principle. The blade aerodynamic loading is obtained from strip theory based on a quasi-steady approximation of two-dimensional incompressible unsteady airfoil theory. The derivation of the equations has its basis in the geometric nonlinear theory of elasticity and the resulting equations are consistent with the small deformation approximation in which the elongations and shears are negligible compared to unity. These equations are suitable for studying vibrations, static and dynamic aeroelastic instabilities, and dynamic response. Several possible methods of solution of the equations, which have periodic coefficients, are discussed.

K.L.

N80-18497*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

NUMERICAL CALCULATION OF STEADY INVISCID FULL POTENTIAL COMPRESSIBLE FLOW ABOUT WIND TURBINE BLADES

Djordje S. Dulikravich 1980 11 p refs Presented at the Wind Energy Conf., Boulder, Colo., 9-11 Apr. 1980; sponsored

by AIAA and Midwest Energy Research Inst.
(NASA-TM-81438; E-361; AIAA-Paper-80-0607) Avail: NTIS
HC A02/MF A01 CSCL 10B

An exact nonlinear mathematical model that accounts for three-dimensional cascade effects about the inner portions of the rotor blades and compressibility effects about the tip regions of the blades was derived. An artificially time dependent version was iteratively solved by a finite volume technique involving an artificial viscosity and a three-level consecutive mesh refinement. The exact boundary conditions were applied by generating a boundary conforming periodic computation mesh. K.L.

N80-18547# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN UNITED STATES. EVALUATION OF POTENTIAL GEOTHERMAL RESOURCE AREAS

Franklin O. Mitchell Jul. 1979 53 p refs
(Contracts EX-76-A-36-1008; DE-A101-79ET-27025)
(PB-299925/8; APL/JHU-QM-79-163-GT) Avail: NTIS
HC A04/MF A01 CSCL 08I

A method for the comparative evaluation of geothermal prospects in the eastern United States is proposed and illustrated. Comparisons are based on quantified data from geologic, engineering, and socio-economic sources including temperature gradient, depth to basement, drilling costs, population, and distribution by town size, as well as energy use in residential, commercial, and industrial applications. GRA

N80-18553 Oklahoma Univ., Norman.
ANALYSIS OF THE GEOTHERMAL BINARY CYCLE USING PARAFFIN HYDROCARBONS AS WORKING FLUIDS
Ph.D. Thesis

Khan Zafar Iqbal 1979 301 p
Avail: Univ. Microfilms Order No. 8004390

It is demonstrated that the analysis of the geothermal binary cycles is simplified through the use of basic thermodynamic relations. The complex interrelationships of thermodynamic, equipment, unit operational, and cost parameters are presented. It is shown that mixtures provide a significantly greater amount of work compared to pure fluids. Furthermore, mixture composition and behavior can be changed over the plant lifetime to match the changes in the geothermal resource. For fixed brine flow rate conditions, a decrease in the resource temperature results in a decrease in the net plant power. For the 300 F georesource temperature, the resource utilization and cost optima nearly coincide. Dissert. Abstr.

N80-18554*# Spectrolab, Inc., Sylmar, Calif.
DEVELOPMENT OF IMPROVED WRAPAROUND CONTACTS FOR SILICON Final Report

Jay W. Thornhill Dec. 1979 41 p
(Contract NAS3-20065)
(NASA-CR-159748) Avail: NTIS HC A03/MF A01 CSCL
10A

A developmental process for fabricating 2 X 4 cm back surface field silicon solar cells featuring wraparound contacts and screen printed dielectric isolation is described. The process was then used to fabricate a number of cells for evaluation and study, as well as to establish the validity of the process sequence. While a number of cells exhibiting relatively good conversion efficiencies were produced, nearly all had low I-V curve factors for the level of efficiencies attained. Cells with conversion efficiencies of more than 15 percent (air mass zero and 25 C) had fill factors of only 0.76. Evidence as to the cause of this has not been conclusive, but is most probably linked to isolation failure in the wraparound dielectric and associated shunting problems. Author

N80-18555*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FLEXIBLE FORMULATED PLASTIC SEPARATORS FOR ALKALINE BATTERIES Patent Application

D. W. Scheibley, J. M. Bozek, and D. G. Soltis, inventors (to NASA) Filed 28 Sep. 1979 10 p
(NASA-Case-LEW-12363-4; US-Patent-Appl-SN-079914) Avail:
NTIS HC A02/MF A01 CSCL 10C

A flexible separator for alkaline batteries is disclosed. The separator is comprised of a coating which is applied to a nonwoven porous substrate such as sheets or mats of asbestos or other materials which are inert with respect to the alkaline electrolyte of the battery. The coating material comprises a polyphenylene oxide polymer, an organic additive and inorganic and organic fillers which comprise 55% by volume or less of the coating material. Preferably, at least one inorganic filler material which is reactive with the electrolyte is included to produce desirable pores in the coating. The organic additive is a polymeric polyester material which is hydrolyzed by the alkaline electrolyte to improve conductivity of the coating. NASA

N80-18556*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FLEXIBLE FORMULATED PLASTIC SEPARATORS FOR ALKALINE BATTERIES Patent Application

D. W. Scheibley, J. M. Bozek, and D. G. Soltis, inventors (to NASA) Filed 19 Jul. 1979 10 p
(NASA-Case-LEW-12363-3; US-Patent-Appl-SN-058658) Avail:
NTIS HC A02/MF A01 CSCL 10C

A flexible separator for alkaline batteries is disclosed. The separator is comprised of a coating which is applied to a nonwoven porous substrate such as sheets or mats of asbestos or other materials which are inert with respect to the alkaline electrolyte of the battery. The coating material is comprised of a polyphenylene oxide polymer, an organic additive and inorganic and organic fillers which comprise 55% by volume or less of the coating material. Preferably, at least one inorganic filler material which is reactive with the electrolyte is included to produce desirable pores in the coating. The organic additive is a polymeric polyester material which is hydrolyzed by the alkaline electrolyte to improve conductivity of the coating. NASA

N80-18557*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

CATALYST SURFACES FOR THE CHROMOUS/CHROMIC REDOX COUPLE Patent Application

Jose D. Giner (Giner, Inc.) and Kathleen J. Cahill, inventors (to NASA) (Giner, Inc.) Filed 27 Jul. 1979 15 p Sponsored by NASA
(NASA-Case-Lew-13148-2; US-Patent-Appl-SN-061555) Avail:
NTIS HC A02/MF A01 CSCL 10A

An electricity producing cell of the reduction-oxidation type is disclosed. The cell is divided into two compartments by a membrane and each compartment contains a solid inert electrode. A ferrous/ferric couple in a chloride solution serves as a cathode fluid which is circulated through one of the compartments to produce a positive electric potential disposed therein. A chromic/chromous couple in a chloride solution serves as an anode fluid which is circulated through the second compartment to produce a negative potential on an electrode disposed therein. The electrode is an electrically conductive, inert material plated with copper, silver or gold. A thin layer of lead plates onto the copper, silver or gold layer when the cell is being charged, the lead ions being available from lead chloride which has been added to the anode fluid. If the REDOX cell is then discharged, the current flows between the electrodes causing the lead to deplete from the negative electrode and the metal coating on the electrode will act as a catalyst to cause increased current density. NASA

N80-18558*# National Aeronautics and Space Administration, Washington, D. C.

CONTROL STRATEGY FOR A VARIABLE-SPEED WIND ENERGY CONVERSION SYSTEM

A. Jacob, D. Veillette, and V. Rajagopalan Nov. 1979 10 p refs Transl. into ENGLISH from Proc. of New York Inst. of Elec. Engineers Inc., 1978 p 528-531 In FRENCH Presented at Can. Commun. and Power Conf., Montreal, 18-20 Oct. 1978 Transl. by Kanner (Leo) Associates, Redwood City, Calif. (Contract NASw-3199)
(NASA-TM-75512) Avail: NTIS HC A02/MF A01 CSCL
10A

A control concept for a variable-speed wind energy conversion system is proposed, for which a self-excited asynchronous

cage generator is used along with a system of thyristor converters. The control loops are the following: (1) regulation of the entrainment speed as function of available mechanical energy by acting on the resistance couple of the asynchronous generator; (2) control of electric power delivered to the asynchronous machine, functioning as a motor, for start-up of the vertical axis wind converter; and (3) limitation of the slip value, and by consequence, of the induction currents in the presence of sudden variations of input parameters. Author

N80-18559*# Avco Corp., Wilmington, Mass.
PARAMETRIC STUDY OF POTENTIAL EARLY COMMERCIAL MHD POWER PLANTS Final Report
 Finn A. Hals Dec. 1979 246 p refs
 (Contracts DEN3-51; EF-77-A-01-2674)
 (NASA-CR-159633; DOE/NASA/0051-79/1) Avail: NTIS HC A11/MF A01 CSCL 10B

Three different reference power plant configurations were considered with parametric variations of the various design parameters for each plant. Two of the reference plant designs were based on the use of high temperature regenerative air preheaters separately fired by a low Btu gas produced from a coal gasifier which was integrated with the power plant. The third reference plant design was based on the use of oxygen enriched combustion air preheated to a more moderate temperature in a tubular type metallic recuperative heat exchanger which is part of the bottoming plant heat recovery system. Comparative information was developed on plant performance and economics. The highest net plant efficiency of about 45 percent was attained by the reference plant design with the use of a high temperature air preheater separately fired with the advanced entrained bed gasifier. The use of oxygen enrichment of the combustion air yielded the lowest cost of generating electricity at a slightly lower plant efficiency. Both of these two reference plant designs are identified as potentially attractive for early MHD power plant applications. R.E.S.

N80-18565*# General Electric Co., Philadelphia, Pa. Space Div.
APPENDIX: MOD-1 WIND TURBINE GENERATOR ANALYSIS AND DESIGN REPORT, VOLUME 2 Final Report
 May 1979 425 p
 (Contracts NAS3-20058; EX-77-A-29-1010)
 (NASA-CR-159496; DOE/NASA/0058-79/2-Vol-2-App) Avail: NTIS HC A18/MF A01 CSCL 10B

The MOD-1 detail design is appended. The supporting analyses presented include a parametric system trade study, a verification of the computer codes used for rotor loads analysis, a metal blade study, and a definition of the design loads at each principal wind turbine generator interface for critical loading conditions. Shipping and assembly requirements, composite blade development, and electrical stability are also discussed. K.L.

N80-18567*# Naval Postgraduate School, Monterey, Calif.
SOLAR ENERGY DESIGN IMPROVEMENT: A METHODOLOGY FOR HYDRONIC FLATPLATE COLLECTOR SYSTEMS M.S. Thesis
 Lawrence William Kozoyed Sep. 1979 236 p refs
 (AD-A076836) Avail: NTIS HC A11/MF A01 CSCL 03/2

A methodology for solar energy system design improvement has been developed and coupled with a constrained function optimization code resulting in an automated solar energy system design procedure. The scope of the methodology is limited to systems using flat plate collectors and water as the working fluid. Eight parameters have been included as independent design variables. The design variables included collector area, collector tile angle, collector and storage fluid stream velocities, and collector to storage heat exchanger dimensions. The procedure includes an accounting for economic parameters as an intimate part of the design process. The resulting methodology has been used for the design of solar energy systems which would use shelf item collectors for the purpose of determining the optimum design variable vector for a given situation. The methodology could also be used on a limited basis for collector design

optimization by exploring the effects of changing selected collector parameters on system performance. The methodology is coded in the FORTRAN computer language under the name SOLOAD-1 (Solar Energy Optimization Analysis or Design). GRA

N80-18568*# SRI International Corp., Menlo Park, Calif.
A FEASIBILITY STUDY OF WINDPOWER FOR THE NEW ENGLAND AREA Final Report, 4 Jun. - 31 Oct. 1979
 Patrick Martin, Michael Balma, Gwen Crooks, Roy Endlich, and Christopher Maxwell Oct. 1979 238 p refs
 (Contract N00014-79-C-0539; SRI Proj. 8569)
 (AD-A076614) Avail: NTIS HC A11/MF A01 CSCL 05/3

SRI International examined the applicability of large-scale windpower electricity generating systems (WEGS) as an alternative source of energy for the New England States in general and for the U.S. Navy Portsmouth Shipyard at Kittery, Maine, in particular. The Boeing Mod 2 wind machine was selected as representative of current technology in the appropriate size range of 2.5 megawatts (MW) rated capacity. Parametric economic analyses led to the conclusion that WEGS electricity can be at economic parity with the incremental electricity from conventional generators using oil or gas without any allowance for a capacity credit, provided that the annual utilization factor for the WEGS is at least 50%. Such utilization appears to be achievable at elevations between 620 and 1,240 m (2,000 and 3,000 ft). About one-eighth of the 35,500 sq kilometers of air space reviewed in New Hampshire is at such elevations. Nonutility financing and capitalization can halve the costs of WEGS electricity. Nonutility ownership of WEGS is encouraged by recent state and federal legislation. The primary potential WEGS environmental impact, interference with television reception, can be mitigated by installation of cable TV service. GRA

N80-18570*# American Univ., Washington, D. C.
THE PREPARATION OF SOME NOVEL ELECTROLYTES: SYNTHESIS OF PARTIALLY FLUORINATED ALKANESULFONIC ACIDS AS POTENTIAL FUEL CELL ELECTROLYTES Final Report
 C. Bunyagidj, H. Pietrowska, and M. H. Aldridge Sep. 1979 77 p refs
 (Contract DAAK70-77-C-0047; DA Proj. 1L1-61102-AH-51)
 (AD-A078473) Avail: NTIS HC A05/MF A01 CSCL 10/2

The objective of this research was to prepare some strong acids for evaluation by Fort Belvoir as potential fuel cell electrolytes. The major acid, other than phosphoric, H₃PO₄, currently under investigation by Fort Belvoir as a fuel cell electrolyte is TFMSA, CF₃SO₃H.H₂O, trifluoromethanesulfonic acid monohydrate aqueous solutions and sodium salt mixtures. TFMSA has been found to be superior to H₃PO₄ from the standpoint of electrode kinetics, but certain undesirable characteristics (volatility; wetting of Teflon) led to this research for a better fuel cell electrolyte. GRA

N80-18578*# Bundesministerium fuer Wissenschaft und Forschung, Vienna (Austria). Sektion Forschung.
THE STORAGE OF ELECTROCHEMICAL ENERGY [ELEKTROCHEMISCHE ENERGIESPEICHERUNG: BESTANDSAUFNAHME NATIONALER UND INTERNATIONALER FORSCHUNGEN UND ENTWICKLUNGEN VON ELEKTROCHEMISCHEN ENERGIESPEICHERN]
 Jan. 1976 77 p refs In GERMAN
 Avail: NTIS HC A05/MF A01

A brief survey of national and international research is compiled. Progress is noted in electrochemical batteries, chemical electrolytes electric production, and fuel cells. Author (ESA)

N80-18579*# Open Univ., Milton (England). Energy Research Group.
REPORT ON THE GAS SUPPLY INDUSTRY
 G. Alexander, R. Armson, M. Barrett, D. Casper, P. Chapman, D. Crabbe, G. Gravelle, D. Hemming, D. Herd, S. Johnson et al Mar. 1979 212 p refs
 (ERG-027) Avail: NTIS HC A10/MF A01; Secretary, Energy Res. Group, Milton Keynes, England

The evolution of the natural gas industry in the UK is reviewed, then an assessment of its operations in the foreseeable

future is made. Its rapidly growing significance in the formulation of UK energy policy is emphasized, especially in regard to decisions in the development of nuclear energy. The impact on the UK coal industry is also shown and the relevance to planning for substitute natural gas production is pointed out. Pricing issues are covered as well. Supporting data presented include gas industry statistics on supply and demand, fuel price statistics, gas appliance statistics, and a load curve analysis used to foresee the possibility of a gas supply shortfall. Author (ESA)

N80-18583 North Carolina Univ. at Chapel Hill.
EVALUATION OF A PHOTOCHEMICAL SYSTEM FOR NITROGEN OXIDES CONTROL Ph.D. Thesis

John Randolph Richards 1979 199 p
 Avail: Univ. Microfilms Order No. 8005069

The technical feasibility of a photochemical pretreatment system for NO_x control at coal fired boilers was evaluated. This approach utilizes reaction mechanisms similar to those responsible for photochemical oxidant incidents. The reactions are initiated under controlled conditions while the pollutants are at high concentration and while the reaction products can be removed. Results indicate that under time limited and light limited conditions, it is possible to quench the photochemical reactions at the NO₂ peak and prior to the formation of ozone, aerosols, and other secondary products. However, the photochemical system will not be commercially competitive unless serious operational problems limit the alternative techniques or unless the photochemical system can be refined to reduce cost. Dissert. Abstr.

N80-18593 Texas Technological Univ., Lubbock.
COMPUTATION OF SYNTHETIC SEISMOGRAMS BY THE METHOD OF CHARACTERISTICS Ph.D. Thesis

Louis Reyes Castro 1979 65 p
 Avail: Univ. Microfilms Order No. 8003211

The method of characteristics is applied to one-dimensional stress wave propagation problems of exploration interest. Several seismograms computed from dry, elastic, and viscoelastic near surface models are compared to data recorded by various types of receivers. The characteristics method is also used to obtain a solution to Biot's equations for wave propagation in saturated media. Synthetic seismograms are computed from various core and reservoir models saturated with different types of fluids. The computed seismograms are used to study the effect of variable reservoir conditions on a seismic wavelet. Dissert. Abstr.

N80-18825# Wisconsin Univ. - Madison. Mathematics Research Center.

A NEWTON METHOD FOR THE PIES ENERGY MODEL

Norman H. Josephy Jun. 1979 33 p refs
 (Contract DAAG29-75-C-0024; Grant NSF MCS-74-20584)
 (AD-A077102; MRC-TRC-1971) Avail: NTIS
 HC A03/MF A01 CSCL 12/1

Newton's method is a well known and often applied technique for computing a zero of a nonlinear function. By using the theory of generalized equations, a Newton method has been developed to solve problems arising in both mathematical programming and mathematical economics. It is shown how Newton's method for generalized equations can be applied to the economic equilibrium problem of the Project Independence Evaluation System (PIES) Energy Model. Solutions to a simplified version of PIES are obtained using a Newton method, and comparisons are made to solutions which have appeared in the literature.

GRA

N80-18990*# Transportation Systems Center, Cambridge, Mass.
IMPLICATIONS OF FUEL-EFFICIENT VEHICLES ON RIDE QUALITY AND PASSENGER ACCEPTANCE: WORKSHOP PROCEEDINGS Final Report, 6-8 Sep. 1979

Anna M. Wichansky, ed. and A. R. Kuhlthau, ed. (Virginia Univ.)
 Aug. 1979 120 p refs Conf. held at Woods Hole, Mass., 6-8 Sep. 1978
 (NASA-CP-2096; DTS-532; DOT-TSC-RSPA-79-21) Avail:
 NTIS HC A06/MF A01 CSCL 13F

Topics discussed include ride quality and passenger acceptance problems associated with enhanced fuel efficiency of automobiles and aircraft shifts in intermediate range (100-

500 miles) travel from automobiles to public transit and implications of increased size disparity for ground transport freight and passenger vehicles using shared guideways. Major problem areas were identified and strategies for conducting pertinent research were outlined. A glossary of technical terms is included. K.L.

N80-18991*# Brobeck (William M.) and Associates, Berkeley, Calif.

STUDY OF ADVANCED ELECTRIC PROPULSION SYSTEM CONCEPT USING A FLYWHEEL FOR ELECTRIC VEHICLES Final Report

Francis C. Younger and Heinz Lackner Dec. 1979 231 p refs
 (Contracts DEN3-78; EC-77-A-31-1011)
 (NASA-CR-159650; DOE/NASA/0078-79/1;
 WMB/A-4500-131-3-R1) Avail: NTIS HC A11/MF A01 CSCL 10B

Advanced electric propulsion system concepts with flywheels for electric vehicles are evaluated and it is predicted that advanced systems can provide considerable performance improvement over existing electric propulsion systems with little or no cost penalty. Using components specifically designed for an integrated electric propulsion system avoids the compromises that frequently lead to a loss of efficiency and to inefficient utilization of space and weight. A propulsion system using a flywheel power energy storage device can provide excellent acceleration under adverse conditions of battery degradation due either to very low temperatures or high degrees of discharge. Both electrical and mechanical means of transfer of energy to and from the flywheel appear attractive; however, development work is required to establish the safe limits of speed and energy storage for advanced flywheel designs and to achieve the optimum efficiency of energy transfer. Brushless traction motor designs using either electronic commutation schemes or dc-to-ac inverters appear to provide a practical approach to a mass producible motor, with excellent efficiency and light weight. No comparisons were made with advanced system concepts which do not incorporate a flywheel. M.G.

N80-19287# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.

DIESEL ENGINE ENDURANCE TEST WITH WATER-CONTAINING FIRE-RESISTANT FUEL Interim Report, Mar. - Sep. 1977

J. V. Moffitt, E. C. Owens, B. R. Wright, and W. D. Weatherford, Jr. Sep. 1979 59 p refs
 (Contracts DAAG53-76-C-0003; DAAK70-78-C-0001)
 (AD-A078665; AFLRL-94) Avail: NTIS HC A04/MF A01 CSCL 21/4

A production LDT-465-1C multifuel diesel engine was operated according to a double-length Army/CRC Wheeled Vehicle Test Cycle (420 total hours) using a fire-resistant diesel fuel containing 10 vol % water. The effects of this water-in-fuel macroemulsion on engine power output, deposits, wear, and oil degradation were examined. The results indicate that this fire-resistant fuel formulation, under the conditions evaluated, does not result in abnormal deposits nor are there any major effects (adverse or favorable) on engine wear or oil degradation. However, a significant loss in horsepower output as a function of test duration did result. Post-test examinations indicated the presence of fuel-origin deposits in the injection system which were attributed to the sugar-type surfactants used in this investigation. Author (GRA)

N80-19292# Delaware Univ., Newark.
KINETICS AND MECHANISM OF DESULFURIZATION AND DENITROGENATION OF COAL-DERIVED LIQUIDS Quarterly Report, 21 Jun. - 20 Sep. 1978

B. C. Gates, J. R. Katzer, J. H. Olson, H. Kwart, and A. B. Stiles 16 Mar. 1979 134 p refs
 (Contract EX-76-C-01-2028)
 (FE-2028-15; QR-13) Avail: NTIS HC A07/MF A01

Studies of competing hydroprocessing reactions catalyzed by Ni-Mo/gamma-Al₂O₃ and involving quinoline, indole, dibenzothiophene, and naphthalene in n-hexadecane show that marked interactions exist. The naphthalene hydrogenation rate is reduced by the presence of quinoline; whereas the reactivity of quinoline

is unchanged by the naphthalene. The rate of hydrodenitrogenation of indole, a non-basic nitrogen-containing compound is strongly reduced by the presence of quinoline, whereas the rate of hydro-denitrogenation of quinoline, a basic nitrogen-containing compound, is unaffected by the presence of indole. The hydrogenation reactions in the dibenzothiophene reaction network are inhibited severely as indicated by the reduction in their pseudo first-order-rate constants as are the hydrogenation reactions for naphthalene. Thus the hydrogenation rate is reduced 30-fold by increasing the initial quinoline concentration from 0.0 to 0.5 wt % in naphthalene hydrogenation and in dibenzothiophene hydrodesulfurization. The rate of direct sulfur removal is reduced by only 3-fold by increasing the quinoline concentration from 0.0 to 0.5 wt %.

DOE

N80-19293# Lehigh Univ., Bethlehem, Pa.
CENTRIFUGAL FLUIDIZED COMBUSTION OF COAL Final Report

E. K. Levy and J. C. Chen Jan. 1979 130 p refs
 (Contract EX-76-S-01-2516)
 (FE-2516-9) Avail: NTIS HC A07/MF A01

Batch experiments on bed startup, minimum fluidization, and pressure drop were performed using room temperature air at atmospheric pressure. Particular attention was given to the effects of grid pressure drop, grid taper angle, mass of bed material, speed of rotation, and particle size and density on fluidization. The experiments demonstrated that it is possible to start up a centrifugal fluidized bed (CFB) from rest, that the system fluidizes in a predictable fashion, and that the minimum fluidization velocities and bed pressure drops are in good agreement with the theoretical models developed for the CFB. The experimental data indicate that it is possible to feed and remove solids continuously and achieve a stable bed thickness in a rotating fluidized bed. Experiments performed on particle elutriation show that the air flow rate at which particle loss is initiated is a strong function of the angular velocity of the bed and the bed thickness. At higher flow rates, the rate of particle loss depends on air flow rate, angular velocity, and bed thickness.

DOE

N80-19294# Brookhaven National Lab., Upton, N. Y.
POTENTIAL OF BIOMASS CONVERSION IN MEETING THE ENERGY NEEDS OF THE RURAL POPULATIONS OF DEVELOPING COUNTRIES: AN OVERVIEW

V. Mubayi, J. Lee, and R. Chatterjee (State Univ. of New York, Stony Brook) 1979 18 p refs Presented at the Am. Chem. Soc. Natl. Meeting, Washington, D.C., 11-14 Sep. 1979
 (Contract EY-76-C-02-0016)

(BNL-26721; CONF-790917-11) Avail: NTIS
 HC A02/MF A01

A preliminary assessment is presented of the contribution biomass conversion could make in the context of the rural areas of six developing countries: India, Indonesia, Peru, Sudan, Tanzania, and Thailand. The technologies selected for analysis are: anaerobic digestion of wet biomass to produce methane and pyrolysis of dry biomass to produce charcoal, liquid fuels, and low Btu gases. Preliminary estimates are made of the amounts of fuels that could be produced in each of the selected countries by a combination of these technologies. It was found that, with the exception of India, implementation of these technologies could potentially meet the future energy needs of their rural populations for both subsistence and development.

DOE

N80-19295# California Univ., Livermore, Lawrence Livermore Lab.

METHANOL AS A TRANSPORTATION FUEL: ASSESSMENT OF ENVIRONMENTAL AND HEALTH RESEARCH

H. Timourian and F. Milanovich 18 Jun. 1979 97 p refs
 (Contract W-7405-eng-48)

(UCRL-52697) Avail: NTIS HC A05/MF A01

The current status of knowledge on the health and environmental impacts resulting from the use of methanol and methanol-gasoline blends as automotive fuels is evaluated. The physical and technical background on methanol as an automotive fuel is reviewed, as well as the environmental, biological, and human health effects associated with the impact of methanol use and production. The main issues that must be resolved by

further research programs, and recommended research to address the main issues are outlined. An extensive bibliography is included.

DOE

N80-19296# Department of Energy, Bartlesville, Okla. Energy Technology Center.

PHYSICAL PROPERTIES OF GASOLINE/ALCOHOL BLENDS

F. W. Cox Sep. 1979 36 p refs
 (BERC/RI-79/4) Avail: NTIS HC A01/MF A01

Experimental data were generated for the octane number, water tolerance, micro vapor pressure, and distillation characteristics of gasoline/alcohol blends. The alcohols studied were methanol, ethanol, n-propanol, i-butanol, and two synthetic methyl fuels, each at 5, 10, and 15 weight percent in two gasolines which had substantially different property values. Each physical property is discussed in reference to value changes brought about by gasoline differences and those brought about by alcohol differences.

DOE

N80-19298# Carnegie-Mellon Univ., Pittsburgh, Pa.
THE CHEMISTRY OF SULFUR IN CHAR AND THE IMPLICATIONS FOR HYDROGASIFICATION/HYDRODESULFURIZATION Ph. D. Thesis

A. E. McIver Sep. 1979 289 p refs
 (Contract EX-76-C-01-2449)

(FE-2449-9) Avail: NTIS HC A13/MF A01

Experimental results, which elucidate the factors which govern the equilibrium distribution of sulfur between organic sulfur in char and gaseous hydrogen sulfide, are presented. These experiments were conducted at between 1200 F and 1600 F, for values of the ratio ($P_{\text{sub H}_2\text{S}}/P_{\text{sub H}_2}$) ranging from 1 to 100 atmospheric pressure and for several chars. The rank of the parent coals from which these chars were derived ranged from lignite to anthracite. It is shown that the partial pressure ratio ($P_{\text{sub H}_2\text{S}}/P_{\text{sub H}_2}$) is the pressure-dependent parameter which governs the extent of char sulfidation. It is also shown that the extent of char sulfidation is not uniquely dependent upon the char surface area, but decreases with increasing rank of the char, and the rank of the coal from which the char is derived. Char sulfidation is shown to be a reversible process. The kinetics of char desulfurization are shown to be a function of the physicochemical history of the char - i.e., char desulfurization is a path-dependent process. The analogy between the chemistries of oxygen and sulfur in char are explored, and the implications for coal sulfur management are outlined.

DOE

N80-19300# Physical Sciences, Inc., Woburn, Mass.
COAL PROCESSING FUEL CELL UTILIZATION. TASK 8: H₂S REMOVAL BY CALCIUM-BASED SORBENTS

Girard A. Simons and W. T. Rawlins Mar. 1979 44 p refs
 (Contract EW-78-A-21-8450)

(PSI-TR-167) Avail: NTIS HC A03/MF A01

A transport model was developed to describe the diffusion limited processes in SO₂ cleanup by limestone. Equilibrium calculations indicate an optimum thermodynamic limit of (H₂S)/(H₂O) for a typical fluidized bed gasification process using limestone or dolomite at temperatures of 1000 to 1200 K; thus the minimum H₂S level which can be attained in the gasifier is probably near 100 ppm. Detailed kinetic investigations show that the kinetic rate constant for CaO with H₂S is of the same magnitude as that with SO₂ and that the activation energy for both reactions is less than 10 K cal/mole. The model takes into account the following: (1) the grain theory; (2) the addition of sulfur deposits; and (3) the effects of the calcination temperature and CO₂ background on the pore structure.

R.E.S.

N80-19302# Lehigh Univ., Bethlehem, Pa. Center for Surface and Coatings Research.

METHANOL AND METHYL FUEL CATALYSTS Quarterly Report, Jun. - Aug. 1979

Kamil Klier and Richard G. Herman Sep. 1979 10 p
 (Contract ET-78-S-01-3177)

(FE-3177-4) Avail: NTIS HC A02/MF A01

It is shown that CuO/ZnO/La₂O₃ 25/65/10, CuO/ZnO/CeO₂ = 25/65/10, and CuO/ZnO/Al₂O₃ = 60/30/10 wt

percent catalysts are active in the synthesis of methanol from syngas. Analogous to the binary CuO/ZnO = 30/70 catalysts, an increase in methanol yield was noted over the cerium dioxide based catalyst when the CO₂ concentration in the syngas mixture was reduced from 6 percent to about 2 percent. A similar decrease in the CO₂ concentration over the aluminum-based catalyst, however, resulted in a decrease in catalytic activity. Thus, the roles played by the Al₂O₃ and CeO₂ supports are distinctly different. Over the lanthanum-based catalyst, a decrease in the CO(CO₂) flow rate decreased the gas hourly space velocity and increased the H₂/C ration and appeared to result in the direct reaction of CO₂ with H₂. DOE

N80-19303# Brigham Young Univ., Provo, Utah. Dept. of Chemical Engineering.

MIXING AND GASIFICATION OF COAL IN ENTRAINING FLOW SYSTEMS Quarterly Technical Progress Report, 1 Jan. - 31 Mar. 1979

L. Douglas Smoot and Paul O. Hedman Apr. 1979 25 p refs (Contract EF-77-S-02-2666)

(FE-2666-T1; QTPR-8) Avail: NTIS HC A02/MF A01

Four cold-flow mixing tests were conducted to help resolve difficulties in reproducing gas mixing data. The difficulty was identified and corrected. Nine additional cold-flow mixing tests were also performed to investigate the effect of coal particles in place of silicon particles. The secondary jet swirl generator for use in the cold-flow facility was completed. The method of blanketing the coal feeder with an inert gas was modified during the period, and pressure gauges were added to the system to allow coal feeder and reactor pressures to be monitored. The feasibility of using specific ion electrodes for analysis of sulfide in the quench water was demonstrated. A two-dimensional axi-symmetric gasification model was formulated, coded, and evaluated. Comparison between prediction and measurement for both cold-flow and reacting gases were made. DOE

N80-19304# Exxon Research and Engineering Co., Bayton, Tex. Research and Development Div.

FLUID COKING OF COAL LIQUEFACTION RESIDUES: THE FOURTH RESIDUE Final Technical Progress Report

S. Zaczepinski Jan. 1979 73 p

(Contract EX-76-C-01-2422)

(FE-2422-28) Avail: NTIS HC A04/MF A01

The applicability of current fluid coking technology to processing of coal liquefaction residues was evaluated by characterizing the coal liquefaction residues and assessing the effect of major coking process variables on yields and operability. Summary statements of results obtained on residues 1, 3 and 4 are: the ash content and feed fraction boiling below 1000 F are the only major analytical differences between these three residues; the net liquid recovered expressed on an ash-free 1000 F+ feed basis shows no feed dependence and no process variable effects; and the liquids recovered in fluid coking of these residues are the 1000 F- fraction of the feed and net 1000 F+ boiling product liquid. The process will recover the feed fraction boiling below 1000 F, but the net liquid produced boils at temperatures greater than 1000 F fluid coking operability (bogging) does not appear to be a limit over the temperature range of interest. Interim results are reported on the fourth sample (H-coal vacuum still bottoms): The sample is high in ash and processing results are generally similar to the above. DOE

N80-19305# Institute of Gas Technology, Chicago, Ill. **ENVIRONMENTAL ASSESSMENT OF THE HYGAS PROCESS. VOLUME 1: HYGAS ENVIRONMENTAL CHARACTERIZATION, DATA SYNTHESIS, ANALYSIS, AND INTERPRETATION, TESTS 37 - 64 Interim Report**

Robert J. Jonardi, Louis J. Anastasia, Michael J. Massey (Carnegie-Mellon Univ.), and Richard H. Karst Jun. 1979 207 p refs

(Contract EX-76-C-01-2433; Proj. 61014)

(FE-2433-25-Vol-1) Avail: NTIS HC A10/MF A01

Report data published in the form of monthly and quarterly reports covering HYGAS test 37 through 64 are analyzed. The current program state-of-the-art, is described and future tasks are outlined. The environmental data base is divided into parts

one for the coal pretreatment section, and the other for the gasification section and related downstream operations. The format employed is to identify the fate of selected coal constituents (for example, coal nitrogen, sulfur, and trace elements) along with other environmentally important species liberated or produced during the gasification process (for example, phenolic compounds). DOE

N80-19306# Hydrocarbon Research, Inc., Lawrenceville, N. J. **DEVELOPMENT OF A FAST FLUID BED GASIFIER, TASK 2 AND 3 Quarterly Progress Report, Oct. - Dec. 1978**

Feb. 1979 23 p refs

(Contract EX-76-C-01-2361)

(FE-2361-40) Avail: NTIS HC A02/MF A01

A coal gasifier for low Btu gas utilizing the principle of the fast fluid bed unit operation is considered. The gasifier will be operated to determine operating parameters, feasibility and viability of a fast fluid bed gasifier. Procurement and construction of the experimental gasifier system was finished in December. A cold test program was also satisfactorily completed. The test lasted for seven days and included instrument checks, equipment evaluation and pressure testing for leaks. DOE

N80-19307# Purdue Univ., Lafayette, Ind. **SYSTEMS STUDIES OF COAL CONVERSION PROCESSES USING A REFERENCE SIMULATOR Quarterly Report, 1 Jan. - 31 Mar. 1979**

G. V. Reklaitis, M. K. Sood, Y. Soni, B. W. Overturf, W. Weide, Jr., C. R. Wilkinson, J. Boo, and P. Buchanan Jun. 1979 90 p refs

(Contract EX-76-C-01-2275)

(FE-2275-11) Avail: NTIS HC A05/MF A01

Manuals were completed for the physical properties (PPR-OPS), process costing (PCOST), and detailed simulation (DSP-I) packages. A final manual was issued for the steady state pyrolysis system (SS/PP) model. The process simulation package (S4) was revised and used to execute simulations of the bulk methanation and water quench pyrolysis vapor recovery process sections. Sample results from these simulations are given. The DSP-I system was used to execute design calculations for the process steam and power generation section. Work was completed on the lift-tube model. The mixed algebraic and ordinary differential equation model is quite stiff and requires the use of Gear's implicit method for successful integration. Parameter studies indicate that, for purposes of converging the gasifier-combustion section recycle flows, a simplified form of the lift-tube model will suffice. However, for design of the device, the detailed model is required. DOE

N80-19308# Grace (W. R.) and Co., Memphis, Tenn. Agricultural Chemicals Group.

SYNTHESIS GAS DEMONSTRATION PLANT PROGRAM, PHASE 1 Quarterly Technical Progress Report, 1 Jan. - 31 Mar. 1979

M. R. Simpson 1979 27 p

(Contract ET-77-C-01-2577)

(FE-257706; QTPR-06) Avail: NTIS HC A03/MF A01

All activities regarding the commercial plant design, including the various trade-off studies, are essentially complete. Evidence of this stage of activity includes the delivery to DOE of all schematics, plot plans and plot elevations for the commercial plant. Demonstration plant design progressed satisfactorily (27.2 percent as of December 31, 1978, versus 58.4 percent complete as of March 31, 1979). Two additional pilot plant runs were completed. Coal feedstock was selected so as to verify the operability of the coal gasification process on coals of varying characteristics within the Kentucky No. 9 seam. Activities continued regarding development of the Environmental Report and of the various plans for obtaining raw materials and utilizing or otherwise disposing of products and by-products. Work has initiated in the areas of the capital and operating cost estimates and the phase 2 construction plan. DOE

N80-19309# Research Triangle Inst., Research Triangle Park, N. C.

POLLUTANTS FROM SYNTHETIC FUELS PRODUCTION: SAMPLING AND ANALYSIS METHODS FOR COAL GASIFICATION Final Report, Aug. 1978 - Jul. 1979

S. K. Gangwal, P. M. Grohse, D. E. Wagoner, D. J. Minick, and C. M. Sparacino Aug. 1979 102 p refs (Grant EPA-R-804979) (PB80-104656; EPA-600/7-79-201) Avail: NTIS HC A06/MF A01 CSCL 07D

Methods described for sampling and analyzing particulates, organic condensibles, and vapors or gases in the raw product stream of the gasifier as well as for solid residues include: (1) gas chromatography procedures for measuring fixed gases, C1-C5 hydrocarbons, sulfur gases, and C6-C8 aromatics; (2) atomic adsorption procedures for measuring toxic trace elements include those for arsenic, selenium, lead, cadmium, chromium, and mercury; (3) using polymeric sorbents to collect volatile or organics from the gas stream for analysis by glass capillary mass spectrometry; and (4) the prefractionation of tar by solvent partitioning into acid, base, and neutral fractions. Each fraction is analyzed by capillary GC/MS or high-performance liquid chromatography (HPLC). Typical results are given to illustrate the nature of the compounds studied, the methodologies, and their sensitivities. GRA

N80-19310# Catalytic, Inc., Philadelphia, Pa. APPLICATION OF COKE PLANT CONTROL TECHNOLOGIES TO COAL CONVERSION Final Report, Aug. 1977 - Mar. 1979

S. M. Hossain, A. B. Cherry Cilione, and W. J. Wasylenko, Jr. Aug. 1979 214 p refs Sponsored by EPA (Contract EPA-68-02-2167) (PB80-108954; EPA-600/7-79-184) Avail: NTIS HC A10/MF A01 CSCL 13B

Process and waste stream characteristics from the by-product coke oven process are compared with selected gasification and liquefaction processes. Recommendations are given regarding control technologies for air, water, and solid wastes. State and Federal regulations for the disposal and treatment of coke oven wastes are presented, along with a brief assessment of health effects attributed to coke oven emissions. Study results indicate that a number of coke oven control technologies are applicable to coal conversion systems. By-product upgrading and fugitive emission control technologies may be readily transferable to analogous coal conversion applications. Desulfurization and wastewater treatment technologies, however, cannot be transferred readily to applications where significant differences exist in the composition, temperature, and pressure of the two categories of process/waste streams. GRA

N80-19424*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. A LINEAR MAGNETIC MOTOR/GENERATOR Patent Application

Philip A. Studer, inventor (to NASA) Filed 7 Feb. 1980 27 p (NASA-Case-GSC-12518-1; US-Patent-Appl-SN-119336) Avail: NTIS HC A03/MF A01 CSCL 09C

A linear magnetic motor/generator is described which uses magnetic flux to provide mechanical motion or electrical energy. The linear magnetic motor/generator includes an axially movable actuator mechanism. A permanent magnet mechanism defines a first magnetic flux path which passes through a first end portion of the actuator mechanism. Another permanent magnet mechanism defines a second magnetic flux path which passes through a second end portion of the actuator mechanism. A drive coil defines a third magnetic flux path passing through a third central portion of the actuator mechanism. The invention has potential applications on all types of spacecraft requiring the use of a motor or generator, or in environments requiring long life with minimum maintenance. Presently the invention is to be used in cryogenic refrigerators aboard future spacecraft. NASA

N80-19443# Magnetic Corp. of America, Waltham, Mass. MAGNETOHYDRODYNAMIC (MHD) MAGNET MODELING Interim Technical Report, Mar. - Sep. 1978

Z. J. J. Stekly, Robert D. Pillsbury, Jr., Alan R. Beckwith, and R. Doug Holmes Wright-Patterson AFB, Ohio Jun. 1979

225 p Prepared in cooperation with General Dynamics Corp., San Diego, Calif. (Contract F33615-77-C-3117; AF Proj. 3145) (AD-A078865; MCA-WP13-01; AFAPL-TR-79-2045) Avail: NTIS HC A10/MF A01 CSCL 20/3

This report presents the results of a study to establish scaling criteria for a lightweight, superconducting magnet system for use in magnetohydrodynamic power generation. The scaling criteria are used to determine the appropriate size for a model magnet to be built to demonstrate the major system parameters of a full scale, 30 MWe, magnet system. GRA

N80-19492 Illinois Univ. at Urbana-Champaign. ENERGY CONSERVATION IN THE U.S. ECONOMY FROM INCREASED RECYCLE OF OBSOLETE STEEL SCRAP Ph.D. Thesis

James Ray Brodrick 1979 111 p Avail: Univ. Microfilms Order No. 8004142

An energy model of the steel industry is formed from information on both the steel production technologies and the scrap recycle industry. The model is optimized by use of linear programming techniques to minimize the energy intensity of steel. The optimum point of obsolete scrap recycle is about six times the amount recycled in 1967 for a decrease of 8.5 percent in the existing energy intensity. With this amount of recycling, some scrap accumulated in disposal areas from previous years would have to be reclaimed. The scrap-intensive steelmaking processes, especially the all-scrap open hearth, increase their portion of the production, while the basic oxygen production decreases. The labor impact of this energy conservation measure is a tradeoff between the labor of the iron ore and coal mines to the labor of the scrap recycling industry. As more scrap is recycled, the labor intensity of the steel producing system is increased. Dissert. Abstr.

N80-19503# Naval Postgraduate School, Monterey, Calif. WASTE HEAT RECOVERY UNIT DESIGN FOR GAS TURBINE PROPULSION SYSTEMS M.S. Thesis

Robert Meredith Combs Sep. 1979 301 p refs (AD-A078154) Avail: NTIS HC A14/MF A01 CSCL 13/10

A design model for a once-through waste heat recovery unit with a segmented fin-tube arrangement was developed along with a simple model of a combined gas and steam (COGAS) turbine propulsion system. These models were integrated and applied in a computer program written in FORTRAN IV for the IBM 360-67 computer. Waste heat recovery unit designs were produced and tested at off-design conditions. Using the space constraints and power requirements of a Navy destroyer-type ship, one design was selected and employed to make estimates of possible fuel savings to be realized through the application of a COGAS system. GRA

N80-19510# Department of Energy, Washington, D. C. Office of Technology Impacts. ISSUES CONCERNING THE LIGHT-DUTY DIESEL

Sep. 1979 145 p refs (DOE/EV-0050/1) Avail: NTIS HC A07/MF A01

Major issues in diesel-related policy considerations are discussed. The issues are summarized in three areas: health and environmental protection, fuel conservation, and economic and programmatic trade-offs. K.L.

N80-19604# System Development Corp., Santa Monica, Calif. REGIONAL SYSTEMS DEVELOPMENT FOR GEOTHERMAL ENERGY RESOURCES. PACIFIC REGION: CALIFORNIA AND HAWAII. TASK 1: IMPLEMENTATION PLAN DEVELOPMENT

D. W. Michler 26 Mar. 1979 509 p refs (Contract ET-78-C-03-1530) (DOE/ET-28432-1) Avail: NTIS HC A22/MF A01

The utilization of geothermal energy resources for the generation of electrical power is considered as an alternative to fossil fuels or nuclear energy. The development of implementation plans for the commercialization of geothermal resources is described. The plans represent 21 reservoir-site developments

and 48 geothermal power plant developments. Each plan consists of three integrated elements: (1) a bar-chart schedule that depicts interdependencies among activities and shows significant milestones on the path from initial exploration to power on-line; (2) task descriptions; and (3) the responsible performers of each task. A set of recommendations for the accelerated development of geothermal energy resources is given and the potential implementors are identified. J.M.S.

N80-19605# System Development Corp., Santa Monica, Calif. **REGIONAL SYSTEMS DEVELOPMENT FOR GEOTHERMAL ENERGY RESOURCES. PACIFIC REGION: CALIFORNIA AND HAWAII. TASK 2: REGIONAL PROGRAM MONITORING AND PROGRESS EVALUATION**

19 Mar. 1979 132 p refs
(Contract ET-78-C-03-1530)
(DOE/ET-28432-2) Avail: NTIS HC A07/MF A01

The status of power plant projects is reported and major problems for each of the power plants are identified. Recommendations to alleviate these problems are outlined. J.M.S.

N80-19606# System Development Corp., Santa Monica, Calif. **REGIONAL SYSTEMS DEVELOPMENT FOR GEOTHERMAL ENERGY RESOURCES. PACIFIC REGION: CALIFORNIA AND HAWAII. TASK 3: WATER RESOURCES EVALUATION**

J. L. Sakaguchi 19 Mar. 1979 375 p refs
(Contract ET-78-C-03-1530)
(DOE/ET-28432-3/1) Avail: NTIS HC A16/MF A01

The availability of surface and ground water for potential use as power plant make-up water in the major geothermal areas of California and Hawaii was assessed. The analysis concentrated on identifying the major sources of surface and ground water, potential limitations on the usage of this water, and the resulting constraints on potentially developable electrical power in each geothermal resource area. The water requirements for representative types of energy conversion processes were developed using a case study approach. Cooling water requirements for each type of energy conversion process were estimated based upon a specific existing or proposed type of geothermal power plant. The make-up water requirements for each type of conversion process at each resource location were then estimated as a basis for analyzing any constraints on the megawatts which potentially could be developed. DOE

N80-19607# System Development Corp., Santa Monica, Calif. **REGIONAL SYSTEMS DEVELOPMENT FOR GEOTHERMAL ENERGY RESOURCES. PACIFIC REGION: (CALIFORNIA AND HAWAII). TASK 3: WATER RESOURCES EVALUATION, APPENDICES**

19 Mar. 1979 343 p refs
(Contract ET-78-C-03-1530)
(DOE/ET-28432-3/2) Avail: NTIS HC A15/MF A01

The appendices for the water resources evaluation report are included for the Imperial Valley KGRA's Coso, Mono-Long Valley, Geysers Calistoga, Surprise Valley, Wendell Amedee, Glass Mountain, Lassen, Puna, and for power plant case studies. DOE

N80-19609*# Florida Univ., Gainesville. Dept. of Electrical Engineering.

STUDIES OF SILICON p-n JUNCTION SOLAR CELLS Final Technical Report, Sep. 1977 - Dec. 1979

A. Neugroschel and F. A. Lindholm Dec. 1979 177 p refs
(Grant NSG-3018)
(NASA-CR-162832) Avail: NTIS HC A09/MF A01 CSCL 10A

To provide theoretical support for investigating different ways to obtain high open-circuit voltages in p-n junction silicon solar cells, an analytical treatment of heavily doped transparent-emitter devices is presented that includes the effects of bandgap narrowing, Fermi-Dirac statistics, a doping concentration gradient, and a finite surface recombination velocity at the emitter surface. Topics covered include: (1) experimental determination of bandgap narrowing in the emitter of silicon p-n junction devices;

(2) heavily doped transparent regions in junction solar cells, diodes, and transistors; (3) high-low-emitter solar cell; (4) determination of lifetimes and recombination currents in p-n junction solar cells; (5) MOS and oxide-charged-induced BSF solar cells; and (6) design of high efficiency solar cells for space and terrestrial applications. A.R.H.

N80-19610*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. **ORBITER FUEL CELL PERFORMANCE CONSTRAINTS. STS/OPS PRATT WHITNEY FUEL CELLS. OPERATING LIMITS FOR MISSION PLANNING**

Harry E. Kolkhorst Feb. 1980 35 p
(NASA-TM-80958; Rept-79-FM-45; JSC-16255) Avail: NTIS HC A03/MF A01 CSCL 10A

The orbiter fuel cell powerplant (FCP) performance constraints listed in the Shuttle Operational Data Book (SODB) were analyzed using the shuttle environmental control requirements evaluation tool. The effects of FCP lifetime, coolant loops, and FCP voltage output were considered. Results indicate that the FCP limits defined in the SODB are not valid. K.L.

N80-19611*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

LSA FIELD TEST Annual Report, Aug. 1978 - Aug. 1979

Peter Jaffe 15 Dec. 1979 51 p
(Contract NAS7-100)
(NASA-CR-162798; JPL-Pub-80-5; DOE/JPL-1012-38) Avail: NTIS HC A04/MF A01 CSCL 10A

Degradation tests indicate that electrical degradation is not a slow monotonically increasing phenomenon as originally thought but occurs abruptly as the result of some traumatic event. This finding has led to a change in the test philosophy. A discussion of this change is presented along with a summary of degradation and failure data from all the sites and results from a variety of special tests. New instrumentation for in-field measurements are described. Field testing activity was expanded by the addition of twelve remote sites located as far away as Alaska and the Canal Zone. Descriptions of the new sites are included. R.E.S.

N80-19612*# Jay - Carter Enterprises, Inc., Burkburnett, Tex. **A 15 kW_e (NOMINAL) SOLAR THERMAL-ELECTRIC POWER CONVERSION CONCEPT DEFINITION STUDY: STEAM RANKIN RECIPROCATOR SYSTEM Final Report**

W. Wingenback and J. Carter, Jr. Jun. 1979 46 p refs
(Contracts DEN3-63; EX-76-A-29-1060)
(NASA-CR-159591; DOE/NASA/0063-79/1) Avail: NTIS HC A03/MF A01 CSCL 10A

A conceptual design of a 3600 rpm reciprocation expander was developed for maximum thermal input power of 80 kW. The conceptual design covered two engine configurations: a single cylinder design for simple cycle operation and a two cylinder design for reheat cycle operation. The reheat expander contains a high pressure cylinder and a low pressure cylinder with steam being reheated to the initial inlet temperature after expansion in the high pressure cylinder. Power generation is accomplished with a three-phase induction motor coupled directly to the expander and connected electrically to the public utility power grid. The expander, generator, water pump and control system weigh 297 kg and are dish mounted. The steam condenser, water tank and accessory pumps are ground based. Maximum heat engine efficiency is 33 percent; maximum power conversion efficiency is 30 percent. Total cost is \$3.307 or \$138 per kW of maximum output power. R.E.S.

N80-19613*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TEETERED, TIP-CONTROLLED ROTOR: PRELIMINARY TEST RESULTS FROM MOD-0 100-kW EXPERIMENTAL WIND TURBINE

J. C. Glasgow and D. R. Miller 1980 16 p refs Presented at Wind Energy Conf., Boulder, Colo., 9-11 Apr. 1980; sponsored by Am. Inst. of Aeron. and Astronautics and the Midwest Res. Inst.
(Contract EX-76-I-01-1028)

(NASA-TM-81445; DOE/NASA/1028-80/26; E-365) Avail: NTIS HC A02/MF A01 CSCL 10B

Results of tests conducted using the MOD-0 100 kW experimental wind turbine are evaluated. The teetered rotor significantly decreased loads on the yaw drive mechanism and reduced blade cyclic flapwise bending moments by 25 percent at the 20 percent span location when compared to the rigid hub rotor. The teetered hub performed well, but impacted the teeter stops on occasion as wind speed and/or direction varied rapidly. The tip-controlled rotor performed satisfactorily with some expected loss of control when compared to the full span pitchable blade. The performance results indicate that a review of techniques used to calculate rotor power is in order. K.L.

N80-19614*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

INSTALLATION AND CHECKOUT OF THE DOE/NASA MOD-1 2000-kW WIND TURBINE GENERATOR

Richard L. Puthoff and John L. Collins 1980 25 p refs Presented at Wind Energy Conf., Boulder, Colo. 9-11 Apr. 1980; sponsored by Am. Inst. of Aeron. and Astronautics and the Midwest Res. Inst.

(Contract EX-77-A-29-1010)

(NASA-TM-81444; DOE/NASA/1010-80/6; E-364) Avail: NTIS HC A02/MF A01 CSCL 10B

The Mod-1 machine was assembled without the blades, tested, and sent to the site at Boone, North Carolina for erection. The blades were transported directly to the site. A series of checkout tests were then conducted to evaluate performance and loads. The results of these tests compared well with the design data. K.L.

N80-19615*# United Technologies Corp., South Windsor, Conn. Power Systems Div.

ADVANCED TECHNOLOGY LIGHT WEIGHT FUEL CELL PROGRAM Final Report, 28 Jul. 1978 - 28 Jul. 1979

R. E. Martin 1979 52 p refs

(Contract NAS3-21257)

(NASA-CR-159807; FCR-1657) Avail: NTIS HC A04/MF A01 CSCL 10B

The development of a long life, high performance, high efficiency, hydrogen oxygen alkaline fuel cell configuration for application to a NASA orbiting space vehicle is documented. Seven full-size 0.25 ft 2 active area single cells were constructed and tested at cell temperatures between 140 F and 200 F, current densities out to 500 ASF, and reactant pressures up to 30 psia. Cells incorporating platinum-supported-on-carbon catalyst anodes demonstrated 8,085 cell-hours of endurance operation with virtually no change in performance and 2,995 cell-hours of operation to a cyclical load profiles with no apparent loss in cathode performance due to high voltage operation. Cell edge frame materials and heat treated polybenzimidazole (PBI) matrix samples were corrosion tested in 42 wt % aqueous potassium hydroxide at 250 F. Based upon available test data, PBI appears unsuitable for use as a fuel cell matrix material. Five semiconducting oxides were evaluated as cathode catalysts and as cathode catalyst supports. The candidate supports LaMnO3 and LaNiO3 appear to have development potential and merit further study. K.L.

N80-19617*# Dow Corning Corp., Midland, Mich. **DEVELOP SILICONE ENCAPSULATION SYSTEMS FOR TERRESTRIAL SILICON SOLAR ARRAYS Final Report**

Dec. 1979 57 p Prepared for JPL and DOE

(Contract JPL-954995)

(NASA-CR-162840; DOE/JPL-954995-80/6) Avail: NTIS HC A04/MF A01 CSCL 10A

A cost effective encapsulant system was identified and a silicone acrylic cover material containing a durable ultraviolet screening agent was prepared. The effectiveness of the cover material in protecting photo-oxidatively sensitive polymers was demonstrated. K.L.

N80-19620*# SOL/LOS, Inc., Los Angeles, Calif.

A NEW METHOD OF METALLIZATION FOR SILICON SOLAR CELLS Final Report, Dec. 1978 - Sep. 1979

Milo Macha Dec. 1979 67 p Prepared for JPL and DOE (Contract JPL-955318)

(NASA-CR-162823; DOE/JPL-955318-79/3; JPL-9950-288)

Avail: NTIS HC A04/MF A01 CSCL 10A

The new metallization process based on Mo-Sn system was studied. The reaction mechanism of MoO3 and its mixture with Sn was examined. The basic ink composition was modified in order to obtain a low ohmic contact to the cell. The electrical characteristics of the cells were comparable with the existing metallization processes. However, in comparison with the standard processes using silver as the contacting metal, the saving obtained by the use of the new process was substantial. K.L.

N80-19621*# Sanders Associates, Inc., Nashua, N. H. Energy Systems Center.

HIGH TEMPERATURE SOLAR THERMAL RECEIVER Final Report

Dec. 1979 109 p Prepared for JPL and DOE

(Contract JPL-955454)

(NASA-CR-162831; JPL-9950-283) Avail: NTIS HC A06/MF A01 CSCL 10A

A design concept for a high temperature solar thermal receiver to operate at 3 atmospheres pressure and 2500 F outlet was developed. The performance and complexity of windowed matrix, tube-header, and extended surface receivers were evaluated. The windowed matrix receiver proved to offer substantial cost and performance benefits. An efficient and cost effective hardware design was evaluated for a receiver which can be readily interfaced to fuel and chemical processes or to heat engines for power generation. K.L.

N80-19622*# General Electric Co., Schenectady, N. Y.

LOW COST POINT FOCUS SOLAR CONCENTRATOR. PHASE 1: PRELIMINARY DESIGN Final Report

16 Mar. 1979 235 p Prepared for JPL

(Contract JPL-955210)

(JPL-9950-273; NASA-CR-162830) Avail: NTIS HC A11/MF A01 CSCL 10A

The preliminary design of a low cost point focus solar concentrator is presented. The analysis, design, testing, and manufacturing assessments are described. R.E.S.

N80-19623*# Varian Associates, Lexington, Mass. **SLICING OF SILICON INTO SHEET MATERIAL. SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SILICON SHEET TASK OF THE LOW COST SOLAR ARRAY PROJECT Final Report, 9 Jan. 1976 - 30 Sep. 1979**

J. R. Fleming, S. C. Holden, and R. G. Wolfson 21 Sep. 1979 460 p Prepared for JPL and DOE

(Contracts NAS7-100; JPL-954374)

(NASA-CR-162828; DOE/JPL-954374-79/10; JPL-9950-272) Avail: NTIS HC A20/MF A01 CSCL 10A

The use of multiblade slurry sawing to produce silicon wafers from ingots was investigated. The commercially available state of the art process was improved by 20% in terms of area of silicon wafers produced from an ingot. The process was improved 34% on an experimental basis. Economic analyses presented show that further improvements are necessary to approach the desired wafer costs, mostly reduction in expendable materials costs. Tests which indicate that such reduction is possible are included, although demonstration of such reduction was not completed. A new, large capacity saw was designed and tested. Performance comparable with current equipment (in terms of number of wafers/cm) was demonstrated. R.E.S.

N80-19624*# Boeing Engineering and Construction, Seattle, Wash.

LOW COST POINT FOCUS SOLAR CONCENTRATOR, PHASE 1

Mar. 1979 181 p Prepared for JPL

(Contract JPL-995209)

(NASA-CR-162848; JPL-9950-279) Avail: NTIS HC A09/MF A01 CSCL 10A

Design concepts and plans for mass-production facilities and equipment, field installation, and maintenance were developed

and used for cost analysis of a pneumatically stabilized plastic film point focus solar concentrator which has potential application in conjunction with Brayton cycle engines or supply of thermal energy. A sub-scale reflector was fabricated and optically tested by laser ray tracing to determine focal deviations of the surface slope and best focal plane. These test data were then used for comparisons with theoretical concentrator performance modeling and predictions of full-scale design performance. Results of the economic study indicate the concentrator design will have low cost when mass-produced and has cost/performance parameters that fall within current Jet Propulsion Laboratory goals. A.R.H.

N80-19625*# Acurex Corp., Mountain View, Calif. Alternate Energy Division.

LOW-COST POINT-FOCUS SOLAR CONCENTRATOR, PHASE 1 Final Report
E. V. Nelson, T. C. Derbridge, D. Erskine, R. A. Maraschin, W. A. Niemeyer, M. J. Matsushita, and P. T. Overly 16 Mar. 1979 260 p Prepared for JPL
(Contract JPL-955208)
(NASA-CR-162839; JPL-9550-28; Acurex-FR-79-340) Avail: NTIS HC A12/MF A01 CSCL 10A

The results of the preliminary design study for the low cost point focus solar concentrator (LCPFSC) development program are presented. A summary description of the preliminary design is given. The design philosophy used to achieve a cost effective design for mass production is described. The concentrator meets all design requirements specified and is based on practical design solutions in every possible way. R.E.S.

N80-19626*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COGENERATION TECHNOLOGY ALTERNATIVES STUDY (CTAS), VOLUME 1: SUMMARY
Gerald J. Barna, Raymond K. Burns, and Gary D. Sagerman Jan. 1980 89 p
(Contract EC-77-A-31-1062)
(NASA-TM-81400; DOE/NASA/1062-80/4; E-312) Avail: NTIS HC A05/MF A01 CSCL 10B

Various advanced energy conversion systems that can use coal or coal-derived fuels for industrial cogeneration applications were compared to provide information needed by DOE to establish research and development funding priorities for advanced-technology systems that could significantly advance the use of coal or coal-derived fuels in industrial cogeneration. Steam turbines, diesel engines, open-cycle gas turbines, combined cycles, closed-cycle gas turbines, Stirling engines, phosphoric acid fuel cells, molten carbonate fuel cells, and thermionics were studied with technology advancements appropriate for the 1985-2000 time period. The various advanced systems were compared and evaluated for wide diversity of representative industrial plants on the basis of fuel energy savings, annual energy cost savings, emissions savings, and rate of return on investment as compared with purchasing electricity from a utility and providing process heat with an on-site boiler. Also included in the comparisons and evaluations are results extrapolated to the national level. F.O.S.

N80-19627*# IBM Federal Systems Div., Huntsville, Ala.
SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION: SEASONAL REPORT FOR SEMCO, LOXAHATCHEE, FLORIDA Contractor Report, Oct. 1978 - Aug. 1979
Jan. 1980 75 p refs Sponsored in part by DOE
(Contract NAS8-32036)
(NASA-CR-161379) Avail: NTIS HC A04/MF A01 CSCL 10A

The operational and thermal performance of a variety of solar systems installed in operational test sites are described. The analysis used is based on instrumented system data monitored and collected for at least one full season of operation. The long-term field performance of the installed system and the technical contributions to the definition of techniques and requirements solar energy system design are analyzed. The solar energy system was designed to supply domestic hot water for a family of four, single-family residences. It consists of two liquid flat plate collectors, single tank, controls, and transport lines. F.O.S.

N80-19628*# Wyle Labs., Inc., Huntsville, Ala.
THERMAL PERFORMANCE EVALUATION OF THE NORTHROP MODEL NSC-01-0732 CONCENTRATING SOLAR COLLECTOR ARRAY AT OUTDOOR CONDITIONS

Dec. 1979 18 p Sponsored in part by DOE
(Contract NAS8-32036)
(NASA-CR-161354; WYLE-TR-531-39) Avail: NTIS HC A02/MF A01 CSCL 10A

The thermal efficiency of the concentrating, tracking solar collector was tested after ten months of operation at the Marshall Space Flight Center solar house. The test procedures and results are presented. K.L.

N80-19629*# IBM Federal Systems Div., Huntsville, Ala.
SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION: A SEASONAL REPORT FOR SEMCO, MACON, GEORGIA Contractor Report, May 1978 - Apr. 1979

Jan. 1980 72 p refs Sponsored in part by DOE
(Contract NAS8-32036)
(NASA-CR-161380) Avail: NTIS HC A04/MF A01 CSCL 10A

The solar energy system for heating water in a single-family residence for a family of four is described. The system operation, the operating energy, energy savings, maintenance, and performance are analyzed. F.O.S.

N80-19630*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

INSTALLATION GUIDELINES FOR SOLAR HEATING SYSTEM, SINGLE-FAMILY RESIDENCE AT NEW CASTLE, PENNSYLVANIA

Jan. 1980 169 p Sponsored in part by DOE
(Contract NAS8-32093)
(NASA-CR-161355) Avail: NTIS HC A08/MF A01 CSCL 10A

The solar heating system installer guidelines are presented for each subsystem. This single family residential heating system is a solar-assisted, hydronic-to-warm-air system with solar-assisted domestic water heating. It is composed of the following major components: (1) liquid cooled flat plate collectors; (2) water storage tank; (3) passive solar-fired domestic water preheater; (4) electric hot water heater; (5) heat pump with electric backup; (6) solar hot water coil unit; (7) tube-and-shell heat exchanger, three pumps, and associated pipes and valving in an energy transport module; (8) control system; and (9) air-cooled heat purge unit. Information is provided on the operating procedures, controls, caution requirements, and routine and schedule maintenance in the form of written descriptions, schematics, detail drawings, pictures, and manufacturer's component data. R.E.S.

N80-19631*# Boeing Aerospace Co., Seattle, Wash.
SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY, VOLUME 1, PHASE 2: EXECUTIVE SUMMARY Final Report

Nov. 1979 36 p Revised
(Contract NAS9-15636)
(NASA-CR-160540; D180-25461-1-Vol-1-Rev-A) Avail: NTIS HC A03/MF A01 CSCL 10A

A review of solar energy conversion and utilization is presented. The solar power satellite system is then described. Overall system definition and integration is discussed. Principal reference system study accomplishments and conclusions are presented. R.E.S.

N80-19632*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ANNUAL TECHNICAL REPORT, FISCAL YEAR 1979, VOLUME 1: EXECUTIVE SUMMARY Annual Report

John W. Lucas 15 Jan. 1980 46 p Sponsored in part by DOE
(Contract NAS7-100)
(NASA-CR-159715; JPL-Pub-79-112-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 10A

N80-19634

Accomplishments of the Point-Focusing Distributed Receiver Technology project are presented. The following aspects of the project are discussed: information dissemination, concentrator development, receiver and heat transport network development, power conversion, manufacturing, systems engineering, and tests and evaluations. R.E.S.

N80-19634*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE EFFECTS OF REGIONAL INSOLATION DIFFERENCES UPON ADVANCED SOLAR THERMAL ELECTRIC POWER PLANT PERFORMANCE AND ENERGY COSTS

A. F. Latta, J. M. Bowyer, T. Fujita, and P. H. Richter 1 Feb. 1980 117 p refs Revised Sponsored in part by DOE (Contract NAS7-100)

(NASA-CR-162886; JPL-Pub-79-39-Rev-1;

DOE/JPL-1060-17-Rev-1) Avail: NTIS HC A06/MF A01 CSCL 10A

The performance and cost of four 10 MWe advanced solar thermal electric power plants sited in various regions of the continental United States was studied. Each region has different insolation characteristics which result in varying collector field areas, plant performance, capital costs and energy costs. The regional variation in solar plant performance was assessed in relation to the expected rise in the future cost of residential and commercial electricity supplied by conventional utility power systems in the same regions. A discussion of the regional insolation data base is presented along with a description of the solar systems performance and costs. A range for the forecast cost of conventional electricity by region and nationally over the next several decades is given. R.E.S.

N80-19637# Massachusetts Inst. of Tech., Cambridge. Water Resources and Hydrodynamics Lab.

WAVE POWER EXTRACTION BY FLOATING BODIES

C. C. Mei and J. N. Newman Nov. 1979 27 p refs

(Contract N00014-76-C-0214)

(AD-A078058) Avail: NTIS HC A03/MF A01 CSCL 10/2

The linearized theory of water waves is reviewed in the context of wave-energy absorbers. A global analysis is outlined, leading to relatively simple expressions for the maximum energy absorption. Calculations are presented for the performance of Salter cam in two dimensions, and of a Cockerell raft in both two and three dimensions. Similar rates of optimum energy absorption are anticipated for other devices including the Kaimei ship and French air bag. Author (GRA)

N80-19639# UOP, Inc., Des Plaines, Ill. Corporate Research Center.

OPTIMIZATION OF Pt-DOPED KOCITE (TRADE NAME) ELECTRODES IN H₃PO₄ FUEL CELLS Final Technical Report, Sep. 1978 - May 1979

L. B. Welsh and R. W. Leyerle Aug. 1979 74 p refs (Contract DAAG53-76-C-0014; DA Proj. 1L1-62733-AH-20) (AD-A075372; TR-6) Avail: NTIS HC A04/MF A01 CSCL 09/1

The use of UOP Inc. Kocite (R*)-derived electrocatalysts as low-cost air and/or fuel electrocatalysts in phosphoric acid electrolyte fuel cells has been optimized with respect to some of the electrocatalyst and electrode structure parameters. Kocite-derived electrocatalysts are made from Kocite R* 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 and cathodes in model fuel cells. Author (GRA)

N80-19640# Naval Civil Engineering Lab., Port Hueneme, Calif. **SOLAR-POWERED SUN TRACKER Final Report, Feb. 1977 - Sep. 1979**

Carter J. Ward Jun. 1979 33 p refs (ZF57571001)

(AD-A078653; CEL-TN-1556) Avail: NTIS HC A03/MF A01 CSCL 13/1

A solar-powered sun tracker believed to be capable of repositioning equipment to within 1 degree of the angle-of-incident

radiation is described in this report. The proposed tracker is designed to reposition itself automatically after cloudy periods and should prove inexpensive as well as reliable. Included in this report are (1) a description of two tracker concepts, (2) a derivation of the heat-balance equation used to predict work available for equipment rotation, (3) a discussion of the experimental model fabricated to prove concept feasibility, and (4) an economic analysis comparing the cost of generating steam with a solar-powered boiler with the cost of generating steam with a coal-fired boiler. GRA

N80-19641# New Mexico Univ., Albuquerque. Center for Environmental Research and Development.

SOLAR POWERED LIQUID PISTON STIRLING CYCLE IRRIGATION PUMP Research Report, 1 May - 31 Dec. 1978

G. C. Bell 10 Apr. 1979 29 p refs

(Contract ET-78-G-03-1894)

(SAN/1894-1) Avail: NTIS HC A03/MF A01

A laboratory prototype of the liquid piston Stirling cycle heat engine was constructed with modeling and simulation. A range of engine sizes was used to determine lift head ranges. Preliminary investigations of solar energy inputs indicate numerous feasible methods to operate heat engines. The maximum rate of pumping obtained was one liter per 26 seconds through 109 cm lift head. DOE

N80-19642# San Diego State Univ., Calif. **RESEARCH ON DYNAMICS OF TUNDRA ECOSYSTEMS AND THEIR POTENTIAL RESPONSE TO ENERGY RESOURCE DEVELOPMENT Progress Report, 1 May 1978 - 30 Apr. 1979**

P. C. Miller Jan. 1979 133 p refs

(Contract EE-77-S-03-1525)

(DOE/SF-01525-1) Avail: NTIS HC A07/MF A01

The ecological effects (costs and benefits) of impacts that can be expected from the development and utilization of energy resources in the arctic were investigated. The impacts studied include: altered nutrient availability (nitrogen and phosphorus); altered patterns of soil water drainage; and vehicle tracks. The general ecosystem characteristics used as integrative measures of the possible ecological effects include annual primary production and the relative aboveground growth of the different species or growth forms comprising the vegetation. Plant growth forms were defined by height, leaf longevity, position of the perennating bud, and rooting pattern. The main conclusion of the research is that species respond individually in terms of nutrient and total nonstructural carbohydrates accumulation to fertilization, and that the growth forms studied are not distinctive from each other on the basis of plant nutrition or growth. DOE

N80-19644# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.

MODELING THE SPACE CONDITIONING ENERGY DEMAND OF A COMMUNITY AS A FUNCTION OF WEATHER

E. R. Reiter, A. M. Starr, C. C. Burns, H. H. Leong, and G. R. Johnson Sep. 1979 16 p refs

(Contract EY-76-S-02-1340)

(COO-1340-65) Avail: NTIS HC A02/MF A01

The computer model which calculated the daily energy demand during the heating season of Greeley, Colorado, Cheyenne, Wyoming, and Minneapolis, Minnesota is discussed. The model was found to be excellently suited to test certain conservation strategies. However, preliminary tests of energy demands during the air conditioning season revealed gross inefficiency of some of the cooling systems presently in operation. DOE

N80-19645# Midwest Research Inst., Golden, Colo. **GENERAL RELIABILITY AND SAFETY METHODOLOGY AND ITS APPLICATION TO WIND ENERGY CONVERSION SYSTEMS**

M. Edesess and R. D. McConnell Sep. 1979 52 p refs

(Contract EG-77-C-01-4042)

(SERI/TR-35-234) Avail: NTIS HC A04/MF A01

In conventional system reliability calculations, each component may be in the operable state of the under repair state. These calculations derive system unavailability, or the probability of the system's being down for repairs. By introducing a third component state between 'operable' and 'under repair'-namely, 'defective, but defect undetected'-the methods developed in this report enable system safety projections to be made in addition to availability projections. Also provided is a mechanism for computing the effect of inspection schedules on both safety and availability. A reliability and safety program (RASP) is detailed which perform these computations and also calculates costs for system inspections and repairs. RASP is applied to a simplified wind energy conversion system example. DOE

N80-19646# General Electric Co., Schenectady, N. Y.
SCREENING EVALUATION OF ELECTRIC POWER CYCLES INTEGRATED WITH COAL GASIFICATION PLANTS

S. P. Gallagher and D. J. Ahner Sep. 1979 80 p refs
(EPRI-AF-1160) Avail: NTIS HC A05/MF A01

Potentially lower cost alternatives to present concepts for integrated gasification combined cycle power plants were investigated. A relatively simple, potentially low cost, non steam-bottomed cycle was evolved and the system thermal efficiency calculated. Thermal efficiencies were also determined for several steam-bottomed cycles. The non steam-bottomed cycle was found to have a thermal efficiency of 32 percent. The steam-bottomed cycles analyzed in the study showed efficiency estimates between 38.8 and 40.3 percent, substantially higher than the non steam-bottomed case. The efficiency for an integrated gasification combined cycle using gas turbines at current firing temperatures was estimated at 37.6 percent. Performance at this level suggests the possibility that integrated gasification combined cycles using current gas turbines may be attractive for near term application. DOE

N80-19647# Institute for Energy Analysis, Oak Ridge, Tenn.
ENERGY ACCOUNTING FOR SOLAR AND ALTERNATIVE ENERGY SOURCES

Warren D. Devine, Jr. Jun. 1979 76 p refs
(Contracts EY-76-C-05-0033)

(ORAU/IEA(R)-79-11) Avail: NTIS HC A05/MF A01

Several inadequacies in present energy accounting practices are considered and an energy-accounting framework based upon the actual services provided to end users is proposed. Fifteen categories of energy service are described, and some of their characteristics are identified. The proposed energy accounting framework consists of two matrices - an energy-service matrix and an energy-carrier matrix. The energy-service matrix displays quantities of energy services provided in various ways as well as quantities of energy carriers used to provide energy services. The energy-carrier matrix displays quantities of energy carriers used to produce and distribute energy carriers to ultimate consumers. This accounting framework is illustrated with 1972 energy data for the United States, and several observations are made relative to long range solar energy research and development policy. DOE

N80-19648# Los Alamos Scientific Lab., N. Mex.
CHARACTERIZATION AND ASSESSMENT OF SELECTED SOLAR THERMAL ENERGY SYSTEMS FOR RESIDENTIAL AND PROCESS HEAT APPLICATIONS

J. C. Hyde Aug. 1979 55 p refs
(Contract W-7405-eng-36)

(LA-7995-TASE) Avail: NTIS HC A04/MF A01

The environmental data presented are in partial response to the Technology Assessment of Solar Energy (TASE) program, an assessment of the potential environmental, socioeconomic, and institutional impacts of solar technologies on the national, regional, and local community levels. The results of studies of seven solar thermal energy applications are presented. Five of these are residential applications and the remaining two applications produce industrial process heat. For each application, a representative system model and preliminary designs of major system elements were established. Then the following data were generated: annual useful energy produced, type and weight of

the basic component materials, environmental residuals generated during system operation, and land and water requirements, the system characteristics and the environmental impacts are discussed. DOE

N80-19649# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ON INFLUENCING THE OPERATING TEMPERATURES OF MOTOROLA AND ARCO SOLAR PHOTOVOLTAIC MODULES

P. Raghuraman 11 Oct. 1979 30 p refs
(Contract EY-76-C-02-4094)

(COO-4094-59) Avail: NTIS HC A03/MF A01

The electrical power output of photovoltaic solar cell modules decreases with increasing cell temperatures. Two such efforts on Motorola and Arco Solar modules are detailed using test measurements and analysis to increase the heat transfer from the modules and thereby lower the cell operating temperatures. The radiant heat emitted by the rear stainless steel pan of Motorola modules was increased by painting the pan with black and with white paint. This produced a pan temperature cooling of 3.7 C to 5 C, resulting in an increased electrical power output of 1.7 to 1.95 percent. Arco Solar modules were oriented horizontally and vertically to compare the effect of natural with forced convection cooling in the interior air column of the module. Natural convective heat transfer by vertical orientation produced a 1 to 3.5 C cooling over forced convective cooling by horizontal orientation. This cooling resulted in an increased cell electrical power output of 1 to 2.5 percent. DOE

N80-19650# Central Maine Power Co., Augusta.
CATARACT HYDROELECTRIC DEVELOPMENT EXPANSION STUDY

Jan. 1979 68 p refs Prepared in cooperation with Tippetts-Abbott-McCarthy-Stratton, New York, N.Y.
(Contract EW-78-F-07-1796)

(DOE/ID-01796-1) Avail: NTIS HC A04/MF A01

The Cataract hydroelectric power plant and dam was constructed in 1937-1938 and has been operated continually since that date. This unit is a vertical shaft Kaplan type machine with a rated output of 6650 kW at a design head of 44 ft. Maximum output is 8000 kW. The feasibility of expanding this existing plant was studied. The results indicate the following: the available head and unused flow at the Cataract Project will support an additional 6250 kW of generating capacity, the estimated gross plant investment cost of this plant would be \$5,230,000 at present day costs. If a fishway is required the investment is estimated to be \$5,730,000; and based on the analysis of 60 y of historical flow records this capacity addition would generate an average of 15,910,000 kWh annually. This feasibility study indicates that redevelopment of the Cataract site is a marginally economic proposition, which might offer some savings, over the life of the unit. DOE

N80-19651# Parsons-Brinckerhoff-Tudor-Bechtel, San Francisco, Calif.

POTENTIAL HYDROELECTRIC POWER, VERTICAL TURBINE, SPILLWAY COMBINE BROADWATER DAM Final Report

David C. Willer Apr. 1979 237 p
(Contract EW-78-F-07-1822)

(DOE/ID-01822-1) Avail: NTIS HC A11/MF A01

A feasibility study was made of the hydroelectric power potential at Broadwater Dam in western Montana. Two alternative configurations for the potential project were evaluated and the economics of four possible sources of project funding were assessed. The optimal project alternative was determined to be the apron-mounted configuration. The final choice of funding would be dependent on the power purchaser. It was shown that, regardless of the configuration or funding source selected, the project would be feasible. The cost of the apron-mounted configuration, which would consist of four turbine-generator units for a total installed capacity of 9.76 MW, was estimated as \$13,250,000 with financing provided by either a PL-984 loan or tax-exempt bonds. The cost per installed kilowatt was therefore \$1,350, and the cost per kilowatt-hour was 19.6 mills. The

average annual energy was estimated to be 56.44 million kWh.
DOE

N80-19653# Boeing Aerospace Co., Seattle, Wash.
EMERGING MATERIALS SYSTEMS FOR SOLAR CELL APPLICATIONS-Cu/SUB 2-x/Se Quarterly Technical Progress Report, 1 Aug. - 1 Nov. 1979
R. A. Mickelsen, J. M. Stewart, W. S. Chen, and L. F. Buldhaupt
Nov. 1979 16 p refs
(Contract DE-AC04-79ET-23005)
(DOE/ET-23005-T2; QTPR-2) Avail: NTIS HC A02/MF A01

The feasibility of using CU/sub 2-x/Se as a semiconductor material for the low cost production of photovoltaic solar cells was investigated. The Cu/sub 2-x/Se films was produced by coevaporation from individually monitored Cu and Se vapor sources. With a substrate temperature of 170 C, single phase cubic Cu/sub 2-x/Se films were produced. These films had a direct band gap of 2.2 eV and an indirect band gap of 1.4 eV.
DOE

N80-19654# Brookhaven National Lab., Upton, N. Y.
ELECTROLYSIS-BASED HYDROGEN STORAGE SYSTEMS OVERVIEW AND RATIONALE OF THE BROOKHAVEN NATIONAL LABORATORY MANAGED PROGRAM
A. Mezzina 1979 5 p Presented at the DOE Chem. Energy Storage and Hydrogen Energy Systems Contracts Rev. Meeting, Reston, Va., 12 Nov. 1979
(Contract EY-76-C-02-0016)
(BNL-26904; CONF-791127-4) Avail: NTIS HC A02/MF A01

A technological base in chemical/hydrogen storage technology is developed and near-term opportunities for technology transfer are identified. The emphasis is on conversion of our inexhaustible resources in a cost effective manner. Budget allocations are summarized showing electrolytic hydrogen production as the highest priority area. A budget activity summary is also presented.
DOE

N80-19655# Oklahoma Univ., Norman. Science and Public Policy Program.
ENERGY FROM THE WEST: IMPACT ANALYSIS REPORT, VOLUME 2: SITE-SPECIFIC AND REGIONAL IMPACT ANALYSES Final Report, Jul. 1975 - Oct. 1979
Irvin L. White, Michael A. Chartock, R. Leon Leonard, Steven C. Ballard, and Martha W. Gilliland Mar. 1979 991 p refs
(Contract EPA-68-01-1916)
(PB80-113574; EPA-600/7-79-082B) Avail: NTIS HC A99/MF A01 CSCL 10A

The results of impact analyses conducted as a part of a technology assessment of the development of six energy resources (coal, geothermal, natural gas, oil, oil shale and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah and Wyoming) during the period 1975-2000 are presented. The likely impacts of deploying typical energy resource development technologies at sites representative of the kinds of conditions likely to be encountered are described. Local and regional impacts are discussed. GRA

N80-19656# National Technical Information Service, Springfield, Va.
CADMIUM SULFIDE SOLAR CELLS, VOLUME 1. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - 1977
Brian Carrigan Dec. 1979 256 p
(PB80-802218) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

Citations from Federally-funded research cover cadmium sulfide solar cell theory, design, development, fabrication, and degradation. Studies include junctions with thin films of copper sulfide, selenides, and tellurides. The performance, testing, analysis, efficiency, and costs of these cells are covered. This updated bibliography contains 248 abstracts, none of which are new entries to the previous edition. GRA

N80-19657# National Technical Information Service, Springfield, Va.

SOLAR ELECTRIC POWER GENERATION, VOLUME 3. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, Oct. 1978 - Nov. 1979
Audrey S. Hundemann Dec. 1979 115 p Supersedes NTIS/PS-78/1109; NTIS/PS-77/0900; NTIS/PS-76/0797 (PB80-803034; NTIS/PS-78/1109; NTIS/PS-77/0900; NTIS/PS-76/0797) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

A worldwide literature survey cites power generation by direct conversion with solar cells and indirect conversion using solar heat. Topic areas cover solar tower power plants, orbital solar energy technology, photovoltaic power generation, and solar augmentation of hydroelectric power systems. A few abstracts pertain to the future role that solar energy will play in production of electric power and general studies comparing the technical and economic feasibility of various methods of electric power generation. Abstracts dealing with solar sea power generation and spacecraft power supplies are excluded. This updated bibliography contains 108 abstracts, all of which are new entries to the previous edition. GRA

N80-19658# National Technical Information Service, Springfield, Va.
SOLAR ELECTRIC POWER GENERATION, VOLUME 2. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Sep. 1978
Audrey S. Hundemann Dec. 1979 235 p
(PB80-803000) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

Citations of Federally-funded research are presented pertaining to electric power generation by both direct conversion with solar cells and indirect conversion using solar heat. Topic areas cover equipment design, site surveys, economics, and feasibility studies of solar power satellite systems, photovoltaic systems, solar total energy systems, and central receiver solar thermal power systems. A few abstracts deal with phase change materials and thermal energy storage systems. This updated bibliography contains 228 abstracts, none of which is new to the previous edition. GRA

N80-19659# National Technical Information Service, Springfield, Va.
SOLAR ELECTRIC POWER GENERATION, VOLUME 3. CITATIONS FROM THE NTIS DATA BASE Progress Report, Oct. 1978 - Nov. 1979
Audrey S. Hundemann Dec. 1979 141 p Supersedes NTIS/PS-78/1108; NTIS/PS-77/0898; NTIS/PS-76/0796; NTIS/PS-75/691; NTIS/PS-75/346 (PB80-803018; NTIS/PS-78/1108; NTIS/PS-77/0898; NTIS/PS-76/0796; NTIS/PS-75/691; NTIS/PS-75/346) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

Equipment design, site surveys, economics, and feasibility studies of solar power satellite systems, photovoltaic systems, solar total energy systems, and central receiver solar thermal power systems are discussed in the 134 Federally-sponsored research reports cited in this updated bibliography. All entries are new to the previous edition. GRA

N80-19660# National Technical Information Service, Springfield, Va.
SOLAR ELECTRIC POWER GENERATION, VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1976 - Sep. 1978
Audrey S. Hundemann Dec. 1979 253 p
(PB80-803026) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

Solar tower power plants, orbital solar energy technology, photovoltaic power generation, and solar augmentation of hydroelectric power systems are discussed in citations of worldwide reports. The technical and economic feasibility of various methods of electric power generation is also considered. This updated bibliography which contains 246 abstracts. None of the entries is new to the previous edition. GRA

N80-19661# National Technical Information Service, Springfield, Va.

SOLAR SEA POWER PLANTS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Nov. 1979

Audrey S. Hundemann Dec. 1979 314 p Supersedes NTIS/PS-78/1223; NTIS/PS-77/1056; NTIS/PS-76/0901 (PB80-802580; NTIS/PS-78/1223; NTIS/PS-77/1056; NTIS/PS-76/0901) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

Federally-funded research studies dealing with the technical and economic feasibility of solar sea power plants are discussed. Topic areas cover condenser, evaporator, and heat exchanger design, and fouling and corrosion prevention. Site selection, dynamic modeling studies, and general studies dealing with solar sea power as an energy alternative are included. This updated bibliography contains 307 abstracts, 97 of which are new entries to the previous edition. GRA

N80-19662# National Technical Information Service, Springfield, Va.

SOLAR SEAPOWER PLANTS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Nov. 1979

Audrey S. Hundemann Dec. 1979 257 p Supersedes NTIS/PS-78/1224; NTIS/PS-77/1057; NTIS/PS-76/0902 (PB80-802598; NTIS/PS-78/1224; NTIS/PS-77/1057; NTIS/PS-76/0902) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 10B

The present status and future prospects of using the ocean thermal gradient for production of electric power are discussed in these citations from worldwide research. Engineering, economic, and feasibility studies are covered, including studies dealing with systems and component design. This updated bibliography contains 250 abstracts, 126 of which are new entries to the previous edition. GRA

N80-19666# Battelle Pacific Northwest Labs., Richland, Wash.
ALASKAN ENVIRONMENTAL RESEARCH. SECTION 12.0 OF PART 2: ECOLOGICAL SCIENCES Annual Report, 1978

W. C. Hanson and L. E. Eberhardt Jul. 1979 31 p refs (Contract EY-76-C-06-1830) (PNL-2850-Pt-2-Suppl) Avail: NTIS HC A03/MF A01

Ecological consequences of resource developments in northern Alaska were investigated. Qualitative and quantitative results that describe environmental costs incurred by petroleum resource extraction and transportation, including interaction of industrial activities with arctic foxes (*Alopex lagopus*), small mammals, and tundra-nesting birds in the Prudhoe Bay field and along the Trans-Alaska pipeline and haul road are presented. Similar information from the Colville River delta, baseline information on moose (*Alces alces*) populations, caribou (*Rangifer tarandus*) range quality and use, and lichen communities that are or will be impacted by resource developments is included. Field experiments to determine lichen sensitivities to sulfur oxide concentrations likely to be encountered near pipeline pumping stations; food chain transfer of stable and radioactive elements that utilize a data base of some 19 years for comparative purposes; and evaluation of oil field development activities on rabies and other physiological phenomena in foxes are described. DOE

N80-19668# Argonne National Lab., Ill.
ENVIRONMENTAL AND ECONOMIC EVALUATIONS OF ENERGY RECOVERY FROM AGRICULTURAL AND FORESTRY RESIDUES

Jerome P. Harper, Antonios A. Antonopoulos, and Andrew A. Sobek Aug. 1979 113 p refs (Contract W-31-109-eng-38) (ANL/EES/TM-58) Avail: NTIS HC A06/MF A01

Six biomass energy production model systems involving four conversion methods and five residues are described: hydrolysis of corn residues, pyrolysis of corn residues, combustion of cotton-ginning residues, pyrolysis of wheat residues, fermentation of molasses, and combustion of pulp and papermill wastes. Estimates of material and energy flows for those systems are given per 10 to the 12th power Btu of recovered energy.

Regionalization of the model systems to the primary production region for the crop from which the residue is obtained was undertaken. The associated environmental consequences of residue utilization were then assessed for the production region. The environmental impacts of operating the model systems are examined. On the basis of estimates found in the literature, capital, operating, and maintenance cost estimates are given for the model systems. The study indicates that the most serious environmental impacts arise from residue removal rather than from conversion. DOE

N80-19672# Southern Research Inst., Birmingham, Ala.
ANALYSIS OF THERMAL DECOMPOSITION PRODUCTS OF FLUE GAS CONDITIONING AGENTS Final Report, 7 Jan. 1977 - 31 Mar. 1979

R. B. Spafford, E. B. Dismukes, and H. K. Dillon Aug. 1979 117 p refs

(Contract EPA-68-02-2200; Proj. 3832-27) (PB80-111818; SORI-EAS-79-267; EPA-600/7-79-179) Avail: NTIS HC A06/MF A01 CSCL 13B

The reactions of several flue gas conditioning agents in a laboratory-scale facility simulating conditions in the flue gas train of a coal-burning power plant were studied. The compounds investigated were sulfur trioxide, ammonia, triethylamine, sodium carbonate, ammonium sulfate, and diammonium hydrogen phosphate. The predominant types of reactions observed in these experiments were thermal decomposition at high temperatures, recombination of decomposition fragments at lower temperatures, and reactions with normal components of the flue gas. The only significant environmental threat of any product identified was the formation of N-nitrosodiethylamine as the result of injecting triethylamine into the flue gas. This potent carcinogen was found in trace amounts when triethylamine was injected at 160 C. GRA

N80-19678# Land-Air, Inc., Bethesda, Md. Applied Research Div.

ENGINEERING EVALUATION OF CONTROL TECHNOLOGY FOR H-COAL AND EXXON DONOR SOLVENT PROCESSES Final Report, Jan. 1977 - Mar. 1979

K. R. Sarna and D. T. Oleary Jul. 1979 125 p refs (Contract EPA-68-02-2601)

(PB80-108566; EPA-600/7-79-168) Avail: NTIS HC A06/MF A01 CSCL 13B

The results of an evaluation of the control technology of two coal liquefaction processes, H-Coal and Exxon Donor Solvent, are presented. The effluent streams were characterized and quantified for both processes and plants (pilot and conceptualized commercial). The gaseous, liquid, and solid stream emissions were analyzed for their controllability, process complexity, and efficiency. Extrapolations to the larger commercial size were based partly on pilot plant data and (where such data was unavailable) engineering judgment. Several information gaps were encountered for liquid and solid effluent streams, especially as to composition. These deficiencies were pointed out and recommendations were outlined. GRA

N80-20260*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

THE ROLE OF TECHNOLOGY AS AIR TRANSPORTATION FACES THE FUEL SITUATION

Cornelius Driver Mar. 1980 15 p Presented at Upper Midwest Council, Minneapolis, 1 Nov. 1979 (NASA-TM-81793) Avail: NTIS HC A02/MF A01 CSCL 01C

Perspectives on the air transportation fuel situation are discussed including intercity air traffic, airline fuel consumption, fuel price effects on ticket price, and projected traffic and fuel usage between now and the year 2000. Actions taken by the airlines to reduce consumption are reviewed, as well as efforts currently underway to improve fuel consumption. Longer range technology payoffs resulting from NASA research programs are reviewed and results from studies on the use of alternate fuels are discussed. A.W.H.

N80-20272*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EFFECT OF WATER INJECTION AND OFF SCHEDULING OF VARIABLE INLET GUIDE VANES, GAS GENERATOR SPEED AND POWER TURBINE NOZZLE ANGLE ON THE PERFORMANCE OF AN AUTOMOTIVE GAS TURBINE ENGINE

Edward L. Warren Mar. 1980 35 p

(Contract EC-77-A-31-1040)

(NASA-TM-81415; E-333; DOE/NASA/1040-80/10) Avail: NTIS HC A03/MF A01 CSCL 21E

The Chrysler/ERDA baseline automotive gas turbine engine was used to experimentally determine the power augmentation and emissions reductions achieved by the effect of variable compressor and power engine geometry, water injection downstream of the compressor, and increases in gas generator speed. Results were dependent on the mode of variable geometry utilization. Over 20 percent increase in power was accompanied by over 5 percent reduction in SFC. A fuel economy improvement of at least 6 percent was estimated for a vehicle with a 75 kW (100 hp) engine which could be augmented to 89 kW (120 hp) relative to an 89 Kw (120 hp) unaugmented engine. Author

N80-20306*# United Technologies Corp., South Windsor, Conn. **LIGHTWEIGHT FUEL CELL POWERPLANT COMPONENTS PROGRAM Final Report, 18 Mar. 1974 - 31 Dec. 1979**

R. E. Martin 22 Feb. 1980 103 p refs

(Contract NAS8-30637)

(NASA-CR-161412; FCR-1656)

Avail: NTIS

HC A06/MF A01 CSCL 10B

A lightweight hydrogen-oxygen alkaline fuel cell incorporated into the design of a lightweight fuel cell powerplant (LFCP) was analytically and experimentally developed. The powerplant operates with passive water removal which contributes to a lower system weight and extended operating life. A preliminary LFCP specification and design table were developed along with a lightweight power section for the LFCP design, consisting of repeating two-cell modules was designed. Two, four-cell modules were designed incorporating 0.508 sq ft active area space shuttle technology fuel cells. Over 1,200 hours of single-cell and over 8,800 hours of two-cell module testing was completed. The 0.25 sq ft active area lightweight cell design was shown to be capable of operating on propellant purity reactants out to a current density of 600ASF. Endurance testing of the two-cell module configuration exceeded the 2,500-hour LFCP voltage requirements out to 3700-hours. A two-cell module capable of operating at increased reactant pressure completed 1000 hours of operation at a 30 psia reactant pressure. A lightweight power section consisting of fifteen, two-cell modules connected electrically in series was fabricated. J.M.S.

N80-20340*# Massachusetts Inst. of Tech., Cambridge. Sloan Automotive Lab.

COMBUSTION AND OPERATING CHARACTERISTICS OF SPARK-IGNITION ENGINES Final Report, Jan. 1979 - Jan. 1980

John B. Heywood, James C. Keck, Gian Paolo Beretta, and Paula A. Watts 28 Mar. 1980 13 p refs

(Grant NsG-3245)

(NASA-CR-162896) Avail: NTIS HC A02/MF A01 CSCL 21B

The spark-ignition engine turbulent flame propagation process was investigated. Then, using a spark-ignition engine cycle simulation and combustion model, the impact of turbocharging and heat transfer variations or engine power, efficiency, and NO sub x emissions was examined. R.E.S.

N80-20404*# Kentucky Univ., Lexington. Inst. for Mining and Minerals Research.

EXPERIMENTAL LABORATORY MEASUREMENT OF THERMOPHYSICAL PROPERTIES OF SELECTED COAL TYPES Final Report

William G. Lloyd 13 Sep. 1979 113 p refs Prepared for JPL

(Contracts NAS7-100: JPL-955381)

(NASA-CR-162913; JPL-9950-317)

Avail: NTIS

HC A06/MF A01 CSCL 21D

A number of bituminous coals of moderate to high plasticity were examined, along with portions of their extrudates from the JPL 1.5-inch 850 F screw extruder. Portions of the condensed pyrolysis liquids released during extrusion, and of the gaseous products formed during extrusion were also analyzed. In addition to the traditional determinations, the coals and extrudates were examined in terms of microstructure (especially extractable fractions), thermal analysis (especially that associated with the plastic state), and reactivity towards thermal and catalyzed hydroliquefaction. The process of extrusion increases the fixed carbon content of coals by about 5% and tends to increase the surface area. Coals containing 25% or more DMF-extractable material show an increase in extractables as a result of extrusion; those initially containing less than 20% extractables show a decrease as a result of extrusion. Both the raw and extruded samples of Kentucky no. 9 coal are highly reactive towards hydroliquefaction, undergoing conversions of 75 to 80% in 15 min and 85-94% in 60 min in a stirredclave. A.R.H.

N80-20407*# Chevron Research Co., Richmond, Calif. **REFINING AND UPGRADING OF SYNFUELS FROM COAL AND OIL SHALES BY ADVANCED CATALYTIC PROCESSES Quarterly Report, Jan. - Mar. 1979**

R. F. Sullivan Apr. 1979 41 p

(Contract EX-76-C-01-2315)

(FE-2315-37) Avail: NTIS HC A03/MF A01

Pilot plant tests on the hydrotreating of SRC-2 process product indicate that this coal-derived feed is suitable for refining using advanced commercial petroleum processing technology. Nitrogen in the whole SRC-2 process product can be reduced to a concentration of less than 0.5 ppm in a single catalytic stage. Sulfur and oxygen can also be reduced to low levels; and at high severity, most of the aromatic compounds are converted to naphthenes. As the processing severity is decreased, product nitrogen increases and the product becomes more aromatic. In the latter case, further hydrotreating of the naphtha is required before it can be fed to the second stage of a catalytic reformer. Depending on the severity employed, the jet boiling range product must be further hydrogenated for specification jet fuel. Experiments were made to determine appropriate conditions for these processing steps. DOE

N80-20412*# Institute of Gas Technology, Chicago, Ill.

SYNTHETIC FUELS FROM PEAT GASIFICATION

D. V. Punwani, S. A. Weil, J. E. Paganessi, and M. J. Kopstein (DOE, Washington, D.C.) 1979 7 p Presented at the 14th Intersoc. Energy Conversion Eng. Conf., Boston, 5-10 Aug. 1979

(Contract EW-78-C-19-0042)

(CONF-790803-55) Avail: NTIS HC A02/MF A01

U.S. peat resources are estimated to be about 1440 quads. Tests were conducted in laboratory and process development unit-scale equipment using peats. It was found that conversion of peat to synthetic fuel is technically feasible. The important gasification characteristics of the three peats is discussed. The peatgas process is described along with highlights of its economics for converting peat to substitute natural gas (SNG), benzene, and fuel oil. On the basis of the gasification characteristics, compared to coal, peat is a better raw material from which to make SNG as well as gasoline blending feedstock, in that a greater fraction of the energy results in these products and requires milder operating conditions. Also compared to coal, peat gasification permits more flexibility in the relative yields of gas and liquid hydrocarbons. The estimates show that the economics of converting peat (containing 50% moisture) to SNG is competitive with those of converting Eastern coal to SNG. DOE

N80-20413*# Chem Systems, Inc., New York.

LIQUID PHASE METHANATION/SHIFT PILOT PLANT OPERATION AND LABORATORY SUPPORT WORK Final Report, 1 Jul. 1976 - 30 Nov. 1978

Mar. 1979 330 p

(Contract EX-76-C-01-2036)

(FE-2036-37) Avail: NTIS HC A15/MF A01

The liquid phase methanation (LPM) Pilot Plant construction was completed and shipped to the HYGAS Pilot Plant in Chicago, Illinois. The unit was reassembled and installed. Operations included seven runs totaling 2347 hours of on-stream time with 122 hours of methanation of HYGAS synthesis gas and 193 hours of steam-methane reformer gas. The basic operability of the process was demonstrated in this 50 fold scale-up from a smaller process development unit. Catalyst rate constants were determined and the LPM kinetic model was checked over a wide range of process conditions for three different catalysts. Information accumulated also includes extent of the shift reaction, by-product selectivities, catalyst bed fluidization and circulating oil stability. An experimental program studying the rates of carbon formation in vapor-phase methanators was conducted. DOE

N80-20414# Rockwell International Corp., Canoga Park, Calif. Environmental and Energy Systems Div.

ADVANCED DEVELOPMENT OF A SHORT-RESIDENCE-TIME HYDROGASIFIER Quarterly Technical Progress Report, 1 Jan. - 31 Mar. 1979

Apr. 1979 86 p refs

(Contract ET-78-C-01-3125)

(FE-3125-5; QTPR-2) Avail: NTIS HC A05/MF A01

Minor modification to the 1-TPH design were made so that the injector could be accommodated within the existing pressure vessel as a nominal 3/4-TPH hydrogasifier injector. One injector made out of Type 321 stainless steel was fabricated and delivered to the test stand. Other existing reactor hardware components were reevaluated with the viewpoint of assessing the need for any modifications. The needed modifications were completed, and all of the hardware was readied for installation at the test stand. Design work on the hydrogen cooled recuperator was initiated. The purpose of the recuperator is to recover the sensible heat from the reaction products by transferring it to the reactant hydrogen. A three module, shell and tube, counterflow type of heat exchanger concept has been chosen for this recuperator, and detailed design drawings were nearly completed. DOE

N80-20415# Oklahoma State Univ., Stillwater.

PHOTOCHEMICAL CONVERSION OF COAL TO GASOLINE IN AN ENTRAINED BED REACTOR Ph.D. Thesis

S. Sundaram Jul. 1979 252 p refs

(Contract EY-76-S-05-5020)

(ORO-5020-T1) Avail: NTIS HC A12/MF A01

Reading anthracite, Pittsburg Hi-Seam, Illinois No. 6, Utah Emery, Montana Rosebud, coals and synthane char were entrained in a rapidly flowing stream of hydrogen and then interacted with photoproducted hydrogen atoms. The reactivity of Illinois No. 6 coal was studied in detail. Products were collected in traps cooled by liquid nitrogen. Gas yields qualitatively decrease in the order given, i.e., with decreasing rank. The gaseous hydrocarbon produced corresponded to gasoline in the C1-C8 range, all isomers present and identified by GC-MS. The liquid products contained benzene, toluene, xylenes, naphthalenes, phenanthrene, pyrene, fluoranthene, benzanthracene, and benzopyrenes. The results suggest that the product distribution, yield and percent conversion are probably controlled by a rate limiting step in which phenanthrene type precursors are cracked from the coal surface and followed by secondary H atom reactions to produce smaller hydrocarbons. DOE

N80-20416# Department of Energy, Pittsburgh, Pa. Energy Technology Center.

COAL LIQUEFACTION WITH SYNTHESIS GAS

H. R. Appell, R. D. Miller, E. G. Illig, E. C. Moroni, and F. W. Steffgen Sep. 1979 65 p refs

(PETC/TR-79/1) Avail: NTIS HC A04/MF A01

The effects of changing gas composition, temperature, pressure, solvents, catalysts and coal types were studied to better understand the process fundamentals and to lay the groundwork for studies in continuous reactors on a larger scale. A variety of coals were converted in batch autoclaves to a low sulfur fuel oil at temperature of 425 C and pressures of 2200 to 2400 psig, using 1:1 (H₂:CO) synthesis gas at reaction times of 30 to 60 minutes at temperature. Although early work suggested that

lignites could be readily liquefied without added catalytic agents, later experiments showed that a greatly improved product could be obtained by adding pyrite, which is normally present only in small amounts. Pyrite or, in particular, its reduction product pyrrhotite, appear to be important catalysts for coal liquefaction, and, in general, the reactivity of coals correlates well with the pyrite (or iron plus sulfur) content. DOE

N80-20417# Department of Energy, Pittsburgh, Pa.

TRACE AND MINOR ELEMENT ANALYSES OF COAL LIQUEFACTION PRODUCTS

R. G. Lett, J. W. Adkins, R. R. DeSantis, and F. R. Brown Aug. 1979 37 p refs

(PETC/TR-79/3) Avail: NTIS HC A03/MF A01

The feed coal and products from a single batch of a long term liquefaction run on the 400 lb coal/day process development unit were sampled. Trace and minor element determinations were made on the Virginia hvAb feed coal, gross liquid product, and centrifuged liquid product and centrifuge residue from both the first and second centrifuging of the liquid product. Spark source mass spectrometry was used to determine the distribution and general level of about sixty elements. More precise determinations of specific trace (copper, chromium, manganese, nickel, zinc, lead, and cadmium) and minor elements (iron, silicon, aluminum, magnesium, and potassium) were made for elemental balance purposes. Results are compared with those previously obtained from a Kentucky hvBb coal run. Centrifugation of the liquid product from the West Virginia coal results in a preferential removal of iron and several other elements which were not observed in the Kentucky coal run. DOE

N80-20419# Energy and Environmental Analysis, Inc., Arlington, Va.

INDUSTRIAL FUEL CHOICE ANALYSIS MODEL VOLUME 2: APPENDICES TO MODEL DOCUMENTATION

Jan. 1979 160 p refs

(Contract EJ-78-C-01-2832)

(DOE/EIA-2832/1-Vol-2-App) Avail: NTIS HC A08/MF A01

Description, documentation, and other information are included in these appendices dealing with industrial fuel choices; energy consumption data base; major fuel burning installation survey; American Boiler Manufacturers Association data file; midrange energy forecasting system; projection method; capacity utilization rates; nonboiler characteristics; boiler capital and O & M cost data; nonboiler capital and O & M cost data; approach to estimating energy impacts of the conversion regulatory program index or acronyms. DOE

N80-20422# Mobil Research and Development Corp., Princeton, N. J.

EXPLORATORY STUDIES IN CATALYTIC COAL LIQUEFACTION Final Report, Jun. 1978 - Mar. 1979

D. D. Whitehurst, T. O. Mitchell, M. Farcsiu, and J. J. Dickert, Jr. Sep. 1979 167 p refs

(EPRI-AF-1184) Avail: NTIS HC A08/MF A01

Catalyst aging tests simulating H-coal conditions with Illinois No. 6 coal were run for approximately 10 days with Cyanamid 1442A (CoMo/Al₂O₃), Cyanamid NiMo/Al₂O₃, Armak NiMo/Al₂O₃, Amocat 1A (CoMo/Al₂O₃), and Amocat 1B (Mo/Al₂O₃) catalysts. Fresh and aged catalysts were examined for hydrogenation, hydrocracking, isomerization, desulfurization, denitrogenation, and deoxygenation. Several minerals were also included in the tests. Fresh commercial catalysts, especially NiMo/Al₂O₃, appear to be undesirably active for the H-Coal process. All catalysts age extensively but the used catalysts are still quite active. Activities for all reactions are reduced, in the presence of nitrogen compounds. It was found that 400 F product mixtures become more complex as catalysts age, and that the catalysts affect especially the highest boiling products, but lose the ability to lower molecular weight as they age. Hydrogen donor catalyst systems are described briefly. DOE

N80-20423# Sandia Labs., Albuquerque, N. Mex.

CATALYST CHARACTERIZATION IN COAL LIQUEFACTION Quarterly Report, 1 Apr. - 30 Jun. 1979

N80-20424

M. G. Thomas Oct. 1979 18 p refs
(Contract EY-76-C-04-0789)

(SAND-79-1969; QR-3) Avail: NTIS HC A02/MF A01

A charge of neutron activated CoMo catalyst was prepared for use in the H-Coal Process Demonstration Unit. Catalysts tested in a fixed bed with low ash feedstock and in ebullated and fixed beds with higher-ash containing feedstocks corroborate other evidence that the regions of high reflectivity near used catalyst surfaces are due to the pressure of containment mineral matter, primarily iron and titanium. Parametric experiments with coal, preasphaltene, asphaltene, and oil in tubing reactors show that production of hydrocarbon gases increases in the series oil < asphaltene < preasphaltene, that both a CoMo catalyst and pyrite addition lowers the production of C1 to C4 hydrocarbons, and that pyrite significantly increases the amount of CO and CO2 generated. DOE

N80-20424# Southwest Research Inst., San Antonio, Tex. Mobile Energy Div.

STABILITY SURVEY OF HYDROCARBON FUELS Final Report

J. N. Bowden Oct. 1979 35 p refs
(Contract EW-78-C-03-1778)

(BETC-1778-4) Avail: NTIS HC A03/MF A01

The storage stability characteristics of No. 2 diesel fuels, JP-4 turbine fuels, and unleaded and leaded gasolines were evaluated. The 43.3 C storage stability test, which included gum determinations after periods of 4, 8, 16, and 32 weeks, was conducted on all samples. The thermal stability of the JP-4 fuels was also measured. Results indicate that the JP-4 fuels are the most stable, followed by the unleaded gasolines, leaded gasolines, and the diesel fuels. None of the jet fuels showed any degree of deterioration during the 32 weeks of storage, while at least one of each type of gasolines and four diesel fuels appeared to have some measure of instability. DOE

N80-20425# Fluor Engineers and Constructors, Inc., Irvine, Calif. COAL LIQUEFACTION TEST CENTER Quarterly Technical Progress Report, Oct. - Dec. 1978

Jun. 1979 69 p

(Contract EX-76-C-01-1517)

(FE-1517-78) Avail: NTIS HC A04/MF A01

Repairs from the damage incurred during the August fire were completed along with major modifications to the J-A608C/D hydrogenation reactor recycle pumps. Integrated operation of the Cresap Pilot Plant was carried out for two periods of 24 and 40 hours during Runs 014 and 015. Extraction operations in the front end totaled 37 and 7 hours for these runs. On stream hydrogenation time in section 600 consisted of 154 hours processing feedstock from storage and 64 hours on fresh extract. Because of the short periods of stabilized operation, characterization data collected were minimal. However, it is estimated that depth of extraction was about 75% on coal during each run. Hydrogenation effected about 80% conversion of +880 F material and 60% sulfur reduction in final product. DOE

N80-20426# Conoco Coal Development Co., Library, Pa. Research Div.

ZINC HALIDE HYDROCRACKING PROCESS FOR DISTILLATE FUELS FROM COAL Annual Technical Progress Report, 1 Feb. 1978 - 31 Jan. 1979

C. W. Zielke, Melvyn Pell, C. R. Greene, J. T. Maskew, and R. T. Struck 15 May 1979 105 p refs
(Contract EX-76-C-02-1743)

(FE-1743-68) Avail: NTIS HC A06/MF A01

Final results from the continuous bench-scale work showed that single-stage liquefaction of Montana subbituminous coal can be operated up to 427 C and in multiple-stage operation, the final stage at 17.5 MPa can be as high as 496 C without coke formation. This will permit increased throughput and eliminate a melt extraction step in the process. A study of crushing and drying of subbituminous coal showed that the oxygen level in the drying gases can be controlled to a level where no degradation of the coal results. An economic study comparing direct coal feeding with producing SRC 1 and feeding it to zinc chloride processing showed an incentive for direct coal feeding. DOE

N80-20427# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

SURVEY OF BIOMASS GASIFICATION. VOLUME 1: SYNOPSIS AND EXECUTIVE SUMMARY

Jul. 1979 45 p

(Contract EG-77-C-01-4042)

(SERI/TR-33-239-Vol-1) Avail: NTIS HC A03/MF A01

The conversion of biomass into a clean burning gaseous fuel that can be used to retrofit existing gas/oil boilers, to power engines, to generate electricity, and as a base for synthesis of methanol, gasoline, ammonia, or methane is considered with emphasis on biomass gasification. Aspects reviewed include the technical background necessary for understanding the science, engineering, and commercialization of biomass; the present status of gasification processes; economics/gas conditioning; fuel synthesis; and the institutional role to be played by the federal government. Recommendations for future research and development are presented. DOE

N80-20428# McElroy (Ralph) Co., Austin, Tex.

PRODUCTION OF METHANE USING AN ANAEROBIC FILTER

Knud B. Pedersen Apr. 1979 20 p Transl. into ENGLISH of Produccion de Metano Usando un Filtro Anaerobico (Puerto Rico), 5 Aug. 1978 22 p Sponsored by DOE Prepared for Argonne National Lab., Ill.

(ANL-Trans-1164) Avail: NTIS HC A02/MF A01

The treatment of waste products using an anaerobic process results in methane gas as a by-product and this gas can be used as a source of energy. The viability of producing methane gas - under the conditions which are valid for Puerto Rico - from domestic sewage, using an anaerobic filter, are considered. DOE

N80-20429# Missouri Univ. -Rolla. Materials Research Center.

CHEMICAL AND PHYSICAL STABILITY OF REFRACTORIES FOR USE IN COAL GASIFICATION Quarterly Progress Report, 1 Aug. - 31 Oct. 1979

Abbas Fakhr and Delbert E. Day 31 Oct. 1979 25 p refs
(Contract EY-76-S-02-2904)

(COO-2904-14) Avail: NTIS HC A02/MF A01

The corrosion resistance of refractories, especially the bond phases, in high pressure/high temperature gases and liquids present in coal gasification environments are described. The results of completed exposures are given. Comparison of liquid versus vapor exposure, for various castables is given. As previously observed for castables exposed to pure steam, all the dense alumina castable had a higher strength after exposure to either the saturated vapor or immersed in liquid, compared with their controls (fired at 5000 F in air for 18 h). Results are reported. DOE

N80-20430# Argonne National Lab., Ill.

SUPPORT STUDIES IN FLUIDIZED-BED COMBUSTION 1978 ANNUAL REPORT Annual Report, Jul. 1977 - Sep. 1978

I. Johnson, G. J. Vogel, S. H. D. Lee, D. S. Moulton, and F. F. Numes Aug. 1979 112 p refs
(Contract W-31-109-eng-38)

(PB80-112758; ANL/CEN/FE-78-10; EPA-600/7-79-203) Avail: NTIS HC A06/MF A01 CSCL 13B

Results of laboratory and process scale EPA studies supporting the national development of atmospheric and pressurized fluidized bed combustion (PFBC) of coal are presented. Limestone sulfation enhancement experiments showed CaCl2 and MgCl2 to be more effective than NaCl in increasing the pore size and hence the sulfation capability of calcined limestones. Experiments to evaluate coal pyrolysis char as a feedstock for FBC were conducted on Wyoming subbituminous coal pyrolyzed at about 650 C. Char combustion efficiencies were 94-99 percent. The use of oil shale for SO2 emission control in FBC was evaluated. Considerably larger quantities of shale (than limestone or dolomite) would be required because of shale's lower CaO content. GRA

N80-20506# National Bureau of Standards, Washington, D.C. Electron Devices Div.

MEASUREMENT TECHNIQUES FOR HIGH POWER SEMI-CONDUCTOR MATERIALS AND DEVICES Annual Report, 1 Oct. 1977 - 30 Sep. 1978

Oct. 1979 144 p refs
(DOE/RA-0041; NBSIR-79-1756) Avail: NTIS HC A07/MF A01

Results of research directed toward the development of measurement methods for semiconductor materials and devices which will lead to more effective use of high-power semiconductor devices in applications for energy generation, transmission, conversion, and conservation are reported. Emphasis is on the development of measurement methods for materials for thyristors and rectifier diodes. The use of thermally stimulated current and capacitance measurements and other deep level measurement techniques developed as a means for characterizing lifetime-controlling or leakage source defects in power grade silicon material and devices are described. Procedures to enable spreading resistance measurements of thyristor starting material and layer profiles to be made on a reliable basis are included. DOE

N80-20532*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FACTORS AFFECTING CLEANUP OF EXHAUST GASES FROM A PRESSURIZED, FLUIDIZED-BED COAL COMBUSTOR

R. James Rollbuhler and John A. Kobak Mar. 1980 .37 p refs
(NASA-TM-81439; E-382) Avail: NTIS HC A03/MF A01 CSCL 20D

The cleanup of effluent gases from the fluidized-bed combustion of coal is examined. Testing conditions include the type and feed rate of the coal and the sulfur sorbent, the coal-sorbent ratio, the coal-combustion air ratio, the depth of the reactor fluidizing bed, and the technique used to physically remove fly ash from the reactor effluent gases. Tests reveal that the particulate loading matter in the effluent gases is a function not only of the reactor-bed surface gas velocity, but also of the type of coal being burnt and the time the bed is operating. At least 95 percent of the fly ash particulates in the effluent gas are removed by using a gas-solids separator under controlled operating conditions. Gaseous pollutants in the effluent (nitrogen and sulfur oxides) are held within the proposed Federal limits by controlling the reactor operating conditions and the type and quantity of sorbent material. M.G.

N80-20551# Engineering Societies Commission on Energy, Inc., Washington, D. C.

BASIC RESEARCH IN ENGINEERING: FLUID DYNAMICS AND THERMAL PROCESSES

Aug. 1979 98 p refs Presented at the Fluid Dyn. and Thermal Processes Workshop, Lexington, Ky., 1 Feb. 1979
(Contract EF-77-C-01-2468)
(FE-2468-54; CONF-790240-1) Avail: NTIS HC A05/MF A01

Critical areas for research in fluid mechanics, separation phenomena, energy processing, and energy reactions are identified and discussed for four workshop papers. DOE

N80-20720 Case Western Reserve Univ., Cleveland, Ohio.
RESOURCE AND ENERGY CONSTRAINTS OF REGIONAL AND GLOBAL AVAILABILITY OF ALUMINUM COPPER, AND IRON 1975 - 2000: A COMPUTER STUDY
Ph.D. Thesis

Aldo Francis Barsotti 1979 482 p
Avail: Univ. Microfilms Order No. 8005352

A computer submodel of a world integrated model system indicates that globally the resources and reserves of all three metals are more than adequate to meet projected metal needs, not only for the remainder of this century, but for at least through the year 2025 (assuming some accuracy of projections over that time horizon). The share of total energy needs accounted for by the metal (aluminum, copper and iron) industry varies considerably among countries. Based on economic settings in the model, and projections in growth of downline metal

production capacity, the model indicates that forecasted energy production will be inadequate and have a major constraining effect on metal supply in most regions by the year 2000. The regions most affected by that shortage are Oceania, Japan, and Latin America. Because of its total lack of energy resources, Japan will be most vulnerable. Dissert. Abstr.

N80-20792# Nevada Bureau of Mines and Geology, Reno.
ASSESSMENT OF LOW- TO MODERATE-TEMPERATURE GEOTHERMAL RESOURCES OF NEVADA Final Report, Apr. 1978 - Jun. 1979

D. T. Trexler, Thomas Flynn, and Brian A. Koenig 1979 36 p refs
(Contract ET-78-S-08-1556)
(NVO-01556-1) Avail: NTIS HC A03/MF A01

A geothermal resource map of Nevada was produced that provides detailed information on low- to moderate-temperature geothermal systems, and that also evaluates their potential for direct non-electric utilization. The information shown on the map can be divided into two categories: spot data and regional assessment (or potential evaluation). Specific geochemical information, such as temperature, pH, and chemical species, is represented by approximately 300 circle and diamond-shaped symbols. Thirty-seven larger regions were evaluated for their potential for direct-use on the basis of a numerical technique, which is fully described. An additional 15 sites were designated as areas that may provide a basis for investigations, but that lack sufficient data for a detailed potential evaluation at this time. DOE

N80-20800# General Accounting Office, Washington, D. C. Energy and Minerals Div.

ANALYSIS OF CURRENT TRENDS IN U.S. PETROLEUM AND NATURAL GAS PRODUCTION

7 Dec. 1979 11 p
(PB80-116056; EMD-80-24) Avail: NTIS HC A02/MF A01 CSCL 08I

Petroleum and natural gas production in the U.S. is forecasted through the 1990's. It is concluded that production will decline in the 1980's, but could be stabilized in the 1990's provided new enhanced oil recovery techniques are utilized. Developments in frontier areas are also addressed. GRA

N80-20801# Texas Univ. at San Antonio. Div. of Environmental Studies.

ANALYSIS OF WATER RESOURCES REQUIREMENT FOR THE ENHANCED (TERTIARY) OIL RECOVERY IN THE SOUTHERN PLAINS REGION OF THE UNITED STATES

Chia Shun Shih and Susan H. Hamilton Sep. 1979 222 p refs
(Contract DI-14-34-0001-8120)
(PB80-110869; W80-01005; OWRT-B-218-TEX(1)) Avail: NTIS HC A10/MF A01 CSCL 08I

Water resources requirements are analyzed in terms of both water quantity and quality, for the anticipated enhanced oil recovery operations to be implemented in the Southern Plains region of the United States. The enhanced oil recovery potential of each oil-producing reservoir in the four states of Texas, Oklahoma, New Mexico, and Louisiana is assessed using parameters describing the basic characteristics of crude oil and the reservoir formation. The water quality impacts of enhanced recovery method are assessed considering surface water pollution by discharged chemicals and waste waters, groundwater pollution by the fracture of well casings, and infiltration of chemical and oil/water mixtures. GRA

N80-20806 North Carolina State Univ. at Raleigh.
COMPARISON OF THEORETICAL AND EXPERIMENTAL SOLAR CELL PERFORMANCE Ph.D. Thesis

Ching Yuh Robert Fang 1979 235 p
Avail: Univ. Microfilms Order No. 8005560

A detailed comparison of the theoretically predicted performance of silicon solar cells and the experimentally observed performance is presented. The comparison includes the dark one through five characteristics, the spectra response characteristics, and one through five characteristics under air mass zero illumination. In general it is found that the agreement between

N80-20807

theory and experimental behavior is very good. This good agreement is obtained for a variety of cells fabricated with junction depths ranging from 0.1 micrometer to more than 1 micrometer and for base layer resistivities from 10 ohms-cm to 0.1 ohms-cm
Dissert. Abstr.

N80-20807 Rensselaer Polytechnic Inst., Troy, N. Y. **A COMPARATIVE STUDY OF THE ENERGY ALTERNATIVES FOR THE STATE OF NEW YORK** Ph.D. Thesis

Lewis Chester Cohen 1979 303 p
Avail: Univ. Microfilms Order No. 7922226

The energy supply and demand picture for the State of New York is examined. The alternatives available to meet future needs are compared. The subject matter is addressed in an interdisciplinary fashion, focusing on the economic, health, environmental, and technological state of the art of the various options. Major economic factors affecting the energy supply problem are illustrated. Various energy alternatives are discussed, which include coal use for gasification versus electrification, large scale generation of electricity, cogeneration, district heating and total energy systems, low lead hydrogeneration of electricity, fuels from biomass, wood, solid waste, solar, and wind. A suggested optimal energy path is developed, along with a scenario of how energy needs should be met. Dissert. Abstr.

N80-20810* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

COMBINED SOLAR COLLECTOR AND ENERGY STORAGE SYSTEM Patent

Ronald N. Jensen, inventor (to NASA) Issued 11 Mar. 1980
6 p Filed 28 Apr. 1978 Supersedes N78-23567 (16 - 14, p 1868)

(NASA-Case-LAR-12205-1; US-Patent-4,192,290;
US-Patent-Appl-SN-900843; US-Patent-Class-126-437;
US-Patent-Class-126-434; US-Patent-Class-165-32;
US-Patent-Class-126-419) Avail: US Patent and Trademark Office CSCL 10A

A combined solar energy collector, fluid chiller and energy storage system is disclosed. 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. Official Gazette of the U.S. Patent and Trademark Office

N80-20811 California Univ., Los Angeles. **ENERGY CONSERVATION IN THE US: SOME INTERDISCIPLINARY APPROACHES WITH AN EMPHASIS ON INDUSTRIAL COGENERATION** Ph.D. Thesis

Ali Khaki-Kashani 1979 273 p
Avail: Univ. Microfilms Order No. 8007434

The potential for energy conservation in the United States through industrial cogeneration and energy recovery from municipal solid waste was evaluated. Candidate industries with the highest potential for industrial cogeneration were identified, current and advanced energy conversion systems for cogeneration were analyzed and various cogeneration strategies to maximize the potential fuel savings, were considered. Future market potential, potential energy savings, and the national benefits of industrial cogeneration were studied. Technical analyses for cogeneration systems were performed at several industrial sites and detailed institutional, environmental, and economic analyses were conducted for major categories of institutional settings. The impact of the National Energy Act on the commercialization of industrial cogeneration was discussed. The current status of the various processes available for energy recovery from municipal solid waste was assessed along with the costs associated with each process.
Dissert. Abstr.

N80-20812* Motorola, Inc., Phoenix, Ariz. **MARKET DEFINITION STUDY OF PHOTOVOLTAIC POWER FOR REMOTE VILLAGES IN THE UNITED STATES**

Clyde Ragsdale and Prosper Quashie Feb. 1980 71 p
(Contract DEN3-49; Contract DE-AI01-79ET-20485)
(NASA-CR-159800; DOE/NASA/0049-80/1) Avail: NTIS HC A04/MF A01 CSCL 10B

A grass roots evaluation of the market potential was carried out for photovoltaic applications in remote villages in the U. S. and its possessions. An estimate of almost 14 MWp available for conversion from a potential to a real market was defined. The total power potential was based on the energy needs of almost 400 sites reported by Federal agencies and inputs from over 100 Indian tribes. The methodology used, the results achieved, and some recommendations of how to convert this domestic market potential into a real market are detailed. R.E.S.

N80-20813* Honeywell, Inc., Minneapolis, Minn. **QUALIFICATION TEST PROCEDURES AND RESULTS FOR HONEYWELL SOLAR COLLECTOR SUBSYSTEM, SINGLE-FAMILY RESIDENCE**

Washington, D.C. DOE Feb. 1977 43 p Prepared for NASA and DOE

(Contract NAS8-32093)
(NASA-CR-161382) Avail: NTIS HC A03/MF A01 CSCL 10B

The test procedures and results in qualifying the Honeywell single family residence solar collector subsystem are presented. Testing was done in the following areas: pressure, service loads, hail, solar degradation, pollutants, thermal degradation, and outgassing.
R.E.S.

N80-20814* Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.

ANALYSIS AND EVALUATION IN THE PRODUCTION PROCESS AND EQUIPMENT AREA OF THE LOW-COST SOLAR ARRAY PROJECT Quarterly Report, May - Aug. 1979

H. Goldman and M. Wolf Aug. 1979 63 p refs Prepared for JPL and DOE

(Contract JPL-954796)
(NASA-CR-162904; DOE/JPL-954796-79/7) Avail: NTIS HC A04/MF A01 CSCL 10A

The energy consumed in manufacturing silicon solar cell modules was calculated for the current process, as well as for 1982 and 1986 projected processes. In addition, energy payback times for the above three sequences are shown. The module manufacturing energy was partitioned two ways. In one way, the silicon reduction, silicon purification, sheet formation, cell fabrication, and encapsulation energies were found. In addition, the facility, equipment, processing material and direct material lost-in-process energies were appropriated in junction formation processes and full module manufacturing sequences. A brief methodology accounting for the energy of silicon wafers lost-in-processing during cell manufacturing is described. Author

N80-20820* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

THE 1979 GODDARD SPACE FLIGHT CENTER BATTERY WORKSHOP

Gerald Halpert, ed. Apr. 1980 521 p refs Workshop held in Greenbelt, Md., 13-15 Nov. 1979

(NASA-CP-2117) Avail: NTIS HC A22/MF A01 CSCL 10C

Papers discussing the latest results of testing, analysis, and development of the sealed nickel cadmium cell system are presented. Metal hydrogen and lithium cell technology and applications are also discussed. The purpose of the workshop was to share flight and test experience, stimulate discussion on problem areas, and to review the latest technology improvements.

N80-20821* National Aeronautics and Space Administration, Washington, D. C.

OVERVIEW OF NASA BATTERY TECHNOLOGY PROGRAM

Robert W. Riebling *In* NASA. Goddard Space Flight Center The 1979 Goddard Space Flight Center Battery Workshop Apr. 1980 p 5-11

Avail: NTIS HC A22/MF A01 CSCL 10C

Highlights of NASA's technology program in batteries for space applications are presented. Program elements include: (1) advanced ambient temperature alkaline secondaries, which

are primarily nickel-cadmium cells in batteries; (2) a toroidal nickel cadmium secondaries with multi-kilowatt-hour storage capacity primarily for lower orbital applications; (3) ambient temperature lithium batteries, both primary and secondaries, primarily silver hydrogen and high-capacity nickel hydrogen.

R.E.S.

N80-20830*# GTE Labs., Inc., Waltham, Mass.

LITHIUM THIONYL CHLORIDE HIGH RATE DISCHARGE
Keith A. Klinedinst *In* NASA. Goddard Space Flight Center
The 1979 Goddard Space Flight Center Battery Workshop Apr. 1980 p 121-133

Avail: NTIS HC A22/MF A01 CSCL 10C

Improvements in high rate lithium thionyl chloride power technology achieved by varying the electrolyte composition, operating temperature, cathode design, and cathode composition are discussed. Discharge capacities are plotted as a function of current density, cell voltage, and temperature. K.L.

N80-20831*# Boeing Aerospace Co., Seattle, Wash.

LITHIUM BATTERY DISCHARGE TESTS
Chris J. Johnson *In* NASA. Goddard Space Flight Center
The 1979 Goddard Space Flight Center Battery Workshop Apr. 1980 p 135-146

Avail: NTIS HC A22/MF A01 CSCL 10C

The long term discharge of a variety of lithium cells was characterized and the susceptibility of the cells to chemical variation during the slow discharge was tested. A shunt resistor was set across the terminals to monitor the voltage as a function of time. Failures were identified by premature voltage drops. K.L.

N80-20832*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CHARACTERIZATION OF PROTOTYPE SECONDARY LITHIUM BATTERY
Robert Somoano *In* NASA. Goddard Space Flight Center
The 1979 Goddard Space Flight Center Battery Workshop Apr. 1980 p 147-154

Avail: NTIS HC A22/MF A01 CSCL 10C

The performance characteristics of ambient temperature secondary lithium batteries were determined through continuous cycle tests with periodic current and voltage measurements. Cycle life of the lithium anode was found to be an important problem area as was the formation of dendrite breakage and subsequent shorting. Energy density was increased by using more efficient cathode structures. K.L.

N80-20834*# Exxon Enterprises, Inc., Somerville, N.J. Battery Div.

THE EXXON RECHARGEABLE CELLS
Paul A. Malachuk *In* NASA. Goddard Space Flight Center
The 1979 Goddard Space Flight Center Battery Workshop Apr. 1980 p 169-178

Avail: NTIS HC A22/MF A01 CSCL 10C

The design and performance of ambient temperature secondary cells based on the titanium disulfide cathode are discussed. These limited performance products were developed for microelectronic applications such as solar rechargeable watches and clocks which require low drain rate and do not require many deep cycles. K.L.

N80-20846*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LIFE TEST RESULTS OF THE NASA STANDARD 20 AMPERE HOUR CELLS

Gerald Halpert *In* its The 1979 Goddard Space Flight Center Battery Workshop Apr. 1980 p 321-330

Avail: NTIS HC A22/MF A01 CSCL 10C

The data collected from life cycle tests results of a 20-ampere cells are discussed. A total of 50 cells were evaluated. R.C.T.

N80-20864*# General Electric Co., Philadelphia, Pa. Space Div.

MOD 1 WIND TURBINE GENERATOR FAILURE MODES AND EFFECTS ANALYSIS

Feb. 1979 95 p

(Contracts NAS3-20058; EX-77-A-29-1010)

(NASA-CR-159494; DOE/NASA/0058-79/1) Avail: NTIS HC A05/MF A01 CSCL 10B

A failure modes and effects analysis (FMEA) was directed primarily at identifying those critical failure modes that would be hazardous to life or would result in major damage to the system. Each subsystem was approached from the top down, and broken down to successive lower levels where it appeared that the criticality of the failure mode warranted more detail analysis. The results were reviewed by specialists from outside the Mod 1 program, and corrective action taken wherever recommended.

A.R.H.

N80-20865*# Honeywell, Inc., Minneapolis, Minn.

SOLAR ENERGY HEATING SYSTEM DESIGN PACKAGE FOR A SINGLE-FAMILY RESIDENCE AT NEW CASTLE, PENNSYLVANIA

Aug. 1977 187 p Prepared for DOE

(Contract NAS8-32093)

(NASA-CR-161356) Avail: NTIS HC A09/MF A01 CSCL 10A

The design of a solar heating and hot water system for a single family dwelling is described. Cost trade studies on the energy conservation and architectural features of the solar house are discussed. The present status of verification for the single family heating system, i.e., proof that the components and the system meet applicable physical and functional requirements, is reported. The system integration drawings, the major subsystems drawings, and the architect's specifications and plans are included.

A.W.H.

N80-20866*# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.

SOLAR HEATING SYSTEM DESIGN PACKAGE FOR A SINGLE-FAMILY RESIDENCE AT WILLIAM O'BRIEN STATE PARK, MINNESOTA

Jul. 1977 173 p Prepared for NASA and DOE

(Contract NAS8-32093)

(NASA-CR-161357) Avail: NTIS HC A08/MF A01 CSCL 10A

The plans, specifications, cost trade studies, and verification status of a prototype solar heating and hot water system for the Minnesota Department of Natural Resources's single-family dwelling located at O'Brien State Park, 30 miles east of Minneapolis, Minnesota are presented.

R.E.S.

N80-20867# Army Armament Research and Development Command, Dover, N. J. Management Information Systems Directorate.

THE APPLICATION OF DC-DC ENERGY CONVERSION IN A SOLAR ENERGY SYSTEM Final Report

John P. Tobak Sep. 1979 156 p

(AD-A077112; AD-E400363; ARMID-TR-78002) Avail: NTIS HC A08/MF A01 CSCL 10/2

Expressions of voltage gain, current, and efficiency are developed for each of five different methods of DC-DC energy conversion. One of the five methods is selected as the design model for a prototype converter to be used in solar energy applications. Both the prototype's performance and the test methods employed are described. Efficiencies as high as 86% are measured along with a constant voltage line regulation of 0.04 volts per volt and a constant voltage load regulation of 0.034 volts per ohm. The prototype acts as a constant 12-volt power supply capable of delivering up to 10-amp currents. GRA

N80-20868# Little (Arthur D.), Inc., Cambridge, Mass.

WIND ENERGY IN THE MOUNTAINS OF NEW HAMPSHIRE AS A POTENTIAL ENERGY SOURCE FOR PORTSMOUTH NAVAL SHIPYARD Final Report

William A. Vachon, William T. Downey, Frederic March, Frederick R. Madio, Gerald A. Schimke, and John E. Wade Oct. 1979 188 p

(Contract N00014-79-C-0536; NR Proj. 521-710)

(AD-A076975) Avail: NTIS HC A09/MF A01 CSCL 04/2

A feasibility study was conducted to determine whether the wind energy in the mountainous regions of New Hampshire could be used as a possible energy course for the Portsmouth Naval Shipyard in Portsmouth, New Hampshire. The results indicate that there is adequate wind energy available at mountain sites to drive even the largest wind turbine generators (WT's) now planned, and that many potential sites exist in relatively close proximity to utility lines. Eight specific sites were identified on the basis of available wind speed data, the incidence of severe icing, environmental constraints, plus on-site interpretation of vegetative deformation by the wind (tree flagging). Based on the experiences of this study there appears to be a limited number of available WT sites which have sufficient geographic extent to support large clusters (i.e., farms) of WT's of approximately 20-100 MW rating. Technically, the local utility can 'wheel' power to the Naval Shipyard from mountain sites, but doing so would not be cost-effective for the Shipyard because of an abundance of on-site, low-cost cogenerated electricity. A simple near-term approach to wind power development in New Hampshire appears to be through the private exploitation of WT clusters of less than 5 MW capacity on private land. GRA

N80-20869# Army Electronics Research and Development Command, Fort Monmouth, N. J. Electronics Technology/Devices Lab.

MILITARIZED THERMOELECTRIC POWER SOURCES

G. Guazzoni, A. Herchakowski, and J. Angello Jul. 1979 9 p refs

(DA Proj. 1L1-62705-AH-94)

(AD-A075609; DELET-TR-79-17)

Avail: NTIS

HC A02/MF A01 CSCL 10/2

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

Author (GRA)

N80-20870# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

COMPUTER SIMULATION OF A SOLAR ENERGY SYSTEM WHICH UTILIZES FLAT-PLATE COLLECTORS M.S. Thesis

Barry Eugene Prins Dec. 1979 102 p refs

(AD-A079906; AFIT/GAE/AA/79D-15)

Avail: NTIS

HC A06/MF A01 CSCL 10/2

This thesis is a computer simulation of a solar energy system that utilizes flat-plate solar collectors. By using available data from the U.S. Weather Bureau, the location and orientation of the collector, characteristics of the collector, and the type of storage and backup heat system in use, it is possible to find the amount of solar energy collected and transferred to storage. A life cycle cost analysis can be accomplished by using financial data and an inflation-discount function to reduce all costs to present year dollars. By varying any of a number of parameters the operator can determine what effect it has on the amount of energy collected and the life cycle costs. Results of running the program for a solar water heater system indicate that such a system is cost effective, when compared to a gas water heater system, only when the federal and state tax incentives were taken into account. However, electricity is approximately three times as expensive as gas per BTU of energy gained so the solar energy system is economically feasible when compared to an electric water heating system. GRA

N80-20873# Thermo Electron Corp., Waltham, Mass.

DOE/JPL ADVANCED THERMIONIC TECHNOLOGY PROGRAM Progress Report, Dec. 1978 - Jan. 1979

1979 63 p refs

(Contract EY-76-C-02-3056)

(COO-3056-37; PR-37) Avail: NTIS HC A04/MF A01

Continuing research on thermionic converters is described. Topics include thermionic converter plasma studies, low temperature converter development, component hardware development, and combustion-heated thermionic device. Basic surface experiments, tripole converter experiments, design of cylindrical converter, and high efficiency conversion experiments are described. DOE

N80-20874# Sandia Corp., Albuquerque, N. Mex. Advanced Energy Projects Div.

MECHANICAL ENERGY STORAGE TECHNOLOGY DEVELOPMENT Annual Report, 1978 - 1979

Sep. 1979 31 p refs

(Contract EY-76-C-04-0789)

(SAND-79-1151) Avail: NTIS HC A03/MF A01

Program efforts to evolve components for flywheel energy storage systems are described. Components discussed include: commercial wheels, bearings, and vacuum technology. R.E.S.

N80-20876# Burns and McDonnell, Kansas City, Mo.

FEASIBILITY OF COGENERATION APPLICATION OF A 4.8 MW FUEL CELL POWER PLANT AT A SANTA CLARA, CALIFORNIA PAPER MILL Final Report

D. E. Criner Jul. 1979 300 p refs

(Contract ET-78-C-03-2189)

(SAN-2189-T1; Rept-78-805-4-005)

Avail: NTIS

HC A13/MF A01

The feasibility of employing a 4.8-MW fuel cell power plant in a cogeneration mode was evaluated. Ways for utilizing the waste heat from the fuel cell within the paper mill were studied. Several uses were identified which would reduce the amount of process steam now generated by conventional fossil fuel boilers in the paper mill. The electrical energy from the fuel cell could be fed to the municipal electric system or could be used directly by the paper mill, depending upon the form of ownership for the fuel cell. Economic analyses were performed for several scenarios involving different fuels and ownership arrangements. Breakeven capital costs for the fuel cell power plant were computed for the various scenarios. Sensitivity studies were performed to determine the impact of variations in assumed base values for fuel price, electric rates, and other parameters. The environmental implications of the fuel cell power plant were also assessed. DOE

N80-20877# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.

ENERGY EFFICIENT BUILDINGS PROGRAM Annual Report

Aug. 1979 68 p refs

(Contract W-7405-eng-48)

(LBL-9576; EEB-79-5) Avail: NTIS HC A04/MF A01

Experimental and theoretical research into energy use in buildings, and the analysis of energy conservation strategies and measures are outlined. Topics discussed include: (1) building envelopes program; (2) ventilation program; (3) indoor air quality - gas stove emissions; (4) DOE-1 computer program for building energy analysis; (5) schools program; (6) hospitals program; (7) energy efficient windows program; (8) energy efficient lighting program; and (9) passive systems analysis and design. DOE

N80-20878# Argonne National Lab., Ill. Energy and Environmental Systems Div.

PROJECTIONS OF DIRECT ENERGY CONSUMPTION BY MODE: THE 1975 - 2000 BASELINE

Rita E. Knorr and Marianne Miller Aug. 1979 139 p refs

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

(ANL/CNSV-4) Avail: NTIS HC A07/MF A01

A comprehensive set of activity and energy-demand projections are presented for each of the major transportation modes and submodes. Projections were developed for a business-as-usual case which provides a benchmark for assessing the impact of potential conservation strategies. This baseline case assumes a continuation of present trends and no new energy-conserving programs beyond currently mandated fuel economy stands. However, because of anticipated changes in personal vehicle fuel economy, fuel prices, modal shifts, and a lower than historic rate of economic growth, projected growth rates in transportation activity and energy consumption depart from historic patterns. The factors responsible for this departure are discussed. The assumption and methodologies used to develop the modal projections are described and the projections are discussed with other efforts. DOE

N80-20879# Illinois Univ., Chicago. Dept. of Energy Engineering.

THERMAL FLUID SELECTION FOR LONG-DISTANCE HEAT TRANSMISSION

S. Szepe and J. M. Calm 1979 8 p refs Presented at the 14th Intersoc. Energy Conversion Conf., Boston, 5 Aug. 1979 Prepared in cooperation with Argonne National Lab., Ill. (Contract W-31-109-eng-38)

(CONF-790803-47) Avail: NTIS HC A02/MF A01

A model for evaluating fluids for long distance thermal energy transport is presented. The model uses power function approximations for physical and economical relations, and its simplified version provides analytical insights into the optimal allocation of major cost components as well as a solution for the total transmission cost. The model was used to develop a criterion for screening candidate liquids for long distance thermal energy transport. The criterion derived is dependent on the physical properties and unit costs of the candidate fluids, and on the transport requirements. It can be used for fast screening and ranking of a great number of fluids. This approach may save considerable effort by eliminating the need for detailed engineering, economic, environmental, and safety studies on those fluids which would ultimately prove economically undesirable. Representative fluids are discussed and compared with the reference case of transmission by hot water. DOE

N80-20880# Dubin-Bloome Associates, New York.

HEAT-PUMP-CENTERED INTEGRATED COMMUNITY ENERGY SYSTEMS: SYSTEM DEVELOPMENT Final Report

Fred S. Dubin, Paul Herzog, and Amos Halfon Aug. 1979 450 p refs

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

(ANL/CNSV-TM-8) Avail: NTIS HC A19/MF A01

The performance of heat-pump centered integrated community energy systems (HP-ICES) is reported for two case studies, one in Washington, D.C. and the other in Boston, Massachusetts. The ice-generating HP-ICES uses the heat of fusion of water as a heat source for the heat pump, thus converting the water into ice. The ice is stored in a bin and used the following summer for cooling, which, therefore, could be considered a byproduct of heating. The annual source energy input and the return on investment is cited for each project. The life cycle annual average cost and annual average operating and administration cost for the HP-ICES is given in comparison to corresponding quantities and costs of a conventional central system with equal heating and cooling capacity. DOE

N80-20881# Technical Information Center, Oak Ridge, Tenn. **ENERGY INFORMATION DATA BASE Report, Feb. 1978 - Sep. 1979**

Sep. 1979 124 p refs Supplement to TID-4579-R10

(DOE/TIC-4579-R10-Suppl-6) Avail: NTIS HC A06/MF A01

Changes and additions to TID-4579-R10 (the authority list for serial titles) are presented. The supplement is cumulative from February 1978. DOE

N80-20882# Midwest Research Inst., Golden, Colo.

CONVERSION SYSTEM OVERVIEW ASSESSMENT. VOLUME 1: SOLAR THERMOELECTRICS

T. S. Jayadev, J. Henderson, J. Finegold, and D. Benson Aug. 1979 214 p refs

(Contract EG-77-C-01-4042)

(SERI/TR-35-078-Vol-1) Avail: NTIS HC A10/MF A01

An assessment of thermoelectrics for solar energy conversion is given. There is significant potential for solar thermoelectrics in solar technologies where collector costs are low; e.g., Ocean Thermal Energy Conversion and solar ponds. Reports of two studies by manufacturers assessing the cost of thermoelectric generators in large scale production are included and several new concepts thermoelectric systems are presented. DOE

N80-20883# Midwest Research Inst., Golden, Colo.

WIND ENERGY INFORMATION DIRECTORY

Oct. 1979 30 p refs

(Contract EG-77-C-01-4042)

(SERI/SP-69-290) Avail: NTIS HC A03/MF A01

Wind Energy Information was prepared to provide researchers, designers, manufacturers, distributors, dealers, and users of wind energy conversion systems, with easy access to technical information. This directory lists organizations and publications which have the main objective of promoting the use of wind energy conversion systems, some organizations that can respond to requests for information on wind energy or make referrals to other sources of information, and some publications that occasionally include information on wind energy. DOE

N80-20884# Physical Sciences, Inc., Woburn, Mass.

PERFORMANCE MODEL FOR MOLTEN CARBONATE FUEL CELLS Final Report, 5 Jul. 1978 - 5 Jul. 1979

G. Wilemski, T. Wolf, D. Bloomfield, M. L. Finson, E. R. Pugh, and K. L. Wray Aug. 1979 171 p refs

(Contract ET-78-C-03-2083)

(TR-190) Avail: NTIS HC A06/MF A01

The development of a performance model for molten carbonate fuel cells is reported. Key physical and chemical phenomena modeled include mass transport, ohmic losses, electrode kinetics, fuel and oxidant utilization, gas phase convective heat transfer and in-plane heat conduction through cell hardware. Numerical schemes were developed and programmed to calculate overpotential versus current density curves for individual electrodes, current-voltage performance curves for entire cells, the cell current density distribution, and the cell temperature distribution. Agreement between model predictions and available experimental data for isothermal electrode and cell performance ranges from good to excellent. Predictions of nonisothermal cell performance are also presented and discussed. DOE

N80-20885# Energy and Environmental Analysis, Inc., Arlington, Va.

INDUSTRIAL SECTOR TECHNOLOGY USE MODEL (ISTUM): INDUSTRIAL ENERGY USE IN THE UNITED STATES, 1974 - 2000. VOLUME 2: RESULTS Final Report

Oct. 1979 117 p

(Contract EX-76-C-01-2344)

(DOE/FE-2344/2) Avail: NTIS HC A06/MF A01

The results of the initial base-case run of ISTUM are presented in four sections: (1) introduction; (2) projected trends in industrial fuel consumption; (3) projected contributions of technologies to the industrial sector (fossil, conservation, solar, geothermal, coal direct heat cogeneration, conventional technologies); and (4) service sector perspectives of ISTUM base-case results (steam sector, intermediate and dirty direct heat, coal-capable indirect heat, machine-drive service sector, electrolyte sector, space heat, not coal-capable indirect heat, calcining, glass melting, brick and clay firing, iron making, steel reheating). DOE

N80-20886# Brookhaven National Lab., Upton, N. Y.

HYDROGEN STORAGE FOR AUTOMOBILES

G. Strickland 1979 4 p refs Presented at the DOE Chem.

Energy Storage and Hydrogen Energy Systems Contracts Rev. Meeting, Reston, Va., 12 Nov. 1979

(Contract EY-76-C-02-0016)

(BNL-26906; CONF-791127-5)

Avail: NTIS

HC A02/MF A01

An analysis of hydrogen-fueled automobiles is presented. The hydrogen is stored either as a metal hydride at moderate pressure in TiFe-Mn-H/sub x/ and at low pressure in MgH/sub x/ catalyzed with 10 wt % Ni, or it is stored in hollow glass microspheres at pressures up to about 400 atm. Each system is briefly described. The results of the vehicle analysis are compared with those for the conventional automobile and with electric vehicles powered by Pb-acid or Ni-Zn batteries. Comparisons are made on the basis of automobile weight, initial user cost, and life-cycle cost. The results are limited to those for the 5-passenger vehicle in the period 1985-1990, and are provided as probable and optimistic values. DOE

N80-20887# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.

RESIDENTIAL SOLAR HEATING AND COOLING USING EVACUATED TUBE SOLAR COLLECTORS: CSN SOLAR

HOUSE 3 Final Report, 1 Feb. 1976 - 30 Sep. 1978

D. S. Ward, J. C. Ward, and H. S. Oberoi Mar. 1979 119 p refs

(Contract EY-76-S-02-2858)

(COO-2858-24-Summ) Avail: NTIS HC A06/MF A01

A residential solar heating and cooling system utilizing an array of evacuated tube solar collectors was evaluated. The evacuated tube collectors were removed and replaced with a state of the art liquid-heating flat plate solar collector array. The installation, performance, and operating experience of the evacuated tube solar collector integrated with the CSU Solar House 3 residential sized solar heating and cooling system was examined. DOE

N80-20888# General Atomic Co., San Diego, Calif.

INSTALLATION AND STARTUP OF THE FIXED MIRROR SOLAR CONCENTRATOR COLLECTOR FIELD SUBSYSTEM Final Report, 31 Jan. 1977 - 31 Mar. 1979

G. H. Eggers Jun. 1979 111 p refs

(Contract EY-76-C-04-0789)

(GA-A-15344; SAND-79-7015)

Avail: NTIS

HC A06/MF A01

The design, fabrication, installation, and startup of the fixed mirror solar concentrator is described. The total system cost was \$773 per m squared. The system cost projection for a commercial plant is \$188.73 per m squared. At design conditions, with the oil inlet temperature at 245 C and the oil outlet temperature at 316 C, the peak system efficiency at noon was 36.8%. DOE

N80-20889# Woodard-Clyde Consultants, San Francisco, Calif. Fossil Fuel and Advanced Systems Div.

ENVIRONMENTAL ASSESSMENT METHODOLOGY: SOLAR POWER PLANT APPLICATIONS. VOLUME 3. ENVIRONMENTAL IMPACT ASSESSMENT APPLICATION Final Report

K. Nair and A. Sichertman May 1979 112 p refs

(EPRI Proj. 551)

(EPRI-ER-1070-Vol-3) Avail: NTIS HC A06/MF A01

The environmental impact assessment methodology described in another volume is applied to a problem of site selection for solar thermal power plants. Environmental impact assessment of selected solar-thermal sites are compared. Certain potential impacts of solar-thermal and wind energy central systems are examined. In appendix A a data base system that was used to organize the literature on selected data base sites is described. Appendix B contains detailed calculations and preliminary data used in the environmental impact assessment. Appendix C presents a discussion of generic attributes for measuring biological impacts. Appendix D is a selected bibliography of general references dealing with environmental impacts of solar-thermal and wind energy central systems. DOE

N80-20890# California Univ., Berkeley, Lawrence Berkeley Lab. Energy and Environment Systems Div.

EVALUATION OF A SULFUR OXIDE CHEMICAL HEAT STORAGE PROCESS FOR A STEAM SOLAR ELECTRIC PLANT

Joshua Dayan, Scott Lynn, and Alan Foss Jul. 1979 198 p refs Revised

(Contract W-7405-eng-48)

(LBL-7868-Rev) Avail: NTIS HC A09/MF A01

A technically feasible process configuration was developed for the sulfur oxide system, 2 SO₃ reversible 2 SO₂ + O₂ in energy storage. Complete material and energy balances are presented for a base case that represents a middle range of expected operating conditions. Equipment sizes and costs were estimated for the base case to obtain an approximate value for the cost of the electricity that would be produced from such an installation. In addition, the sensitivity of the efficiency of the system to variations in design and operating conditions was determined for the most important parameters and design details. The overall efficiency of converting heat into electricity is about 26%. DOE

N80-20891# Sandia Labs., Albuquerque, N. Mex.

DARRIEUS VERTICAL AXIS WIND TURBINE PROGRAM OVERVIEW

Richard H. Braasch 1979 15 p refs Presented at the 4th Biennial Conf. and Workshop on Wind Energy Conversion Systems, Washington, D.C., 28 Oct. 1979

(Contracts EY-76-C-04-0789; DE-AC04-76DP00789)

(SAND-79-2146C; CONF-791097-1)

Avail: NTIS

HC A02/MF A01

Some of the more salient recent developments in the Darrieus vertical axis wind turbine technology are presented. First generation costs and future plans are discussed. Potential design improvements are presented along with their cost benefits. Aerodynamic structural, and system analyses capabilities were developed to support and evaluate the system design. DOE

N80-20892# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

WIND ENERGY SYSTEMS Quarterly Review, 1 Jul. - 30 Sep. 1979

Dec. 1979 176 p

(Contract EG-77-C-01-4042)

(SERI/PR-351-480) Avail: NTIS HC A09/MF A01

An overview of the wind energy systems (WES) program is presented. The objectives, accomplishments, activities, and outputs of each of the tasks in the WES program are described. DOE

N80-20893# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

OPTICAL ANALYSIS AND OPTIMIZATION OF LINE FOCUS COLLECTORS

P. Bendt, A. Rabl, H. W. Gaul, and K. A. Reed Sep. 1979 73 p refs

(Contract EG-77-C-01-4042)

(SERI/TR-34-092) Avail: NTIS HC A04/MF A01

A macroscopic approach to the optical analysis of a solar concentrator is described. The method yields all the parameters needed for the optical design of line focus parabolic troughs. The flux at the receiver is determined as a function of concentrator along with receiver size, width of Sun, and optical errors. All causes of image spreading are quantified as angular standard deviation. Ray tracing with a real reflector and a real Sun is shown to be equivalent to convoluting the angular acceptance function of a perfect concentrator with an effective radiation source. This effective source, in turn, is obtained by convoluting the distribution function of optical errors with the angular profile of the Sun. The problem is reduced to two dimensions by projecting the three dimensional motion of the Sun on the plane normal to the tracking axis. In this frame the apparent width of the Sun increases with incidence angle. A formula and a simple graphical procedure are provided for finding the optimal geometric concentration ratio, maximizing net power output. The results are illustrated by specific examples. DOE

N80-20894# TRW, Inc., McLean, Va. Energy Systems Group.

THERMAL ENERGY STORAGE APPLICATION AREAS

Mar. 1979 105 p

(Contract EC-77-C-01-5113)

(CONS/5113-T4) Avail: NTIS HC A06/MF A01

The use of thermal energy storage in the areas of building heating and cooling, recovery of industrial process and waste heat, solar power generation, and off-peak storage and load management in electric utilities is reviewed. DOE

N80-20895# Center for Legislative Improvement, Denver, Colo. ENERGY SOURCE BOOK

Dewitt John and Davey Klearman Aug. 1979 167 p

(Contract EW-78-X-48-0409)

(DOE/TIC-10190) Avail: NTIS HC A08/MF A01

Data are compiled on energy sources for the Rocky Mountain Region. The National Energy Act, major Federal energy legislation, and the state energy legislation, 1974-1979, are covered. Energy consumption and conservation are discussed with the aid of charts and statistics. Topics discussed include potential for energy conservation in the Mountain-Plain States; potential energy savings from Weatherization; residential energy conserva-

tion programs; and thermal efficiency standards for new buildings; energy reserves and production by state: oil, gas, coal, and uranium; potential for energy production from renewable and non-conventional sources; oil refining capacity; pipelines and movement of petroleum; electrical generation; water requirements for energy production; and severance taxes in the Mountain-Plain States. Information sources and a glossary are provided. DOE

N80-20896# Brookhaven National Lab., Upton, N. Y.
PERFORMANCE OF HEAT PUMPS AT ELEVATED EVAPORATING TEMPERATURES WITH APPLICATION TO SOLAR INPUT

E. A. Kush 1979 9 p refs Presented at the ASME Ann. Meeting, New York, 3-7 Dec. 1979
 (BNL-26772; CONF-791205-15) Avail: NTIS HC A02/MF A01

The performance of the heat pump component in the solar-assisted heat pump (SAHP) system was investigated under conditions attendant to series solar input. Theoretical predictions, results of systematic experiments run on a special heat pump simulator, and interpretation/analysis of how high coefficients of performance heat pumps can be used in installed SAHP systems are presented. DOE

N80-20897# Los Alamos Scientific Lab., N. Mex.
THE 1-GWh DIURNAL LOAD-LEVELING SUPERCONDUCTING MAGNETIC ENERGY STORAGE SYSTEM REFERENCE DESIGN. APPENDIX C: DEWAR AND STRUCTURAL SUPPORT

J. G. Bennett and F. D. Ju Sep. 1979 56 p refs
 (Contract W-7405-eng-36)
 (LA-7885-MS-Vol-6) Avail: NTIS HC A04/MF A01

The mechanical aspects of the dewar to contain a 1-GWh superconducting coil in a 1.8 K helium bath are discussed along with the means for supporting the coil and dewar against the rock of an underground excavation. DOE

N80-20898# Oak Ridge National Lab., Tenn.
PERSPECTIVE ON WORLD ENERGY

Truman D. Anderson 25 Sep. 1979 25 p
 (Contract W-7405-eng-26)
 (DOE/TIC-10273) Avail: NTIS HC A02/MF A01

The problems associated with a rapidly increasing world population in the midst of fixed land resources are addressed. The unconventional resources of oil, gas, and uranium are compared in terms of abundance to conventional reserves. Nuclear fission energy is evaluated for its capability of solely supporting the world energy demands. DOE

N80-20899# Spectrolab, Inc., Sylmar, Calif.
DESIGN AND FABRICATION OF PROTOTYPE COMBINED PHOTOVOLTAIC/THERMAL NON-TRACKING COLLECTOR

H. Jandorf, L. Flourswetz, and F. M. Schwartz Jun. 1979 56 p
 (Contract EY-76-C-04-0789)
 (SAND-79-7014) Avail: NTIS HC A04/MF A01

Work performed to design, fabricate, test and analyze future production costs of a combined photovoltaic/thermal collector is summarized. Design improvement recommendations and future applications of the combined collector are considered. DOE

N80-20900# Wisconsin Univ. - Madison.
INTERFEROMETRIC STUDY OF THE NATURAL CONVECTION CHARACTERISTICS OF FLAT PLATE, SLAT AND VEE-CORRUGATED SOLAR COLLECTORS Final Report

M. M. ElWakil and J. W. Mitchell 30 Jun. 1979 7 p
 (Contract EY-76-S-02-2971)
 (COO-2971-6) Avail: NTIS HC A02/MF A01

The natural convection heat transfer relations for the heat transfer between absorber and cover plates of solar collectors were studied. Interferometric techniques were employed to evaluate the local coefficients. Average values were obtained by integration of the local values. The results are presented in terms of correlations between Nusselt number and Grashof number. The investigations were carried out over tilt angles of 45 to 90 degrees. The Grashof number range tested was representative

of that existing in flat plate collectors. The various geometrics included large flat enclosures, small aspect ratio enclosures representative of honeycomb or slat collectors, vee-corrugated uranium; potential for energy production from renewable and (vee-grooved) collectors, and compound parabolic concentrators. DOE

N80-20901# California Univ., Berkeley, Lawrence Berkeley Lab.

METHODOLOGY FOR EVALUATING PHYSICAL CONSTRAINTS ON RESIDENTIAL SOLAR ENERGY USE

P. L. Smith and S. T. McCreary 1979 73 p refs
 (Contract W-7405-eng-48)

(UCRL-15001) Avail: NTIS HC A04/MF A01

A procedure is set forth for assessing physical constraints on solar energy use at the site scale and for computerized findings as a data base for analysis at the community, sub-community, and individual parcel scales. Background information regarding the development of the project is presented. Next, the solar technologies being considered, their requirements for optimal performance, and physical constraints on the achievement of those requirements are described. This theoretical discussion is followed by a description of its application to a case study community. A discussion of the types of analyses in which the computerized data can be used is followed by a discussion of the way in which these analyses can be used at various points in governmental and private planning and decision-making processes. DOE

N80-20902# Mitre Corp., McLean, Va.
STATUS OF THE DOE BATTERY AND ELECTROCHEMICAL TECHNOLOGY PROGRAM

R. Roberts Sep. 1979 177 p refs
 (Contract ET-78-C-01-3295)

(MTR-8026) Avail: NTIS HC A09/MF A01

Research on electrochemical storage systems is reviewed with emphasis on secondary batteries. Batteries in the research, development, and demonstration phases include nickel/iron, lithium/metal sulfide, zinc/chloride, metal/air, and hydrogen/chlorine. Supporting research on the morphology of active materials and cell performance is also reviewed. Potential contributions of the battery program to electric vehicles, photovoltaic systems, distributed electrical systems, and industrial energy conservation are discussed. K.L.

N80-20903# Battelle Pacific Northwest Labs., Richland, Wash.
ECONOMICS OF THERMAL ENERGY STORAGE FOR COMPRESSED AIR ENERGY STORAGE SYSTEMS

S. C. Schulte Aug. 1979 8 p refs
 (Contract EY-76-C-06-1830)

(PNL-SA-7949) Avail: NTIS HC A02/MF A01

The costs of compressed air energy storage (CAES) systems utilizing thermal energy storage are compared with the costs of conventional CAES systems and combustion gas turbine systems. Comparisons are made on the basis of system energy cost leveled over system operating lifetime (mills/kWh). Two principal conclusions resulted from the study. First, given today's fuel prices and the expected fuel prices in the 1980's, conventional CAES systems yield lower energy cost estimates than combustion gas turbine systems. Second, thermal energy system storage/adiabatic CAES systems yield equivalent and, in some instances, slightly lower energy cost estimates than conventional CAES systems while requiring considerably less turbine fuel oil. DOE

N80-20904# Battelle Pacific Northwest Labs., Richland, Wash.
ECONOMICS OF COMPRESSED AIR ENERGY STORAGE EMPLOYING THERMAL ENERGY STORAGE

S. C. Schulte and R. W. Reilly Nov. 1979 34 p refs
 (Contract EY-76-C-06-1830)

(PNL-3191) Avail: NTIS HC A03/MF A01

System design and capital cost estimates are adopted from three independent studies to arrive at a series of leveled energy costs over a system's lifetime. In addition, some analyses are provided to gauge the sensitivity of these leveled energy costs to fuel and compression energy costs and to system capacity

factors. The systems chosen for comparison are conventional CAES, hybrid CAES, adiabatic CAES, and an advanced-design gas turbine. In conventional CAES systems the heat of compression generated during the storage operation is rejected to the environment, and later, during the energy generation phase, turbine fuel must be burned to reheat the compressed air. In the hybrid systems some of the heat of compression is stored and reapplied later during the generation phase, thereby reducing turbine fuel requirements. The adiabatic systems store adequate thermal energy to eliminate the need for turbine fuel entirely. The gas turbine is included within the report for comparison purposes.

DOE

N80-20905# Department of Energy, Washington, D. C.
BIOMASS ENERGY SYSTEMS: ENVIRONMENTAL READINESS DOCUMENT

Sep. 1979 50 p

(DOE/ERD-0021) Avail: NTIS HC A03/MF A01

A number of environmental and socio-economic impacts of biomass energy systems are identified. The large land and water requirements for terrestrial biomass energy production might lead to socio-economic conflicts. It might also lead to an increase in potential for air and water erosion of the soil. Severe ecosystems impacts would result from disturbing 100 million acres of marginal farm land and 350 million acres of forest land. Removal of residues could increase nutrient removal and reduce the amount of organic matter returning to the soil and limit future biomass production. Air pollution from the direct combustion of biomass must be considered. The systems of ethanol with stillage is dependent on the feedstock. The energy costs to purify the ethanol and pollution control costs appear to prevent economical production of ethanol in the near term.

DOE

N80-20907# Oak Ridge Associated Universities, Tenn. Inst. for Energy Analysis.

LIMITS TO ENERGY MODELING

A. M. Weinberg Sep. 1979 19 p refs

(Contract EY-76-C-05-0033)

(ORAU-IEA-79-16(0)) Avail: NTIS HC A02/MF A01

The limitations of energy modeling are described. Possible approaches to energy policy that avoid the necessity of depending on uncertain predictions are discussed.

R.E.S.

N80-20908# Stanford Univ., Calif. Dept. of Operations Research.

DETERMINING THE FEASIBILITY OF INCORPORATING WATER RESOURCE CONSTRAINTS INTO ENERGY MODELS Final Report

N. Buras Aug. 1979 132 p refs Sponsored by Elec. Power Res. Inst.

(EPRI-EA-1147) Avail: NTIS HC A07/MF A01

The availability of regional water resources for energy related activities is discussed in terms of the feasibility of integrating these availabilities into energy models. Following reviews of water resources data bases, of technologies involved in energy development, and of energy models with regional disaggregation, two models are used for the study of this integration: the Regional Energy System Optimization Model (RESOM), and the Energy Policy Model (EPM). Water resources constraints are introduced in these models, and exploratory computer runs using demonstration scenarios are made. The test scenarios assumed that nonenergy users would make increasing demands upon regional water resources, leaving limited amounts of increasingly more expensive water for energy activities. The results of the exploratory runs demonstrate the feasibility of integrating water resources availabilities and water consumption data into energy-economy models.

DOE

N80-20909*# Paragon Pacific, Inc., El Segundo, Calif.
WIND ENERGY SYSTEM TIME-DOMAIN (WEST) ANALYZERS USING HYBRID SIMULATION TECHNIQUES Final Report

John A. Hoffman Oct. 1979 30 p refs Prepared for NASA and DOE

(Contracts DEN3-26)

(NASA-CR-159737; PPI-1030-6; DOE/NASA/0026-79/1) Avail: NTIS HC A03/MF A01 CSCL 10B

Two stand-alone analyzers constructed for real time simulation of the complex dynamic characteristics of horizontal-axis wind energy systems are described. Mathematical models for an aeroelastic rotor, including nonlinear aerodynamic and elastic loads, are implemented with high speed digital and analog circuitry. Models for elastic supports, a power train, a control system, and a rotor gimbal system are also included. Limited correlation efforts show good comparisons between results produced by the analyzers and results produced by a large digital simulation. The digital simulation results correlate well with test data. K.L.

N80-20910# National Technical Information Service, Springfield, Va.

SOLAR WATER PUMPS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Nov. 1979

Audrey S. Hundemann Dec. 1979 71 p Supersedes NTIS/PS-78/1288; NTIS/PS-77/1161

(PB80-802531; NTIS/PS-78/1288; NTIS/PS-77/1161) Avail: NTIS HC \$30.00/MF \$30.00 CSCL 02C

Design concepts and the technical and economic feasibility of using solar energy to pump water are discussed in abstracts from worldwide literature. Topic areas cover the use of solar heat actuated Rankine cycle engines and free cylinder Stirling engines for solar powered water pumps, pumps driven by photovoltaic modules, and application of solar pumps to irrigation and electric power generation. This updated bibliography contains 85 abstracts, 25 of which are new entries to the previous edition.

GRA

N80-20911# General Accounting Office, Washington, D. C. Energy and Minerals Div.

HOW TO BURN COAL EFFICIENTLY AND ECONOMICALLY, AND MEET AIR POLLUTION REQUIREMENTS: THE FLUIDIZED-BED COMBUSTION PROCESS

9 Nov. 1979 56 p

(PB80-107501; EMD-80-12) Avail: NTIS HC A04/MF A01 CSCL 13B

The Department of Energy's program to demonstrate fluidized bed coal combustion are presented as well as ways the program could be improved. It specifically recommends that the Secretary of Energy: (1) enter into an interagency agreement with the Department of Defense to place industrial demonstration plants in Defense industrial facilities; and (2) enter into an interagency agreement with the Tennessee Valley Authority for hosting the 200-megawatt utility demonstration plant. The questionable need and utility of a component test and integration unit are discussed and options for terminating the contractor and selling or modifying the facility for other uses are suggested.

GRA

N80-20912# Cedar Associates, Evanston, Ill.
SNOW AND ICE ACCUMULATION AT SOLAR COLLECTOR INSTALLATIONS IN THE CHICAGO METROPOLITAN AREA Final Report

Ross B. Corotis, Charles H. Dowding, and Edwin C. Rossow Aug. 1979 109 p Sponsored in part by DOE, Washington, D.C.

(PB80-113749; NBS-GCR-79-181) Avail: NTIS HC A06/MF A01 CSCL 10A

Observations and data concerning snow and ice on eighteen flat plate solar collector installations in the Chicago area are presented. The data were collected in February and March of 1979, following a record snowfall in January. Nearly all of the installations were on the roofs of buildings, and about half were mounted flush with the roof. The remainder were mounted on racks at an angle to the roof. Sketches and photographs of the buildings and snow accumulation, weather data for the entire winter, and comments of the owners are included, as well as a technique for the extraction of linear measurements from the photographs.

GRA

N80-20913# New Mexico Univ., Albuquerque. Dept. of Physics.

SOLAR PONDS FOR RESIDENTIAL HEATING, HEAT EXTRACTION FROM A SALT GRADIENT SOLAR POND

Final Report, 19 Aug. 1976 - 30 Jun. 1977

F. Zangrando and H. C. Bryant Jul. 1979 41 p refs Sponsored in part by New Mexico Energy and Minerals Dept., Santa Fe (PB80-108624; NMEI-45) Avail: NTIS HC A03/MF A01 CSCL 10A

A salt gradient solar pond is an efficient, low cost solar energy collection and long range storage system for low temperature heat. Research efforts to establish operational parameters, selection criteria for the materials to be used, cost and performance are described. The physical behavior of doubly diffusive systems exposed to the environment was also studied.

GRA

N80-20914# New Mexico Energy Inst., Las Cruces. Mechanical Engineering Dept.

AN ECONOMICAL SOLAR HEATED AND COOLED RESIDENCE FOR SOUTHERN NEW MEXICO Final Report, 1 Sep. 1976 - 31 Aug. 1979

Thomas R. Mancini and Phillip R. Smith Jul. 1979 51 p refs (PB80-108616; NMEI-16) Avail: NTIS HC A04/MF A01 CSCL 13A

The construction and performance of 'Skytherm' solar heated and cooled passive house located on the campus of New Mexico State University in Las Cruces, New Mexico are described. GRA

N80-20915# National Zoological Park, Washington, D.C.

NATIONAL SOLAR HEATING AND COOLING PROGRAMS Aug. 1979 64 p refs Presented at the Intern. Solar Energy Society Congress, Atlanta, 28 May - 1 Jun. 1979

(Contract DE-AC01-79CS-30108) (PB80-104987; CCMS-109) Avail: NTIS HC A04/MF A01 CSCL 13A

Status reports on the national solar heating and cooling programs of seventeen countries participating in the Committee on the Challenges of Modern Society's Solar Energy Pilot Study are presented. R.E.S.

N80-20920*# National Aeronautics and Space Administration, Washington, D. C.

A GLOBAL BIOGEOCENOTICAL BIOSPHERE SIMULATION

N. N. Moiseyev Mar. 1980 12 p refs Transl. into ENGLISH from Biogeofiz. i Mate. Metody Issled. Geosistem (Moscow), 1978 p 37-49 Transl. by Kanner (Leo) Associates, Redwood City, Calif. (NASA-TM-76042) Avail: NTIS HC A02/MF A01 CSCL 13B

This model of the D. Forrester type, constructed in differential equations, predicts the food and mineral supply for the factors biosphere population, depending on two socio-economic factors, until about the year 2500. If contemporary rates of natural resources utilization are maintained and there is no management of the environment, food resources will begin to limit human population growth after 2200, and mineral resources will after 2300. A decrease in the biosphere pollution, increase in effective agricultural production, and discovery of new energy sources may forestall or completely avert the onset of a crisis situation. Conservation measures, according to the model, are to a considerable extent realizable only if carried out simultaneously in both areas. Author

N80-20921# Department of Energy, Washington, D. C. **ENVIRONMENTAL DEVELOPMENT PLAN: COAL EXTRACTION AND PREPARATION**

Sep. 1979 98 p refs (DOE/EDP-0050) Avail: NTIS HC A05/MF A01

The environmental strategy to be used by DOE to resolve environmental concerns associated with coal extraction and preparation will be to: (1) schedule environmental research in coordination with the development of the technology through its research, development and demonstration phases; (2) identify what environmental research is already underway; (3) provide for an Environmental Coordination Committee to ensure that the appropriate research is conducted in a timely manner; (4) schedule

compliance activities, such as National Environmental Policy Act (NEPA) documents and Environmental Readiness Documents (ERD's) at appropriate times in the RD and D cycle; and (5) develop a monitoring approach to track the compliance of each technology with applicable Federal, State and local standards and with the performance goals established for that technology. The initial evaluation of the coal extraction and preparation program indicates that the demonstrations of technologies in the program will be undertaken within existing industrial mining/preparation facilities and therefore will not present significant identifiable impacts. Project-specific Environmental Assessment or Impact Statements will be made on a project specific basis. Even so, assessments must be made prior to the employment of program elements. DOE

N80-20922# Department of Energy, Washington, D. C. **ENVIRONMENTAL DEVELOPMENT PLAN FOR SPACE APPLICATIONS**

Sep. 1979 83 p refs (DOE/EDP-0057) Avail: NTIS HC A05/MF A01

The planning and management requirements and schedules needed to evaluate and assess the environmental, health, and safety aspects of the Space Applications Program are identified. Environment is defined in its broadest sense to include environmental, health (occupational and public), safety, socioeconomic, legal, and institutional aspects. Topics considered include: (1) space nuclear power system nuclear fuel fabrication; (2) space nuclear power system heat source fabrication; (3) testing of subsystems and assembled systems; (4) research and development in support of space nuclear system development; (5) nuclear system responses to launch and reentry accidents; and (6) nuclear system environmental behavior and recovery. DOE

N80-20926# Woodard-Clyde Consultants, San Francisco, Calif. **ENVIRONMENTAL ASSESSMENT METHODOLOGY: SOLAR POWER PLANT APPLICATIONS. VOLUME 1. ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY** Final Report

K. Nair and A. Sicherman May 1979 161 p refs (EPRI Proj. 551) (EPRI-ER-1070-Vol-1) Avail: NTIS HC A08/MF A01

A methodology for environmental impact assessment of solar power stations based on decision analysis is presented. A general overview of the methodology is given including a discussion of the issues warranting a formal analysis, the advantages of decision analysis from the decision maker's perspective, and some case study examples where the methodology was applied. The step-by-step implementation procedure for performing an environmental impact assessment using the methodology is described. The manner in which the methodology can incorporate cost into the analysis, both as a concern and as a yardstick of comparison, is discussed. Decision analysis and cost-benefit analysis are compared and contrasted. The appendix includes a bibliography concerning methods used by industry and/or government to make monetary estimates of environmental impacts. DOE

N80-20929# Energy and Environmental Analysis, Inc., Arlington, Va.

ADEQUACY ANALYSIS OF AIR QUALITY MONITORING ACTIVITIES RELEVANT TO CALIFORNIA THERMAL ENHANCED OIL RECOVERY FIELDS

Judy Matthews and J. Thomasian Nov. 1979 139 p refs (Contract ET-78-C-01-3092) (SAN-12093-1) Avail: NTIS HC A07/MF A01

A summary of enhanced oil recovery (EOR) activities in California is presented. Ambient air monitoring requirements are discussed in terms of state and Federal regulations. In addition, ambient air quality monitoring in California is considered with emphasis on specific monitoring requirements for new source regulation. An inventory of California EOR air quality monitoring activity is given and the adequacy of the air monitoring activity in the California EOR fields is discussed. DOE

N80-20930# Brookhaven National Lab., Upton, N. Y. **COAL-CONVERSION TECHNOLOGIES: SOME HEALTH**

AND ENVIRONMENTAL EFFECTS

S. C. Morris, P. D. Moskowitz, W. A. Sevia, S. Silberstein, and L. D. Hamilton, Feb. 1979 27 p refs
(Contract EY-76-C-02-0016)

(BNL-5103; TID-4500) Avail: NTIS HC A03/MF A01

Selected health and environmental concerns of four coal conversion and four existing technologies are compared. Quantitative occupational health and safety estimates are presented covering extraction, transportation, distribution, processing, and conversion activities; also included are estimates of public health damage arising from fuel transportation and air pollution impacts. Qualitative estimates of health damage due to polycyclic organic matter and reduced sulfur are discussed. In general, energy inefficiencies, residuals, and implied environmental and health damages increase as follows: (1) direct combustion of natural gas and oil; (2) direct combustion of synthetic gas and oil; (3) central station electric power from synthetic gas; (4) central station electric power from coal; and (5) central station electric power from combustion of synthetic liquid fuels. Compliance and conflict of these technologies with Clean Air Act Amendments and other legislation are discussed. DOE

N80-20945# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.

LIGHT-DUTY DIESEL GASEOUS EMISSIONS MEASUREMENT - COMPARISON OF DILUTION TUNNEL TEST RESULTS TO CERTIFICATION CELL TEST RESULTS

Jeff Alson Jan. 1979 13 p

(PB80-115991; SDSB-79/04) Avail: NTIS HC A02/MF A01 CSCL 13B

Gaseous emissions data are summarized for eleven light-duty diesel vehicles using both the standard certification test procedure and the dilution tunnel test procedure which incorporates particulate measurement. The greatest variability was found in the HC variability inherent in measuring HC and, in the extreme cases, also to equipment inconsistencies between the test cells. CO, NOx and CO2 data from the dilution tunnel test procedure were generally in good agreement with the certification data with the only trend being slightly lower NOx and CO2 values from the dilution tunnel. This is hypothesized as a possible dynamometer effect. It is concluded that there are no significant differences in the two test procedures with regards to the measurement of gaseous emissions. GRA

N80-20949# Land-Air, Inc., Holloman, N. Mex. Applied Research Div.

CONTROL TECHNOLOGIES FOR PARTICULATE AND TAR EMISSIONS FROM COAL CONVERTERS

C. Chen, C. Koralek, and L. Breitstein Jul. 1979 115 p refs
(Contract EPA-68-02-2601)

(PB80-108392; EPA-600/7-79-170) Avail: NTIS HC A06/MF A01 CSCL 13B

Solid and tar particulate emissions in raw product gases from several types of coal gasifiers are characterized in terms of their total quantities, chemical composition, and size distribution. Control technologies for particulate emissions were assessed with respect to the limitations of the control device and to existing and proposed regulations. Fabric filters were not suitable where tar particulates were found or at higher than 300 C. Electrostatic precipitators operated as high as 1100 C. Rotary cyclones showed the widest range of applicability, but conventional cyclones were most economical for particles larger than 50 microns. Solid and tar particulate emissions collected for 250,000 scfd of a medium-Btu gas contained up to 1.6 million kg of particulate. GRA

N80-20950# Land-Air, Inc., Holloman, N. Mex. Applied Research Div.

HOT GAS CLEANUP PROCESS Final Report, Jan. 1977 - Mar. 1979

A. Bekir Onursal Jul. 1979 155 p refs

(Contract EPA-68-02-2601)

(PB80-108467; EPA-600/7-79-169) Avail: NTIS HC A08/MF A01 CSCL 13B

The results of a study to identify and classify 22 hot gas cleanup (HGC) processes for desulfurizing reducing gases at above 430 C according to absorbent type into groups employing solid, molten salt, and molten metal absorbents are presented. Each process is described in terms of its status, chemistry, operating characteristics, problems, and uncertainties. The applicability of non HGC processes to a variety of coal gasification systems for several end uses for the product gases is assessed. Advantages and disadvantages of HGC relative to conventional low temperature cleanup systems with respect to thermal efficiency, the presence and/or emissions of tars, particulates, and NOx, and corrosion are described. GRA

N80-20973# Battelle Columbus Labs., Ohio.
CHARACTERIZATION AND ANALYSIS OF DEVONIAN SHALES AS RELATED TO RELEASE OF GASEOUS HYDROCARBONS Quarterly Progress Report, Jan. - Mar. 1979

R. S. Kalyoncu, J. P. Boyer, and M. J. Snyder 15 Apr. 1979 240 p

(Contract EY-76-C-05-5205)

(ORO-5205-10) Avail: NTIS HC A11/MF A01

This program has the objective of determining the relationships between the shale characteristics, hydrocarbon gas contents, and well location, and thereby provide a sound basis for (1) assessing the productive capacity of the Eastern Devonian Gas Shale deposits and (2) guiding research, development, and demonstration projects to enhance the recovery of natural gas from the shale deposits. The Y-1 well in Allegany County, New York was sampled in September 1978. 412 samples were collected from the Allegany County, New York well. Characterization data on Y-1 (EGSP New York No. 1), Allegany County, New York well is reported and discussed. Analysis of the hydrocarbon gases in Y-1 samples indicates that the longer chain hydrocarbon gases (ethane, propane, butane) in these shales are significantly higher than in previous wells. The carbon contents of the Y-1 (Allegany County, New York) well, on the other hand, are somewhat lower than predicted from the hydrocarbon gas contents. There is still a positive relationship between the carbon and hydrocarbon gas contents, however. A similar relationship is also apparent between the sulfur and hydrocarbon gas contents. No unusual trends are observed in the porosity values, and a reasonable agreement exists between the measured Hg-intrusion values and those calculated from the density data. Higher porosity values are associated with low bulk densities. From limited lithological observations New York shales exhibit variable clay, mineral, and quartz contents. Generally, low levels of pyrite and carbonate minerals are observed. The low pyrite and carbonate contents noted in the powder examination of the samples are supported by the EDAX results showing low Ca and S contents. DOE

N80-20993# Sandia Labs., Albuquerque, N. Mex. Environmental Research Div.

WIND CHARACTERISTICS FOR FIELD TESTING OF WIND CONVERSION SYSTEMS

Robert E. Akins Nov. 1979 55 p refs

(Contract EY-76-C-04-0789)

(SAND-78-1563) Avail: NTIS HC A04/MF A01

Techniques are presented to determine placement of instrumentation to be used in measurement of wind characteristics for field testing of wind energy conversion systems (WECS). Potential errors in the measurement of a reference wind velocity as a result of physical separation between an anemometer and a WECS and interference between the WECS and the reference anemometer are outlined. Methods of correcting errors caused by both of these sources are developed. DOE

N80-21149 Illinois Univ. at Chicago Circle, Chicago.
NONIDEAL COMPENSATION IN MHD GENERATORS Ph.D. Thesis

David A. Carl 1979 274 p

Avail: Univ. Microfilms Order No. 8009457

Nonideal compensation, the distortion of the total magnetic flux density by the induced magnetic flux density despite the presence of compensating bus bars, was examined with one

and two dimensional models. The conducting fluid was assumed to be an incompressible liquid at a constant velocity. The iterative solution technique used in both models consisted of iterating between an equivalent circuit model that solves for the air gap current distribution, given the total magnetic flux density distribution, and a magnetic field model that solves for the total magnetic flux density distribution, given the air gap current distribution. End loss was modeled by a shunt resistance. The one dimensional model was intended to indicate general trends. The two dimensional model was intended to provide a more detailed analysis. Dissert. Abstr.

N80-21160# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
DEVELOPMENT, TESTING AND EVALUATION OF MHD MATERIALS AND COMPONENTS DESIGNS Quarterly Report, Jul. - Sep. 1978
 John W. Sadler, J. Bein, and D. L. Black Dec. 1978 94 p refs

(Contract EX-76-C-01-2248)
 (FE-2248-22) Avail: NTIS HC A05/MF A01

Laboratory screening tests, including electrochemical corrosion and anode arc erosion tests, are reported. Results of electrochemical tests are presented which imply that for MHD channels operating under liquid slagging wall conditions the deleterious reactions with slag, presently recognized as limiting channel operation, metallic Fe formation at the cathode, and O₂ gas release and cavitation at the anode, can be prevented with the use of ionic oxide electrodes. Initial results of investigations of arc impingement damage to selected metallic anode materials over the temperature range of 185 C to 650 C are presented. DOE

N80-21165# Department of Energy, Washington, D. C. Office of Fusion Energy.

FUSION TECHNOLOGY DEVELOPMENT

Aug. 1979 151 p refs
 (DOE/ET-0116/1) Avail: NTIS HC A08/MF A01
 Conceptual design studies of fusion energy and fusion reactors are presented. The magnetics of fusion reactors are discussed with an overview of a large coil program included. Plasma heating, fueling, and exhaust systems for the reactors are described and research on materials for fusion reactors is discussed. A.W.H.

N80-21166# Argonne National Lab., Ill.

ADVANCES IN MHD TECHNOLOGY

M. Petrick, R. V. Shanklin, III (DOE, Washington, D.C.), and G. Rudins (DOE, Washington, D.C.) 1979 52 p refs Presented at the Advances in Coal Util. Symp., Louisville, Ky., 14-15 May 1979

(Contract W-31-109-eng-38)
 (CONF-790598-5) Avail: NTIS HC A04/MF A01
 The operation of magnetohydrodynamic (MHD) generators is discussed. The thermodynamic and economic potential, the technical status and recent advances, and the environmental issues associated with MHD power plants are examined. A national program for developing MHD conversion is described and experimental MHD generator operations in the U.S. and U.S.S.R. are reported. A.W.H.

N80-21197# Real Estate Research Corp., Chicago, Ill.
MARKETING AND MARKET ACCEPTANCE DATA FROM THE RESIDENTIAL SOLAR DEMONSTRATION PROGRAM. VOLUME 1: DETAILED ANALYSIS, AUTUMN 1979

1979 218 p refs Sponsored in part by HUD
 (PB80-115298; HUD-0050579) Avail: NTIS HC A10/MF A01 CSCL 05C

The marketing and market acceptance components of HUD's residential solar heating and cooling demonstration program, designed to promote the development of a self-sustaining solar energy industry, are analyzed. The actual experiences of actors and institutions involved in the market acceptance of solar houses are described. Emerging trends in the characteristics, opinions, and actions of participants in the demonstration program are identified and explored. All findings are based on marketing interviews with program participants, with a market acceptance

model used to guide analysis. Practical information relevant to the construction industry and solar manufacturers is emphasized. GRA

N80-21198# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

GEOHERMAL ENERGY MARKET PENETRATION: DEVELOPMENT OF A MODEL FOR THE RESIDENTIAL SECTION

Allen C. Goodman Sep. 1979 34 p refs
 (Contracts EX-76-A-36-1008; DE-A101-79ET-27025)
 (PB80-118359; APL/JHU-QM-79-209; APL/JHU-GEMS-006; MCGER-79/003) Avail: NTIS HC A03/MF A01 CSCL 05C

A model was developed that examines the feasibility of using geothermal technology in heating residential structures. Specific account is taken of the small contribution of new housing to the total stock in any given year and of the durability of houses and their furnaces. Both aspects constrain the penetration of geothermal energy into the residential market. Other market penetration paradigms are discussed and a simple model of market penetration is presented that is based on the premise that homeowners will not abandon an existing furnace until its economic life is over. Behavioral parameters are considered and the model is extended from 20 to 40 years. Methods are discussed for collecting the needed data to determine market penetration, and ideas are proposed of ways to induce homeowners to give up economically viable furnaces to allow the firm providing the energy to reduce costs. GRA

N80-21200*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SUPPORTING RESEARCH AND TECHNOLOGY FOR AUTOMOTIVE STIRLING ENGINE DEVELOPMENT

William A. Tomazic 1980 20 p Presented at 5th Intern. Automotive Propulsion System Symp., Dearborn, Mich., 14-18 Apr. 1980

(NASA-TM-81495; E-400; DOE/NASA/1040-80/13) Avail: NTIS HC A02/MF A01 CSCL 13F

The technology advancement topics described are a part of the supporting research and technology (SRT) program conducted to support the major Stirling engine development program. This support focuses on developing alternatives or backups to the engine development in critical areas. These areas are materials, seals control, combustors and system analysis. Specific objectives and planned milestone schedules for future activities as now envisioned are described. These planned SRT activities are related to the timeline of the engine development program that they must support. A.M.S.

N80-21201*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FUEL ECONOMY SCREENING STUDY OF ADVANCED AUTOMOTIVE GAS TURBINE ENGINES

John L. Klann Mar. 1980 57 p
 (Contract EC-77-A-31-1040)
 (NASA-TM-81433; E-357; DOE/NASA/1040-80/11) Avail: NTIS HC A04/MF A01 CSCL 13F

Fuel economy potentials were calculated and compared among ten turbomachinery configurations. All gas turbine engines were evaluated with a continuously variable transmission in a 1978 compact car. A reference fuel economy was calculated for the car with its conventional spark ignition piston engine and three speed automatic transmission. Two promising engine/transmission combinations, using gasoline, had 55 to 60 percent gains over the reference fuel economy. Fuel economy sensitivities to engine design parameter changes were also calculated for these two combinations. Author

N80-21204# Department of Energy, Washington, D. C. Office of Conservation and Solar Applications.

ELECTRIC AND HYBRID VEHICLE PROGRAM Quarterly Report, Apr. - May 1979

Aug. 1979 31 p refs
 (DOE/CS-0026-7) Avail: NTIS HC A03/MF A01

Progress in U.S. programs on the design, development, production, and performance testing of electric powered and hybrid electric powered vehicles is briefly summarized. DOE

N80-21205# Cambridge Systematics, Inc., Mass. URBAN MASS TRANSPORTATION ENERGY CONSERVATION: SRGP OPERATING INSTRUCTIONS AND PROGRAM DOCUMENTATION, VOLUME 5 Final Report

J. F. MacMann and R. E. Nestle Oct. 1979 120 p refs (Contract EM-76-C-01-8628)

(DOE/PE/8628-1-Vol-5) Avail: NTIS HC A06/MF A01
A computer program for Short Range Generalized transportation Policy (SRGP) analysis developed for use in analyzing the energy conservation potential of a broad spectrum of transit, carpooling, vanpooling, parking, pricing, and other transportation system management measures is described. It is intended for use in either an areawide or corridor context and in what is referred to as a sketch planning style of analysis. Output includes changes in fuel consumption, vehicle emissions, vehicle miles of travel, and modal shares for drive alone, shared ride, and transit. Changes in travel behavior are forecast relating to auto ownership, work trip mode choice, and the frequency, destination, and mode choice for both shopping and social/recreational nonwork travel. Using a random sample household forecasting procedure, SRGP is a modified version of the program UMODEL, distributed by the U.S. Urban Mass Transportation Administration as part of UTPS, the Urban Transportation Planning System. DOE

N80-21206# Cambridge Systematics, Inc., Mass. URBAN TRANSPORTATION ENERGY CONSERVATION: CASE CITY APPLICATIONS OF ANALYSIS METHODOLOGIES, VOLUME 3 Final Report, Jul. 1976 - Sep. 1978

T. J. Atherton and J. H. Suhrbier Oct. 1979 160 p refs (Contract EM-76-C-01-8628)

(DOE/PE/8628-1-Vol-3) Avail: NTIS HC A08/MF A01
Disaggregate travel demand methodologies were applied to the analysis of potential energy conservation strategies in three urban areas: Denver, Colorado; Fort Worth, Texas; and San Francisco, California. The methodologies are sketch planning in nature and include the forecasting of changes in automobile ownership; work trip modal shares by drive alone, shared ride, and transit; nonwork trip frequency, destination, and mode choice; fuel consumption and vehicle emissions. Policies analyzed include those related as employer based ride sharing, parking management, transit, pricing, and traffic operations. Considerable variations in the potential effectiveness was found, among the three urban areas, depending in large part on the availability of alternative travel modes such as transit. Descriptions are provided of the individual policy analyses performed, the methods by which example policies were analyzed, the necessary data preparation activities, and the procedures used to adapt the set of travel demand models to the unique conditions of each of the three metropolitan areas. DOE

N80-21207# Cambridge Systematics, Inc., Mass. URBAN TRANSPORTATION ENERGY CONSERVATION: ANALYTICAL PROCEDURES FOR ESTIMATING CHANGES IN TRAVEL DEMAND AND FUEL CONSUMPTION, VOLUME 2 Final Report, Jul. 1976 - Sep. 1978

T. J. Atherton and J. H. Suhrbier Oct. 1979 153 p refs (Contract EM-76-C-01-8628)

(DOE/PE/8628-1-Vol-2) Avail: NTIS HC A08/MF A01
Analytical tools used to evaluate the effectiveness of alternative transportation policies in achieving reductions in overall fuel consumption are presented. To ensure a high measure of accuracy, the analysis goes beyond the first order effects, i.e., the shift from single occupant autos as the mode chosen for the work trip to more fuel efficient means of travel. Questions treated include what will happen with the autos left at home as a result of increased carpooling for work trips. The methodology developed links together several disaggregate, travel demand models to predict auto ownership, work trip mode choice, and nonwork travel demands. The theoretical basis for the travel demand models used is introduced. These models and their linkages both with each other and with the various submodels are described. The assumptions made in developing the model system and using it to forecast responses to alternative transportation policies are included. Emphasis is placed on the conceptual framework of the model system and specification of the individual models and submodels. DOE

N80-21208# Cambridge Systematics, Inc., Mass. ANALYTICAL PROCEDURES FOR URBAN TRANSPORTATION ENERGY CONSERVATION: SUMMARY OF FINDINGS AND METHODOLOGIES, VOLUME 1 Final Report, Jul. 1976 - Apr. 1979

J. H. Suhrbier and W. D. Byrne Oct. 1979 54 p refs 5 Vol. (Contract EC-76-C-01-8628)

(DOE/PE/8628-1-Vol-1) Avail: NTIS HC A04/MF A01
Analytical methodologies are described and illustrated for use in analyzing the energy conservation potential of candidate urban transportation measurements. Quantitative methodologies oriented to carpooling, vanpooling, transit, pricing, traffic regulation and control, and auto ownership are provided based on the use of disaggregate behavioral travel demand models. Changes are indicated in trip frequency and distribution as well as in travel model, operating conditions, and vehicle miles of travel. Trip-based estimates of fuel consumption and vehicle emissions are included. The methodologies employ manual sketch planning procedures, a programmable calculator, or a fully-calibrated computer program utilizing a random sample household enumeration forecasting technique. The developed methodologies were applied in cooperation with metropolitan planning organizations representing the Dallas-Fort Worth, San Francisco, and Denver urban areas. DOE

N80-21209# Booz-Allen and Hamilton, Inc., Bethesda, Md. Energy and Environment Div.

MECHANICAL ENERGY STORAGE TECHNOLOGY FOR TRANSPORTATION APPLICATIONS PROJECT PLAN
30 Nov. 1979 50 p refs Prepared for California Univ., Livermore. Lawrence Livermore Lab. (Contract W-7405-eng-48)

(UCRL-15138; Rept-2613-005-001) Avail: NTIS HC A03/MF A01
Flywheel systems for regenerative braking and load leveling in electric and hybrid vehicles were studied with emphasis on safety and economy. It is concluded that the use of flywheel energy storage regenerative braking and load leveling systems will upgrade the performance of electric and hybrid vehicles and improve the fuel economy of heat engine/flywheel vehicles to a level required for acceptable market penetration. DOE

N80-21210# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

TEST AND EVALUATION REPORT OF THE ERDC HYBRID-ELECTRIC VAN (HEVAN)
G. J. Klose May 1979 67 p (Contract EX-76-A-31-1011)

(DOE/TIC-10232) Avail: NTIS HC A04/MF A01
The HEVAN or Hybrid-Electric Van is a battery powered electric vehicle with an on board gasoline fueled electric power generation unit. The HEVAN was developed from a Volkswagen transporter chassis. It is propelled by a series wound dc traction motor rated at 20 HP (14.9 kW) which is powered by sixteen 6-volt SGL lead acid batteries of nominally 96 volts. The motor power is controlled by an SCR chopper with a bypass contractor and drives the vehicle through a four-speed VW transaxle. The conventional VW hydraulic brake system is used; there is no provision for regenerative braking. The on board electric power generator consists of a 16-HP (11.9kW) gasoline engine driving a 7.5 kW alternator with a dc rectifier; this provides electrical power either directly to the drive motor or to the battery pack, depending on the battery charge state and the motor power requirements. Numerous tests were conducted with pure electric operation, but only limited results were obtained in the hybrid mode due to continual problems with the motor generator set. DOE

N80-21211# California Univ., Livermore. Lawrence Livermore Lab.

ENERGY STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION
L. G. O'Connell 26 Nov. 1979 35 p (Contract W-7405-eng-48)

(UCID-18320) Avail: NTIS HC A03/MF A01

Energy storage power systems that are credible alternatives to the internal combustion engine system are evaluated. It is concluded that automotive electrical power systems can be developed for various performance levels. Most electricity using vehicles will weigh more and cost more than their internal combustion engine equivalents. If performance of these vehicles is reduced, they can be more cost competitive. Mechanical energy storage propulsion systems appear useful as power boosters for certain mission applications. DOE

N80-21379*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

GENERAL SENSITIVITY ANALYSIS OF SOLAR THERMAL-ELECTRIC PLANTS

F. L. Lansing, E. W. Hayes, and C. S. Yung *In its* The Deep Space Network 15 Apr. 1980 p 130-142

Avail: NTIS HC A08/MF A01 CSCL 10A

A unified and generalized treatment for predicting the technical performance of many present or future solar thermal electric power system designs and configurations is presented. In order to screen the major design parameters whose effect on performance is high and to assess the system improvement or deficiency resulting from their change, a sensitivity analysis is performed. The sensitivity, defined as the percentage change of output divided by the percentage change in input, is evaluated analytically for seven major system design parameters. These design parameters are: the solar radiation intensity, the ambient temperature, the optical-thermal characteristics of the collector subsystem (concentrator-receiver), the relative thermal efficiency for the energy conversion subsystem, the working fluid operating temperature, and the rate of fluid heat capacity. General performance sensitivity expressions are derived and numerically evaluated for the range of possible operating conditions. The effect of these major parameters on the system performance optimization is presented to identify future improvement areas and to pave the way for the second phase study in the economic sensitivity analysis on bus bar energy costs. A.W.H.

N80-21396*# Boeing Aerospace Co., Seattle, Wash.
SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY, VOLUME 4, PHASE 2 Final Report, Jan. - Nov. 1979

Dec. 1979 308 p refs Sponsored in part by DOE

(Contract NAS9-15636)

(NASA-CR-160565; D180-25461-4) Avail: NTIS HC A14/MF A01 CSCL 22B

Results of an overall evaluation of the solar power satellite concept are reported. Specific topics covered include: solid state sandwich configuration; parametric development of reliability design; power distribution system for solid state solar power satellites; multibeam transmission; GEO base system configuration; suppression of the heavy lift launch vehicle trajectory; conceptual design of an offshore space center facility; solar power satellite development and operations scenario; and microwave power transmission technology, advancement, development, and facility requirements. J.M.S.

N80-21456# Oak Ridge National Lab., Tenn.
OUTGASSING BEHAVIOR OF CARBON-BONDED CARBON-FIBER THERMAL INSULATION

G. C. Wei, C. D. Reynolds, and G. W. Brassell 1979 7 p refs Presented at 14th Carbon Conf., University Park, Pa., 25 Jun. 1979

(Contract W-7405-eng-26)

(CONF-790625-8) Avail: NTIS HC A02/MF A01

A carbon-bonded carbon-fiber (CBCF3) thermal insulation was developed and has demonstrated acceptable strength, thermal conductivity, and outgassing properties for the selenide isotope generator. Primary outgassing at 1350 C and 0.1 mPa (10 to the minus 6th power torr) for 70 h seemed satisfactory because reabsorption during exposure to argon or air was minimal and the total weight loss during secondary outgassing was also very small. The total outgassing of CBCF3 insulation during generator startup and operation was equivalent to the weight loss during secondary outgassing, (i.e., 0.08 mg per gram of CBCF3 insulation). The dominating gaseous species of secondary

outgassing are CO and CO₂. Primary outgassing (1350 C at 0.1 mPa (10 to the minus 6th power torr) for 70 h) causes no increases in the thermal conductivity of CBCF3 insulation. Specimen size affected the first few hours of primary outgassing and thus the fraction of total amount of volatile species being driven off at the end of primary outgassing. DOE

N80-21520# International Nickel Co., Inc., Suffern, N. Y. Research and Development Center.

EVALUATION OF HIGH CHROMIUM OVERLAYS TO PROTECT LESS ALLOYED SUBSTRATES FROM CORROSION IN A COAL GASIFICATION ATMOSPHERE Quarterly Report, 1 Sep. - 30 Nov. 1978

Edward P. Sadowski 1978 33 p refs

(Contract EF-77-C-01-2621)

(FE-2621-5) Avail: NTIS HC A03/MF A01

Inspection by Dy-chek and bend tests were completed. All AWS-ER 309 and INCONEL Filler Metal 72 weldments and fifteen of eighteen R139 weldments were bent 180 deg around a mandrel successfully. Mixed results were obtained on three of the R139 weldments. Stress-rupture testing at 1800 F shows no significant differences in the tensile strength of weldments due to filler metal, substrate or weld process and indicate that the substrates and welding process have an effect on the stress rupture strength. The weldments with the INCOLOY alloy 800H substrate with inert gas deposited overlays have the higher stress rupture strength. The submerged-arc weldments had the lowest stress rupture strength for each filler metal and substrate. DOE

N80-21554# Westinghouse Electric Corp., Madison, Pa. Advanced Coal Conversion Dept.

ADVANCED COAL GASIFICATION SYSTEM FOR ELECTRIC POWER GENERATION, FY 1978 Quarterly Progress Report, 1 Jul. - 30 Sep. 1978

28 Dec. 1978 123 p refs

(Contract EX-76-C-01-1514)

(FE-1514-93; QPR-4) Avail: NTIS HC A07/MF A01

A gasifier was to evaluate performance with coke breeze and char derived from coal using oxygen and steam as the gasification media. Since suitable chars were not available, direct coal feed to the gasifier was used. Four tests were run, TP-018-1 through -4, and operating summaries and test results are described. The operating results for Test TP-018-1 are summarized. Test TP-018-2 was the first gasifier test to be run with oxygen. Total time for the test exceeded 180 hours, with 50 hours of operation using Pittsburgh seam coal as feedstock. Product gas higher heating values of a dry basis ranged from 120 Btu/scf for coke breeze to 260 Btu/scf for Pittsburgh coal. An experimental test grid designed to show the effect of increased oxygen flow on reactor temperatures and heating values with the high-caking Pittsburgh seam coal was established and added to with each test conducted. Successful operation of the single stage gasifier reactor with oxygen was demonstrated with this series of tests with some rather significant results. Summaries of these results are given. DOE

N80-21557# Lummus Co., Bloomfield, N. J.
SOLVENT REFINED COAL PROCESS: DATA CORRELATION AND ANALYSIS Final Report

J. F. S. Frith, S. Viswanathan, and A. Gupta Aug. 1979 308 p Sponsored by the Elec. Power Res. Inst.

(EPRI-AF-1157) Copyright. Avail: Issuing Activity

Available pilot plant and other experimental data on coal liquefaction were evaluated and useful correlations for design and scale-up to commercial size plants were developed. The available operating data were obtained from three pilot plants. The reviewed data was organized into comparative tables to facilitate its use in subsequent studies. To reduce the data into forms useful for design calculations, a number of correlations were developed. Product yields were correlated with reaction severity expressed as hydrogen consumption. The liquefaction reactions were studied by calculating reaction rate constants for the processes of hydrogen consumption, coal conversion and organic sulfur removal. To aid the design of the vapor-liquid separation equipment, a means of characterizing coal liquids was

proposed. This was used successfully with methods that are currently available to predict physical properties and vapor liquid equilibria for petroleum mixtures. DOE

N80-21558# Braun (C. F.) and Co., Alhambra, Calif.
COAL-TO-METHANOL VIA NEW PROCESSES UNDER DEVELOPMENT: AN ENGINEERING AND ECONOMIC EVALUATION Final Report

W. S. Chia, G. E. Good, and Y. S. Ng Oct. 1979 112 p
 Sponsored by Elec. Power Res. Inst.
 (EPRI-AF-1227) Avail: NTIS HC A06/MF A01

The results of a screening study are presented evaluating two coal to methanol routes via processes under development. A total of two coals investigated in two different plant configurations: (1) Illinois No. 6 bituminous coal in an all methanol scheme; and (2) Wyodak subbituminous coal in a methanol and distillate fuel oil coproduction scheme. In both schemes the Liquid Phase Methanol process was used for the synthesis of methanol from cleaned and conditioned synthesis gas. All other processes incorporated in the plant configurations were commercially proven in the petrochemical, chemical, or petroleum refinery industry. The conceptual designs for the two grass roots coal conversion complexes each designed to produce approximately 300 billion Btu per day of storable fuels are presented; included are overall block flow diagrams, steam and utility balances, and water management schemes. Cost estimates, economic assessments, and overall thermal efficiencies are provided for each of the two processing schemes considered. DOE

N80-21612# Office of Technology Assessment, Washington, D. C.

BENEFITS OF INCREASED USE OF CONTINUOUS CASTING BY THE UNITED STATES STEEL INDUSTRY

Oct. 1979 41 p refs
 (PB80-104904; OTA/TM/ISC-2; LC-79-600177) Avail: NTIS HC A03/MF A01 CSCL 11F

The continuous casting process is described and the advantages of the process are examined. The rate of adoption of this technology in the U.S. steel industry is compared with that in the foreign steel industries. The factors that have constrained the greater adoption of continuous casting in the United States are briefly discussed and the economic costs and benefits of converting existing capacity to this new process are analyzed. GRA

N80-21697# National Bureau of Standards, Boulder, Colo. Thermophysical Properties Div.

HELIUM RESEARCH IN SUPPORT OF SUPERCONDUCTING POWER TRANSMISSION

David E. Daney Oct. 1979 64 p refs Prepared in cooperation with Brookhaven National Lab., Upton, N.Y.
 (PB80-116502; NBSIR-79-1618) Avail: NTIS HC A04/MF A01 CSCL 09C

The preparation of computer codes and numerical computation of SPTL cool down were completed and the results are given. These calculations confirm original intuitive judgement that cool down times for the counterflow arrangement can be long, twenty days or more. Two sections of cable underwent extensive thermal cycling, and the results of these tests are given. The complex structure of the cable leads to unusual (although reproducible) load vs time curves. GRA

N80-21707# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.

METHODS FOR MANUFACTURING HEAT PIPES FOR CIRCUIT CARDS Final Report, 30 Sep. 1977 - 31 Mar. 1979

Kal S. Sekhon and Lloyd A. Nelson Mar. 1979 90 p
 (Contract DAAK40-77-C-0242)
 (AD-A080188; FR79-12-292) Avail: NTIS HC A05/MF A01 CSCL 09/5

Manufacturing processes to fabricate heat pipes for circuit cards were evaluated. These included shell and wick fabrication, shell and wick joining, and vacuum/fill and testing. Cost effective processes were selected to meet production requirements. A

production facility was designed based on cost trade-offs. The results of the evaluation, selection of recommended manufacturing methods and the design of the production facility are presented. GRA

N80-21754*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PARAMETRIC TESTS OF A TRACTION DRIVE RETRO-FITTED TO AN AUTOMOTIVE GAS TURBINE

Douglas A. Rohn, Stuart H. Lowenthal, and Neil E. Anderson 1980 21 p refs Presented at the 5th Intern. Automotive Propulsion Systems Symp., Dearborn, Mich., 14-18 Apr. 1980 Prepared in cooperation with Army Aviation Research and Development Command, Cleveland, Ohio
 (Contract EF-77-A-31-1011)

(NASA-TM-81457; AVRADCOM-TR-80-8; DOE/NASA/1011-80/4) Avail: NTIS HC A02/MF A01 CSCL 13I

The results of a test program to retrofit a high performance fixed ratio Nasvytis Multiroller Traction Drive in place of a helical gear set to a gas turbine engine are presented. Parametric tests up to a maximum engine power turbine speed of 45,500 rpm and to a power level of 11 kW were conducted. Comparisons were made to similar drives that were parametrically tested on a back-to-back test stand. The drive showed good compatibility with the gas turbine engine. Specific fuel consumption of the engine with the traction drive speed reducer installed was comparable to the original helical gearset equipped engine. Author

N80-21755*# National Aeronautics and Space Administration, Washington, D. C.

STORAGE PEAK GAS-TURBINE POWER UNIT

B. Tsinkotski Jan. 1980 25 p refs Transl. into ENGLISH from Period. Polytech. Mech. Eng. (USSR), v. 22, no. 2, 1978 p 95-113 Original language document announced as A79-24507 Transl. by Scientific Translation Service, Santa Barbara, Calif.
 (Contract NASw-3198)

(NASA-TM-75757) Avail: NTIS HC A02/MF A01 CSCL 10B

A storage gas-turbine power plant using a two-cylinder compressor with intermediate cooling is studied. On the basis of measured characteristics of a .25 Mw compressor computer calculations of the parameters of the loading process of a constant capacity storage unit (0.3 million cu m) were carried out. The required compressor power as a function of time with and without final cooling was computed. Parameters of maximum loading and discharging of the storage unit were calculated, and it was found that for the complete loading of a fully unloaded storage unit, a capacity of 1 to 1.5 million cubic meters is required, depending on the final cooling. Author

N80-21760# Santa Clara Univ., Calif.
EXHAUST CHARACTERIZATION OF NEAT ALCOHOL FUELED IC ENGINES Final Report

B. Pullman, R. Pefley, Richard Bechtold (DOE, Bartlesville, Okla.), and Jerry Ailsup (DOE, Bartlesville, Okla.) Oct. 1979 30 p refs Sponsored by DOE

(BETC/P-B-8-1943-1) Avail: NTIS HC A03/MF A01

A late-model vehicle was converted to operate using methanol, gasoline, or ethanol as fuel and experimental work was done to obtain energy economy and exhaust emissions data for each of the three fuels. Results are compared at equal equivalence ratios both with and without an oxidation catalyst in the exhaust system. Using a catalyst for emissions control, unburned (hydro) carbon emissions were lowest during lean operating conditions and were nearly the same for all three fuels under those conditions. Oxides of nitrogen emissions typically were reduced by over 50 percent in changing from gasoline to methanol or ethanol. Composition of the exhaust hydrocarbons was determined from analysis via gas chromatography. These data were used for calculating photochemical reactivities and comparisons were made among the fuels during cold start and FTP weighted tests. DOE

N80-21824# Department of Energy, Washington, D. C. Oil and Gas Analysis Div.

PROJECTIONS OF ENHANCED OIL RECOVERY, 1985 - 1995

Joan Heinkel Sep. 1979 43 p
(DOE/EIA-0183/11; TR/ES/79-30) Avail: NTIS
HC A03/MF A01

The production potential from thermal recovery methods, miscible and immiscible gas flooding, and chemical flooding methods were estimated. It was assumed that existing EOR technology is conventionally applied requiring a 10 percent real after tax rate of return similar to that assumed for conventional recovery method. Five alternative price paths for world supplies of crude oil were investigated. Supply possibilities from these enhanced methods are estimated as 0.9 million bbl/d in 1985 and show no variation despite the \$6 range in price among the scenarios. Although thermal recovery techniques provide the bulk of production in the 1985-1995, they should decline in importance over time, providing 52 to 57 percent of ultimate recovery. Gas flooding will increase production over time to account for 37 to 41 percent of ultimate recovery and chemical flooding accounts for 6 to 7 percent. DOE

N80-21827# General Accounting Office, Washington, D. C. Energy and Minerals Div.

GEOTHERMAL ENERGY: OBSTACLES AND UNCERTAINTIES IMPEDE ITS WIDESPREAD USE

18 Jan. 1980 51 p refs
(PB80-134430; EMD-80-36) Avail: NTIS HC A04/MF A01
CSCL 081

This report to Congress assesses the development and potential of geothermal energy and discusses Federal actions needed to help accelerate geothermal development and use. GRA

N80-21828* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

WIND WHEEL ELECTRIC POWER GENERATOR Patent

John W. Kaufman, inventor (to NASA) Issued 4 Mar. 1980
8 p Filed 24 Feb. 1978 Supersedes N78-22469 (16 - 13,
p 2137)

(NASA-Case-MFS-23515-1; US-Patent-4,191,505;
US-Patent-Appl-SN-880726; US-Patent-Class-415-2;
US-Patent-Class-415-101) Avail: US Patent and Trademark
Office CSCL 10B

Wind wheel electric power generator apparatus includes a housing rotatably mounted upon a vertical support column. Primary and auxiliary funnel-type, venturi ducts are fixed onto the housing for capturing wind currents and conducting to a bladed wheel adapted to be operatively connected with the generator apparatus. Additional air flows are also conducted onto the bladed wheel; all of the air flows positively effecting rotation of the wheel in a cumulative manner. The auxiliary ducts are disposed at an acute angle with respect to the longitudinal axis of the housing, and this feature, together with the rotatability of the housing and the ducts, permits capture of wind currents within a variable directional range.

Official Gazette of the U.S. Patent and Trademark Office

N80-21830# Brookhaven National Lab., Upton, N. Y. REVIEW OF RECENT RESEARCH ON ENERGY STORAGE IN RESIDENTIAL SOLAR TOTAL ENERGY SYSTEMS

Richard W. Leigh May 1979 15 p refs
(Contract EY-76-C-02-0016)
(BNL-51012) Avail: NTIS HC A02/MF A01

Current and recent research relevant to residential applications of solar total energy are reviewed. For each project or study, the types of energy storage devices chosen and the methods used to integrate them with solar collectors and backup devices are emphasized. Several general conclusions are distilled from the studies to guide subsequent research. DOE

N80-21831*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

AMPLIFIED WIND TURBINE APPARATUS Patent Application

William N. Myers, inventors (to NASA) and Leopold A. Hein
Filed 12 Mar. 1980 16 p

(NASA-Case-MFS-23830-1; US-Patent-Appl-SN-129780) Avail:
NTIS HC A02/MF A01 CSCL 10A

An amplified wind turbine apparatus is disclosed wherein ambient inlet air is prerotated in an air rotation chamber having a high pressure profile. A second rotation chamber adjacent and downstream of the turbine has a low pressure core profile whereby flow across the turbine is accelerated and thereafter exits the turbine apparatus through a draft anti-interference device. The draft device eliminates interference with ambient winds at the outlet of the turbine apparatus. Pivotal vanes controlled in response to prevailing wind direction admit air to the chambers and aid in imparting rotation. NASA

N80-21833*# Westinghouse Research and Development Center, Pittsburgh, Pa.

PHASE 2 OF THE ARRAY AUTOMATED ASSEMBLY TASK FOR THE LOW COST SOLAR ARRAY PROJECT Final Report, 1 Oct. 1978 - 30 Oct. 1979

R. B. Campbell, J. R. Davis, J. W. Ostroski, P. Rai-Choudhury, A. Rohatgi, E. J. Seman, and R. E. Stapleton 1979 151 p refs Prepared for JPL and DOE
(Contracts NAS7-100; JPL-954873)
(NASA-CR-162628; DOE/JPL-954873-79/08) Avail: NTIS
HC A08/MF A01 CSCL 10A

The process sequence for the fabrication of dendritic web silicon into solar panels was modified to include aluminum back surface field formation. Plasma etching was found to be a feasible technique for pre-diffusion cleaning of the web. Several contacting systems were studied. The total plated Pd-Ni system was not compatible with the process sequence; however, the evaporated TiPd-electroplated Cu system was shown stable under life testing. Ultrasonic bonding parameters were determined for various interconnect and contact metals but the yield of the process was not sufficiently high to use for module fabrication at this time. Over 400 solar cells were fabricated according to the modified sequence. No sub-process incompatibility was seen. These cells were used to fabricate four demonstration modules. A cost analysis of the modified process sequence resulted in a selling price of \$0.75/peak watt. R.E.S.

N80-21835*# City of Huntsville, Ala.

SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT THE SENIOR CITIZEN CENTER, HUNTSVILLE, ALABAMA Final Report

Feb. 1980 140 p Sponsored by NASA
(Contract EG-77-A-01-4071)

(NASA-CR-161384) Avail: NTIS HC A07/MF A01 CSCL 10B
The solar energy system installed at the Huntsville Senior Citizen Center is described. Detailed drawings of the complete system and discussions of the planning, the hardware, recommendations, and other pertinent information are presented. R.E.S.

N80-21836*# IBM Federal Systems Div., Huntsville, Ala.

SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION: SEASONAL REPORT FOR IBM SYSTEM 2, TOGUS, MAINE Contractor Report, May 1978 - Apr. 1979

Jan. 1980 68 p refs Sponsored in part by DOE
(Contract NAS8-32036)

(NASA-CR-161383) Avail: NTIS HC A04/MF A01 CSCL 10B

The solar energy system, SIMS Prototype System 2, was designed to supply domestic hot water to single family residences. The system consists of flat plate collectors, silicone working fluid, storage tanks, pumps, heat exchanger, controls, and associated plumbing. The long term field performance of the installed system was analyzed and the results are described. R.E.S.

N80-21837*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FLAME TUBE PARAMETRIC STUDIES FOR CONTROL OF FUEL BOUND NITROGEN USING RICH-LEAN TWO-STAGE COMBUSTION

Donald F. Schultz and Gary Wolfbrandt 1980 25 p refs
Presented at Western States Sect. of the Combust. Inst. of Spring

Meeting, Irvine, Calif., 21-22 Apr. 1980
(Contract EF-77-A-01-2593)
(NASA-TM-81472; DOE/NASA/2593-80/15; E-405) Avail:
NTIS HC A02/MF A01 CSCL 21B

An experimental parametric study of rich-lean two-stage combustion in a flame tube is described and approaches for minimizing the conversion of fuel-bound nitrogen to nitrogen oxides in a premixed, homogeneous combustion system are evaluated. Air at 672 K and 0.48 MPa was premixed with fuel blends of propane, toluene, and pyridine at primary equivalence ratios ranging from 0.5 to 2.0 and secondary equivalence ratios of 0.5 to 0.7. Distillates of SRC-II, a coal syncrude, were also tested. The blended fuels were proportioned to vary fuel hydrogen composition from 9.0 to 18.3 weight percent and fuel nitrogen composition from zero to 1.5 weight percent. Rich-lean combustion proved effective in reducing fuel nitrogen to NO sub x conversion; conversion rates up to 10 times lower than those normally produced by single-stage combustion were achieved. The optimum primary equivalence ratio, where the least NO sub x was produced and combustion efficiency was acceptable, shifted between 1.4 and 1.7 with changes in fuel nitrogen content and fuel hydrogen content. Increasing levels of fuel nitrogen content lowered the conversion rate, but not enough to avoid higher NO sub x emissions as fuel nitrogen increased. M.G.

N80-21838# Hughes Aircraft Co., Los Angeles, Calif.
HIGH EFFICIENCY SOLAR PANEL, PHASE 2, GALLIUM ARSENIDE Interim Report, 15 Sep. 1977 - 15 Jan. 1979
G. Vendura, S. Kamath, and G. Wolfe Jul. 1979 65 p refs
(Contract F33615-77-C-3150; AF Proj. 682J)
(AD-A079635; HAC-SCG-90324M; HAC-REF-E0773;
AFAPL-TR-79-2058) Avail: NTIS HC A04/MF A01 CSCL 10/2

This interim report presents the progress of the GaAs High Efficiency Solar Panel program (Phase II) goal of development of space qualified solar cells of 16 percent efficiency AMO during the period of September 1977 through January 1979. Results of development research involving the basic GaAs substrate, the epitaxial reactors, LPE growth processes, ohmic contacts/metalizations, welding capability, and environmental testing are included. Efforts to increase substrate size and fabrication yield to enhance the feasibility of larger scale GaAs solar cell production are also detailed. GRA

N80-21842# California Univ., Livermore. Lawrence Livermore Lab.
EFFECT OF A HEATED ATMOSPHERE ON THE TEMPERATURE DEPENDENCE OF THE TOTAL EMITTANCE OF BLACK CHROME SOLAR ABSORBER PIPES M.S. Thesis
Thomas Alexander Reitter Oct. 1979 79 p refs
(Contract W-7405-eng-48)
(UCRL-52851) Avail: NTIS HC A05/MF A01

An apparatus for measuring the total hemispherical emittance of pipes of length suitable for in a prototype solar collector is reported. The apparatus was used to measure the total hemispherical emittance as a function of temperature of black chrome, nickel, and bare steel surfaces, before and after exposure to heated humid or dry air atmospheres. Exposure to a heated atmosphere lowered the emittance of the black chrome surfaces on the order of 20%. Similar exposure increased the emittance of the bare steel surface significantly, but had no effect on the nickel surface. It was hypothesized that the lowering of the black chrome emittance is due to the oxidation and subsequent outgassing of carbon contaminants on and in the black chrome layer. The actual causes may be a combination of this and other effects. However, due to the complexity of the black chrome layer it was not possible to explain the changes in the black chrome emittance in terms of changes in the coating. DOE

N80-21846# Boeing Engineering and Construction, Seattle, Wash.
SOLAR CENTRAL RECEIVER PROTOTYPE HELIOSTAT, VOLUME 1 Final Technical Report
1 Jun. 1979 207 p refs
(Contract EG-77-C-03-1604)
(SAN-1604-1) Avail: NTIS HC A10/MF A01

A prototype heliostat design for a solar central receiver is presented in detail. The manufacturing installation, and maintenance procedures are described. DOE

N80-21847# Stearns-Roger Corp., Denver, Colo.
SOLAR THERMAL REPOWERING SYSTEMS INTEGRATION Final Report
L. J. Dubberly Aug. 1979 156 p refs Sponsored in part by SERI, Golden, Colo.
(Contract EG-77-C-01-4042)
(SERI/TR-8037-1) Avail: NTIS HC A08/MF A01

Solar repowering interface requirements for water/steam and salt or sodium-cooled central receivers are defined for unit sizes ranging from 50 MWe non-reheat to 350 MWe reheat. Balance of plant cost estimates are presented for each of six combinations of plant type, receiver and percent solar repowering. DOE

N80-21848# Midwest Research Inst., Golden, Colo.
ANALYSIS OF A HEAT EXCHANGER-THERMOELECTRIC GENERATOR SYSTEM
Jon Henderson 1979 7 p refs Presented at the 14th Intersoc. Energy Conversion Engineering Conference, Boston, 5-10 Aug. 1979
(Contract EG-77-C-01-4042)
(SERI/TP-35-253; CONF-790803-56) Avail: NTIS HC A02/MF A01

Analysis of a thermoelectric generator (TEG) in an ocean thermal energy conversion (OTEC) application is presented. An analytic model was developed for describing the heat exchanger-TEG interactions. This model was used to illustrate limitations of applying conventional fixed junction temperature assumptions to systems experiencing significant temperature drops across the heat exchanger surfaces. Design methods were developed for determining the thermoelectric element geometry that produces maximum output power. Results show that a heat exchanger-TEG system may deliver about 100 W/sq m of heat exchanger surface. This compares favorably with conventional OTEC schemes. DOE

N80-21849# Brookhaven National Lab., Upton, N. Y.
USE OF EARTH COUPLING IN SOLAR ASSISTED HEAT PUMPS
P. D. Metz, E. A. Kush, and J. N. Andrews 1979 11 p refs Presented at a Nordic Symp. on Earth Heat Pump Systems, Goteborg, Sweden, 15-16 Oct. 1979
(Contract EY-76-C-02-0016)
(BNL-26748; CONF-791119-1) Avail: NTIS HC A02/MF A01

The use of thermal coupling between the earth and the storage element of a solar source heat pump system was investigated. Four buried tanks and five configurations of serpentine plastic pipe with various control strategies were studied. System heating and cooling performance, detailed earth temperature profiles, and soil thermal properties were measured. Experimental results were used to validate heat flow models. The integration of ground coupling with solar heat pump systems is explained, the tank and pipe field configurations are described, and the heat flow model development is outlined. The experimental results, are reported and are compared to model predictions. DOE

N80-21850# California Univ., Berkeley. Lawrence Berkeley Lab.
AEROSPACE TECHNOLOGY REVIEW FOR LBL WINDOW/PASSIVE SOLAR PROGRAM Final Report
R. Viswanathan Jun. 1979 388 p refs
(Contract W-7405-eng-48)
(LBL-9608; EEB-W-79-13) Avail: NTIS HC A17/MF A01

A review of aerospace literature to uncover material pertinent to the Window and Passive Solar Programs is reported. Areas covered are: optical shutters, soils, thermal storage and transfer, optical properties of materials and clouds, human engineering, high efficiency light sources and solid state electronics, thermal and optical properties of landscape and building materials, and measurement and diagnostic techniques. DOE

N80-21851# Lockheed Missiles and Space Co., Sunnyvale, Calif.
EVALUATION OF SELECTIVE ABSORBERS Semiannual Report

1979 12 p refs
 (Contracts DE-AC04-78CS-15361)
 (TP-5461) Avail: NTIS HC A02/MF A01

Six selective absorber materials were characterized with respect to initial optical properties and abbreviated environmental exposures. For the plated black chrome, uniformity was poor in terms of α /sub s/ and epsilon as measured on 1 sq ft panels. Short term environmental exposures caused no substantial changes in optical or physical properties of the materials. DOE

N80-21852# Argonne National Lab., Ill.
APPLICATION OF GLASS TECHNOLOGY TO NOVEL SOLAR ENERGY COLLECTORS

Kent A. Reed 1979 17 p refs Presented at Am. Sci. Glass Blowers Soc. Symp., Detroit, Mich., 29 Jun. 1979
 (Contract W-31-109-eng-38)
 (CONF-7906118-1) Avail: NTIS HC A02/MF A01

Various compound parabolic concentrator (CPC) configurations are described and the application of glass technology to CPC absorbers, evacuated receivers, and evacuated tube receivers are considered. Also a floodlamp collector concept and a fluorescent tube collector concept are discussed. DOE

N80-21853# California Univ., Livermore.
ECONOMIC ANALYSIS OF SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS. A METHODOLOGY TO DETERMINE ANNUAL REQUIRED REVENUE AND INTERNAL RATE OF RETURN

W. C. Dickinson and K. C. Brown 17 Aug. 1979 46 p refs
 (Contract W-7405-eng-48)
 (UCRL-52814) Avail: NTIS HC A03/MF A01

To permit an economic evaluation of solar industrial process heat systems, a methodology to determine the annual required revenue and the internal rate of return was developed. First, a format is provided to estimate the solar system's installed cost, annual operating and maintenance expenses, and net annual solar energy delivered to the industrial process. Then an expression is presented that gives the annual required revenue and the price of solar energy. The economic attractiveness of the potential solar investment can be determined by comparing the price of solar energy with the price of fossil fuel, both expressed in leveled terms. DOE

N80-21854# Sandia Labs., Albuquerque, N. Mex.
REVIEW OF SELECTED ON-SITE DOE SMALL SOLAR THERMAL POWER PLANT EXPERIMENTS

Robert L. Alvis 1979 12 p ref Presented at the Fourth Annual National Conf. on Technology for Energy, Albuquerque, N. Mex., 30 Oct. 1979
 (Contract EY-76-C-04-0789)

(SAND-79-1040C; CONF-791052-1) Avail: NTIS HC A02/MF A01

Three solar power plants are reviewed that were developed in an effort to find an alternate energy source for powering irrigation pumps. Power generation by the conversion of solar energy is shown to be technically feasible in the construction and operation of these three solar thermal power systems. The thermal cycling inherent in solar energy is shown to be more stressful on the system components and requires special design attention to obtain satisfactory performance. The economic benefit of these one-of-a-kind systems are not competitive with the conventional power systems. However, predictions for similar systems in large production indicate that power could be generated for approximately 5 cents/kWh in the Southwest. Recent increases in conventional energy costs, and continuing component development, are combining to make solar power systems a potential near-term reality. DOE

N80-21855# California Univ., Livermore. Lawrence Livermore Lab.
COMPOSITE-LAMINATE FLYWHEEL-ROTOR DEVELOPMENT PROGRAM

S. V. Kulkarni 9 Nov. 1979 13 p refs
 (Contract W-7405-eng-48)
 (UCRL-83554) Avail: NTIS HC A02/MF A01

The tapered thickness Stodola rotor concept is considered with emphasis on improving the performance of the rotor. Topics discussed include: (1) redesigning the Stodola rotor to increase the energy density; (2) testing laminate coupons to establish the degree of strength anisotropy of various quasi-isotropic laminates; (3) spin testing of constant thickness, composite laminate rotors to establish a relationship between design data and failure speed; (4) developing a matched-metal-die compression molding process to fabricate thick, high fiber volume, low void content composite panels; and (5) exploring the feasibility of manufacturing low cost rotors from structural sheet molding compounds. DOE

N80-21856# Brookhaven National Lab., Upton, N. Y.
MULTI-OBJECTIVE ENERGY ANALYSIS

E. A. Cherniavsky Nov. 1979 29 p refs Presented at NATO Advanced Res. Inst. Conf., Upton, N.Y., 12 Nov. 1979
 (Contract EY-76-C-02-0016)
 (BNL-26882; CONF-791152-1) Avail: NTIS HC A03/MF A01

Analytic models, which are applied to energy planning problems in an effort to assess the probable impacts of alternative courses of action on vital social concerns such as the quality of the environment, the state of the economy, or extent of dependence on insecure foreign energy sources, were studied. The tradeoffs between different social objectives were identified and quantified. Associated problems are explored and discussed in the light of experience with applications to energy planning models. Conclusions are drawn concerning the most fruitful directions for future research in this area. DOE

N80-21857# Cambridge Systematics, Inc., Mass.
ANALYTIC PROCEDURES FOR URBAN TRANSPORTATION ENERGY CONSERVATION. VOLUME 1: SUMMARY OF FINDINGS AND METHODOLOGIES Final Report

J. H. Suhrbier and W. D. Byrne Apr. 1979 40 p refs
 (Contract EM-76-C-01-8628)

(Cons-8626-T1-Vol-1) Avail: NTIS HC A03/MF A01
 Analytical methodologies are described and illustrated for use by metropolitan planning organizations and other state and local transportation agencies in analyzing the energy conservation potential of candidate urban transportation measures. Quantitative methodologies oriented to carpooling, vanpooling, transit, pricing, traffic regulation and control, and auto ownership are provided based on the use of disaggregate behavioral travel demand models. Changes are indicated in trip frequency and distribution as well as in travel model, operating conditions, and vehicle miles of travel. Trip-based estimates of fuel consumption and vehicle emissions are included. Application of the developed methodologies was performed in cooperation with metropolitan planning organizations representing the Dallas-Fort Worth, San Francisco, and Denver urban areas. DOE

N80-21859# EcoSystems, Inc., McLean, Va.
POTENTIAL FOR SOLAR/CONSERVATION TECHNOLOGIES IN THE STATE OF WASHINGTON

David Baylon, J. Brautigam, H. Reichmuth, B. Boulter, S. Gross, A. Stewart, and S. Worthman 4 Apr. 1979 70 p refs
 (Contract EG-77-G-01-4099)
 (WAOENG-79-3) Avail: NTIS HC A04/MF A01

A data base for Washington State energy consumption by fuel type is presented and divided into energy end use temperatures and types. Solar/conservation technologies are classed according to their immediacy as options for use, cost effectiveness, current availability, and compatibility with intended uses. The effect of presently feasible solar conservation technologies on Washington State energy consumption, if fully deployed, amounts to approximately 15 percent of the total 1974 energy use. Agricultural, industrial, commercial and residential end uses are also discussed. DOE

N80-21860# Eltra Corp., Plymouth Meeting, Pa. C and D Batteries Div.

RESEARCH, DEVELOPMENT AND DEMONSTRATION OF LEAD-ACID BATTERIES FOR ELECTRIC VEHICLE PROPULSION Annual Report, 1978

Oct. 1979 69 p refs

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

(ANL/OEPM-78-7) Avail: NTIS HC A04/MF A01

Progress status during the period from 4/15/78 to 8/31/78 is reported for each task in the Program's Work Breakdown Statement scheduled to be activated. The general considerations required for electric vehicle battery design are presented. The procedures followed in generating its ISOA design are described. DOE

N80-21863# Institute for Energy Analysis, Oak Ridge, Tenn. ARE THE ALTERNATIVE ENERGY STRATEGIES ACHIEVABLE?

Alvin M. Weinberg Sep. 1979 29 p refs

(Contract EY-76-C-05-0033)

(ORAU/IEA-79-15(0)) Avail: NTIS HC A03/MF A01

The constraints on penetration of energy technologies (time and information, net energy, and capital cost) are discussed. Related to the energy/time exchange is the economic cost of intermittency of energy supply. Renewable energy sources, particularly solar sources, are characteristically intermittent. To eliminate intermittency imposes a cost that must be considered in planning energy futures based on renewable sources. The article concludes that alternative energy strategies are achievable if they are subsidized by the government in the form of support for research, development and demonstration projects. R.E.S.

N80-21864# Tennessee Univ., Tullahoma. Space Inst. DEVELOPMENT PROGRAM FOR MHD DIRECT COAL-FIRED POWER GENERATION TEST FACILITY Quarterly Technical Progress Report, Apr. - Jun. 1978

J. B. Dicks, Y. C. L. Wu, and R. C. Attig 25 Jan. 1979 52 p refs

(Contract EY-76-C-01-1760)

(FE-1760-34) Avail: NTIS HC A04/MF A01

The following program activities are described: vitiation heater/comburntor development, NO/sub x/ testing, relative temperature measurement in support of combustion of combustor testing, progress in the design and construction of the coal fired flow facility, and materials experimentation to determine the rate of potassium loss from seeded coal slag at various temperatures. DOE

N80-21865# Oak Ridge National Lab., Tenn. Chemistry Div. MOLTEN CARBONATE FUEL CELL PROGRAM: EMF AND TEMPERATURE RELAXATION IN LiKCO 3 TILES. TRANSFERENCE CELL MEASUREMENTS Progress Report, 1 Jan. - 31 Mar. 1979

J. Braunstein, H. R. Bronstein, A. R. Manner, J. Nwalor, and Duane H. Smith Dec. 1979 18 p refs

(Contract W-7405-eng-26)

(ORNL/TM-7003) Avail: NTIS HC A02/MF A01

Progress was made in resolving the thermoelectric contributions to the relaxing electromotive forces (EMF) of electrolyzed LiKCO₃-LiAlO₂ tiles in a study of mass transport in molten carbonate fuel cell electrolytes. The thermoelectric effect was a measurable contribution, but only in the early stages of the relaxation. Preliminary measurements with the transference EMF cell are reported along with estimates of the transference number in LiKCO₂. DOE

N80-21866# Burns and Roe, Inc., Woodbury, N. Y. CONCEPTUAL DESIGN OF AN AFBC ELECTRIC POWER GENERATING PLANT. VOLUME 3: APPENDICES

E. Kimel, S. Panico, J. Bianchini, M. Novack, J. Armstrong, and J. Wysocki Feb. 1979 328 p

(Contract EF-77-C-01-2455)

(FE-2455-27-Vol-3) Avail: NTIS HC A15/MF A01

Aspects of the conceptual design of an atmospheric fluidized-bed combustion (AFBC) electric power generating plant are examined including: coal and limestone preparation; fluidized-bed combustor performance, boiler design, performance, and cost; the development of model facilities for boiler performance testing;

projections on the limestone feed requirements for a 600 MWe AFBC plant using subbituminous western coal; testing with such coals; and limestone availability in the U.S. DOE

N80-21869# Washington State Univ., Pullman. Environmental Research Center.**WASHINGTON STATE ENERGY USE PROFILE, 1960-1978**

G. Allen, C. Culver, E. Quarles, and J. Robertson Jun. 1979 145 p refs

(WAOENG-79-1) Avail: NTIS HC A07/MF A01

An overview of demographic and economic factors, energy use, energy resources, and prices is presented. Energy use by fuel type: petroleum, natural gas, and coal is covered along with electricity use, supply, and prices. Energy use disaggregated by end use and consuming sector is covered for the residential, commercial, industrial, agricultural, and transportation sectors. DOE

N80-21870# Prototech, Inc., Newton Highlands, Mass. ENERGY SAVINGS BY MEANS OF FUEL CELL ELECTRODES IN ELECTRO-CHEMICAL INDUSTRIES Progress Report,**1 Nov. - 31 Jan. 1978**

Robert J. Allen, Walter Juda, R. W. Lindstorm, and H. G. Petrow 19 Mar. 1979 72 p refs

(Contract ET-78-C-02-4881)

(COO-4881-6) Avail: NTIS HC A04/MF A01

Data are presented for air depolarized cathode performance in caustic half cells and hydrogen depolarization of anodes for the electrowinning of zinc. Investigation with air depolarized Pt cathodes in caustic half cells include: progress of the one year old RA19 type air diffusion cathode; data involving incorporation of a Hg/HgO reference electrode into the standard hardware; studies investigating cathode loading vs. cell performance; continued evaluation of thin, porous, conducting substrates; and cathode performance as a function of electrolyte concentration. In the area of zinc electrowinning, short term tests (4 hours) with pure hydrogen feeds were carried out under various cell operating conditions. In addition, tests with CO-containing hydrogen were initiated utilizing different levels of carbon monoxide poison. A preliminary economic evaluation for electric energy savings versus hydrogen costs is presented. DOE

N80-21871# Sandia Labs., Albuquerque, N. Mex. Component and Subsystem Development Div.**TECHNOLOGY ASSESSMENT: LINE-FOCUS CONCENTRATORS**

J. F. Banas Sep. 1979 11 p refs Presented at the Solar Industrial Process Heat Conf., San Francisco, 31 Oct. 1979

(Contract EY-76-C-04-0789)

(SAND-79-2221c; CONF-791024-10) Avail: NTIS HC A02/MF A01

Eleven solar thermal collectors and two systems are evaluated in order to define engineering development problems requiring solution to commercialization initiatives. The major engineering problems and near-term development emphasis are described. DOE

N80-21872# Los Alamos Scientific Lab., N. Mex. SOLAR ENERGY RESEARCH AT LASL Progress Report,**1 Oct. 1977 - 31 Mar. 1978**

Charles A. Bankston and Donald A. Nepper Oct. 1979 81 p refs

(Contract W-31-109-eng-36)

(LA-7741-PR) Avail: NTIS HC A05/MF A01

Research on solar collectors, studies and evaluations of both passive and active solar heating systems, and information dissemination activities are described. DOE

N80-21875# Pennsylvania State Univ., University Park. Dept. of Architectural Engineering.**PERFORMANCE OF A SOLAR ENERGY-ASSISTED HEAT PUMP HEATING SYSTEM: ANALYSIS AND CORRELATION OF FIELD-COLLECTED DATA M.S. Thesis**

Ronald Craig Williams Aug. 1979 219 p refs

(Contract EY-76-S-02-2704)

(COO-2704-T1) Avail: NTIS HC A10/MF A01

An analysis of building energy usage and thermal load for the Solar Building during the winter heating seasons of 1974-75 and 1975-76 is reported. The one-story office building is located in Albuquerque, New Mexico. Its mechanical heating and cooling equipment is categorized as a solar-assisted heat pump system consisting of solar collectors, water thermal storage, a water to water heat pump and five smaller water-to-air heat pump packaged units. Building energy usage examined with emphasis on the time of day energy was consumed and the source from which the energy was obtained. The rate of electrical energy consumption was found to be very dependent on building use. High rates of electrical energy usage during occupied periods required cooling during parts of even the coldest days. Mechanical equipment heating was found to vary as a function of building usage as well as a function of the indoor-outdoor temperature differential. DOE

N80-21876# Midwest Research Inst., Golden, Colo.
SOLAR POND FOR INDUSTRIAL PROCESS HEAT
 K. C. Brown, M. Edesess, and T. S. Jayadev Oct. 1979 7 p refs Presented at the Solar Ind. Process Heat Conf., Oakland, Calif., 31 Oct. - 2 Nov. 1979
 (Contract EG-77-C-01-4042)
 (SERI/TD-351-460; CONF-791024-11) Avail: NTIS HC A02/MF A01

Solar ponds offer perhaps the simplest technique for conversion of solar energy to thermal energy, which can be used for industrial process heat. It is unique in its capability in acting both as collector and storage. Further, the cost of solar pond per unit area is less than any active collectors available today. Combination of these economic and technical factors make solar ponds attractive as a fuel saver in industrial process heat (IPH) applications. Detailed calculations are given for solar ponds in two specific applications: providing hot water for aluminum can washing in a manufacturing plant and hot water for washing in a large commercial laundry. With the help of computer codes, it is shown that solar ponds are far more cost effective than any other solar IPH technology for these applications. DOE

N80-21877# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
LOW COST PERFORMANCE EVALUATION OF PASSIVE SOLAR BUILDINGS
 Larry S. Palmiter, L. Blair Hamilton, and Michael J. Holtz Oct. 1979 60 p refs
 (Contract EG-77-C-01-4042)
 (SERI/RR-63-223) Avail: NTIS HC A04/MF A01

An approach to low cost instrumentation and performance evaluation of passive solar heated buildings is presented. Beginning with a statement of the need for a low cost approach, a minimum list of measured quantities necessary to compute a set of recommended performance factors is developed. Conflicts and confusion surrounding the definition of various performance factors are discussed and suggestions are made for dealing with this situation. Available instrumentation and data processing equipment is presented. The recommended system would monitor approximately ten variables and compute numerous performance factors on site at a projected system cost of less than \$3,000 per installation. DOE

N80-21879# Berkeley Solar Group, Calif.
PERFORMANCE MONITORING OF A PASSIVE SOLAR HEATED HOUSE, STOCKTON, CALIFORNIA Interim Report
 Anthony Wexler Sep. 1979 50 p refs Sponsored by EPRI (EPRI-ER-1177) Avail: NTIS HC A03/MF A01

The data acquisition system used in monitoring the performance of the passive solar demonstration home in Stockton, California is described. Details about the data logger, the sensors, and the installation procedure are given. The house is briefly described and some of the problems encountered in the project are discussed. DOE

N80-21880# Technische Univ., Berlin (West Germany). Institut fuer Luft- und Raumfahrt.

STUDY ON EUROPEAN ASPECTS OF SOLAR POWER SATELLITES, VOLUME 1 Final Report
 J. Ruth and W. Westphal Jun. 1979 137 p refs
 (Contract ESA-3705/78-F-DK(SC))
 (ESA-CR(P)-1266) Avail: NTIS HC A07/MF A01

A study on implications of the potential electricity supply for Western Europe by Solar Power Satellites (SPS) and of their implementation problems around the turn of the century is presented. Three objectives in this scope have been pursued to provide a decision platform for on-going study and research activities: (1) to establish an information base including relevant data collection and basic SPS-systems understanding; (2) to identify and preliminary assess specific European problems of SPS utilization; and (3) to accomplish recommendations for early study activities of particular European concern. The last item is directly derived from the evaluations of the second study objective and must be seen in the context with SPS activities of the USA. It is concluded that the special European environment calls for special European utilization feasibility analyses, while the principal technical feasibility of a SPS-system should be taken over from U.S. studies. Moreover, if the USA stops its activities, an implementation of a SPS-system for Western Europe would be impractical in the considered time frame (2000-2030). Author (ESA)

N80-21881# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
TORSIONAL OSCILLATIONS OF THE ROTOR DISC FOR HORIZONTAL AXIS WIND TURBINES WITH HINGED OR TEETERED BLADES, PART 12
 Lennart S. Hultgren (MIT) 23 Aug. 1979 39 p refs
 (Contract SWEDBESD-5061.012)
 (FFA-TN-AU-1499-PT-12) Avail: NTIS HC A03/MF A01

The coupling of torsional oscillations of the rotor disc and the blade motions was analyzed for horizontal axis wind turbine hinged or teetered blades. The blades and the tower were assumed to be perfectly rigid. The vibrational analysis was linear and the antisymmetric blade flapping motion was found to be decoupled. Expressions for the eigenfrequencies of the system were obtained. Analytical solutions were constructed for forced vibrations due to gravity, wind shear and tower shadow. Large resonant torsional responses were found to be possible. Numerical examples are presented. Author (ESA)

N80-21883# International Science and Technology Inst., Inc., Washington, D. C.
HYDRO FOR THE EIGHTIES: BRINGING HYDROELECTRIC POWER TO LOW INCOME PEOPLE, THE WORK BOOK. A SLIDE PRESENTATION: AUDIO CASSETTE AND WORKBOOK
 Sep. 1979 44 p
 (Contract CSA-B9AA-007)
 (PB80-103948; CSA/LN-2435) Avail: NTIS HC A03/MF A01 CSCL 10B

The rationale for developing low cost hydroelectric power is presented. Simplified descriptions of techniques for use by community groups to evaluate prospects for small hydro development are given. The pre-feasibility or reconnaissance stage is presented in a step-by-step form. Feasibility studies, licensing and financing procedures are outlined with guidelines identified. GRA

N80-21884# Oklahoma Univ., Norman. Science and Public Policy Program.
ENERGY FROM THE WEST: IMPACT ANALYSIS REPORT, VOLUME 1: INTRODUCTION AND SUMMARY Final Report, Jul. 1975 - Oct. 1979

Irvin L. White, Michael A. Chartock, R. Leon Leonard, Steven C. Ballard, Martha W. Gilliland, Edward J. Malecki, Edward B. Rappaport, Frank J. Calzonetti, Mark S. Eckert, Timothy A. Hall et al Mar. 1979 185 p refs
 (Contract EPA-68-01-1916)
 (PB80-113566; EPA-600/7-79-082A) Avail: NTIS HC A09/MF A01 CSCL 10A

The results of impact analyses conducted as a part of a three year technology assessment of the development of six

N80-21885

energy resources (coal, geothermal, natural gas, oil, oil shale and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah and Wyoming) during the period 1975-2000 are reported. Both site-specific and regional impact analysis results are summarized. GRA

N80-21885# National Bureau of Standards, Washington, D.C. **DATA REQUIREMENTS AND THERMAL PERFORMANCE EVALUATION PROCEDURES FOR SOLAR HEATING AND COOLING SYSTEMS**

Elmer R. Streed, ed., J. Lemming, Ove Jorgensen, Per Isakson, and Guy-Roland Perrin Aug. 1979 87 p refs Sponsored in part by DOE Prepared in cooperation with Technical Univ. of Denmark, Lyngby., Royal Inst. of Tech., Stockholm, and Ecole Polytechnique Federale de Lausanne, Switzerland (NBS Proj. 7422413)

(PB80-120173; NBSIR-80-1980) Avail: NTIS HC A05/MF A01 CSCL 13A

Standardized nomenclature and procedures are presented to serve as a guide to monitor and evaluate research or demonstration type solar hot water or heated and/or cooled systems, components, and buildings. Performance factors, data requirements, measurement parameters, and data analysis methods are described for typical solar energy systems. GRA

N80-21886# General Accounting Office, Washington, D. C. Energy and Minerals Div.

HYDROPOWER, AN ENERGY SOURCE WHOSE TIME HAS COME AGAIN

11 Jan. 1980 96 p

(PB80-127715; EMD-80-30) Avail: NTIS HC A05/MF A01 CSCL 10B

Recent price increases in imported oil demonstrate the urgency for the U.S. to rapidly develop its renewable resources. One such renewable resource for which technology is available now is hydropower. Studies indicate that hydropower potential, particularly at existing dam sites, can save the country hundreds of thousands of barrels of oil per day. But problems and constraints-economic, environmental, institutional, and operational-limit is full potential. Federal programs have had little impact on helping to bring hydro projects on line. Specifically, the Department of Energy's Small Hydro Program could do more to overcome hydro constraints and problems through an effective outreach program and more emphasis on demonstration projects. GRA

N80-21888# AiResearch Mfg. Co., Torrance, Calif.

FLYWHEEL ENERGY STORAGE SWITCHER. VOLUME 1: STUDY SUMMARY AND DETAILED DESCRIPTION OF ANALYSIS Final Report, Sep. 1977 - Jan. 1979

L. M. Cook, W. T. Curran, R. McConnell, and A. K. Smith Apr. 1979 442 p refs

(Contract DOT-FR-777-4247-1)

(PB80-121478; FRA/ORD-79/20.1-Vol.1;

AiResearch-79-15651-1) Avail: NTIS HC A19/MF A01 CSCL 13F

The application of flywheel energy storage to the railroad switchyard locomotive was studied to determine the practicality and viability of such a system. The system, as originally conceived, required the use of separately excited traction motors and a major task of the study was to test separately excited version of the Electro-Motive Division's D77 traction motor. The attractiveness of the system is very dependent on the operational scenario of the switching locomotive. The operation of locomotives at three flatyards were studied, Dillard (Southern Railway System), Baldwin (Seaboard Coast Line), and Whitefish (Burlington Northern). Also, a large amount of data concerning the operation environment of switching locomotives was collected. It is concluded that a boxcar was required to carry the energy storage unit because no room existed on the locomotive. This, combined with the increased auxiliary load, results in the same energy consumption with or without the FESS system, for a typical flatyard operation in spite of the energy recuperated and reused. Brake maintenance savings, although significant, are not sufficient to give an attractive return on investment. GRA

N80-21889# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

ENERGY PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY Quarterly Report, Jul. - Sep. 1979

Oct. 1979 25 p refs Sponsored in part by DOE

(PB80-125651; JHU/APL/EQR/79-3) Avail: NTIS HC A02/MF A01 CSCL 10A

Work in developing energy resources, utilization concepts, and storage methods is reported. The first section, geothermal energy development planning, reports progress of various geothermal-related tasks. The tasks include the ongoing Atlantic Coastal Plain Geothermal Energy Market Survey, Delmarva Geothermal Development Prospectus, analysis geothermal energy at Crisfield, Md., analysis of the Crisfield well data, and comments on limited tasks. The second section, operational research, hydroelectric power development, contains a report on the survey of smallscale hydroelectric in the southeastern states and an analysis of institutional, legal, environmental, and economic factors. Landfill methane recovery and liquefied natural gas safety are also discussed. GRA

N80-21896# Industrial Environmental Research Lab., Research Triangle Park, N. C.

POLLUTION CONTROL PRACTICES, FUEL CONVERSION AND ITS ENVIRONMENTAL EFFECTS

H. Gold (Water Purification Associates, Cambridge, Mass.), J. A. Nardella (DOE, Germantown, Md.), and C. A. Vogel Aug. 1979 9 p refs Repr. from Chem. Engineering Progr., v. 75, no. 8.

Aug. 1979 p 58-64 Presented at AIChE, Miami Beach, Fla. Nov. 1978

(PB80-119704; EPA-600/J-79-032) Avail: NTIS HC A02/MF A01 CSCL 13B

Water-related effects that could be expected from siting specific conversion plants at given locations in the major coal and oil shale bearing regions of the U.S. were investigated. The synthetic fuel technologies examined include: coal gasification to convert coal to pipeline gas; coal liquefaction to convert coal to low-sulfur fuel oil; coal refining to produce a de-ashed, low-sulfur solvent-refined (clean) coal; and oil shale retorting to produce synthetic crude. The results presented include the range of water requirements, the conditions for narrowing the range and optimizing the use of water, the ranges of residual solid wastes, and the cost and energy requirements for wastewater treatment. GRA

N80-21912# PEDCo-Environmental, Inc., Cincinnati, Ohio.

OVERVIEW OF POLLUTION FROM COMBUSTION OF FOSSIL FUELS IN BOILERS OF THE UNITED STATES Final Report, Jan. - Jun. 1979

P. W. Spate and T. W. Devitt Oct. 1979 69 p refs

(Contract EPA-68-02-2603)

(PB80-124969; EPA-600/7-79-233) Avail: NTIS HC A04/MF A01 CSCL 13B

The fossil-fuel-fired boiler population of the U.S. are described. Data is given on the number and capacity of boilers for categories most relevant to producing pollution. Information presented includes: type of fuel burned (coal, residual oil, distillate oil, natural gas); usage sector (utility, industrial, commercial); size category (less than 25 million Btu/hr, 25-250 million Btu/hr, greater than 250 million Btu/hr); and heat transfer configuration (water tube, fire tube, cast iron). Fuel consumption data are presented for each type of fuel burned in each usage sector. These data are used to estimate the amount of sulfur oxide, nitrogen oxide, and particulate air emissions produced by boiler operation. Other air pollutants are discussed qualitatively. Solid waste and water pollution from boiler operation is discussed generally. GRA

N80-21913# Research Triangle Inst., Research Triangle Park, N. C.

SYMPOSIUM PROCEEDINGS: ENVIRONMENTAL ASPECTS OF FUEL CONVERSION TECHNOLOGY, IV Final Report, Sep. 1978 - Sep. 1979

Franklin A. Ayer, comp. and N. Stuart Jones, comp. Sep. 1979
 572 p refs Conf. held at Hollywood, Fla., Apr. 1979
 (Contract EPA-68-02-3132)
 (PB80-134729; EPA-600/7-79-217) Avail: NTIS
 HC A24/MF A01 CSCL 21D

The proceedings document presentations made at the symposium on Environmental Aspects of Fuel Conversion Technology. The symposium acted as a colloquium for discussion of environmentally related information on coal gasification and liquefaction. The program included sessions on program approach, environmental assessment, and control technology development.
 GRA

N80-21955# SRI International Corp., Menlo Park, Calif.
ESTIMATION OF WIND CHARACTERISTICS AT POTENTIAL WIND ENERGY CONVERSION SITES

Oct. 1979 149 p refs Prepared for Battelle Pacific Northwest Lab., Sequim, Wash.
 (Contract EY-76-C-06-1830)
 (PNL-3074) Avail: NTIS HC A07/MF A01

The development and application of a method for determining wind characteristics at candidate wind energy conversion sites where no available historical data exists are described. The method uses a mass consistent wind flow model (COMPLEX) to interpolate between stations where wind data are available. The COMPLEX model incorporates the effects of terrain features and airflow. The procedure requires acquisition and merger of wind data from three to five stations, application of COMPLEX to each of the seven to eleven eigenvectors, reconstruction of the hourly interpolated winds at the site from the eigenvector solutions, and estimating the wind characteristics from the simulated hourly values. Possible improvements to the procedure are discussed.
 DOE

N80-22083*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

POTENTIALITIES OF TEC TOPPING: A SIMPLIFIED VIEW OF PARAMETRIC EFFECTS

James F. Morris 1980 21 p refs Presented at Intern. Conf. on Plasma Sci., Madison, Wisc., 19-21 May 1980; sponsored by IEEE
 (Contract EC-77-A-31-1062)
 (NASA-TM-81468; DOE/NASA/1062-80/5; E-399) Avail: NTIS HC A02/MF A01 CSCL 10A

An examination of the benefits of thermionic-energy-conversion (TEC)-topped power plants and methods of increasing conversion efficiency are discussed. Reductions in the cost of TEC modules yield direct decreases in the cost of electricity (COE) from TEC-topped central station power plants. Simplified COE, overall-efficiency charts presented illustrate this trend. Additional capital-cost diminution results from designing more compact furnaces with considerably increased heat transfer rates allowable and desirable for high temperature TEC and heat pipes. Such improvements can evolve of the protection from hot corrosion and slag as well as the thermal expansion compatibilities offered by silicon-carbide clads on TEC-heating surfaces. Greater efficiencies and far fewer modules are possible with high-temperature, high-power-density TEC: This decreases capital and fuel costs much more and substantially increases electric power outputs for fixed fuel inputs. In addition to more electricity, less pollution, and lower costs, TEC topping used directly in coal-combustion products contributes balance-of-payment gains. M.G.

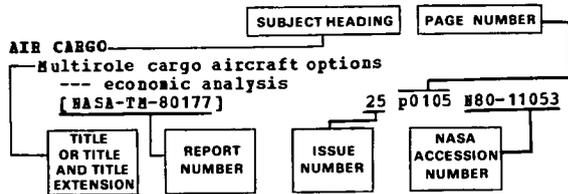
N80-22128# Bradford National Corp., Washington, D.C.
ADVANCED AUTOMOTIVE PROPULSION SYSTEMS: INCENTIVE FINANCING

Washington, D. C. DOE Feb. 1979 60 p refs
 (Contract EM-78-C-01-5181)
 (CONS-5181-1) Avail: NTIS HC A04/MF A01

The need for Federal guarantees of financial obligations for advanced automotive propulsion systems research, development, demonstrations, and commercial availability was surveyed in order to facilitate development and rapid implementation of AAPS energy conservation programs. Results of the survey are presented along with a background review of the complexities of AAPS and of financial incentives. Conclusions and recommendations are given
 J.M.S.

SUBJECT INDEX

Typical Subject Index Listing



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 26 p0210 A80-23518
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 26 p0210 A80-23519

PROJECTIONS OF ENHANCED OIL RECOVERY, 1985 - 1995

Joan Heinkel Sep. 1979 43 p
(DOE/EIA-0183/11; TR/ES/79-30) Avail: NTIS
HC A03/MF A01

The production potential from thermal recovery methods, miscible and immiscible gas flooding, and chemical flooding methods were estimated. It was assumed that existing EOR technology is conventionally applied requiring a 10 percent real after tax rate of return similar to that assumed for conventional recovery method. Five alternative price paths for world supplies of crude oil were investigated. Supply possibilities from these enhanced methods are estimated as 0.9 million bbl/d in 1985 and show no variation despite the \$6 range in price among the scenarios. Although thermal recovery techniques provide the bulk of production in the 1985-1995, they should decline in importance over time, providing 52 to 57 percent of ultimate recovery. Gas flooding will increase production over time to account for 37 to 41 percent of ultimate recovery and chemical flooding accounts for 6 to 7 percent. DOE

N80-21827# General Accounting Office, Washington, D. C. Energy and Minerals Div.

GEOTHERMAL ENERGY: OBSTACLES AND UNCERTAINTIES IMPEDE ITS WIDESPREAD USE

18 Jan. 1980 51 p refs
(PB80-134430; EMD-80-36) Avail: NTIS HC A04/MF A01
CSCL 081

This report to Congress assesses the development and potential of geothermal energy and discusses Federal actions needed to help accelerate geothermal development and use. GRA

N80-21828* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

WIND WHEEL ELECTRIC POWER GENERATOR Patent

John W. Kaufman, inventor (to NASA) Issued 4 Mar. 1980
8 p Filed 24 Feb. 1978 Supersedes N78-22469 (16 - 13,
p 2137)

(NASA-Case-MFS-23515-1; US-Patent-4,191,505;
US-Patent-Appl-SN-880726; US-Patent-Class-415-2;
US-Patent-Class-415-101) Avail: U S Patent and Trademark
Office CSCL 10B

Wind wheel electric power generator apparatus includes a housing rotatably mounted upon a vertical support column. Primary and auxiliary funnel-type, venturi ducts are fixed onto the housing for capturing wind currents and conducting to a bladed wheel adapted to be operatively connected with the generator apparatus. Additional air flows are also conducted onto the bladed wheel; all of the air flows positively effecting rotation of the wheel in a cumulative manner. The auxiliary ducts are disposed at an acute angle with respect to the longitudinal axis of the housing, and this feature, together with the rotatability of the housing and the ducts, permits capture of wind currents within a variable directional range.

Official Gazette of the U.S. Patent and Trademark Office

N80-21830# Brookhaven National Lab., Upton, N. Y. REVIEW OF RECENT RESEARCH ON ENERGY STORAGE IN RESIDENTIAL SOLAR TOTAL ENERGY SYSTEMS

Richard W. Leigh May 1979 15 p refs
(Contract EY-76-C-02-0016)
(BNL-51012) Avail: NTIS HC A02/MF A01

Current and recent research relevant to residential applications of solar total energy are reviewed. For each project or study, the types of energy storage devices chosen and the methods used to integrate them with solar collectors and backup devices are emphasized. Several general conclusions are distilled from the studies to guide subsequent research. DOE

N80-21831*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

AMPLIFIED WIND TURBINE APPARATUS Patent Application

William N. Myers, inventors (to NASA) and Leopold A. Hein
Filed 12 Mar. 1980 16 p

(NASA-Case-MFS-23830-1; US-Patent-Appl-SN-129780) Avail:
NTIS HC A02/MF A01 CSCL 10A

An amplified wind turbine apparatus is disclosed wherein ambient inlet air is prerotated in an air rotation chamber having a high pressure profile. A second rotation chamber adjacent and downstream of the turbine has a low pressure core profile whereby flow across the turbine is accelerated and thereafter exits the turbine apparatus through a draft anti-interference device. The draft device eliminates interference with ambient winds at the outlet of the turbine apparatus. Pivotable vanes controlled in response to prevailing wind direction admit air to the chambers and aid in imparting rotation. NASA

N80-21833*# Westinghouse Research and Development Center, Pittsburgh, Pa.

PHASE 2 OF THE ARRAY AUTOMATED ASSEMBLY TASK FOR THE LOW COST SOLAR ARRAY PROJECT Final Report, 1 Oct. 1978 - 30 Oct. 1979

R. B. Campbell, J. R. Davis, J. W. Ostroski, P. Rai-Choudhury, A. Rohatgi, E. J. Seman, and R. E. Stapleton 1979 151 p
refs Prepared for JPL and DOE

(Contracts NAS7-100; JPL-954873)
(NASA-CR-162628; DOE/JPL-954873-79/08) Avail: NTIS
HC A08/MF A01 CSCL 10A

The process sequence for the fabrication of dendritic web silicon into solar panels was modified to include aluminum back surface field formation. Plasma etching was found to be a feasible technique for pre-diffusion cleaning of the web. Several contacting systems were studied. The total plated Pd-Ni system was not compatible with the process sequence; however, the evaporated TiPd-electroplated Cu system was shown stable under life testing. Ultrasonic bonding parameters were determined for various interconnect and contact metals but the yield of the process was not sufficiently high to use for module fabrication at this time. Over 400 solar cells were fabricated according to the modified sequence. No sub-process incompatibility was seen. These cells were used to fabricate four demonstration modules. A cost analysis of the modified process sequence resulted in a selling price of \$0.75/peak watt. R.E.S.

N80-21835*# City of Huntsville, Ala. SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT THE SENIOR CITIZEN CENTER, HUNTSVILLE, ALA. BAMA Final Report

Feb. 1980 140 p Sponsored by NASA
(Contract EG-77-A-01-4071)

(NASA-CR-161384) Avail: NTIS HC A07/MF A01 CSCL 10B
The solar energy system installed at the Huntsville Senior Citizen Center is described. Detailed drawings of the complete system and discussions of the planning, the hardware, recommendations, and other pertinent information are presented. R.E.S.

N80-21836*# IBM Federal Systems Div., Huntsville, Ala. SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION: SEASONAL REPORT FOR IBM SYSTEM 2, TOGUS, MAINE Contractor Report, May 1978 - Apr. 1979

Jan. 1980 68 p refs Sponsored in part by DOE
(Contract NAS8-32036)
(NASA-CR-161383) Avail: NTIS HC A04/MF A01 CSCL
10B

The solar energy system, SIMS Prototype System 2, was designed to supply domestic hot water to single family residences. The system consists of flat plate collectors, silicone working fluid, storage tanks, pumps, heat exchanger, controls, and associated plumbing. The long term field performance of the installed system was analyzed and the results are described. R.E.S.

N80-21837*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio. FLAME TUBE PARAMETRIC STUDIES FOR CONTROL OF FUEL BOUND NITROGEN USING RICH-LEAN TWO-STAGE COMBUSTION

Donald F. Schultz and Gary Wolfbrandt 1980 25 p refs
Presented at Western States Sect. of the Combust. Inst. of Spring

N80-21838

Meeting, Irvine, Calif., 21-22 Apr. 1980
(Contract EF-77-A-01-2593)
(NASA-TM-81472; DOE/NASA/2593-80/15; E-405) Avail:
NTIS HC A02/MF A01 CSCL 21B

An experimental parametric study of rich-lean two-stage combustion in a flame tube is described and approaches for minimizing the conversion of fuel-bound nitrogen to nitrogen oxides in a premixed, homogeneous combustion system are evaluated. Air at 672 K and 0.48 MPa was premixed with fuel blends of propane, toluene, and pyridine at primary equivalence ratios ranging from 0.5 to 2.0 and secondary equivalence ratios of 0.5 to 0.7. Distillates of SRC-II, a coal syncrude, were also tested. The blended fuels were proportioned to vary fuel hydrogen composition from 9.0 to 18.3 weight percent and fuel nitrogen composition from zero to 1.5 weight percent. Rich-lean combustion proved effective in reducing fuel nitrogen to NO sub x conversion; conversion rates up to 10 times lower than those normally produced by single-stage combustion were achieved. The optimum primary equivalence ratio, where the least NO sub x was produced and combustion efficiency was acceptable, shifted between 1.4 and 1.7 with changes in fuel nitrogen content and fuel hydrogen content. Increasing levels of fuel nitrogen content lowered the conversion rate, but not enough to avoid higher NO sub x emissions as fuel nitrogen increased. M.G.

N80-21838# Hughes Aircraft Co., Los Angeles, Calif.
HIGH EFFICIENCY SOLAR PANEL, PHASE 2, GALLIUM ARSENIDE Interim Report, 15 Sep. 1977 - 15 Jan. 1979
G. Vendura, S. Kamath, and G. Wolfe Jul. 1979 65 p refs
(Contract F33615-77-C-3150; AF Proj. 682J)
(AD-A079635; HAC-SCG-90324M; HAC-REF-E0773;
AFAPL-TR-79-2058) Avail: NTIS HC A04/MF A01 CSCL
10/2

This interim report presents the progress of the GaAs High Efficiency Solar Panel program (Phase II) goal of development of space qualified solar cells of 16 percent efficiency AMO during the period of September 1977 through January 1979. Results of development research involving the basic GaAs substrate, the epitaxial reactors, LPE growth processes, ohmic contacts/metalizations, welding capability, and environmental testing are included. Efforts to increase substrate size and fabrication yield to enhance the feasibility of larger scale GaAs solar cell production are also detailed. GRA

N80-21842# California Univ., Livermore. Lawrence Livermore Lab.
EFFECT OF A HEATED ATMOSPHERE ON THE TEMPERATURE DEPENDENCE OF THE TOTAL EMITTANCE OF BLACK CHROME SOLAR ABSORBER PIPES M.S. Thesis
Thomas Alexander Reitter Oct. 1979 79 p refs
(Contract W-7405-eng-48)
(UCRL-52851) Avail: NTIS HC A05/MF A01

An apparatus for measuring the total hemispherical emittance of pipes of length suitable for in a prototype solar collector is reported. The apparatus was used to measure the total hemispherical emittance as a function of temperature of black chrome, nickel, and bare steel surfaces, before and after exposure to heated humid or dry air atmospheres. Exposure to a heated atmosphere lowered the emittance of the black chrome surfaces on the order of 20%. Similar exposure increased the emittance of the bare steel surface significantly, but had no effect on the nickel surface. It was hypothesized that the lowering of the black chrome emittance is due to the oxidation and subsequent outgassing of carbon contaminants on and in the black chrome layer. The actual causes may be a combination of this and other effects. However, due to the complexity of the black chrome layer it was not possible to explain the changes in the black chrome emittance in terms of changes in the coating. DOE

N80-21846# Boeing Engineering and Construction, Seattle, Wash.
SOLAR CENTRAL RECEIVER PROTOTYPE HELIOSTAT, VOLUME 1 Final Technical Report
1 Jun. 1979 207 p refs
(Contract EG-77-C-03-1604)
(SAN-1604-1) Avail: NTIS HC A10/MF A01

A prototype heliostat design for a solar central receiver is presented in detail. The manufacturing installation, and maintenance procedures are described. DOE

N80-21847# Stearns-Roger Corp., Denver, Colo.
SOLAR THERMAL REPOWERING SYSTEMS INTEGRATION Final Report
L. J. Dubberly Aug. 1979 156 p refs Sponsored in part by SERI, Golden, Colo.
(Contract EG-77-C-01-4042)
(SERI/TR-8037-1) Avail: NTIS HC A08/MF A01

Solar repowering interface requirements for water/steam and salt or sodium-cooled central receivers are defined for unit sizes ranging from 50 MWe non-reheat to 350 MWe reheat. Balance of plant cost estimates are presented for each of six combinations of plant type, receiver and percent solar repowering. DOE

N80-21848# Midwest Research Inst., Golden, Colo.
ANALYSIS OF A HEAT EXCHANGER-THERMOELECTRIC GENERATOR SYSTEM
Jon Henderson 1979 7 p refs Presented at the 14th Intersoc. Energy Conversion Engineering Conference, Boston, 5-10 Aug. 1979
(Contract EG-77-C-01-4042)
(SERI/TP-35-253; CONF-790803-56) Avail: NTIS
HC A02/MF A01

Analysis of a thermoelectric generator (TEG) in an ocean thermal energy conversion (OTEC) application is presented. An analytic model was developed for describing the heat exchanger-TEG interactions. This model was used to illustrate limitations of applying conventional fixed junction temperature assumptions to systems experiencing significant temperature drops across the heat exchanger surfaces. Design methods were developed for determining the thermoelectric element geometry that produces maximum output power. Results show that a heat exchanger-TEG system may deliver about 100 W/sq m of heat exchanger surface. This compares favorably with conventional OTEC schemes. DOE

N80-21849# Brookhaven National Lab., Upton, N. Y.
USE OF EARTH COUPLING IN SOLAR ASSISTED HEAT PUMPS
P. D. Metz, E. A. Kush, and J. N. Andrews 1979 11 p refs
Presented at a Nordic Symp. on Earth Heat Pump Systems, Goteborg, Sweden, 15-16 Oct. 1979
(Contract EY-76-C-02-0016)
(BNL-26748; CONF-791119-1) Avail: NTIS
HC A02/MF A01

The use of thermal coupling between the earth and the storage element of a solar source heat pump system was investigated. Four buried tanks and five configurations of serpentine plastic pipe with various control strategies were studied. System heating and cooling performance, detailed earth temperature profiles, and soil thermal properties were measured. Experimental results were used to validate heat flow models. The integration of ground coupling with solar heat pump systems is explained, the tank and pipe field configurations are described, and the heat flow model development is outlined. The experimental results, are reported and are compared to model predictions. DOE

N80-21850# California Univ., Berkeley. Lawrence Berkeley Lab.
AEROSPACE TECHNOLOGY REVIEW FOR LBL WINDOW/PASSIVE SOLAR PROGRAM Final Report
R. Viswanathan Jun. 1979 388 p refs
(Contract W-7405-eng-48)
(LBL-9608; EEB-W-79-13) Avail: NTIS HC A17/MF A01

A review of aerospace literature to uncover material pertinent to the Window and Passive Solar Programs is reported. Areas covered are: optical shutters, soils, thermal storage and transfer, optical properties of materials and clouds, human engineering, high efficiency light sources and solid state electronics, thermal and optical properties of landscape and building materials, and measurement and diagnostic techniques. DOE

N80-21851# Lockheed Missiles and Space Co., Sunnyvale, Calif.
EVALUATION OF SELECTIVE ABSORBERS Semiannual Report

1979 12 p refs
 (Contracts DE-AC04-78CS-15361)
 (TP-5461) Avail: NTIS HC A02/MF A01

Six selective absorber materials were characterized with respect to initial optical properties and abbreviated environmental exposures. For the plated black chrome, uniformity was poor in terms of $a/sub s/$ and ϵ as measured on 1 sq ft panels. Short term environmental exposures caused no substantial changes in optical or physical properties of the materials. DOE

N80-21852# Argonne National Lab., Ill.
APPLICATION OF GLASS TECHNOLOGY TO NOVEL SOLAR ENERGY COLLECTORS

Kent A. Reed 1979 17 p refs Presented at Am. Sci. Glass Blowers Soc. Symp., Detroit, Mich., 29 Jun. 1979
 (Contract W-31-109-eng-38)
 (CONF-7906118-1) Avail: NTIS HC A02/MF A01

Various compound parabolic concentrator (CPC) configurations are described and the application of glass technology to CPC absorbers, evacuated receivers, and evacuated tube receivers are considered. Also a floodlamp collector concept and a fluorescent tube collector concept are discussed. DOE

N80-21853# California Univ., Livermore.
ECONOMIC ANALYSIS OF SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS. A METHODOLOGY TO DETERMINE ANNUAL REQUIRED REVENUE AND INTERNAL RATE OF RETURN

W. C. Dickinson and K. C. Brown 17 Aug. 1979 46 p refs
 (Contract W-7405-eng-48)
 (UCRL-52814) Avail: NTIS HC A03/MF A01

To permit an economic evaluation of solar industrial process heat systems, a methodology to determine the annual required revenue and the internal rate of return was developed. First, a format is provided to estimate the solar system's installed cost, annual operating and maintenance expenses, and net annual solar energy delivered to the industrial process. Then an expression is presented that gives the annual required revenue and the price of solar energy. The economic attractiveness of the potential solar investment can be determined by comparing the price of solar energy with the price of fossil fuel, both expressed in leveled terms. DOE

N80-21854# Sandia Labs., Albuquerque, N. Mex.
REVIEW OF SELECTED ON-SITE DOE SMALL SOLAR THERMAL POWER PLANT EXPERIMENTS

Robert L. Alvis 1979 12 p ref Presented at the Fourth Annual National Conf. on Technology for Energy, Albuquerque, N. Mex., 30 Oct. 1979
 (Contract EY-76-C-04-0789)
 (SAND-79-1040C; CONF-791052-1) Avail: NTIS HC A02/MF A01

Three solar power plants are reviewed that were developed in an effort to find an alternate energy source for powering irrigation pumps. Power generation by the conversion of solar energy is shown to be technically feasible in the construction and operation of these three solar thermal power systems. The thermal cycling inherent in solar energy is shown to be more stressful on the system components and requires special design attention to obtain satisfactory performance. The economic benefit of these one-of-a-kind systems are not competitive with the conventional power systems. However, predictions for similar systems in large production indicate that power could be generated for approximately 5 cents/kWh in the Southwest. Recent increases in conventional energy costs, and continuing component development, are combining to make solar power systems a potential near-term reality. DOE

N80-21855# California Univ., Livermore. Lawrence Livermore Lab.
COMPOSITE-LAMINATE FLYWHEEL-ROTOR DEVELOPMENT PROGRAM

S. V. Kulkarni 9 Nov. 1979 13 p refs
 (Contract W-7405-eng-48)
 (UCRL-83554) Avail: NTIS HC A02/MF A01

The tapered thickness Stodola rotor concept is considered with emphasis on improving the performance of the rotor. Topics discussed include: (1) redesigning the Stodola rotor to increase the energy density; (2) testing laminate coupons to establish the degree of strength anisotropy of various quasi-isotropic laminates; (3) spin testing of constant thickness, composite laminate rotors to establish a relationship between design data and failure speed; (4) developing a matched-metal-die compression molding process to fabricate thick, high fiber volume, low void content composite panels; and (5) exploring the feasibility of manufacturing low cost rotors from structural sheet molding compounds. DOE

N80-21856# Brookhaven National Lab., Upton, N. Y.
MULTI-OBJECTIVE ENERGY ANALYSIS

E. A. Cherniavsky Nov. 1979 29 p refs Presented at NATO Advanced Res. Inst. Conf., Upton, N.Y., 12 Nov. 1979
 (Contract EY-76-C-02-0016)
 (BNL-26882; CONF-791152-1) Avail: NTIS HC A03/MF A01

Analytic models, which are applied to energy planning problems in an effort to assess the probable impacts of alternative courses of action on vital social concerns such as the quality of the environment, the state of the economy, or extent of dependence on insecure foreign energy sources, were studied. The tradeoffs between different social objectives were identified and quantified. Associated problems are explored and discussed in the light of experience with applications to energy planning models. Conclusions are drawn concerning the most fruitful directions for future research in this area. DOE

N80-21857# Cambridge Systematics, Inc., Mass.
ANALYTIC PROCEDURES FOR URBAN TRANSPORTATION ENERGY CONSERVATION. VOLUME 1: SUMMARY OF FINDINGS AND METHODOLOGIES Final Report

J. H. Suhrbier and W. D. Byrne Apr. 1979 40 p refs
 (Contract EM-76-C-01-8628)
 (Cons-8626-T1-Vol-1) Avail: NTIS HC A03/MF A01

Analytical methodologies are described and illustrated for use by metropolitan planning organizations and other state and local transportation agencies in analyzing the energy conservation potential of candidate urban transportation measures. Quantitative methodologies oriented to carpooling, vanpooling, transit, pricing, traffic regulation and control, and auto ownership are provided based on the use of disaggregate behavioral travel demand models. Changes are indicated in trip frequency and distribution as well as in travel model, operating conditions, and vehicle miles of travel. Trip-based estimates of fuel consumption and vehicle emissions are included. Application of the developed methodologies was performed in cooperation with metropolitan planning organizations representing the Dallas-Fort Worth, San Francisco, and Denver urban areas. DOE

N80-21859# EcoSystems, Inc., McLean, Va.
POTENTIAL FOR SOLAR/CONSERVATION TECHNOLOGIES IN THE STATE OF WASHINGTON

David Baylon, J. Brautigam, H. Reichmuth, B. Boulter, S. Gross, A. Stewart, and S. Worthman 4 Apr. 1979 70 p refs
 (Contract EG-77-G-01-4099)
 (WAOENG-79-3) Avail: NTIS HC A04/MF A01

A data base for Washington State energy consumption by fuel type is presented and divided into energy end use temperatures and types. Solar/conservation technologies are classed according to their immediacy as options for use, cost effectiveness, current availability, and compatibility with intended uses. The effect of presently feasible solar conservation technologies on Washington State energy consumption, if fully deployed, amounts to approximately 15 percent of the total 1974 energy use. Agricultural, industrial, commercial and residential end uses are also discussed. DOE

N80-21860# Eltra Corp., Plymouth Meeting, Pa. C and D Batteries Div.

RESEARCH, DEVELOPMENT AND DEMONSTRATION OF LEAD-ACID BATTERIES FOR ELECTRIC VEHICLE PROPULSION Annual Report, 1978

Oct. 1979 69 p refs

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

(ANL/OEPM-78-7) Avail: NTIS HC A04/MF A01

Progress status during the period from 4/15/78 to 8/31/78 is reported for each task in the Program's Work Breakdown Statement scheduled to be activated. The general considerations required for electric vehicle battery design are presented. The procedures followed in generating its ISOA design are described. DOE

N80-21863# Institute for Energy Analysis, Oak Ridge, Tenn. ARE THE ALTERNATIVE ENERGY STRATEGIES ACHIEVABLE?

Alvin M. Weinberg Sep. 1979 29 p refs

(Contract EY-76-C-05-0033)

(ORAU/IEA-79-15(0)) Avail: NTIS HC A03/MF A01

The constraints on penetration of energy technologies (time and information, net energy, and capital cost) are discussed. Related to the energy/time exchange is the economic cost of intermittency of energy supply. Renewable energy sources, particularly solar sources, are characteristically intermittent. To eliminate intermittency imposes a cost that must be considered in planning energy futures based on renewable sources. The article concludes that alternative energy strategies are achievable if they are subsidized by the government in the form of support for research, development and demonstration projects. R.E.S.

N80-21864# Tennessee Univ., Tullahoma. Space Inst. DEVELOPMENT PROGRAM FOR MHD DIRECT COAL-FIRED POWER GENERATION TEST FACILITY Quarterly Technical Progress Report, Apr. - Jun. 1978

J. B. Dicks, Y. C. L. Wu, and R. C. Attig 25 Jan. 1979 52 p refs

(Contract EY-76-C-01-1760)

(FE-1760-34) Avail: NTIS HC A04/MF A01

The following program activities are described: vitiation heater/combustor development, NO/sub x/ testing, relative temperature measurement in support of combustion of combustor testing, progress in the design and construction of the coal fired flow facility, and materials experimentation to determine the rate of potassium loss from seeded coal slag at various temperatures. DOE

N80-21865# Oak Ridge National Lab., Tenn. Chemistry Div. MOLTEN CARBONATE FUEL CELL PROGRAM: EMF AND TEMPERATURE RELAXATION IN LiKCO 3 TILES, TRANSFERENCE CELL MEASUREMENTS Progress Report, 1 Jan. - 31 Mar. 1979

J. Braunstein, H. R. Bronstein, A. R. Manner, J. Nwalor, and Duane H. Smith Dec. 1979 18 p refs

(Contract W-7405-eng-26)

(ORNL/TM-7003) Avail: NTIS HC A02/MF A01

Progress was made in resolving the thermoelectric contributions to the relaxing electromotive forces (EMF) of electrolyzed LiKCO₃-LiAlO₂ tiles in a study of mass transport in molten carbonate fuel cell electrolytes. The thermoelectric effect was a measurable contribution, but only in the early stages of the relaxation. Preliminary measurements with the transference EMF cell are reported along with estimates of the transference number in LiKCO₂. DOE

N80-21866# Burns and Roe, Inc., Woodbury, N. Y. CONCEPTUAL DESIGN OF AN AFBC ELECTRIC POWER GENERATING PLANT. VOLUME 3: APPENDICES

E. Kimel, S. Panico, J. Bianchini, M. Novack, J. Armstrong, and J. Wysocki Feb. 1979 328 p

(Contract EF-77-C-01-2455)

(FE-2455-27-Vol-3) Avail: NTIS HC A15/MF A01

Aspects of the conceptual design of an atmospheric fluidized-bed combustion (AFBC) electric power generating plant are examined including: coal and limestone preparation; fluidized-bed combustor performance, boiler design, performance, and cost; the development of model facilities for boiler performance testing;

projections on the limestone feed requirements for a 600 MWE AFBC plant using subbituminous western coal; testing with such coals; and limestone availability in the U.S. DOE

N80-21869# Washington State Univ., Pullman. Environmental Research Center.**WASHINGTON STATE ENERGY USE PROFILE, 1960-1978**

G. Allen, C. Culver, E. Quarles, and J. Robertson Jun. 1979 145 p refs

(WAOENG-79-1) Avail: NTIS HC A07/MF A01

An overview of demographic and economic factors, energy use, energy resources, and prices is presented. Energy use by fuel type: petroleum, natural gas, and coal is covered along with electricity use, supply, and prices. Energy use disaggregated by end use and consuming sector is covered for the residential, commercial, industrial, agricultural, and transportation sectors. DOE

N80-21870# Prototech, Inc., Newton Highlands, Mass. ENERGY SAVINGS BY MEANS OF FUEL CELL ELECTRODES IN ELECTRO-CHEMICAL INDUSTRIES Progress Report,**1 Nov. - 31 Jan. 1978**

Robert J. Allen, Walter Juda, R. W. Lindstorm, and H. G. Petrow 19 Mar. 1979 72 p refs

(Contract ET-78-C-02-4881)

(COO-4881-6) Avail: NTIS HC A04/MF A01

Data are presented for air depolarized cathode performance in caustic half cells and hydrogen depolarization of anodes for the electrowinning of zinc. Investigation with air depolarized Pt cathodes in caustic half cells include: progress of the one year old RA19 type air diffusion cathode; data involving incorporation of a Hg/HgO reference electrode into the standard hardware; studies investigating cathode loading vs. cell performance; continued evaluation of thin, porous, conducting substrates; and cathode performance as a function of electrolyte concentration. In the area of zinc electrowinning, short term tests (4 hours) with pure hydrogen feeds were carried out under various cell operating conditions. In addition, tests with CO-containing hydrogen were initiated utilizing different levels of carbon monoxide poison. A preliminary economic evaluation for electric energy savings versus hydrogen costs is presented. DOE

N80-21871# Sandia Labs., Albuquerque, N. Mex. Component and Subsystem Development Div.**TECHNOLOGY ASSESSMENT: LINE-FOCUS CONCENTRATORS**

J. F. Banas Sep. 1979 11 p refs Presented at the Solar Industrial Process Heat Conf., San Francisco, 31 Oct. 1979

(Contract EY-76-C-04-0789)

(SAND-79-2221c; CONF-791024-10) Avail: NTIS HC A02/MF A01

Eleven solar thermal collectors and two systems are evaluated in order to define engineering development problems requiring solution to commercialization initiatives. The major engineering problems and near-term development emphasis are described. DOE

N80-21872# Los Alamos Scientific Lab., N. Mex.**SOLAR ENERGY RESEARCH AT LASL Progress Report, 1 Oct. 1977 - 31 Mar. 1978**

Charles A. Bankston and Donald A. Neeper Oct. 1979 81 p refs

(Contract W-31-109-eng-36)

(LA-7741-PR) Avail: NTIS HC A05/MF A01

Research on solar collectors, studies and evaluations of both passive and active solar heating systems, and information dissemination activities are described. DOE

N80-21875# Pennsylvania State Univ., University Park. Dept. of Architectural Engineering.**PERFORMANCE OF A SOLAR ENERGY-ASSISTED HEAT PUMP HEATING SYSTEM: ANALYSIS AND CORRELATION OF FIELD-COLLECTED DATA M.S. Thesis**

Ronald Craig Williams Aug. 1979 219 p refs

(Contract EY-76-S-02-2704)

(COO-2704-T1) Avail: NTIS HC A10/MF A01

An analysis of building energy usage and thermal load for the Solar Building during the winter heating seasons of 1974-75 and 1975-76 is reported. The one-story office building is located in Albuquerque, New Mexico. Its mechanical heating and cooling equipment is categorized as a solar-assisted heat pump system consisting of solar collectors, water thermal storage, a water to water heat pump and five smaller water-to-air heat pump packaged units. Building energy usage examined with emphasis on the time of day energy was consumed and the source from which the energy was obtained. The rate of electrical energy consumption was found to be very dependent on building use. High rates of electrical energy usage during occupied periods required cooling during parts of even the coldest days. Mechanical equipment heating was found to vary as a function of building usage as well as a function of the indoor-outdoor temperature differential. DOE

N80-21876# Midwest Research Inst., Golden, Colo. **SOLAR POND FOR INDUSTRIAL PROCESS HEAT**
K. C. Brown, M. Edesess, and T. S. Jayadev Oct. 1979 7 p refs Presented at the Solar Ind. Process Heat Conf., Oakland, Calif., 31 Oct. - 2 Nov. 1979
(Contract EG-77-C-01-4042)
(SERI/TD-351-460; CONF-791024-11) Avail: NTIS HC A02/MF A01

Solar ponds offer perhaps the simplest technique for conversion of solar energy to thermal energy, which can be used for industrial process heat. It is unique in its capability in acting both as collector and storage. Further, the cost of solar pond per unit area is less than any active collectors available today. Combination of these economic and technical factors make solar ponds attractive as a fuel saver in industrial process heat (IPH) applications. Detailed calculations are given for solar ponds in two specific applications: providing hot water for aluminum can washing in a manufacturing plant and hot water for washing in a large commercial laundry. With the help of computer codes, it is shown that solar ponds are far more cost effective than any other solar IPH technology for these applications. DOE

N80-21877# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst. **LOW COST PERFORMANCE EVALUATION OF PASSIVE SOLAR BUILDINGS**
Larry S. Palmiter, L. Blair Hamilton, and Michael J. Holtz Oct. 1979 60 p refs
(Contract EG-77-C-01-4042)
(SERI/RR-63-223) Avail: NTIS HC A04/MF A01

An approach to low cost instrumentation and performance evaluation of passive solar heated buildings is presented. Beginning with a statement of the need for a low cost approach, a minimum list of measured quantities necessary to compute a set of recommended performance factors is developed. Conflicts and confusion surrounding the definition of various performance factors are discussed and suggestions are made for dealing with this situation. Available instrumentation and data processing equipment is presented. The recommended system would monitor approximately ten variables and compute numerous performance factors on site at a projected system cost of less than \$3,000 per installation. DOE

N80-21879# Berkeley Solar Group, Calif. **PERFORMANCE MONITORING OF A PASSIVE SOLAR HEATED HOUSE, STOCKTON, CALIFORNIA Interim Report**
Anthony Wexler Sep. 1979 50 p refs Sponsored by EPRI (EPRI-ER-1177) Avail: NTIS HC A03/MF A01

The data acquisition system used in monitoring the performance of the passive solar demonstration home in Stockton, California is described. Details about the data logger, the sensors, and the installation procedure are given. The house is briefly described and some of the problems encountered in the project are discussed. DOE

N80-21880# Technische Univ., Berlin (West Germany). Institut fuer Luft- und Raumfahrt.

STUDY ON EUROPEAN ASPECTS OF SOLAR POWER SATELLITES, VOLUME 1 Final Report

J. Ruth and W. Westphal Jun. 1979 137 p refs
(Contract ESA-3705/78-F-DK(SC))
(ESA-CR(P)-1266) Avail: NTIS HC A07/MF A01

A study on implications of the potential electricity supply for Western Europe by Solar Power Satellites (SPS) and of their implementation problems around the turn of the century is presented. Three objectives in this scope have been pursued to provide a decision platform for on-going study and research activities: (1) to establish an information base including relevant data collection and basic SPS-systems understanding; (2) to identify and preliminary assess specific European problems of SPS utilization; and (3) to accomplish recommendations for early study activities of particular European concern. The last item is directly derived from the evaluations of the second study objective and must be seen in the context with SPS activities of the USA. It is concluded that the special European environment calls for special European utilization feasibility analyses, while the principal technical feasibility of a SPS-system should be taken over from U.S. studies. Moreover, if the USA stops its activities, an implementation of a SPS-system for Western Europe would be impractical in the considered time frame (2000-2030). Author (ESA)

N80-21881# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

TORSIONAL OSCILLATIONS OF THE ROTOR DISC FOR HORIZONTAL AXIS WIND TURBINES WITH HINGED OR TEETERED BLADES, PART 12

Lennart S. Hultgren (MIT) 23 Aug. 1979 39 p refs
(Contract SWEDBESD-5061.012)
(FFA-TN-AU-1499-PT-12) Avail: NTIS HC A03/MF A01

The coupling of torsional oscillations of the rotor disc and the blade motions was analyzed for horizontal axis wind turbine hinged or teetered blades. The blades and the tower were assumed to be perfectly rigid. The vibrational analysis was linear and the antisymmetric blade flapping motion was found to be decoupled. Expressions for the eigenfrequencies of the system were obtained. Analytical solutions were constructed for forced vibrations due to gravity, wind shear and tower shadow. Large resonant torsional responses were found to be possible. Numerical examples are presented. Author (ESA)

N80-21883# International Science and Technology Inst., Inc., Washington, D. C.

HYDRO FOR THE EIGHTIES: BRINGING HYDROELECTRIC POWER TO LOW INCOME PEOPLE, THE WORK BOOK. A SLIDE PRESENTATION: AUDIO CASSETTE AND WORKBOOK

Sep. 1979 44 p
(Contract CSA-B9AA-007)
(PB80-103948; CSA/LN-2435) Avail: NTIS HC A03/MF A01 CSCL 10B

The rationale for developing low cost hydroelectric power is presented. Simplified descriptions of techniques for use by community groups to evaluate prospects for small hydro development are given. The pre-feasibility or reconnaissance stage is presented in a step-by-step form. Feasibility studies, licensing and financing procedures are outlined with guidelines identified. GRA

N80-21884# Oklahoma Univ., Norman. Science and Public Policy Program.

ENERGY FROM THE WEST: IMPACT ANALYSIS REPORT. VOLUME 1: INTRODUCTION AND SUMMARY Final Report, Jul. 1975 - Oct. 1979

Irvin L. White, Michael A. Chartock, R. Leon Leonard, Steven C. Ballard, Martha W. Gilliland, Edward J. Malecki, Edward B. Rappaport, Frank J. Calzonetti, Mark S. Eckert, Timothy A. Hall et al Mar. 1979 185 p refs
(Contract EPA-68-01-1916)
(PB80-113566; EPA-600/7-79-082A) Avail: NTIS HC A09/MF A01 CSCL 10A

The results of impact analyses conducted as a part of a three year technology assessment of the development of six

N80-21885

energy resources (coal, geothermal, natural gas, oil, oil shale and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah and Wyoming) during the period 1975-2000 are reported. Both site-specific and regional impact analysis results are summarized. GRA

N80-21885# National Bureau of Standards, Washington, D.C. **DATA REQUIREMENTS AND THERMAL PERFORMANCE EVALUATION PROCEDURES FOR SOLAR HEATING AND COOLING SYSTEMS**

Elmer R. Streed, ed., J. Lemming, Ove Jorgensen, Per Isakson, and Guy-Roland Perrin Aug. 1979 87 p refs Sponsored in part by DOE Prepared in cooperation with Technical Univ. of Denmark, Lyngby., Royal Inst. of Tech., Stockholm, and Ecole Polytechnique Federale de Lausanne, Switzerland (NBS Proj. 7422413)

(PB80-120173; NBSIR-80-1980) Avail: NTIS HC A05/MF A01 CSCL 13A

Standardized nomenclature and procedures are presented to serve as a guide to monitor and evaluate research or demonstration type solar hot water or heated and/or cooled systems, components, and buildings. Performance factors, data requirements, measurement parameters, and data analysis methods are described for typical solar energy systems. GRA

N80-21886# General Accounting Office, Washington, D. C. Energy and Minerals Div.

HYDROPOWER, AN ENERGY SOURCE WHOSE TIME HAS COME AGAIN

11 Jan. 1980 96 p

(PB80-127715; EMD-80-30) Avail: NTIS HC A05/MF A01 CSCL 10B

Recent price increases in imported oil demonstrate the urgency for the U.S. to rapidly develop its renewable resources. One such renewable resource for which technology is available now is hydropower. Studies indicate that hydropower potential, particularly at existing dam sites, can save the county hundreds of thousands of barrels of oil per day. But problems and constraints-economic, environmental, institutional, and operational-limit is full potential. Federal programs have had little impact on helping to bring hydro projects on line. Specifically, the Department of Energy's Small Hydro Program could do more to overcome hydro constraints and problems through an effective outreach program and more emphasis on demonstration projects. GRA

N80-21888# AiResearch Mfg. Co., Torrance, Calif.

FLYWHEEL ENERGY STORAGE SWITCHER. VOLUME 1: STUDY SUMMARY AND DETAILED DESCRIPTION OF ANALYSIS Final Report, Sep. 1977 - Jan. 1979

L. M. Cook, W. T. Curran, R. McConnell, and A. K. Smith Apr. 1979 442 p refs

(Contract DOT-FR-777-4247-1)

(PB80-121478; FRA/ORD-79/20.1-Vol-1;

AiResearch-79-15651-1) Avail: NTIS HC A19/MF A01 CSCL 13F

The application of flywheel energy storage to the railroad switchyard locomotive was studied to determine the practicality and viability of such a system. The system, as originally conceived, required the use of separately excited traction motors and a major task of the study was to test separately excited version of the Electro-Motive Division's D77 traction motor. The attractiveness of the system is very dependent on the operational scenario of the switching locomotive. The operation of locomotives at three flatyards was studied, Dillard (Southern Railway System), Baldwin (Seaboard Coast Line), and Whitefish (Burlington Northern). Also, a large amount of data concerning the operation environment of switching locomotives was collected. It is concluded that a boxcar was required to carry the energy storage unit because no room existed on the locomotive. This, combined with the increased auxiliary load, results in the same energy consumption with or without the FESS system, for a typical flatyard operation in spite of the energy recuperated and reused. Brake maintenance savings, although significant, are not sufficient to give an attractive return on investment. GRA

N80-21889# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

ENERGY PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY Quarterly Report, Jul. - Sep. 1979

Oct. 1979 25 p refs Sponsored in part by DOE

(PB80-125651; JHU/APL/EQR/79-3) Avail: NTIS HC A02/MF A01 CSCL 10A

Work in developing energy resources, utilization concepts, and storage methods is reported. The first section, geothermal energy development planning, reports progress of various geothermal-related tasks. The tasks include the ongoing Atlantic Coastal Plain Geothermal Energy Market Survey, Delmarva Geothermal Development Prospectus, analysis geothermal energy at Crisfield, Md., analysis of the Crisfield well data, and comments on limited tasks. The second section, operational research, hydroelectric power development, contains a report on the survey of smallscale hydroelectric in the southeastern states and an analysis of institutional, legal, environmental, and economic factors. Landfill methane recovery and liquefied natural gas safety are also discussed. GRA

N80-21896# Industrial Environmental Research Lab., Research Triangle Park, N. C.

POLLUTION CONTROL PRACTICES, FUEL CONVERSION AND ITS ENVIRONMENTAL EFFECTS

H. Gold (Water Purification Associates, Cambridge, Mass.), J. A. Nardella (DOE, Germantown, Md.), and C. A. Vogel Aug. 1979 9 p refs Repr. from Chem. Engineering Progr., v. 75, no. 8,

Aug. 1979 p 58-64 Presented at AICHE, Miami Beach, Fla. Nov. 1978

(PB80-119704; EPA-600/J-79-032) Avail: NTIS HC A02/MF A01 CSCL 13B

Water-related effects that could be expected from siting specific conversion plants at given locations in the major coal and oil shale bearing regions of the U.S. were investigated. The synthetic fuel technologies examined include: coal gasification to convert coal to pipeline gas; coal liquefaction to convert coal to low-sulfur fuel oil; coal refining to produce a de-ashed, low-sulfur solvent-refined (clean) coal; and oil shale retorting to produce synthetic crude. The results presented include the range of water requirements, the conditions for narrowing the range and optimizing the use of water, the ranges of residual solid wastes, and the cost and energy requirements for wastewater treatment. GRA

N80-21912# PEDCo-Environmental, Inc., Cincinnati, Ohio. **OVERVIEW OF POLLUTION FROM COMBUSTION OF FOSSIL FUELS IN BOILERS OF THE UNITED STATES Final Report, Jan. - Jun. 1979**

P. W. Spaite and T. W. Devitt Oct. 1979 69 p refs

(Contract EPA-68-02-2603)

(PB80-124969; EPA-600/7-79-233) Avail: NTIS HC A04/MF A01 CSCL 13B

The fossil-fuel-fired boiler population of the U.S. are described. Data is given on the number and capacity of boilers for categories most relevant to producing pollution. Information presented includes: type of fuel burned (coal, residual oil, distillate oil, natural gas); usage sector (utility, industrial, commercial); size category (less than 25 million Btu/hr, 25-250 million Btu/hr, greater than 250 million Btu/hr); and heat transfer configuration (water tube, fire tube, cast iron). Fuel consumption data are presented for each type of fuel burned in each usage sector. These data are used to estimate the amount of sulfur oxide, nitrogen oxide, and particulate air emissions produced by boiler operation. Other air pollutants are discussed qualitatively. Solid waste and water pollution from boiler operation is discussed generally. GRA

N80-21913# Research Triangle Inst., Research Triangle Park, N. C.

SYMPOSIUM PROCEEDINGS: ENVIRONMENTAL ASPECTS OF FUEL CONVERSION TECHNOLOGY, IV Final Report, Sep. 1978 - Sep. 1979

Franklin A. Ayer, comp. and N. Stuart Jones, comp. Sep. 1979
 572 p refs Conf. held at Hollywood, Fla., Apr. 1979
 (Contract EPA-68-02-3132)
 (PB80-134729; EPA-600/7-79-217) Avail: NTIS
 HC A24/MF A01 CSCL 21D

The proceedings document presentations made at the symposium on Environmental Aspects of Fuel Conversion Technology. The symposium acted as a colloquium for discussion of environmentally related information on coal gasification and liquefaction. The program included sessions on program approach, environmental assessment, and control technology development.
 GRA

N80-21955# SRI International Corp., Menlo Park, Calif.
ESTIMATION OF WIND CHARACTERISTICS AT POTENTIAL WIND ENERGY CONVERSION SITES

Oct. 1979 149 p refs Prepared for Battelle Pacific Northwest Lab., Sequim, Wash.
 (Contract EY-76-C-06-1830)
 (PNL-3074) Avail: NTIS HC A07/MF A01

The development and application of a method for determining wind characteristics at candidate wind energy conversion sites where no available historical data exists are described. The method uses a mass consistent wind flow model (COMPLEX) to interpolate between stations where wind data are available. The COMPLEX model incorporates the effects of terrain features and airflow. The procedure requires acquisition and merger of wind data from three to five stations, application of COMPLEX to each of the seven to eleven eigenvectors, reconstruction of the hourly interpolated winds at the site from the eigenvector solutions, and estimating the wind characteristics from the simulated hourly values. Possible improvements to the procedure are discussed.

DOE

N80-22083*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

POTENTIALITIES OF TEC TOPPING: A SIMPLIFIED VIEW OF PARAMETRIC EFFECTS

James F. Morris 1980 21 p refs Presented at Intern. Conf. on Plasma Sci., Madison, Wisc., 19-21 May 1980; sponsored by IEEE

(Contract EC-77-A-31-1062)
 (NASA-TM-81468; DOE/NASA/1062-80/5; E-399) Avail:
 NTIS HC A02/MF A01 CSCL 10A

An examination of the benefits of thermionic-energy-conversion (TEC)-topped power plants and methods of increasing conversion efficiency are discussed. Reductions in the cost of TEC modules yield direct decreases in the cost of electricity (COE) from TEC-topped central station power plants. Simplified COE, overall-efficiency charts presented illustrate this trend. Additional capital-cost diminution results from designing more compact furnaces with considerably increased heat transfer rates allowable and desirable for high temperature TEC and heat pipes. Such improvements can evolve of the protection from hot corrosion and slag as well as the thermal expansion compatibilities offered by silicon-carbide clads on TEC-heating surfaces. Greater efficiencies and far fewer modules are possible with high-temperature, high-power-density TEC. This decreases capital and fuel costs much more and substantially increases electric power outputs for fixed fuel inputs. In addition to more electricity, less pollution, and lower costs, TEC topping used directly in coal-combustion products contributes balance-of-payment gains. M.G.

N80-22128# Bradford National Corp., Washington, D.C.

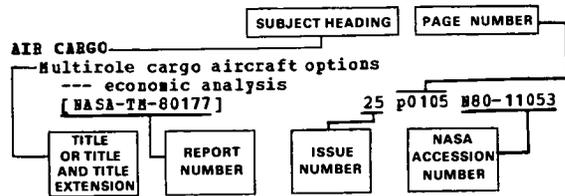
ADVANCED AUTOMOTIVE PROPULSION SYSTEMS: INCENTIVE FINANCING

Washington, D. C. DOE Feb. 1979 60 p refs
 (Contract EM-78-C-01-5181)
 (CONS-5181-1) Avail: NTIS HC A04/MF A01

The need for Federal guarantees of financial obligations for advanced automotive propulsion systems research, development, demonstrations, and commercial availability was surveyed in order to facilitate development and rapid implementation of AAPS energy conservation programs. Results of the survey are presented along with a background review of the complexities of AAPS and of financial incentives. Conclusions and recommendations are given
 J.M.S.

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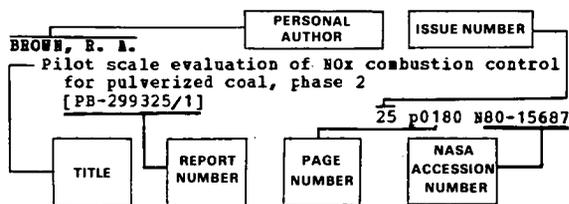
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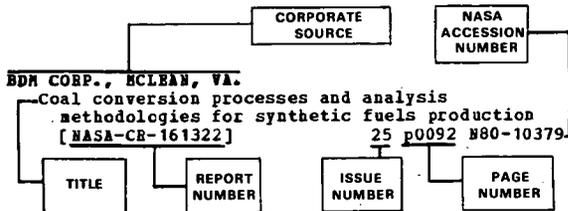
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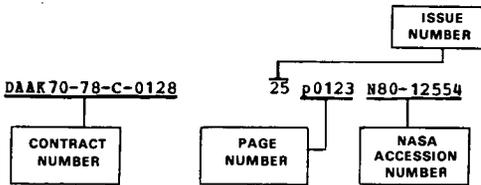
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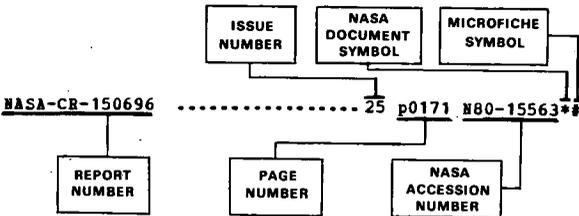
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1. Report No. NASA SP-7043 (26)	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Energy A Continuing Bibliography (Issue 26)		5. Report Date July 1980	6. Performing Organization Code
		8. Performing Organization Report No.	
7. Author(s)		10. Work Unit No.	
9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		11. Contract or Grant No.	
		13. Type of Report and Period Covered	
12. Sponsoring Agency Name and Address		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract This bibliography lists 1134 reports, articles, and other documents introduced into the NASA Scientific and Technical Information System from April 1, 1980 through June 30, 1980.			
17. Key Words (Suggested by Author(s)) Bibliographies Energy Conversion Energy Policy Solar Energy Wind Energy		18. Distribution Statement Unclassified - Unlimited	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 326	22. Price* \$15.00 HC

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