



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

ENTERING OUR SECOND DECADE

LOOKING TO THE FUTURE

Fusion Power Associates was incorporated August 16, 1979, with support from ten charter industrial members (six are still with us). Today, we have 38 corporate members and affiliates.

In late 1979, we expected the decade of the 1980's to be one of increased attention to the engineering and technology of fusion systems. That expectation remains unfulfilled due to subsequent decreased governmental interest in new energy technologies and declining fusion budgets. As one of our first Board members, Tihiro Ohkawa, remarked: "The objective of the fusion program in the 1980's is to survive."

Though little attention was given to engineering and technology, the decade of the 1980's did witness the successful accomplishment of the scientific missions embarked upon during the 1970's. The chart on page 3 clearly illustrates the achievements of magnetic fusion. Similar advances were made in inertial fusion. And there were many additional scientific accomplishments of which the fusion scientific community is rightfully proud.

The 1980's also witnessed the ascendance of the European and Japanese fusion programs as world leaders in fusion research, and the forging of an unprecedented level of international collaboration, the latter based in part on fusion endorsements from the Reagan-Gorbachev Summit meetings.

We have survived the 1980's. A new, high-level U.S. government review of fusion policy has begun. We hope that this review will lead to a renewed commitment to develop fusion to ensure our collective energy future.

JT-60 PROGRESS

The world's largest tokamak, the JT-60 in Japan, has successfully completed its first phase of operations and was recently shut down for extensive upgrading. Values of the plasma density-confinement time-temperature product ($n\tau T$) of $1.3 \times 10^{14} \text{cm}^{-3} \text{sec keV}$ were obtained using pellet injection--about double the value obtained in gas-fueled discharges. Experiments on lower hybrid current drive were also carried out using a newly-developed multi-junction type launcher. A current drive efficiency of $3 \times 10^{19} \text{m}^{-2} \text{A/W}$ was attained, an efficiency which approaches that required for ITER-class machines.

The upgraded machine, called JT-60U, is expected to begin operations about a year from now. It will be capable of 6 MA of plasma current in noncircular divertor deuterium plasmas and will be equipped with 40 MW of neutral beams, 8 MW of ICRF and 15 MW of lower hybrid power.

We congratulate our Japanese colleagues on their many successes in fusion. For further information contact Dr. Akira Oikawa, Japan Atomic Energy Research Institute, Tokai, Naka Ibaraki 319-11, Japan.

BILL ELLIS HONORED

Dr. William R. Ellis was recently awarded a Presidential Senior Executive Service Award. Bill is associate director for research at the U.S. Naval Research Laboratory and a former director of the Magnetic Mirror Systems Division at DOE. He was cited for his "career achievements in the management and execution of research and development programs of national importance."

In addition, he was credited with a series of administrative and management actions at NRL that reduced costs and improved laboratory operations.

IEEE HONORS BRUCE MONTGOMERY

Dr. D. Bruce Montgomery, associate director of the Massachusetts Institute of Technology Plasma Fusion Center and head of the Center's Technology and Engineering Division, has become the first recipient of the Annual Fusion Technology Award sponsored by the IEEE Nuclear and Plasma Sciences Society.

Dr. Montgomery received the award October 4 at the IEEE's annual symposium on fusion engineering, held this year in Knoxville, TN. He was cited "for pioneering contributions to high field magnet development for both the Alcator tokamaks, for broader fusion applications, and for excellence in engineering management and oversight, both at MIT and at a national level."

UCLA FUSION REACTOR REPORTS AVAILABLE

UCLA has published a report (UCLA-PPG-1274, Oct 1989) entitled "The Aries Tokamak Reactor Study," consisting of a collection of papers presented at the IEEE Symposium on Fusion Engineering.

The Aries study is a community effort to develop several visions of tokamaks as fusion power reactors. The aims are to determine the potential economics, safety, and environmental features of a range of possible tokamak reactors, and to identify physics and technology areas with the highest leverage for achieving the best tokamak reactor.

Another report, "The Titan Reversed-Field Pinch Fusion Reactor Study" (UCLA-PPG-1179 and 1180) contains two papers on the Titan study. The Titan Reversed-Field Pinch (RFP) fusion reactor study has been a multi-institutional research effort to determine the technical feasibility and key developmental issues for an RFP reactor operating at high power density. For copies of the reports or further information, contact Dr. Farrokh Najmabadi (213) 825-5435.

NEWS FROM KMS

KMS Fusion, Inc. was awarded a two-year \$3.37 million contract by NASA for the design and development of a sensor-based measurement instrumentation system for use in an unmanned research spacecraft currently scheduled for shuttle launch in 1994.

KMS has also recently completed and delivered a similar \$5.9 million instrument package to NASA Kennedy Space Center called the Orbital Acceleration Research Experiment (OARE) for installation on the Shuttle Orbiter Columbia.

CANADIAN TRITIUM AVAILABLE

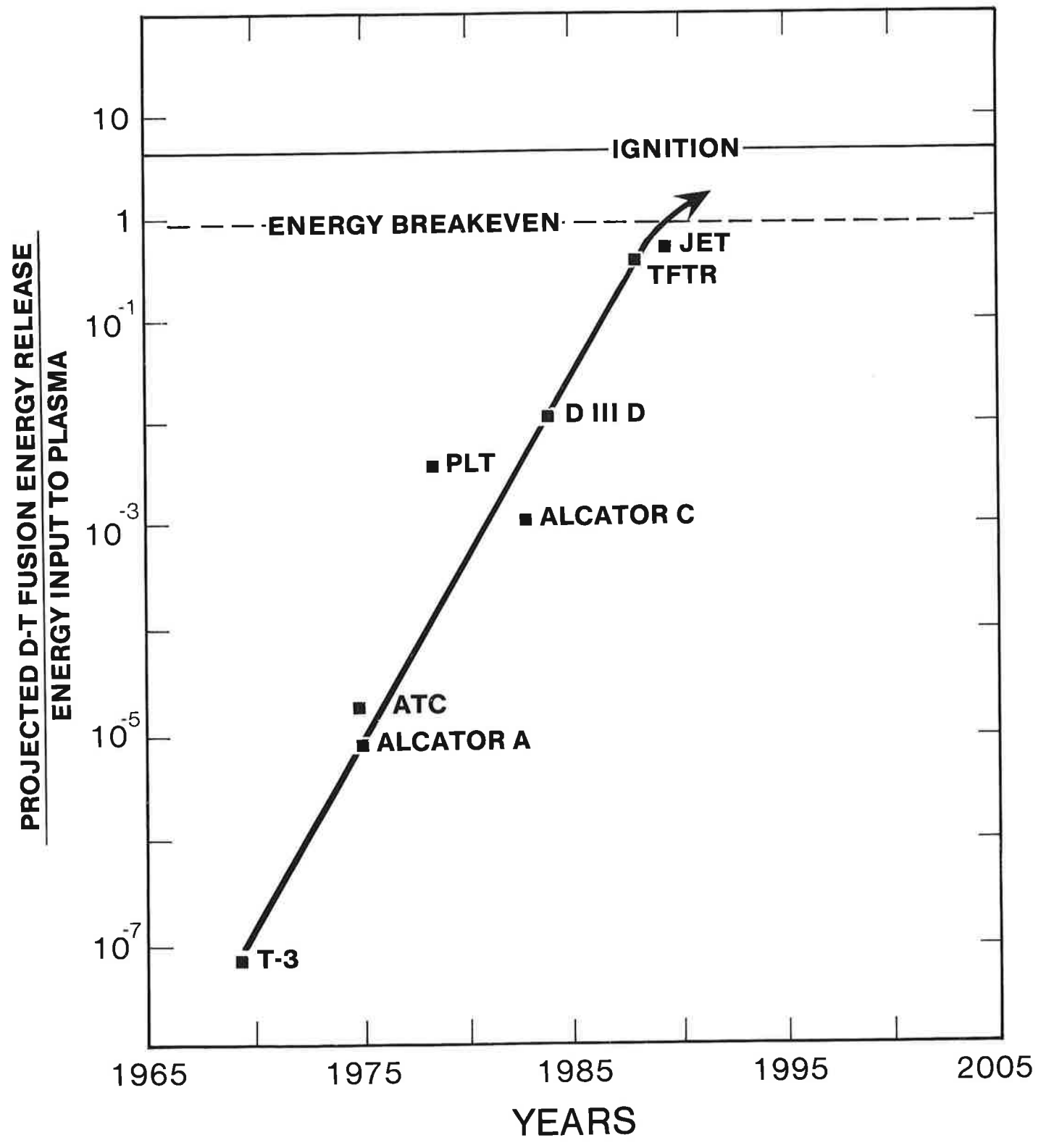
Canadian tritium may now be exported for approved end uses including government-sponsored fusion energy research. The Government of the Province of Ontario has authorized Ontario Hydro to sell tritium produced by its Darlington Tritium Removal Facility (TRF). On August 30, Provincial Energy Minister Lyn Mcleod announced the Ontario government's approval of tritium sales by Ontario Hydro, adding that any tritium sold "... will be used for peaceful purposes only."

Minister Mcleod specified three acceptable end uses for the tritium:

- Government-sponsored fusion energy research;
- Medical research;
- The manufacture in Canada of self-powered tritium lights.

For further information, contact Dr. Don Dautovich, CFFTP, 2700 Lakeshore Road West, Mississauga, Ontario, Canada, L5J 1K3, (416) 823-0200, or FAX (416) 823-8020.

PROGRESS IN ACHIEVING THE CONDITIONS REQUIRED FOR FUSION POWER



THANKS

As we end the decade of the 1980's and look forward to the 1990's, we at Fusion Power Associates wish to thank the many persons and organizations who have helped to make our efforts possible. We thank Al Trivelpiece and Nick Krall who, along with Steve Dean, signed the Articles of Incorporation back in 1979. We thank those who have served as Chairmen of the Board over the years: Nick Krall (1981-83), Bob Hirsch (1983-85), John Landis (1985-87), Harold Forsen (1987-89), Bob Iotti (1989-). We thank our individual affiliates, too numerous to list here. And we especially thank our member and affiliate organizations and their designated representatives listed below:

Richard Aamodt	Lodestar Research Corporation
Conrad Aas	Northern States Power Co.
Robert Alper	Varian Associates
Tom Batzer	Batzer Vacuum Technology Assoc., Inc.
Christian C. Bolta	Combustion Engineering, Inc.
Richard Bolton	Hydro-Quebec
Robert Botwin	Grumman Aerospace Corp.
Jimmy G. Crocker	EG&G Inc.
Don Dautovich	Ontario Hydro
John Davis	McDonnell Douglas Missile Systems Co.
F. David Doty	Doty Scientific, Inc.
Howard R. Drew	Texas Atomic Energy Research Foundation
Donald Ernst	Thermacore, Inc.
Robert Faron	Uranium Pechiney
Harold Forsen	Bechtel National, Inc.
Eric Gregory	Supercon, Inc.
William Grossmann	Science Applications International Corp.
Timothy Henderson	KMS Fusion, Inc.
Alan Hoffman and Robert Center	Spectra Technology, Inc.
Robert C. Iotti	Ebasco Services, Inc.
Dean S. Irwin	D.I.R. Corp.
Nicholas Krall	Krall Associates
Gerald Kulcinski	University of Wisconsin
John Landis	Stone and Webster Engineering Corp.
Robert McCrory	University of Rochester
Art W. McGuigan	Westinghouse Electric Corp.
Steve Meissel	Hipotronics
Michael Montgomery	Maxwell Laboratories
Michael Monsler	W. J. Schafer Associates
David Overskei	General Atomics
Gregory F. Pavlenco	United Engineers and Constructors, Inc.
Barry Ressler	Universal Voltronics
Randall Roe	Burns and Roe, Inc.
Nicholas Sclufer	General Leasing and Management Co.
Dave K. Segawa	Hoya Optics, Inc.
John Sheffield	Martin Marietta Energy Systems, Inc.
Eric Titland	Baltimore Gas and Electric Co.
Bruce A. Zeitlin	Intermagnetics General Corp.

We appreciate your vision, advice and support, and we look forward to working with all of you in the future. Happy New Year!


Stephen O. Dean


Ruth A. Watkins


Susan D. Kinkead



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

NATIONAL ENERGY STRATEGY

DOE Hearings on the National Energy Strategy (see our October and December 1989 newsletters) finally got around to hearing about fusion. In a hearing January 11 in Honolulu, testimony was received by Energy Secretary Watkins from Akira Hasegawa (AT&T Bell Laboratories) and Harold Forsen (Bechtel Group, Inc.). Forsen is a member and former chairman of Fusion Power Associates Board of Directors. Hasegawa is currently chairman of the American Physical Society Division of Plasma Physics.

In his prepared testimony, Forsen stated "We should move forward with a program that will tell us the science of burning plasmas such that the technology development necessary to support that science in fusion power plants can be identified and undertaken on a program schedule to match the need ... We cannot say for sure today what the economics of fusion power might be ... It does seem clear, however, that its emissions, safety and radiological inventory have the potential to be more attractive than the nuclear plants we have."

In discussing the value of international collaboration which he termed "reasonable" and "good," Forsen stated, "It is important to add, however, that any complacency by the United States to not have a strong domestic program in light of where the international program is headed, is sure to lead to commercial disaster for us as suppliers of goods and services in the potential deployment of these systems. An important point here to add is that the United States program lacks sufficient industrial participation as compared with, say, the Japanese ... Mechanisms and budgets must be found to

bring U.S. industries into our program in a meaningful way such that engineering systems and hardware requirements are understood by those who will ultimately build these plants and guarantee their performance."

Hasegawa was invited to testify based on a December 18, 1989 letter he sent to Secretary Watkins on behalf of the APS-DPP Executive Committee. In that letter Hasegawa stated, "Our strong dedication to this goal (of developing fusion as an energy source) has been further intensified by the recognition that the nation and the world are facing a new kind of an energy crisis, one brought about by the deleterious effects of fossil fuel energy sources on the global environment. For the longer term, it appears to us that the development of the more benign energy sources represented by improved fission reactors, solar, and fusion is essential and urgent and needs to be a strong element in the National Energy Strategy being developed by your Department."

He added, "Recently fusion research has made important progress by effectively achieving the energy breakeven condition. Furthermore the advanced fuel fusion, which utilizes isotopes of helium and hydrogen in which the fusion products are primarily charged particles, promises virtual elimination of problems related with neutrons. Fusion reactors also offer the potential of inherent safety where it would be physically impossible to have life-threatening radioactive emission resulting from an uncontrolled energy release."

Hasegawa's letter concludes: "Based on the recent progress it now appears technically feasible, with appropriate increases in fusion funding required, to demonstrate net

fusion electric power in the 2015-2025 time period. However, because of the demanding conditions for sustaining fusion reactions and search for innovative devices for the advanced fuel fusion there are still major scientific and technological challenges in developing a practical fusion energy source. An increase in funding is necessary to allow the advance toward a burning plasma and the parallel advances in plasma science, materials, and technologies that are required to demonstrate fusion as an energy source with attractive economic, environmental, and safety features. Because of its potential as a benign energy source with a nearly unlimited fuel supply, we recommend that a strong, balanced fusion program, focused on the timely demonstration of practical fusion power production, be made part of the National Energy Strategy."

FPA ENGINEERING AWARD NOMINATIONS SOLICITED

The Board of Directors of Fusion Power Associates has established a prize consisting of a certificate and cash award, to be presented annually for Excellence in Fusion Engineering. The prize was established to honor the memory of Prof. David J. Rose of MIT. The purpose of the prize is to recognize and to encourage fusion engineering professionals in the early part of their careers. Nominations, which may come from any source, will be reviewed by an awards committee established by the FPA Board of Directors. Nominations will be judged on the basis of theses, published materials, professional activities and letters of recommendation. Potential for becoming an influential leader in the fusion field will be a consideration in selecting the recipient. Please send your nominations by April 15 to Fusion Power Associates, 2 Professional Drive, Suite 248, Gaithersburg, MD, 20879.

ANS AWARDS

The Honors and Awards Committee of the Fusion Energy Division (FED) of the ANS is currently considering nominations for three awards to be given at the Ninth Topical Meeting on the Technology of

Fusion Energy, October 8-12, 1990, Chicago, Illinois.

The Outstanding Technical Accomplishment Award is presented to an ANS member for recognition of exemplary individual technical accomplishment (however, there could be a partnership) requiring professional excellence of a high caliber in the area of fusion science and engineering.

The Outstanding Achievement Award is presented to an ANS member for recognition of exemplary individual achievement (however, there could be a partnership) requiring professional excellence and leadership of high caliber in the area of fusion science and engineering.

Also, the Honors and Awards Committee is soliciting student papers for the 1990 FED Student Award for Fusion Science and Engineering. The Student Award consists of a Certificate of Accomplishment and a cash award of \$500. Travel support (up to \$500) is also provided if the student attends the meeting to present the paper and receive the award. In addition, the student will be given the opportunity to publish her/his full-length paper in Fusion Technology without a page charge.

Nominations should include a brief statement of why the candidate should receive the award, and should be submitted by June 1, 1990 to: Don Steiner, Chairman, ANS/FED Honors and Awards Committee, Rensselaer Polytechnic Institute, Nuclear Engineering & Engineering Physics Dept., Tibbits Avenue, Troy, NY, 12180-3590; phone (518) 276-4016.

PAPERS SOUGHT FOR ANS TOPICAL

The ANS 9th Topical Meeting on the Technology of Fusion Energy will be held October 8-12, 1990 in Oak Brook, IL. Papers are solicited on the usual range of relevant topics. Deadline for submission of abstracts, approximately 400 words in length, is May 15, 1990. Full paper deadline, September 15, 1990. All abstracts should be directed to Lee Ann Ciarlette, Fusion Power Program, Argonne National Laboratory, 9700 S. Cass Avenue, Bldg. 205, Argonne, IL, 60439; phone (708) 972-4835; FAX (708) 972-5287.

IN MEMORIAM:
ROBERT ELLIS AND SEISHI HAMASAKI

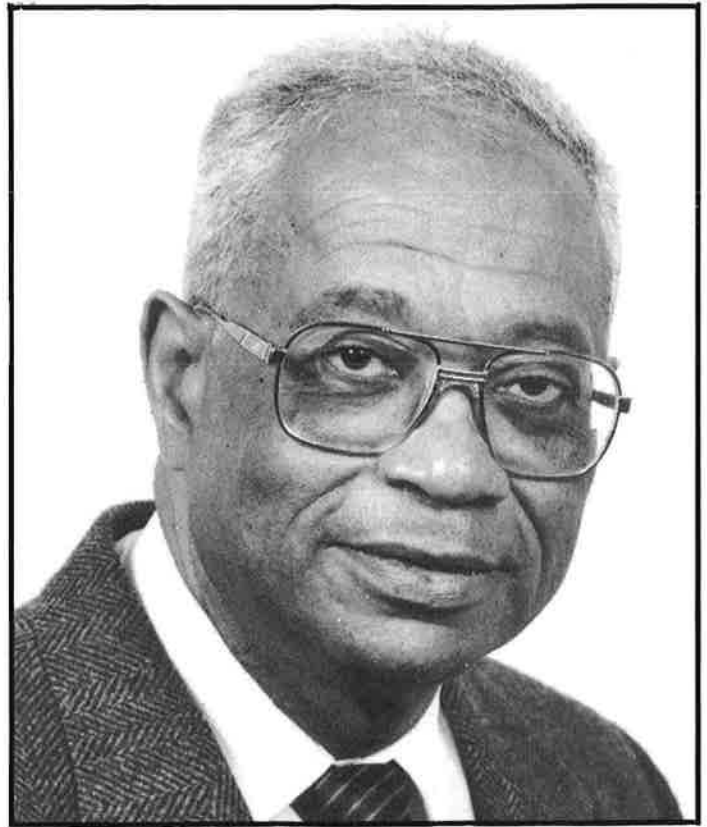
The fusion community was saddened to learn of the deaths of their friends and colleagues Bob Ellis of PPPL and Seishi Hamasaki of Jason Associates.

In announcing the heart attack death of Bob Ellis, PPPL director Harold Furth said, "Bob was one of the pioneers of magnetic fusion research. He applied his sharp intelligence, personal warmth, and strong sense to every aspect of the Laboratory's activities. His loss will be deeply felt."

Bob Ellis held degrees from Fisk, Yale and the University of Iowa. He came to Princeton to work on Project Matterhorn in 1956 and made many basic contributions to plasma physics and fusion research. During the 1970's, Bob headed the Adiabatic Toroidal Compressor (ATC) project, which set world records for auxiliary tokamak plasma heating. During 1979-81, he was Head of the Physics Section of the IAEA in Vienna. He has been Head of the Experimental Projects Division at PPPL and a member of the Laboratory Council since 1988. This past November, Bob was elected by the members of the American Physical Society as Councillor-at-Large. Bob's family requests that there be no gifts or contributions.

Seishi Hamasaki died on December 7, 1989, after a distinguished and productive career in research on plasma physics and controlled fusion. He died at home in Olivenhain, California, a suburb of San Diego, from cancer.

Of Hamasaki, Nick Krall commented: "To all of his work, he brought a level of thoughtfulness, persistence and intelligent inquiry that made him a stimulating colleague and a dear friend. His interests in sports, music, and Japanese culture testified to his breadth. He had many friends in the scientific world (as well as the real world) who found much pleasure in his company. He was never heard to say an unkind word about anyone. Those of us who knew him well find our world poorer for his absence."



DR. ROBERT A. ELLIS, JR.

Dr. Hamasaki was educated at Waseda University, in Japan, where he received a B.S. in Nuclear Engineering in 1961. He came to the United States, obtaining a M.A. degree from Wesleyan University in 1963 and a Ph.D. from the University of Wisconsin in 1967. Dr. Harold Forsen recognized the quality of Seishi's work and was instrumental in his moving to the University of Maryland in 1969 on a grant from the NSF Center for Excellence.

He worked on electron beam physics with Dr. Ravi Sudan at Cornell, and then on the theory of theta pinch implosion with Drs. Griem and Davidson at Maryland. In 1974 he joined Science Applications Inc., in San Diego, performing high quality work on such diverse topics as Linus implosions, z-pinch, relativistic rings and field-reversed concepts (FRC). His work on FRC with Rulon Linford was for many years the "standard model" of that device.

At the time of his death he was employed by Jason Associates, a disadvantaged small business located in Del Mar, CA, working with Dr. Paul Nahayama on physics related to reactor safety.

EDITORIAL: OFF-BUDGET FINANCING FOR FOSSIL FUEL REPLACEMENT TECHNOLOGIES

The world will soon need new central station power plants for electricity, and increasing amounts of fuel for the transportation sector. However, once-vigorous energy programs have been cut to subcritical funding levels because low oil prices and surplus energy supplies during the 1980's have created a false sense of energy security. In addition, demands on the federal budget, combined with a large federal deficit, present a seemingly unsurmountable obstacle to obtaining the funds necessary for the timely development for long-range energy technologies.

A possible solution to the above dilemma would be to create an Energy Technology Development Trust Fund, analogous to the Highway Trust Fund. The Highway Trust Fund collects money from those who use highways now, to pay for providing adequate highways in the future. So too, the Energy Trust Fund would be funded by a set-aside from fossil fuel revenues to be used to ensure that we have technologies to replace fossil fuels in the future.

In the ideal world of the 21st Century, transportation will be mainly provided by electric vehicles, while electricity will be generated by non-fossil fuel technologies. The key non-fossil fuel technologies are fusion, fission and various "renewables," including solar. To ensure the availability of these technologies for central station power early in the 21st Century requires development programs funded at approximately \$5 billion per year. However, the U.S. Department of Energy currently funds these programs at about \$1 billion per year. In the U.S. there are approximately \$200 billion per year in sales of fossil fuel generated electricity and an additional approximately \$200 billion per year in sales of gasoline. Consequently, a national tax on electricity and gasoline of about 1% would be required to provide the revenues necessary for the Energy Technology Development Trust Fund.

There are a number of important issues related to establishing such a fund. These include the legal framework and management structure of the organization charged with allocating the funds, and ensuring that the funds are used for development of long-range technologies and not diverted to near-term fixes. However, a thorough analysis and public discussion of these issues should result in an acceptable charter for the establishment of such a fund. The principle on which the fund should be established is that the users of a scarce national resource (e.g., fossil fuels) should be required to set aside a portion of current revenue to develop replacement technologies for a time when this resource is either no longer available or not socially acceptable.


Stephen O. Dean

MEETINGS

Feb 19-23 Second Transport Workshop.
Hilton Head, SC. Contact Jim Callen
(608) 262-1370.

April 23-25 Sherwood International Fusion
Theory Conference. Williamsburg, VA.
Contact Barbara Sarfaty (609) 243-2440.

May 17-18 ICMC Nonmetallic Materials and
Composites at Low Temperatures.
Heidelberg, FRG. Contact Dr. G.
Hartwig, KfK, Postfach 3640, D-7500,
Karlsruhe 1, FRG.

May 20-25 9th International Conference on
Plasma Surface Interactions. Bournemouth,
UK. Contact J.H.C. Maple, JET, Abingdon,
Oxon, UK, OX14 3EA, Phone (0) 235-28822.

May 21-25 Conference on Lasers and Electro-
Optics. Anaheim, CA. Contact (202) 223-
8130.

May 21-23 17th IEEE International
Conference on Plasma Science. Oakland,
CA. Contact Ms. Noreen M. Curry, Physics
International, 2700 Merced St., San
Leandro, CA, 94577.



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

INERTIAL FUSION REVIEW

An interim report on the "Review of the Department of Energy's Inertial Confinement Fusion Program" by a committee of the National Academy of Sciences, National Research Council, was submitted to DOE in mid-January and sent by DOE to Congress in mid-February. The committee, chaired by Steve Koonin (California Institute of Technology), has been underway since May 1989 (see our May 1989 newsletter). One purpose of the review was to consider progress and to update the recommendation of the last (1986) Academy review, chaired by William Happer (see our June 1986 newsletter).

In its interim report, the Koonin panel states: "The ICF Program has passed a number of significant technical milestones since the time of the Happer report. The NOVA laser at the LLNL has operated at its full design energy, the AURORA laser has become operational, techniques have been developed for smoothing laser beams, new diagnostic techniques and instrumentation have been developed, and direct-drive targets have been imploded to densities several hundred times that of liquid hydrogen. Further, recent work in the Centurion/Halite program of underground experiments has shown qualitatively that the basic concept behind ICF is sound. Although increasingly sophisticated laboratory experiments and computer models have tempered the early optimism that small drivers would be sufficient for laboratory ignition, they are also leading to firmer estimates of the minimum driver size required." The committee notes that a focus of the ICF program has been to develop the science and technology necessary

to construct a Laboratory Micro-fusion Facility or "LMF" (see our June 1989 newsletter) "to achieve and exploit ignition in the laboratory ... A crucial issue for our panel was whether there is now sufficient confidence in driver and target technology to proceed with the LMF, or whether more work with facilities in existence or available soon is required to attain this confidence," the report states.

The committee concludes that "This facility (LMF) would have important military applications almost immediately after basic physics success ... The value and optimal schedule for an LMF depends on the status of underground testing, whether in number of tests or in yield... The committee was impressed by the high level of science and technology in the ICF Program. There is an inherent scientific interest, technological spinoffs, and a relevance to weapons physics and weapon effects simulation. The ICF Program strengthens related scientific programs in the national laboratories by attracting a high calibre of personnel."

The committee further states: "It is our impression that the present ICF Program is somewhat distracted from orderly scientific progress by a desire to push ahead to the LMF. As a consequence, existing facilities are not being fully utilized, and important experiments are not being done. We also perceive too much concern for issues of institutional balance. A national ICF scientific oversight panel, such as recommended by the Happer panel, would help in dealing with some of

these problems. It is unfortunate that such a panel has not been in place during the past five years.

"The 1986 Happer panel recommended a five-year program at level funding (after correction for inflation) to ascertain the physics credibility of ICF, with a subsequent decision about continuing the program. Good progress has been made in the intervening years, but because funding has fallen significantly short of the recommended level and because the ICF effort is divided among five different laboratories with different approaches, program objectives could not be met with the funds available. However, the program is now at the point where restoring the effort to the level recommended by the Happer panel (some \$20 million per year above the FY 90 level) could allow the physics to be in place in a few years for a decision to proceed with an LMF. (A second increment of \$20 million per year would allow the technology for at least one driver--a glass laser--to also be in place at that time.) Whether or not that decision will be made must depend on the perceived need for an LMF at that time."

The committee recommended, as highest priority, "using to their full potential facilities available now or in the next few years, the development of appropriate instrumentation, and an extensive experimental campaign with multilaboratory participation. This effort must be the highest priority in the ICF program."

The Committee recommended the following funding enhancements:

- . Nova upgrade and experimental program, \$25 million per year at LLNL.
- . OMEGA upgrade, \$15 million per year at the University of Rochester.
- . NIKE upgrade, \$1 million per year, at NRL.
- . Approximate doubling of the current support of heavy ion accelerator development to about \$10M per year.

These increments were to be "partially offset by an estimated (savings) of \$20M per year from termination of the Centurion/Halite and CHROMA program(s) and a slowing of advanced laser driver development." The Committee recommended "no increment to present LANL annual funding," and stated "Though we have deferred detailed recommendations on light-ion driver research, we anticipate at most a recommendation to continue spending for that work at the present level."

With respect to the potential energy applications of inertial fusion, the panel states: "Only a modest effort on ICF energy applications is warranted at this time ...Energy applications of ICF are more difficult than defense applications. They require a high-performance driver and capsule, a high driver pulse rate, long lifetime, elaborate schemes to protect the reaction chamber from the explosion, and low target fabrication costs. It may well be that the optimal driver for energy production is very different from that which is appropriate for the LMF. In any event, the LMF is a necessary first step on the path toward ICF energy production. Energy applications should be considered in a major way only after the LMF has operated successfully; they are more likely to require a substantial technology development program."

"Because the most immediate ICF applications are those related to defense, we recommend that the DOE continue to recognize ICF primarily as a defense program. Since we have not looked at other energy programs, we can make no comparisons of ICF with other possibilities, such as magnetic fusion or advanced fission reactors."

In making its recommendations, the Committee's thinking appeared to be heavily influenced by perceived budgetary constraints:

"The recommendations ... are made with an appreciation of the likely very tight federal funding situation. We wish it to be understood that we regard the ICF Program on the whole as a well-managed and well-executed effort that attracts extremely able scientists and engineers to a clear and important national objective. Even those parts of the program that we deem to be of lower priority are worthwhile and, if they could be funded, would give the ICF effort more resilience, strength in depth, and confidence in reaching its goals. Additional funding would accelerate driver development and shorten the time to an LMF, which might at any moment become urgently needed because of underground testing limitations, whether by treaty or other routes."

The report is available from Lee Hunt, Naval Studies Board, National Research Council, 2101 Constitution Ave., Washington, D.C., 20418, (202) 334-3523. Copies are also available from Fusion Power Associates.

WATKINS "NOT HAPPY"

Energy Secretary James Watkins was briefed on the inertial fusion review report by the chairman and several members of the committee on January 31. He was reportedly "not happy" with the panel's conclusions regarding the readiness of the ICF program to become an energy program. Watkins told the Congress in a letter dated June 15, 1989 (see our July 1989 newsletter) that he was formulating "an innovative new policy that embraces all the fusion research in the Department both magnetic and inertial confinement approaches" that would "inspire strongly competitive research and development." He said, "I hope to have the policy review completed, and the final version of the new policy validated, within the next two months." That review has not begun but is rumored to be imminent.

FUSION BUDGETS

The DOE FY 1991 budget request (\$M) to Congress for fusion, and comparisons to FY 1990 are as follows:

	<u>FY 1990</u>	<u>FY 1991</u>
Magnetic Fusion	\$ 320.2	\$325.3
Inertial Fusion	169.2	166.8
Heavy Ion Accelerators	6.2	6.0

ELECTRIC ENERGY SUPPLY

Thirty-one energy experts from 12 countries met January 8-12 at the University of California at Berkeley to hold an "Executive Seminar on Electric Energy Supply." At the conclusion of the seminar, a statement was issued entitled "Findings and Recommendations of the First 1990 Group on Electricity." Copies of the 5-page statement can be obtained from T. K. Fowler, Chairman, Nuclear Engineering, 4155 Etcheverry Hall, University of California, Berkeley, CA, 94820, (415) 642-5010.

Reporting on the meeting, the San Francisco Chronicle quotes Fowler as saying, "The American public is simply not aware of what little margin there is between our electrical output capacity and the demand for electricity...The net result (of a shortage of electricity) could be even more damaging to the environment since it may force governments and utilities to turn to quick and dirty solutions."

Among the group's findings, conclusions and recommendations: "To sustain world economic growth and improve environmental quality, it is imperative that (industrialized nations) begin now to assure their own electric energy supply in the coming decades, make the best use of existing technologies, and reinvigorate research and development on improved energy technologies for the future. This is vital because the developing nations must find ways to increase their

electric generating capacity many-fold over the next half century. It is these nations, rather than the United States and Europe, that will control most of what enters the atmosphere ... People depend on electricity for services that are critical to their jobs, life-style, health and well-being. The U.S. faces foreseeable shortfalls in electric supply before the end of this decade, based on expected demand and supply. Certain regions have already experienced transmission problems, curtailments, brownouts or even rolling blackouts.

Even with outstanding success in conservation initiatives and efficiency improvements, substantial amounts of new generating capacity will still be needed, and decisions are urgent because of the long lead-time (6-10 years or longer) to license and build major power plants. Many options need to be available so that responsible choices can be made; no narrow strategy is realistic... A renewed emphasis on energy research and development, with international cooperation and coordination, is essential. The program should include innovative technologies to conserve energy and a diverse menu of new and improved energy supply technologies including advanced nuclear designs, geothermal, solar and other renewable sources, as well as cleaner and more efficient coal, oil and gas combustion. For the long term, fusion could mean the opportunity to phase out the least attractive of today's options.

We recommend that government leaders send messages to their national parliaments and legislatures on electricity issues, as well as introduce action statements at international meetings such as the annual Economic Summit and the World Energy Council... We believe that the United States electricity supply situation is deteriorating to the extent that the President should deliver a special message to the Congress regarding the importance of adequate electricity to the economic and environmental health of the country. He

should recommend specific programs to deal with the threat of electric power shortfalls well before they become realities.

LEMONICK NAMED DEPUTY AT PPPL

Aaron Lemonick has been appointed as deputy director for administrative operations at the Princeton Plasma Physics Lab for a two year term starting in January 1990. He succeeds Jim Clark, who retired.

"Aaron will be a great asset to PPPL and to the fusion research program," said lab director Harold Furth. "He brings to the laboratory a wide range of administrative experience--as associate director of the Princeton-Penn Accelerator for 6 years in the 1960s, as associate chair of the Physics Department from 1967 to 1969, as dean of the Graduate School from 1969 to 1973, and as dean of the Princeton faculty for 16 years."

Said University President Harold T. Shapiro, "The laboratory is an important part of the University, and I am delighted that Aaron has agreed to take on this new commitment to support and help guide it during these crucial years."

PEOPLE

Don Dudziak of Los Alamos has been appointed head of the North Carolina State University Dept. of Nuclear Engineering, effective May 16.

Al Trivelpiece, director of ORNL, has been appointed to a 3-year term as chairman of the Mathematical Sciences Education Board of the National Academy of Sciences.



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

FUSION REVIEW BEGINS

STEVER TO CHAIR REVIEW

Dr. H. Guyford Stever, will chair a 19 member Fusion Policy Advisory Committee (FPAC), according to a March 5 press release from the U.S. Department of Energy. Dr. Stever has been science advisor to President Ford, director of the National Science Foundation and president of the Carnegie Mellon University. He is currently Foreign Secretary (retired) of the National Academy of Engineering, a member of the DOE's Energy Research Advisory Board and a Washington-based consultant.

According to the announcement, DOE Energy Secretary James Watkins has asked the committee to submit an interim report in July and its final report by the end of September. The committee's meetings will be public and announced in the Federal Register. The first meeting is scheduled for March 22-23 at DOE Headquarters in Washington. For information, contact Dr. Thomas Finn (202) 586-5444.

In announcing the review, Energy Secretary Watkins stated, "Fusion energy has the potential to provide electricity in the next century safely and without the creation of highly radioactive waste products or greenhouse gases. The development of fusion as a viable technology is an important long-term goal of the department. This independent committee will help me determine the best way to reach that goal. I am entirely open to the committee's advice."

According to the announcement, the committee's report will provide advice on how to structure the department's magnetic and inertial confinement fusion programs. The committee will review a draft policy statement that calls for a competition between the two approaches and will either support that strategy, modify it or provide a new approach. The recommended policy will include goals and objectives of the programs, a strategy, an outline of the development path, identification of major decision points, determination of the role of international collaboration and recommendations on funding levels. The committee will address issues including: the balance of research activities within the programs, the timing of experiments to test the burning of plasma fuel, the International Thermonuclear Experimental Reactor (ITER) and the development of laser technologies.

WATKINS INFORMS CONGRESS OF REVIEW

In separate letters to several members of congress, Energy Secretary Watkins apologized for the lengthy delay in setting up the fusion review. "It has taken us many months to organize this Committee. I appreciate your patience in allowing us time to proceed and time to form a new committee. I believe we now have a clear charter and excellent individuals to perform the study." Last June Watkins told Congress the review would be completed by the end of last summer.

Watkins also stated, "In selecting the members, I have relied heavily on suggestions made by members of Congress and by Dr. Allan Bromley, the President's Science Advisor. I am particularly pleased that Dr. H. Guyford Stever has agreed to be the Chairman. his broad and very high-level experience in U.S. science policy and personal integrity assures me that the work of the Committee will be fair, objective, and technically sound. The development of fusion energy is an important element in the National Energy Strategy. The potential benefits of fusion are enormous, and it is important that the Nation establish an effective policy for the development of fusion energy in order to maintain progress and excitement in this program. I expect that this Committee will have a major effect on setting this policy. The Department proposed a policy last year to proceed with a parallel magnetic and inertial fusion program directed at a future energy supply technology. I am asking this Committee to review the proposed policy and to tell me if the policy, some specific modification to it, or some totally different policy, is appropriate. I am entirely open to their advice."

In his letter to Congress, Watkins also stated, "Public Law 96-386, the 'Magnetic Fusion Energy Engineering Act of 1980,' established a technical panel of the Energy Research Advisory Board to review on a triennial basis the conduct of the national magnetic fusion energy program. The technical panel will be constituted from the Fusion Policy Advisory Committee membership and will carry out its review in conjunction with the FPAC review."

WATKINS CLARIFIES CHARGE

In a separate letter to Stever, Watkins said, "The Department of Energy is supporting research and development in two major areas of fusion research, magnetic

confinement and inertial confinement. Last year, a new fusion policy for the Department was proposed by the former Director of Energy Research, Dr. Robert O. Hunter. A key feature of this proposed policy was competition between the two major confinement approaches.

"The Fusion Policy Advisory Committee (FPAC) has been formed to take a broad look at what the Department's fusion policy should be. While the enclosed charter establishing FPAC discusses the Committee's review in relation to a specific policy proposal, I wish to emphasize that my primary interest is in having the Committee provide its best judgment on the optimal way to structure the overall U.S. fusion program. For example, FPAC should feel free to address the question of whether or not there should be a competition between magnetic and inertial confinement.

"Developing fusion energy has proven to be an extremely difficult undertaking. Substantial progress has been made in both the magnetic and inertial confinement programs, but neither has progressed to the point where a practical fusion reactor can be built. I look to your Committee to help the Nation establish a wise, practical, and enduring policy for fusion, one that will enable fusion energy to be a valuable energy source in the next century.

"The 'Magnetic Fusion Energy Engineering Act of 1980,' Public Law 96-386, established a Technical Panel on Magnetic Fusion of the Energy Research Advisory Board (ERAB) to conduct a triennial review of the conduct of the national magnetic fusion energy program. Since such a review is essentially part of the charter of FPAC, I would like the Committee, in conjunction with its work, to perform this review. I will ask the ERAB Chairman to appoint members of your

Committee to serve as the Technical Panel on Magnetic Fusion.

"Thank you for your willingness to chair this important activity for the Department of Energy. I hope to receive an Interim Report from the Committee in July and your Final Report by the end of September."

FPAC CHARTER

According to the official DOE "charter" for the Fusion Policy Advisory Committee, the FPAC's "objectives, scope of activities and duties" are described as follows.

"The Fusion Policy Advisory Committee will, on a one-time basis, review the new draft fusion policy covering both magnetic and inertial confinement, and provide its recommendation for a fusion policy for the Department of Energy. The review will focus on the technical basis for, and the likely effectiveness of, the policy proposed. The final written report will provide advice on how to structure the fusion programs -- either by the proposed policy, some specific modifications to it, or some totally different approach. The policy recommended by this Committee should include goals and objectives of the programs, a coherent strategy, an outline of the development path, identification of major decision points, determination of the role of international collaboration, and recommendations on funding levels. Specific questions that should be addressed include, but are not limited to, the following:

"1. How should the competition between magnetic confinement fusion and inertial confinement fusion be structured to assure the successful development of commercial fusion energy?

"2. What should be the balance in these programs between an emphasis on burning plasma devices and

broadly based physics and technology R&D?

"3. At what point in the program should major burning plasma experiments be undertaken, and when will the level of science and technology be adequate to build these devices with confidence?

"4. How should the international emphasis on proceeding with an International Experimental Thermonuclear Reactor (ITER) be accommodated in the new policy?

"5. How should driver development in the inertial program be carried out in the new policy? Is the approach compatible with the military objectives of inertial fusion research?

"6. What is the appropriate funding for the fusion programs? Can burning plasma devices and international collaboration be accomplished within current total budget levels? Will the proposed transfer of \$50 million from magnetic to inertial fusion establish an effective competition between the programs?"

FPAC GETS STAFF SUPPORT

Dr. James Kane, (415) 642-8585, of the University of California will serve as executive director for the Fusion Policy Advisory Committee. Technical staff support will also be provided by Dr. Loren Schmid of Pacific Northwest Laboratory, (508) 375-2559; Dr. Thomas Finn of the DOE Office of Energy Research, (202) 586-5444; and Dr. Robert Jones of the DOE Division of Inertial Fusion, (301) 353-5492.

FUSION POLICY ADVISORY COMMITTEE

Dr. H. Guyford Stever, Chairman
Foreign Secretary (Retired)
National Academy of Engineering

Dr. Roger Batzel
Director (Retired)
Lawrence Livermore National
Laboratory

Dr. Ira B. Bernstein
Professor of Applied Physics
Yale University

Dr. Robert W. Conn
Professor of Nuclear
Engineering
Institute for Plasma Research
University of California,
Los Angeles

Dr. E. Linn Draper, Jr.
Chairman of the Board and
President
Gulf States Utilities

Dr. Harold K. Forsen
Senior Vice President and
Manager of R&D
Bechtel Group

Dr. John S. Foster, Jr.
Vice President for Science
and Technology (Retired)
TRW

Dr. T. Kenneth Fowler
Chairman, Dept. of Nuclear
Engineering
University of California,
Berkeley

Dr. Melvin B. Gottlieb
Director (Retired)
Princeton Plasma Physics
Laboratory

Dr. William Herrmannsfeldt
Stanford Linear Accelerator
Center

Dr. Charles F. Kennel
Professor of Physics
University of California,
Los Angeles

Dr. Arthur K. Kerman
Director of Laboratory for
Nuclear Science
Massachusetts Institute of
Technology

Dr. Kenneth L. Kliever
Dean, School of Sciences
Purdue University

Mr. John W. Landis
Senior Vice President and
Director
Stone and Webster Engineering
Corporation

Dr. R. Bruce Miller
TITAN Corporation

Dr. Barrett H. Ripin
Head, Space Plasma Branch
Naval Research Laboratory

Dr. Marshall Rosenbluth
Professor of Physics
University of California,
San Diego

Dr. Robert Sproull
President Emeritus
University of Rochester

Dr. Richard Wilson
Mallinckrodt Professor of
Physics
Lyman Laboratory of Physics
Harvard University



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

NEW AFFILIATES

Spar Aerospace, Ltd., Remote Manipulation Systems Division, and Stern Laboratories, Inc. have become corporate affiliates of Fusion Power Associates.

Spar's Remote Maintenance Systems Division developed the NASA Space Shuttle Arm Design and is currently working on a variety of advanced manipulators, including those for the Space Station. They are involved in remote handling equipment issues for JET, NET, ITER, TFTR, and CIT. Brian R. Fuller, Director, Industrial Systems and Products, will be the company's representative. He can be reached at Spar Aerospace Limited, 1700 Ormont Drive, Weston, Ontario, Canada, M9L 2W7, (416) 856-4550, FAX (416) 856-4624.

Stern Laboratories has served the nuclear industry in Canada for 30 years, providing facilities and services to utilities, reactor and fuel designers and vendors, government agencies, equipment suppliers and other laboratories. Frank Stern, President, will be the company's representative to Fusion Power Associates. He can be reached at Stern Laboratories, Inc., 1590 Burlington St. E., Hamilton, Ontario, Canada, L8H 3L3, (416) 548-5300; FAX: (416) 545-5399.

FUSION REVIEW

The Fusion Policy Advisory Committee (see our March 1990 Special Edition) met in Washington March 22-23 and is meeting again in Germantown, MD, April 2-4 as we go to press. (A third meeting is scheduled for May 24-25.) Secretary of Energy James

Watkins opened the March meeting, by indicating his desire to establish a fusion policy that would result in an "exciting" fusion program with the goal of developing fusion into a competitive energy source.

The committee (nicknamed FPAC) heard presentations on magnetic fusion, inertial confinement fusion and heavy ion fusion accelerator research. A recently completed magnetic fusion community program plan was also presented.

In addition, FPA president Steve Dean, during the public comment portion of the meeting, described the purposes, membership and policies of Fusion Power Associates. He also described the interests of another organization, the Agency for the Advancement of Fusion Power, founded by George S. Clemens.

FPAC chairman Guy Stever stated that they would divide their work among three subpanels: a magnetic fusion subpanel chaired by Harold Forsen, senior vice president of Bechtel; an inertial confinement fusion subpanel chaired by Bob Sproull, president-emeritus of the University of Rochester; and a generic issues subpanel chaired by John Landis, senior vice president of Stone and Webster Engineering Corp. The subpanels will make site visits.

FPA POSITION

Steve Dean distributed to FPAC copies of the FPA Board of Directors Policy Statement (copies available from FPA). He emphasized the following points.

- . "Timely commitments to necessary new and improved experimental facilities are needed to ensure continued program momentum and progress into the 1990's.
- . "It would be premature, at this stage, to judge which of the variety of magnetic and inertial fusion concepts will ultimately succeed commercially. This fact should not discourage use of the best available concepts in the design and construction of needed fusion test facilities.
- . "International cooperative agreements have been a substantial factor in fusion progress and should be encouraged. Such agreements, however, are not an effective substitute for focused national efforts, needed national experimental facilities and subsequent engineering test devices.
- . "Governments should encourage and promote the full participation of industry in the planning, research and development as well as in engineering and operating aspects of fusion programs. If industry participates in the government-funded R&D programs now, industry will be better prepared to assess the commercial potential of fusion power in the future.
- . "The time has come to ... place increased emphasis during the next decade on the engineering and systems design aspects of practical fusion energy systems."

AGENCY FOR THE ADVANCEMENT OF FUSION POWER POSITION

A statement from George S. Clemens, president and founder of the Agency for the Advancement of Fusion Power, was distributed to the FPAC. Clemens, a mechanical engineer and successful inventor/entrepreneur, is recovering from back surgery and was unable to be present personally at the FPAC meeting. His views were summarized by Steve Dean, who empha-

sized the following quotations from Clemens's statement:

- . "This country will need non-fossil, central-station power options soon -- by at least 2010 -- to replace existing fossil-fuel-burning plants, to meet increasing electricity demand, and to process hydrogen for transportation fuel.
- . "Energy efficiency and conservation alone cannot provide a complete solution. Nor can we play Russian Roulette for the future of the human race by constructing another generation of fossil-fuel-burning power plants.
- . The (fusion) program is ready for ... engineering development. Breakeven was just effectively reached on JET; a stunning achievement that tops off two decades of remarkable progress.
- . "We must start now on a mission-oriented development program in order to have fusion in place by the key years of 2005 or 2010."

Copies of Clemens' statement are available from Fusion Power Associates.

CLARKE LEAVES DOE

John Clarke has left the U.S. Department of Energy to accept a position as Associate Director, Global Studies Program, Battelle, Pacific Northwest Laboratories, 370 L'Enfant Promenade, S.W., Suite 908, Washington, D. C., 20024. He can be reached at (202) 479-0500; FAX (202) 646-5233. John will continue to serve as chairman of the ITER council.

CALLAN, KINTNER AND ROSENTHAL ELECTED TO ENGINEERING ACADEMY

Congratulations to Jim Callan (University of Wisconsin), Ed Kintner (GPU Nuclear) and Murray Rosenthal (ORNL) on their election to the National Academy of Engineering.



Callen



Kintner



Rosenthal

Callen was cited for "pioneering work in the development of models of neutral beam heating, tokamak discharge macroscopics, and anomalous (turbulent) transport in plasmas."

Kintner was cited for "significant contributions to the development of nuclear submarine propulsion, nuclear power operation and management of magnetic fusion programs."

Rosenthal was cited for "outstanding leadership of nationally important energy technology research and development programs in fission, fusion, coal, conservation, and renewable energy."

MAGNETIC FUSION COMMUNITY PLAN

Rulon Linford (LANL) presented to FPAC a recently-completed community "Plan for the Development of Magnetic Fusion Energy." The document was prepared by David E. Baldwin (University of Texas), E. C. Brolin (PPPL), Stephen O. Dean (FPA), Alexander Glass (LLNL), Linford, David O. Overskei (General Atomics), Ronald R. Parker (MIT) and John Sheffield (ORNL). The document recommends the following statements of goal and strategy for the U.S. program.

"Goal: The goal of the US fusion program is to demonstrate early in the 21st Century that fusion is a practical, safe, reliable, and environmentally-attractive energy source.

"Strategy:

- "Develop plasma-confinement-concept improvements, plasma technologies, and materials needed for practical fusion applications in a core program of science and technology.
- "Construct a burning plasma experiment (CIT) in the US to provide physics information and operating experience for an engineering test reactor, and contribute to the design of a fusion power demonstration facility.
- "Participate in an international engineering test reactor (ITER) to acquire experience with long-pulse burning plasmas and nuclear technologies needed to design a fusion power demonstration facility.
- Construct a fusion power demonstration facility (DEMO) in the US, which would produce net electric power and provide a basis for fusion commercialization."

The document states that "To meet a nominal 2020 operational date for a fusion power demonstration facility, the annual budgets need to be increased to about \$600 million per year by the mid-1990's, and remain at that level (in 1990 dollars) until construction of the DEMO starts."

Copies are available from Fusion Power Associates.

FURTH CONVALESCING

Harold Furth, director of the Princeton Plasma Physics Laboratory, underwent a scheduled, heart-valve operation in mid-February. The operation was successful and Harold is now recuperating. Get-well wishes can be sent to Harold in care of Princeton Plasma Physics Laboratory, P.O. Box 451, Princeton, New Jersey, 08543. We wish him a speedy return to work.

Harold has also announced that he will not accept a third five-year appointment as director of PPPL when his current term expires at the end of this year. Princeton University President Harold Shapiro has announced that a worldwide search for the next director will begin immediately and will be led by Paul Banacerrof, provost of the University.

E.C. ("Tip") Brolin is serving as acting director of PPPL while Furth is recovering from surgery.

STACEY RECEIVES DOE DISTINGUISHED ASSOCIATE AWARD

Regents Professor Weston M. Stacey of the nuclear engineering program in the School of Mechanical Engineering and director of the Fusion Research Center of the Georgia Institute of Technology, was presented the Department of Energy Distinguished Associate Award January 18 during an International Thermonuclear Experimental Reactor (ITER) steering committee meeting.

Robert Dowling, acting deputy associate director for fusion energy of the DOE presented Stacey with a plaque signed by James D. Watkins, Secretary of Energy.

Stacey received this award "in recognition of outstanding technical and managerial contributions over the past 10 years to the International Tokamak Reactor (INTOR) design program and longstanding com-

mitment to the worldwide effort to develop fusion energy."

TTF WORKSHOP

The second Transport Task Force workshop was held at Hilton Head in South Carolina on 19-23 February 1990 under the leadership of Jim Callen (U. Wisc.). Turbulent, Transient and Steady State Transport were on the agenda. In addition, a future devices symposium featuring ITER, CIT and ARIES was held. A few excellent tutorial lectures were presented in theory, analysis and experimentation. The approximately 60 hours' worth of presentation were recorded on video tape by Bob Taylor (UCLA). Copies of the tapes are available at a nominal cost. Those interested should call Christine Taylor at (818) 990-9423.

IN MEMORIAM: DENIS KEEFE

The fusion community mourns the unexpected death of Denis Keefe, leader of the Heavy Ion Accelerator Research Program at LBL. Denis died of a heart attack on March 11. He was much admired, not only for the leadership he provided to his technical field, but also for his integrity and charm.

A native of Dublin, Ireland, he received his bachelor's and master's degrees at the National University of Ireland and his doctorate from the University of Bristol, England. He joined LBL in 1959. Expressions of sympathy may be sent to his wife, Joan, at 854 Santa Barbara Avenue, Berkeley, CA, 94707. The family has asked that memorial donations be made to the American Heart Association.



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

FUSION REVIEW

At its first meeting March 22-23, the Fusion Policy Advisory Committee (FPAC) voted to send an immediate letter to energy secretary James Watkins urging him not to use the review process as an excuse to delay discussions on the future of the International Thermonuclear Experimental Reactor (ITER) project. In a letter dated March 27 to Watkins, FPAC chairman Guyford Stever stated, "During the presentations of the Magnetic Fusion Energy program to the FPAC on March 22, the question was raised about U.S. participation in international discussions starting at the ITER Council meeting April 26 relating to embarking on the engineering design phase of ITER. It is the understanding of FPAC that engaging in such preliminary discussions is an essential step for keeping open the option for formal negotiations later. At its May 24-25 meeting, the Committee needs the latest information about the program, the problems, and the attitudes of the participants in ITER, including the results of Council discussions. The Committee, therefore, strongly recommends that DOE representatives take part in these discussions unless you believe that matters beyond the purview of the Committee militate against it."

Three subcommittees of FPAC have been formed. The magnetic fusion subcommittee is chaired by Harold Forsen (Bechtel). Its members are Ira Bernstein (Yale), Melvin Gottlieb (retired, PPPL), Kenneth Kliever (Purdue), Ken Fowler (UC, Berkeley), and Charles Kennel (UCLA). The inertial fusion subcommittee is

chaired by Robert Sproull (retired, U. Rochester). Its members are Roger Batzel (retired, LLNL), Arthur Kerman (MIT), Barry Ripin (NRL), Bill Hermmannsfeldt (SLAC), Marshall Rosenbluth (UCSD), and Bruce Miller (Titan Corporation). The generic issues subcommittee is chaired by John Landis (Stone and Webster). Its members are Linn Draper (Gulf States Utilities), John Foster (retired, TRW), Richard Wilson (Harvard), Bob Conn (UCLA) and Guyford Stever (chairman, FPAC).

The magnetic fusion subcommittee has scheduled site visits at PPPL, April 16-17; ORNL, April 17-18; LANL, May 2; General Atomics, May 3. The inertial fusion subcommittee has scheduled site visits at LLNL, May 9; LBL, May 10; LANL, May 11; Sandia, May 12. The generic issues subcommittee has not scheduled any meetings. The next meeting of the full committee is scheduled for May 24-25 in Washington.

CRAWFORD LEAVES SCIENCE MAGAZINE

Science Magazine reporter Mark Crawford is leaving his post April 30. He will be working out of his home as a free lance writer and consultant. Mark has written many articles dealing with fusion issues both while at *Science Magazine* and previously as a reporter for *Business Week*. He spoke at a special panel on Fusion and Public Policy at last November's meeting of the APS Division of Plasma Physics. We wish him well. Mark can be reached at (703) 941-0864.

AMERICAN NUCLEAR SOCIETY NEWS

Progress in ITER activities will be covered in two special fusion sessions at the 1990 ANS Annual Meeting to be held at the Opryland Hotel, Nashville, TN (June 10-14, 1990). The special sessions will be on Wednesday, June 13. The ITER National Meeting (June 13 [evening] and June 14 [morning]) will also be held in Nashville in conjunction with the ANS Meeting. Mark your calendars now and do not miss this interesting and exciting meeting. Look for the upcoming issues of *Nuclear News* or *ANS News* for registration and hotel reservation forms as well as details on other programs. The ANS Fusion Energy Division Executive Committee meeting will be held Tuesday, June 12, 6:30-7:30 P.M., in the Shiloh Room. For more information contact Nermin Uckan at (615) 574-1354.

The ANS journal *Fusion Technology* has been operating at a loss and is in danger of being discontinued. You can help by making sure your library maintains a subscription and by having your own personal subscription (\$50/yr.). Call ANS headquarters at (708) 352-6611 to subscribe. Also, please ensure that your institution pays its page charges for articles published. For more information contact George Miley, editor, at (217) 333-3722.

BROBECK DIVISION NEWSLETTER

The Brobeck Division of Maxwell Laboratories, Inc., formed in 1988 when Brobeck Corp. was acquired by Maxwell, has begun to issue a newsletter describing its activities. The first issue, dated March 1990, describes work on the Synchrotron Light Source for LSU and work on the wiggler for the National Institute of Standards and Technology's new free electron laser. To be placed on the mailing list, contact Kenneth M. Thomas, General Manager, Brobeck Division, 4905 Central Ave., Richmond, CA, 94804-5803, Phone (415) 524-8664, FAX (415) 524-8472.

FUSION COMPUTER CENTER LOSES NAME

The National Magnetic Fusion Energy Computer Center (NMFCECC), founded by the fusion community in 1973, has been renamed the National Energy Research Supercomputer Center (NERSC). In renaming the center, acting director of the DOE Office of Energy Research, Jim Decker, said "It's time for us to take note formally that the center is playing a much greater role than just serving the fusion community." Fusion currently accounts for about half of the center's services.

Other users include Basic Energy Sciences (20%), high energy and nuclear physics (18%). The SSC, health and environmental research and applied mathematical sciences also use the center. The center has recently added a new, "one-of-a-kind," Cray-2 machine with eight processors. The center expects to play a major role in calculations dealing with global climate change in the future.

THE COMING ELECTRICITY CRISIS

The shortfall of electricity by the year 2000 will be twice as big as previously predicted, according to P. James Adams, a designer of nuclear power plants with the Kansas City engineering firm Black and Veatch.

Adams estimated that the United States will need at least 200,000 megawatts of new generating capacity by 2000, instead of the 101,000 estimated by the North American Electric Reliability Council (NERC), and the 137,000 estimated by the Department of Energy. The Council on Energy Awareness, the lobby of the nuclear power industry, estimated that the United States will need 120,000 to 200,000 megawatts of new capacity.

According to NERC, there are now only 395 new generating plants planned (of which only ten are nuclear), totaling 54,000 megawatts.



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

FPA LEADERSHIP AWARD

The Fusion Power Associates Leadership Award was presented on May 3 to Paul-Henri Rebut, director of the JET Joint Undertaking "in recognition of [his] outstanding leadership qualities." The award states, "As director of the highly successful JET project you have demonstrated the integration of fusion science and technology. Your results assure the future of fusion."

The FPA Leadership Award was established in 1980 to recognize individuals "who have shown outstanding leadership qualities in accelerating the development of fusion."

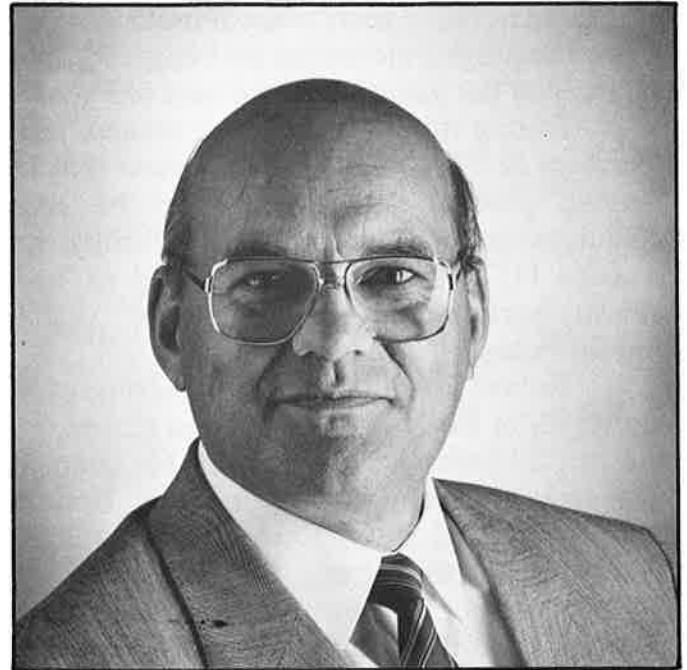
FUSION POLICY REVIEW

The DOE's Fusion Policy Advisory Committee (FPAC) heard reports from its three subcommittees (see our May newsletter) at a meeting in Washington May 24-25. The subcommittees had just completed a round of visits to most of the magnetic and inertial fusion research sites.

FPAC chairman Guyford Stever and the subcommittee chairmen (Harold Forsen, MFE; Robert Sproull, ICF; and John Landis, Generic Issues) stressed the preliminary nature of the reports. Nevertheless, attendees at the meeting, which by law was open to the public, found the reports to be extremely positive about the past progress and current status of fusion research and development, as well as supportive of fusion community plans for an aggressive development schedule.

Magnetic Fusion

The report of the FPAC Magnetic Fusion subcommittee was given by its chairman Harold



Paul-Henri Rebut

Forsen of Bechtel (for subcommittee membership, see our May newsletter). Forsen noted that there had been long, steady progress, both national and international, with an impressive history of international collaboration. He further noted that the declining budgets of the past decade caused the technology component of the program to have "atrophied badly." He concluded that the program needed to proceed with engineering development while maintaining a strong science component, that the physics data for proceeding with a burning plasma experiment is adequate and that the technology component of the program must increase. He recommended that the US proceed with plans for tritium experiments in TFTR and for building both a new burning plasma experiment and a new,

steady-state, non-burning plasma experiment. He felt that the US should propose a US site for the international engineering test reactor (ITER) and form an industrial consortium to implement that activity. He put forth a schedule for operating a demonstration fusion power plant by 2015 and estimated that the budget would have to double during the next five years to accomplish that goal. He recommended increasing the budget by \$50 to \$75 million per year during the next few years.

During the discussion that ensued, some members of FPAC expressed the view that the burning plasma experiment could be more ambitious than the proposed CIT facility, and that the ITER process could be used to "bring industry back into the fusion program."

Inertial Fusion

Robert Sproull (president emeritus of the University of Rochester) reported as chairman of the inertial fusion subcommittee. He endorsed the recent interim report of the National Academy Inertial Fusion Review Committee (see our March newsletter) that recommended enhancement of that program. In addition, he recommended the establishment of a separately funded and managed driver development and reactor design effort aimed at civilian energy applications of inertial fusion, funded initially at about \$20 to \$30 million per year and totaling \$1 billion over 10 years, in order to construct a prototypical driver facility late in the decade. He endorsed an upgrade of the NOVA laser facility at LLNL for the purpose of demonstrating pellet ignition at low gain by the year 2000, as part of the defense program. The total required defense program expenditures were estimated at \$2.2 billion over the next ten years.

In the ensuing discussion, FPAC clearly agreed that the DOE classification policy on inertial fusion was too restrictive and needed to be changed. It was noted that DOE had recently completed a four-year classification review of inertial fusion and made no significant declassification.

Generic Issues

John Landis (Stone and Webster Engineering Corp.) reported as chairman of the Generic Issues subcommittee. Landis stated that the "enduring rationale" for developing new energy technologies like fusion was that the "social and economic development of the world must not be constrained by energy supply." He noted that it was "difficult to quantify" the public acceptance problems of relying on coal and uranium as primary fuels in the future. He noted that sunlight and fusion are the two widely available "inexhaustibles," that sunlight is "meteorologically and materials limited" and that fusion is "difficult to develop but necessary." He believed that the country could justify spending \$1 billion per year on fusion.

Landis suggested that DOE start a process as soon as possible to identify a national fusion power site where the future engineering and demonstration fusion reactors would be built. He felt that the US should play a major role in the international engineering test reactor (ITER) and he suggested a detailed schedule for fusion development.

International Views

The FPAC received briefings from overseas leaders from both the magnetic and inertial fusion communities. The briefings were presented by C. Maisonnier (EEC), E.P. Velikhov (USSR), M. Yoshikawa (Japan), R. Boch (FRG), R. Dautray (France), and Y. Kato (Japan). The FPAC seemed impressed by the extent and quality of the scientific achievements, capabilities and planning of the international programs. FPAC was advised, for example, that a European Fusion Review Board will report by early July, that a new technical status review report had just been completed in Japan, and that a new policy review in Japan was underway and had just made an interim report. Also, R. Dautray announced that the French intended to open their previously-classified ICF research facilities to all-European participation.



Fred Coensgen



Don Grove



Fred Ribe

Industry Views

Fusion Power Associates organized a briefing for the FPAC Generic Issues subcommittee on May 23. FPA president Steve Dean stated that fusion needed 1) a clear statement of an achievable, practical, timely goal; 2) a development schedule, with commensurate budgets, that includes the timely construction of new facilities; and 3) a strategy for fusion development that defines and reserves certain roles for industry. He endorsed the magnetic fusion community program plan (see our April newsletter) as a "reasonable reference case," but also offered an "accelerated option." He stated that "If fusion is to achieve a practical goal, it must be managed as a development program and not as an open-ended research program."

Bob Iotti (Ebasco Services, Inc.) discussed the justification for pursuing fusion, with special reference to the difficulties being experienced in building fossil and nuclear power plants. Jim Maniscalco (TRW) discussed program management, specifically recommending that the DOE should establish an Assistant Secretary for Fusion Energy to make fusion organizationally parallel to the nuclear fission, fossil and renewable energy programs in DOE. He also recommended the establishment of an inertial fusion civilian applications program, the identification of leadership roles for industry within the fusion program, and the establishment of a permanent fusion planning activity

maintained by an industrial contractor.

Others who spoke included Bill Allen (SAIC), Dale DeFreece (McDonnell Douglas Missile Systems), Tony Favale (Grumman), Bob Johnson (General Dynamics), Arthur Kantrowitz (AVCO), Pat Long (KMS Fusion), Mike Monsler (W.J. Schaffer Associates), and Dave Overskei (General Atomics). They argued, for example, that the proper way to develop fusion was to provide opportunities now for industry to participate in the fusion research and development program.

DISTINGUISHED CAREER AWARDS

Fusion Power Associates Distinguished Career Awards were presented on May 23 to Fred Coensgen (LLNL), Don Grove (Ebasco), and Fred Ribe (University of Washington). The awards were established in 1987 by the FPA Board of Directors to recognize individuals who have made distinguished lifelong career contributions to fusion. Previous award recipients are Melvin B. Gottlieb, Donald Kerst, Richard F. Post, Lyman Spitzer Jr., Kodi Husimi, Donato Palumbo and R. Sebastian Pease.

In presenting the awards, FPA president Steve Dean noted that Coensgen, Grove and Ribe had led the efforts to build large experiments going back several decades, and that these contributions have provided us with experience and accomplishments that we build upon in looking toward the future.

PEOPLE

Sheldon Kahalas has been promoted to director of the DOE Office of Weapons Research and Advanced Technology, reporting to the deputy assistant secretary for military applications. Marshall Sluyter has been appointed acting director of the Division of Inertial Confinement Fusion. The ICF division will be one of three reporting to Kahalas.

Ryszard Gajewski, director of the Division of Advanced Energy Projects in the DOE Office of Energy Research, left DOE June 2 to become vice president for R&D at Physical Optics Corporation, 20600 Gramercy Place, Suite 101, Torrance, CA 90501. He can be reached at (213) 320-3088; FAX: (213) 320-4667.

D. Allan Bromley, science advisor to President Bush, has been elected to the National Academy of Sciences.

Fred L. Ribe has retired from the University of Washington and will establish residence in Santa Fe, NM in mid-June.

David Banner, a physicist from LLNL, has joined the IAEA in Vienna as head of the Physics Section, where fusion is one of his responsibilities.

Jerry Bishop, a reporter for the Wall Street Journal, has received the American Institute of Physics Science Writers Award for his coverage of cold fusion.

Bill Hermansfeldt, of the Stanford Linear Accelerator Center, and a member of the DOE Fusion Policy Advisory Committee, has been elected a Fellow of the American Physical Society.

FUSION PBS FILM AIRS

"Fire From the Sun: The Search for Fusion Energy," a one hour documentary produced by Manifold Productions (Michael Pack) and narrated by E.G. Marshall, will be aired nationally June 3 by South Carolina Educational TV. It will be shown by your local PBS stations at various times throughout the summer. Please call the programming director at your local PBS station to express your interest in seeing the program and to ask for information on their air dates and times.



Charlie Damm

IN MEMORIAM: CHARLIE DAMM

Fusion pioneer Charlie Damm, of LLNL, died May 10 after a several-year battle with cancer. Expressions of sympathy can be sent to his wife Gwendolyn at 149 La Sonoma Way, Alamo, CA 94507. Charlie was a primary contributor to the magnetic mirror program from the early 1960's until his death. We join his many friends in expressing our sorrow on this occasion.

QUOTABLES

"Abandon certainty! That's life's deepest command. That's what life is all about. We're a probe into the unknown, into the uncertain."

- Children of Dune

"Nothing would be done at all, if a person waited 'til he could do it so well that no one could find fault with it."

- Cardinal Neuman

"A molehill can be a mountain to a sparrow."

- R. Godden in
"An Episode of Sparrows"



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

NEW AFFILIATES

Creare, Inc. and *Directed Technologies, Inc.* have become Small Business Affiliates of Fusion Power Associates.

Creare, Inc. is an advanced engineering service firm specializing in heat transfer, fluid dynamics, multiphase flow, thermodynamics, turbomachinery, cryogenics and machine design (see feature article, page 4). Dr. Javier A. Valenzuela, Chief Engineer, will represent the company. He can be reached at P.O. Box 71, Hanover, NH, 03755; Tel. (603) 643-3800; Fax: (603) 643-4657.

Directed Technologies, Inc. has recently begun experimentation on a combination magnetic (multipole)-electrostatic confinement concept invented by Robert W. Bussard as an extension of earlier work pioneered by Robert L. Hirsch. The work is being sponsored by DARPA with smaller, companion work being performed at the University of Illinois and at Columbia University. Ira F. Kuhn, Jr., President, will represent the company. He can be reached at 4001 North Fairfax Dr., Suite 775, Arlington, VA, 22203; Tel. (703) 243-3383; Fax: (703) 243-2724.

AMA GROUP ENDORSES FUSION

The American Medical Association House of Delegates has passed a Resolution (139, I-89) calling for the AMA to "urge the President, the Congress and the energy companies to establish a national goal for the achievement of fusion production,"...and to "urge the federal government to expand and intensify research and development for fusion energy."...and to "submit a report to the House of Delegates on the successes of those efforts."

On the basis of this resolution, AMA staff scientists are currently drafting a report, which will be presented for adoption as policy by the AMA Board of Trustees later this year. Adoption of this resolution by the AMA would constitute the first statement of support by a major public constituency in the history of the fusion program. For further information, contact Robert H. Wheeler, Senior Scientist, AMA, 535 Dearborn St., Chicago, IL, 60610, (212) 645-5000.



John W. Landis

LANDIS NAMED TO ENERGY BOARD

John W. Landis, Senior Vice President and Director of Stone and Webster Engineering Corp., has been named to the recently-formed Secretary of Energy Advisory Board (SEAB). In announcing the formation of SEAB, Secretary of Energy James D. Watkins stated, "This new board will give me the high quality, independent advice I need to be able to make the best possible decisions as Secretary of Energy." The chairman of SEAB is Dr. Thomas E. Everhart, president of the California Institute of Technology.

Landis was previously chairman of the Energy Research Advisory Board (ERAB), which has now been replaced by SEAB, and he is also chairman of the DOE Fusion Policy Advisory Committee's common issues subcommittee. He is also a member and former chairman of Fusion Power Associates Board of Directors.

HOUSE SPARES FUSION BUDGET

The House of Representatives has voted to appropriate \$325 million to magnetic fusion, the funding level requested in the President's FY 1991 budget and \$175 million to the inertial fusion program, an increase of \$8.2 million over the President's request. \$16.1 million is earmarked to upgrade the OMEGA laser at the University of Rochester. The Senate has not yet acted on the FY 1991 budget.

In an effort to shore up support for the 1991 fusion budget, rumored to be targeted for heavy cuts, Secretary Watkins sent a letter dated May 31 to House Appropriations Energy and Water Development subcommittee chairman Tom Bevill, urging his "continued support of the Magnetic Fusion Energy Program" and stating that the FY 1991 President's funding request "is the minimum required to maintain the program's infrastructure and allow for the implementation of any new policy with the ambitious goal of developing fusion energy early in the next century."

"I consider fusion to be a very important part of the Department's long-range energy R&D program, with the potential to be an economic and environmentally acceptable source of energy in the next century," Watkins said. Copies of Watkins' letter are available from Fusion Power Associates.

ICF REACTOR STUDIES CONTRACTS

DOE Office of Fusion Energy will award 2-year contracts for ICF reactor studies to *W. J. Schaffer Associates and McDonnell-Douglas Missile Systems Co.* Teamed with Schaffer Associates are the *University of Wisconsin, Bechtel, General Atomics, and AVCO.* Teamed with McDonnell Douglas are *KMS Fusion, TRW, UCLA, Ebasco, Spar Aerospace, and Ontario Hydro.*

FUSION FILM AIRS ON PBS

Fire from the Sun: The Search for Fusion Energy, a one-hour documentary produced by Manifold Productions, will be shown throughout the summer on PBS stations around the country.

Hosted by E. G. Marshall, *Fire from the Sun* places the forty-year effort to master fusion in a larger political and cultural context. Leading fusion scientists, politicians, and critics of the fusion program all present their views. Other sequences include animation illustrating the fusion process, laboratory scenes of tokamaks and lasers, archival footage offering historical parallels, and clips from futuristic movies. The American fusion program is compared to the Japanese, Soviet and European programs, and major issues such as international collaboration, technological competitiveness and U.S. political "stick-to-itiveness" are explored.

Confirmed air dates have been obtained for the following stations: KCTS Seattle; July 25 at 11:00 P.M. KOEC San Francisco: July 28, 7:00 P.M. KOCE Huntington Beach: August 11 at 11:00 P.M.

Please contact the programming director at your local PBS to request information on air dates in your area.

FUSION OP-ED PUBLISHED IN SAN FRANCISCO CHRONICLE

On May 24, the San Francisco Chronicle published an opinion piece submitted by FPA president Steve Dean. In *Call for a National Energy Trust*, Dean urges the establishment of an Energy Trust, similar to the Highway Trust, to collect funds from fossil fuel use in order to finance the development of future energy technologies.

Citing dwindling oil supplies and atmospheric pollution as threats to U.S. energy security, Dean stressed that the U.S. government must begin now to develop non-fossil fuel technologies -- fusion, fission and various renewable energies like solar. Dean estimated that the U.S. DOE currently spends about \$1 billion per year on long-term energy technology development, whereas an estimated \$5 billion per year is required to develop these technologies for the commercial market. Demands on the federal budget make it all but impossible to obtain the required money, Dean stated. He proposed that the additional \$4 billion be raised by placing a one percent national users fee on electricity and gasoline.

CANADA BIDS FOR ITER PROJECT

Canada has announced its interest in hosting the detail design stage of the International Thermonuclear Experimental Reactor (ITER) project. A feasibility study has verified the availability of facilities and local support for this activity. The ITER participants have been advised of Canada's interest.

The ITER is an international cooperative project undertaken jointly by the USA, USSR, Japan and the European Community to provide the data required to build the world's first demonstration reactor. The conceptual design stage was begun in 1988 in Germany, and will be completed by the end of 1990. Two stages remain, the detail design and the construction phases. At the end of each stage, the four parties must negotiate an agreement to proceed to the following stage.

Canada's unique high technology skills and capabilities in tritium technology, robotics, and nuclear engineering, as well as its participation in ITER through the European Community, support Canada's candidacy to host the detail design stage of the project. Other countries, including the U.S. are also vying for the design site.

ANNUAL MEETING DATES SET

Fusion Power Associates' annual meeting and symposium will be held September 27-28 at the Hyatt Regency Hotel, Crystal City, Virginia. The theme for the symposium is "*Energy for a New Age.*" Management-level overview papers will be presented on non-fossil fuel technologies for producing electric power: photovoltaics, advanced fission and fusion. Papers will be presented on energy supply and demand and on energy use and the environment.

The keynote address will be given by Dr. H. Guyford Stever, chairman of the DOE Fusion Policy Committee (FPAC). Papers will be presented on the final FPAC report which is scheduled to be delivered to energy secretary James Watkins in September. Steve Koonin of the California Institute of Technology will also present the final report of the NAS review of inertial fusion.

An array of international speakers will discuss recent reviews of the European and Japanese programs and the current status of ITER. Managers of the magnetic and inertial fusion programs will discuss the status and directions of fusion research.

Details of the meeting will be sent out in a separate mailing in the near future. For further information, contact Ruth Watkins (301) 258-0545.

SUMMIT STATEMENT ON FUSION

Presidents Bush and Gorbachev issued the following joint statement on fusion after the June Summit:

"At their meeting in Geneva in 1985, the leaders of the United States and the Soviet Union emphasized the importance of the work aimed at utilizing controlled thermonuclear fusion for peaceful purposes, and advocated the widest practical development of international cooperation in obtaining this essentially inexhaustible source of energy for the benefit of all mankind.

"The International Thermonuclear Experimental Reactor (ITER) project, involving joint efforts by the USSR, the United States, Japan and the European Community, under the aegis of the International Atomic Energy Agency, is making significant progress towards this end. A conceptual design will soon be completed.

"Noting with satisfaction the results being attained under this project, the United States and the Soviet Union look forward to continued international efforts aimed at promoting further progress in developing controlled thermonuclear fusion for peaceful purposes."

FPA HONORS GEORGE CLEMENS

George S. Clemens, president of the Agency for the Advancement of Fusion Power, was awarded a certificate of appreciation by the Fusion Power Associates Board of Directors, "for his vision and inspiration."

Clemens, a mechanical engineer and inventor, established his association in 1989 to promote the development of fusion for commercial power on the most rapid schedule possible. Active in areas such as population control and global climate change, Clemens is convinced that the U.S. should demonstrate fusion power as early as possible in order to meet the energy needs of the country and to be able to transfer the technology to other nations.

Clemens asked Fusion Power Associates to develop an accelerated fusion development plan aimed at early construction of a fusion pilot plant. Clemens' strong conviction and leadership were instrumental in clarifying the possibilities for a fast-track fusion development program.

PEOPLE

Ronald Sagdeev, one of the Soviet Union's leading physicists and an early proponent of domestic and international glasnost has accepted a Distinguished Professorship at the University of Maryland in College Park, a suburb of Washington, D. C.

Recently Sagdeev received media attention for his bi-continental marriage to Susan Eisenhower, granddaughter of Ike. The choice of Maryland was made for more than personal reasons, however. It was one of the first U.S. institutions he visited 30 years ago, and he has worked with the university's head of the Department of Physics and Astronomy, Chuan Liu, for 20 years. Sagdeev will retain a position at Moscow's Institute for Space Physics (IKI), where he has been head of the theoretical studies division.

William Kruer, of the Lawrence Livermore National Laboratory, will be awarded the 1990 James Clerk Maxwell Prize in plasma physics by the American Physical Society. "This is certainly a pleasure, one of the high points of my research career," said Kruer.

The highly-respected Maxwell prize, awarded each year in recognition of significant contributions to the field of plasma physics, is being given to Kruer "for outstanding an seminal contributions to the theoretical and experimental understanding of the interaction of intense electromagnetic waves with plasmas and for numerous contributions to the understanding of basic plasma phenomena via numerical simulation."

INTRODUCING CREARE, INC.

Creare, Inc. (P.O. Box 71, Hanover, NH, 03755) serves clients in industries ranging from aerospace and defense to process control, oil and gas, and nuclear industries.

Current work includes the development of a high performance heat exchanger for cooling high heat flux components of magnetic fusion reactors. Their approach uses an innovative, helium-cooled heat exchanger, which can match the heat transfer performance of subcooled boiling water. The new design achieves high heat transfer performance while minimizing helium pressure and pumping power requirements.

A major advantage of helium cooling is ease of tritium removal. In addition, helium remains a single-phase gas throughout the proposed divertor cooling module, resulting in more stable flow and heat transfer than is possible with water. Furthermore, helium is chemically inert and compatible with all materials and coolants. It will not damage reactor components should a leak develop in the heat exchanger cooling modules, nor will it react chemically with any blanket coolant. Thus, helium coolant entails fewer system design constraints than does water coolant for high heat flux components.

In the initial phase of Creare's work, they tested a model heat exchanger at heat fluxes up to 850 W/cm^2 . Heat transfer coefficients of $3.5 \text{ W/cm}^2\text{-}^\circ\text{C}$ were achieved at pressure drops of less than 1 psi. A conceptual design for the divertor cooling module has been developed, and Creare is presently developing large-scale fabrication techniques. Ultimately, a prototype cooling module will be constructed based on the design requirements for the International Thermonuclear Experimental Reactor (ITER), and tested in the Plasma Materials Test Facility located at Sandia National Laboratories. The test will provide fabrication techniques and design methods in an environment which stimulates the operating conditions of an actual divertor plate.

For more information on Creare's capabilities, please call Dr. Javier Valenzuela (Chief Engineer) or Ms. Carolyn Keats (Marketing Manager) at (603) 643-3800 or contact them by Fax at (603) 643-4657.

NUCLEAR ENGINEERING SOURCEBOOK

The 1990 Nuclear Engineering Education Sourcebook, published by the American Nuclear Society with support from DOE, is now available. The sourcebook lists the research areas of all nuclear engineering faculty in North America and Japan, and provides additional information on individual NE departments. For copies, contact John Gilligan at North Carolina State University, Department of Nuclear Engineering, Box 7909, Raleigh, NC, (919) 737-2301.

DOMESTIC OIL PRODUCTION IN DECLINE

The DOE reports that domestic crude oil production, which has declined steadily in recent years, is expected to continue declining by 4.8 percent this year and by an additional 4.1 percent next year. These declines are expected to result in an import dependency of 44 percent in 1990 and 47 percent in 1991.

According to an Energy Information Administration press release dated May 10, crude oil production from Alaska fell by more than 140,000 barrels per day last year and should decline by 100,000 barrels per day for 1990 and 1991. Production from the Lower 48 States is also expected to decline through 1991, dropping by 235,000 barrels per day in each of the next two years. These declines follow a drop in total domestic crude oil production of more than 6 percent between 1988 and 1989 -- the largest recorded year-to-year decline.

Projections made in a recent EIA report, *Short-Term Energy Outlook*, indicate that net petroleum imports will increase to 7.6 billion barrels per day by year's end, and by 1991, should reach 8.1 billion barrels per day.

Additional highlights include that, despite below-normal temperatures during the first 3 months of this year, growth in electricity demand is projected to continue rising steadily, averaging 2.7 percent for the year. By 1991, demand is expected to accelerate to 3.8 percent because of higher demand in the industrial sector and continued strength in the residential and commercial sectors.

Copies of the EIA report are available from the U.S. Government Printing Office or through EIA's National Energy Information Center, Room 1F-048, Forrestal Building, Washington, D C., 20585.

STELLARATOR PROGRESS

The January 1990 issue of the ANS Journal *"Fusion Technology"* is devoted to reports on stellarator research. The issue features an overview article, "Near-Term Directions in the World Stellarator Program" by Jim Lyon of ORNL.

Lyon notes that three new stellarator experiments started operation in 1988, that three more are in the final design or construction stage, and that design studies have begun on the next generation of large experiments. A large variety of configurations must be tested, Lyon says, because "their inherently three-dimensional nature make it more difficult to determine an optimum."

ORNL also publishes "Stellarator News", edited by Jim Rome (615) 574-1306.



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879
(301) 258-0545

FUSION POLICY PANEL REPORTS

INTERIM REPORT

The Fusion Policy Advisory Committee (FPAC), established by DOE Energy Secretary James Watkins (see our March 1990 special edition newsletter), delivered its interim report on July 23. A final report is due in late September. The interim report states that "The U.S. fusion program should have as goals an operating Engineering Demonstration Plant by 2025 and an operating Commercial Power Plant by 2040." In a covering letter transmitting the report to Secretary Watkins, FPAC chairman Guyford Stever states, "The total fusion budget (including the military ICF program) will have to double in constant dollars over the next five to seven years in order to achieve the goal of an Engineering Demonstration by 2025." Stever concludes, "We recognize the difficult funding climate which now exists so it is our intent in our final report due in September to examine the priorities and options for taking the first steps in this conceptual plan."

Copies of the report are available from Fusion Power Associates.

Context of the Report

The FPAC, in its Interim Report, states that fusion policy must be formulated in a "context" that includes such issues as "an increasing concern for environmental matters; the shift in national security from military capability to economic competitiveness; and renewed emphasis on a secure supply of economic and acceptable energy."

A key precept for setting fusion policy, as stated by FPAC, is that "The social and economic development of the world community should not be constrained by an inadequate supply of affordable energy. Yet the increasing fraction of U.S. petroleum use that is imported, the environmental concerns surrounding fossil energy, and the public's reluctance to accept nuclear fission energy are alarming constraints."

The FPAC notes that "Fusion research programs worldwide have made steady progress during the last decade" and states

"There is an additional contextual consideration: the growing strength of foreign fusion programs relative to that of the U.S."

The committee states that "the funding climate for federal science and technology programs is an important contextual consideration for fusion energy" and asserts "The Committee believes that the United States should have a far more comprehensive energy program, including fusion, directed toward reliable and environmentally acceptable sources of energy."

The FPAC gives a number of reasons why they believe "that the U.S. must be vigorously involved in and firmly committed to the development of fusion as a source of civilian energy, despite the high cost and technological risk." These include:

- "Fusion is one of very few energy options that offers an essentially inexhaustible and widely available fuel supply."
- "Fusion is now technically ready for these next steps."

General Recommendations

The FPAC Interim Report recommends:

- "support of both Magnetic and Inertial Fusion Energy Programs, although the two are at different levels of maturity, and have different technical pathways toward achieving their goals;"
- "that a separate fusion energy organization be created within DOE, headed by an officer with rank comparable to that of an Assistant Secretary, or that of the Director of the Office of Energy Research;"
- "that the present Division of Inertial Fusion be elevated to an Office of Inertial Fusion within the organization of the Deputy Assistant Secretary for Military Applications, Defense Programs."

Magnetic Fusion

The Committee recommends four major new facilities in magnetic fusion: a burning plasma facility; the International Thermonuclear Experimental Reactor; a 14-MeV neutron source for materials testing; and a steady state hydrogen plasma experiment. They recommend maintaining "a vigorous and diverse base program" that includes research "aimed at detailed scientific understanding;" "deuterium-tritium experiments in TFTR to demonstrate approximate breakeven;" research "related to concept improvement;" and "greatly increased work on low-activation reactor materials, and very extensive technology development."

Inertial Fusion

The Committee recommends that "experimentation continue toward the goal of laboratory ignition of a fuel pellet by the end of the decade" and "endorses the construction of such an (ignition) facility." They recommend maintaining "a vigorous and diverse base program" that includes research "to study the scientific issues in driver-plasma instabilities, hydrodynamic mixing, and target design." They also recommend an inertial fusion energy program, separate from the defense inertial fusion program, focussed on "suitable driver development and target fabrication techniques, and a much improved definition and analysis of possible reactor configurations." As with magnetic fusion, the FPAC recommends "greatly increased work on low-activation materials and very extensive technology development," for inertial fusion.

International Collaboration

The FPAC states that "The emergence of strong programs abroad suggests that a sensible U.S. fusion policy must include a meaningful level of international collaboration, especially in the phases prior to commercial deployment." They recommend that "the U.S. should take the lead in creating a mechanism for in-depth international program planning" and "should participate as an equal partner in the ITER engineering design activity, with major participation by U.S. industry. The U.S. should propose to host the engineering design activity." They further state, "Opportunities for more formal international collaboration (in inertial fusion) will occur as the energy application branch of inertial fusion develops, if they are not hindered by the classification and technology transfer restrictions discussed subsequently."

Industrial Participation

The Committee states "Both MFE (Magnetic Fusion Energy) and IFE (Inertial Fusion Energy) should increase participation by industry as part of the expanded program. A formal fusion industrial participation program should be established. The range of possible relationships includes exchange or loan of personnel, professional-service contracts, purchases of equipment and systems, and construction/maintenance/operating contracts. Increased

industrial involvement will benefit both programs in several ways: broadened technical support, improved program and project management; expert assistance in procurement, quality control, and resource allocation; an enhancement of capability for equipment fabrication, facility construction, and plant operation and maintenance. It will also begin the process of technology transfer to industry."

University Participation

The FPAC states "Both MFE and IFE require strong programs at universities. The university program is essential for providing innovative ideas and educating future scientists and engineers. The universities will need to join with national laboratories and industry in cooperative activities on the largest machines. Nonetheless, each university program must have the resources to support strong and up-to-date home programs. It is important to maintain, and perhaps increase, the number of large centers carrying out broad, integrated programs. There is an urgent short-run need to continue the renewal of confinement experiments at university centers. Specifically for IFE, the DOE should consciously expand the number of university programs and encourage participation at major national facilities."

Inertial Fusion, Defense and Classification

The committee states that the inertial fusion energy program "should be managed to take maximum advantage of the Defense Programs research." They state that, "Classification policies and restrictions on transfer of technology for fusion should be re-examined. Classification hinders the inertial fusion program. Unnecessarily restrictive policies on technology transfer hinder collaboration in both MFE and IFE. The Committee believes that classification guidelines can be written to prevent transfer of weapons technology and yet permit collaboration on the processes and targets of interest for energy applications. These changes should be made as soon as possible, before a damaging effect on public acceptance of IFE is caused."

Funding and Summary

The FPAC states, "To achieve the recommended goal of Demonstration Power Plants by 2025, the total fusion energy budget (including the military ICF program and the construction of the essential facilities) will have to reach approximately \$1 billion/year in constant dollars over the period of the next five to seven years. The Committee recommends that the program be conducted in a disciplined manner, with appropriate milestones, decision points, and downselection of options as required. The Committee further recommends that each major step in the program be subjected to a rigorous technology feasibility and cost analysis by a qualified external group prior to approval."

"This interim report presents a fusion policy that the Committee believes is in the best interests of the Nation in its pursuit of a secure energy future. The recommendations outline the pathway to achieve the explicitly stated goals. It

is clear that the goals cannot be attained without significant increases in funding. The final report, to be submitted in September, will contain additional details on the reasoning and findings of the Committee, and will include a discussion of the funding and schedule priorities that would be assigned to its recommendations."

WATKINS RESPONDS

The Interim Report was presented formally in a meeting with Energy Secretary James Watkins on July 23. In a letter to FPAC chairman Stever from Watkins dated July 24, the Secretary says, "The committee's interim report is a good start towards a comprehensive policy and program for turning nuclear fusion into an energy supply option for the Nation. It articulates a need for a sea-change in the Nation's approach to fusion, from a research program on the physics underlying fusion to an energy development program. It lays out a series of programmatic steps that would be entailed in the optimal approach to fusion energy in which the United States exercises world leadership."

Watkins cautions the committee that "in the current budgetary environment," it will not be "relatively simple" to implement the "ideal path for developing fusion energy" that the committee advocates. Watkins states, "I believe that the committee, as it moves from its interim report to its final report, must make a critical assessment of each milestone on its identified paths to fusion energy. What is the relative importance of U.S. leadership on each milestone? How much would be lost if a given milestone could not be accommodated within the U.S. program? Without such a critical approach, I am afraid that the final report of the committee might not command the credibility necessary for it to lead to the creation of a truly effective fusion energy program.

"I realize that I am asking the committee to undertake tasks that will be difficult and, perhaps, contentious. Yet, I am depending on committee members to give me their best judgement on these tough questions so that I can make hard choices in an enlightened manner. I am most grateful for the diligent and patient work of the committee--it has indeed made substantial progress towards defining a fusion energy program that can attract broad and sustained Federal support. I look forward to your continued dedication on this important task for the Nation."

The complete text of Watkins' letter is available from Fusion Power Associates.

FPAC SCHEDULE

The FPAC meets next in public session (DOE Forrestal Bldg.) on August 27-28 and again on September 24-25. In the meantime they will be preparing drafts of the final report, which they expect to complete at their September meeting. Stever and other members of FPAC are scheduled to summarize the final report at the Fusion Power

Associates annual meeting and symposium, September 27-28 at the Hyatt Regency Hotel, Crystal City, Virginia.

SENATE SPARES FUSION BUDGET

Following House action on the fusion budget (see our July newsletter), the Senate Appropriations committee has similarly spared the fusion program from threatened cuts in the FY 1991 budget. The Senate committee accepted the President's request for \$325 million for magnetic fusion and \$166.8 million for inertial fusion. In report language accompanying the action, the committee endorsed proceeding with DT experiments in TFTR, deferring construction of CIT and participating in the international ITER design efforts.

The FY 1991 fusion budget still hangs under the general cloud of possible across-the-board cuts in federal spending that are expected to be triggered by the efforts to trim the federal deficit.

HEAVY ION FUSION SYMPOSIUM SET

An International Symposium on Heavy Ion Inertial Fusion will be held December 3-6, 1990 at the Monterey Sheraton Hotel, Monterey, CA. It is the latest in a series which have been held approximately every two years since 1976. The purpose of the symposium is to provide for international exchange of information in the field of Heavy Ion Inertial Fusion through the presentation of papers, workshops and informal discussion. For further information, contact Mollie Field, LBL; (415) 486-6387; FAX (415) 486-5401.

FEEDS MEETING SCHEDULED

Fusion Power Associates is sponsoring the Fusion Energy Educational Development Seminar (FEEDS) on September 13-14 at the DOE Forrestal Bldg., Washington, D. C. The seminar brings together administrative and secretarial staff for briefings on the status of fusion and other alternate energy technologies. The focus of this year's meeting will be on the government and its role in funding the fusion program. We urge all our readers to send their senior secretaries and administrative personnel to this important gathering. Those desiring additional information should contact Ruth Watkins (301) 258-0545.

FUSION PBS AIR DATES

The fusion documentary "*Fire from the Sun: The Search for Fusion Energy*," produced by Manifold Productions and distributed by South Carolina Educational TV, will air August 11, 11:00 P.M. on KOCE, Huntington Beach, CA; August 14, 9:00 P.M. on WHMM, Washington, D. C.; and September 16, 6:00 P.M. on KETC, St. Louis.

Please contact the programming director at your local PBS station to request information on air dates in your area.

30 YEARS OF NUCLEAR FUSION

The IAEA journal *Nuclear Fusion* will celebrate its 30 year anniversary in September. It started as a quarterly journal, publishing its first issue in September 1960. During the past 30 years, the journal has matured into a prestigious international monthly journal publishing, on average, 15 peer-reviewed articles per issue (full papers, letters and reviews) as well as conference reviews, book reviews and a fusion calendar. In addition, the journal has traditionally published the summary papers of the IAEA fusion conferences, reports of IAEA Technical Committee meetings, the executive summaries of INTOR and ITER, and status reports on fusion compiled or written by the International Fusion Research Council (IFRC), the advisory body on fusion matters to the IAEA.

The Anniversary Issue of *Nuclear Fusion*, Vol. 30, issue 9, will contain the most recent IFRC status report comprising 13 technical papers detailing all aspects of the status of controlled thermonuclear fusion research. The papers, written by an expert subcommittee of the IFRC, deal with both the physics and the technology of fusion research. The issue opens with an introductory note from Dr. Hans Blix, Director General of the IAEA, followed by an executive summary and a general overview of the technical papers. This part appeared as a separate booklet in June 1990 entitled "Status Report on Controlled Thermonuclear Fusion."

In addition, the Anniversary Issue will include a comprehensive database of tokamak confinement data from several major tokamak experiments. This database is the first in a series of articles meant to provide the fusion community with confinement relevant data from all the major tokamaks in a unified format.

For further information, contact Cor Bobeldijk, editor, *Nuclear Fusion*, IAEA, Box 100, A-1400, Vienna, Austria, FAX 43 1 234564.

IN MEMORIAM: JAY E. HAMMEL

Jay E. Hammel, experimental physicist at the Los Alamos National Laboratory for the past 39 years, died from thyroid cancer on July 19, 1990, at the age of 69.

A fusion pioneer, Jay began working on magnetic fusion at Los Alamos in 1956. He performed early work on rotating plasmas, plasma confinement in multipole fields, penetration of plasmas across magnetic fields, and the more recent, exciting work on high density z-pinches. Jay was instrumental in reviving this earliest of fusion concepts by focusing attention on ohmic heating of Z-pinches in quasi-static pressure equilibrium and applying modern high-voltage technology to heat and maintain these configurations. This highly innovative concept spawned entirely new programs in a number of laboratories around the world and also revived the interest of theorists in the behavior of the z-pinch.



Jay E. Hammel

Jay's retirement in December 1987 was a formality that in no way interrupted the dedication, perseverance, and ingenuity with which he pursued this work until the onset of his illness.

He was an avid outdoorsman, skier, photographer, and wood craftsman who shared these passions with his wife, Betty (40 Chaco, Los Alamos, NM, 87544) and children, Steve, Chris, and Leslie.

PEOPLE

Warren Marton has been named Chief, Plasma Technology Branch, Office of Fusion Energy, DOE, replacing Don Beard who has retired.

DID YOU KNOW THAT...?

- A 5% national sales tax on stock trades would yield \$100 billion in new federal revenues.
- A 3% tax on electricity sales, funneled into a National Energy Technology Development Trust Fund would provide almost \$5 billion, which could be used to fund the development of new energy technologies to replace fossil fuels.
- A Heritage Foundation report* by economist Scott Hodge proposes that the federal deficit be eliminated by (1) killing the SSC, (2) postponing the space station and the manned Mars mission, (3) eliminating energy conservation and energy research activities including solar and fusion, (4) cutting NIH research by 30%, and (5) leasing the entire Arctic National Wildlife Refuge for oil exploitation. (*"A \$130 billion No-Tax Prescription for the Budget Deficit," Heritage Foundation, 31 May, 1990.)



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

NEW SMALL BUSINESS AFFILIATE

InterScience, Inc. has become a Small Business Affiliate of Fusion Power Associates. They provide technical services in the areas of plasma and particle beam technology, electromagnetics, instrumentation and diagnostics. Dr. James T. Woo, president, will represent the company. He can be reached at 105 Jordan Rd., Troy, N.Y. 12180, tel: (518) 283-7500; FAX: (518) 283-7502. We welcome their participation in Fusion Power Associates.

WATKINS VISITS GENERAL ATOMICS

Energy Secretary James D. Watkins visited General Atomics in San Diego on June 15. While there he received a briefing on the GA fusion program and toured the DIII-D tokamak. It was Watkins' first look at a fusion experiment since becoming head of the Department of Energy. San Diego congressman Bill Lowery accompanied Secretary Watkins on the visit. GA fusion vice president Dave Overskei and consultant Marshall Rosenbluth briefed the Secretary on fusion progress.

GROSSMANN, LANDIS, HENDERSON, OVERSKEI, ELECTED TO FPA BOARD

Bill Grossmann (SAIC), John Landis (Stone and Webster), Tim Henderson (KMS Fusion), and Dave Overskei (General Atomics) have been elected to three-year terms on the Fusion Power Associates Board of Directors commencing November 1. Landis, Henderson and Overskei are also members of the current Board. Other members of the Board are Charles C. Baker (ORNL), Christian C. Bolta (Asea Brown Boveri, Inc.), Robert Botwin (Grumman Aerospace Corp.), Robert Center (Spectra Technology), Don Dautovich (Ontario Hydro), Ronald C. Davidson (MIT), John Davis (McDonnell Douglas Missile Systems Co.), Stephen O. Dean (Fusion Power Associates), Harold K. Forsen (Bechtel National, Inc.), Alexander J. Glass (LLNL), Robert C. Iotti (Ebasco Services), Dale M. Meade (PPPL), Michael Monsler (W. J. Schafer Associates), and J. Pace VanDevender (Sandia National Labs).

FPAC REPORT IMMINENT

The Fusion Policy Advisory Committee (FPAC), established by DOE Energy Secretary James Watkins, met in public



Rep. Bill Lowery and Secretary Watkins at GA

session August 27-28 to work on a draft of its final report. The major thrust of their recommendations remain unchanged from those reported in our August newsletter.

In a draft covering letter, which will be used to transmit the report to Secretary Watkins, the committee states "After subjecting the fusion program to close scrutiny, the Committee believes that there are persuasive reasons for the U.S. to commit to a responsible, goal-oriented fusion energy development program. The successful development of this energy source would be of great value to the U.S. and indeed to the citizens of all Nations."

The draft letter states, "We believe that the U.S. fusion program is technically ready in this decade to construct devices to demonstrate significant fusion power production in a burning tokamak plasma and ignition in an inertially confined pellet."

In the body of the draft final report, the FPAC provides several possible near-term budget scenarios in response to Secretary Watkins' request to consider lower cost development paths. For magnetic fusion, the Committee

recommends a two-year stretchout in the construction schedule for the Compact Ignition Tokamak and other schedular delays. For inertial fusion, the Committee recommends maintaining the momentum of the defense inertial fusion program and delaying the civilian energy programs. The Committee makes it clear, however, that they believe the faster-track, higher-cost scenario would be more cost-effective and beneficial to the Nation in the long run.

FUSION IN CHINA

Bill Holtslander (Canadian National Fusion Program) and Kam Wong (CFFTP) visited four fusion sites in the People's Republic of China during April 28-May 8, 1990, at the invitation of Prof. Qui Li-Jan, Deputy Director of the Institute of Plasma Physics, Hefei. The following notes and impressions of the Chinese fusion effort may be of interest to our readers.

China has been doing fusion research for several decades, and work today continues on a broad front. There is also an emphasis on applying fusion, strongly linked to China's fission reactor program. A national effort is in progress to design a fusion-fission hybrid machine, using fusion neutrons to breed fission reactor fuel as well as tritium to sustain the fusion machine. Some Chinese scientists offered the opinion that such a hybrid machine, a net power user and not achieving self-sustaining fusion, would have more moderate physics and engineering demands than a self-sustaining fusion device, and so might possibly be built sooner than an ignited fusion power reactor. In producing fission fuel, the hybrid would provide a net energy gain. At present, there are two alternative tritium breeder blanket design programs for the hybrid, one based on a liquid lithium breeding medium and the other on a lithium ceramic breeder. Key experimental programs in support of hybrid reactor work include in-situ tritium recovery from breeder materials, plasma exhaust purification, neutron radiation damage in materials and fusion blanket neutronics.

The hybrid reactor effort falls under the Energy Section of China's National High Technology Program. An Expert Committee in the Energy Section controls energy technology R&D which includes work on fast breeder and HTGR fission reactors and advanced coal energy, as well as the fusion work.

In general, Chinese fusion workers are interested in integrating their work into world fusion work, and accordingly are attending to areas such as high power ICRF plasma heating, where other countries do not have big programs. China is planning to build during the next decade a tokamak with exceptionally high heating power density, in

the MW/m³ range, using radiofrequency heating.

Sites Visited

Institute of Plasma Physics Academia Sinica - Hefei. The conceptual design group at this institute (IPP) plays a major role in designing IPP's approach to the hybrid reactor, called FFFF (Fusion-Fission Fuel Factory). The IPP approach includes a solid lithium ceramic breeder blanket. Other special interests include ICRF plasma heating, neutral beam technology and superconducting magnets, with experimental work on fields up to 20 Tesla and the manufacture of high temperature superconductors.

IPP has two well-equipped small tokamaks, HT6 and HT6M, and is planning a new mid-sized tokamak called HT-U, to be designed and built almost completely on site. The Institute has excellent fabrication facilities, and exports fusion hardware. IPP is building a new vacuum vessel for the TEXT tokamak at the University of Texas, under a commercial contract.

Southwest Institute of Nuclear Physics and Chemistry - Mian Yang. Fusion work at the Institute (SWINPC) has two main themes; tritium breeding research with lithium ceramics and plasma exhaust processing. The tritium breeding work includes irradiation of lithium aluminate in their 3.5 megawatt pool-type reactor, using both sealed sample capsules and recirculating sweep-gas capsules.

SWINPC is building an experimental plasma exhaust tritium recovery system, with both palladium diffuser and cryosorption trains for separating mixed hydrogen isotopes (H, D, T) from other gases and impurities. Hydrogen isotopes are separated by gas chromatography. Glass microspheres are charged with DT gas for inertial confinement fusion experiments at another institute. SWINPC also makes titanium tritide targets for accelerators, which they can sell to other countries.

Southwest Institute of Physics - Leshan. This Institute (SWIP) is devoted entirely to fusion work. It has three fusion research themes; tokamak research, mirror machine research, and fusion technology. Conceptual design of fusion-fission hybrids with liquid lithium breeders dominates fusion technology work, coupled with a supporting experimental program. Conceptual designs are finished for an experimental hybrid machine and a production fuel-producing device. A liquid lithium loop is planned for 1990 to study materials compatibility and MHD effects. SWIP's HL-1 tokamak has similar scientific objectives to the Canadian Tokamak de Varennes at CCFM, Quebec.

Institute of Atomic Energy - Beijing. The main programs are in nuclear physics, fusion, isotope research and nuclear reactor engineering. In fusion-related work, the institute is interested in tritium breeder research and hydrogen isotope separation, and has an inertial confinement program.

Reprinted from Fusion Canada newsletter of the National Fusion Program of Canada, edited by Bob MacPhee (416) 925-3117.

KINKEAD WEDS

Susan D. Kinkead, Fusion Power Associates' Director of Public Affairs, married John Acree in Winnemucca, Nevada on August 11. Steve Dean and Ruth Watkins attended the wedding at which the principals and guests were dressed in 19th Century western and pioneer attire. Susan and John are currently on an "extended honeymoon" in Guatemala. She will be back in the office in late September. We wish Susan and John a long and happy life together.

LSX DEDICATED AT SPECTRA TECHNOLOGY

The Large S Experiment (LSX), a \$15 million magnetic fusion research experiment, was dedicated at Spectra Technology, Inc. in Bellevue, Washington, on August 7. The LSX will study plasma behavior at temperatures up to 5 million degrees in what is called a "field-reversed configuration." This type of magnetic configuration allows the simultaneous achievement of two advantages: The plasma is confined by magnetic field lines which are endless or toroidal, while the mechanical configuration has the engineering simplicity of being straight or linear. Scientists from the University of Washington, Los Alamos National Laboratory and Osaka University will collaborate with scientists from Spectra Technology on the experiments. For further information contact Dr. Alan Hoffman at (206) 827-0460.

AAAS ESTABLISHES HILLIARD RODERICK PRIZE

The American Association for the Advancement of Science has established the Hilliard Roderick Prize for Excellence in Science, Arms Control, and International Security, in Roderick's memory. Fusion researchers will remember Roderick for his management role in the fusion program at the Atomic Energy Commission in the late 1950's and early 1960's. The AAAS is soliciting nominations for the award, consisting of \$5000 plus a commemorative medal, to be awarded at the AAAS annual meeting in Washington, February 15-19, 1991. Nominations should be sent to Iris M. Whiting, AAAS, 1333 H Street, N.W., Washington, D. C., 20005.



Mr. and Mrs. John Acree

TRITIUM SAFE HANDLING COURSE

A five day, hands-on course on tritium handling course will be given in Toronto and Chalk River, Ontario by the Ontario Hydro Canadian Fusion Fuels Project, September 24-28. The course is of interest to technical, operational, and health and safety personnel; designers and operators; and supervisors and managers. Persons directly involved in nuclear weapons programs are not permitted to enroll in the course. For further information contact Barrie Wallace (416)823-0102.

STATUS PAPER ON FUSION REACTORS

A "white paper" prepared at the request of the IAEA International Fusion Research Council, entitled *Fusion Reactor Economic, Safety and Environmental Prospects* has been prepared and is available from Bob Conn of UCLA, FAX: (213) 206-4832. In addition to Conn, the other authors are J. P. Holdren, D. Steiner, D. Ehst, W. J. Hogan, R. A. Krakowski, R. L. Miller, F. Najmabadi, and K. R. Schultz .

MEETINGS

September 19-22 - Second Workshop on KrF Laser Technology, Banff, Alberta, Canada. Contact Prof. Allan Offenberger, Dept. of EE, University of Alberta, Edmonton, Alberta T66267, Canada.

September 27-28 - Fusion Power Associates Annual Meeting and Symposium on *Energy for a New Age*, Hyatt Regency Hotel, Crystal City, Va. Contact Ms. Ruth Watkins (301) 258-0545.

October 1-6 - IAEA 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Hyatt Regency Hotel, Crystal City, Va. Contact Dr. David Crandall, DOE, (301) 353-4596.

October 8-10 - IAEA Technical Committee Meeting on Tokamak Transport, Princeton, NJ. Contact Prof. J.D. Callen, FAX:(608) 262-6707.

October 7-11 - ANS Ninth Topical Meeting on the Technology of Fusion Energy, Oak Brook, IL. Contact Dr. Dai-Kai Sze, (708) 972-4838.

November 12-16 - APS Division of Plasma Physics annual meeting, Cincinnati, OH. Contact Dr. Akira Hasegawa, (201) 582-2886.

September 24-28 - Applied Superconductivity Conference, Snowmass Village, CO. Contact Conference Coordinator, FAX: (303) 442-8638.

PEOPLE

Kun Mo Chung, a fusion scientist trained at MIT, has been appointed Minister of Science and Technology for the Republic of Korea by Korean president Roh Tae Woo. Chung, who has also worked in the United States at the National Science Foundation, was also the Atomic Energy Commissioner for the Republic of Korea. We congratulate our friend Kun Mo on his distinguished career.

J. Nelson Grace, who provided oversight of the TFTR and the Princeton Plasma Physics Laboratory for the Department of Energy in the late 1970's and early 1980's, has retired from his most recent position as Region II administrator for the Nuclear Regulatory Commission. He is now working as a management consultant and can be reached at (404) 934-2006.

QUOTABLES

"We have learned how to take such a small step that it will certainly not be subject to the criticism that it was a rash step. In fact, these steps are now so small that if we continue this way we will never get there."

Arthur Kantrowitz

"Stronger than all the armies on earth is an idea whose time has come."

Everett Dirksen



**Dr. N. Anne Davies Presents
Award to Dr. D. Bruce Montgomery**

MONTGOMERY RECEIVES DOE DISTINGUISHED ASSOCIATE AWARD

Dr. D. Bruce Montgomery, Associate Director of the Plasma Fusion Center at the Massachusetts Inst. of Technology has received the DOE Distinguished Associate Award. Dr. N. Anne Davies, Acting Associate Director for Fusion Energy, presented the award on behalf of Admiral Watkins, Secretary of Energy, which cited Dr. Montgomery for "recognition of your outstanding contributions to the development of magnets for fusion research and for your leading role in the engineering development, design, and fabrication of the Alcator high field tokamak experiments and the design of the Compact Ignition Tokamak.

The DOE Distinguished Associate Award is the highest department award which can be presented to a DOE contractor and is given "for outstanding individual efforts or achievements."



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

FUSION PANELS ISSUE REPORTS

WATKINS ORDERS DECLASSIFICATION STUDY

CAPORALI NAMED GRUMMAN HEAD

Dr. Renzo L. Caporali has been elected chairman, chief executive officer, and president of Grumman Corporation. Previously, as vice chairman - technology, he directed the office of corporate technology and was responsible for all of Grumman's technical resources, including research, development, engineering and advanced systems functions. In a statement, Caporali stated "My job will be to maintain the course we've set, which includes restructuring the company into a more efficient and cost-competitive form, building on our relationships with our major customers and continuing to develop the technologies that make sense for our rapidly changing markets." Caporali received his Ph.D. in Aeronautical Engineering from Princeton University. He was a member of Fusion Power Associates Board of Directors 1985-88. We congratulate "Cap" on his new responsibilities.



Renzo Caporali

TWO FUSION PANELS REPORT

Two advisory panels, commissioned by the Department of Energy to review fusion, issued their final reports in September.

The Fusion Policy Advisory Committee (FPAC), chaired by former Presidential Science Advisor H. Guyford Stever, sent its report to Energy Secretary James Watkins on September 25 and DOE released the report to the public on September 28. Recommendations contained in the report were presented publicly for the first time at Fusion Power Associates annual meeting and symposium on September 27.

The FPAC was set up by Watkins last March (See our March 1990 Special Edition newsletter) to provide him with advice "on the optimal way to structure the overall U.S. fusion program."

In responding to this charge, the FPAC final report states that "The fusion energy program should have two distinct and separate approaches, magnetic fusion energy (MFE) and inertial fusion energy (IFE), both aimed at the same goal of fusion energy production." These two programs should both be managed within the same office in DOE, the panel says. However, the panel distinguishes between IFE, a new program aimed at energy, and inertial confinement fusion (ICF), the existing program, which it says should remain within the weapons management system at DOE "since its goals are distinct from those of IFE."

In an Interim Report last July (see our August 1990 newsletter), the FPAC recommended that the MFE and IFE programs be managed by a separate organization within DOE "headed by an officer with rank comparable to that of an Assistant Secretary, or that of the Director of the Office of Energy Research." In its final report, this recommendation was scrapped. The FPAC did however advise Watkins on how to structure the defense ICF program, saying that "The Committee recommends that the present Division of Inertial Fusion be elevated to an Office of Inertial Fusion within the organization of the Deputy Assistant Secretary for Military Applications, Defense Programs." They call this "our first and most urgent organizational recommendation."

The DOE also received a final report, on September 15, from the "Committee for a Second Review of the Department of Energy's Inertial Confinement Fusion Program". This committee was established in May 1989 and held its first meeting in July 1989 (See our August 1989 newsletter). The review was mandated by Congress and was commissioned by DOE under the auspices of the National Research Council. Prof. Steven Koonin of the California Institute of Technology chaired the Committee. He gave the first public report of the Committee's findings at Fusion Power Associates annual meeting and symposium on September 27.

This Committee had also issued an Interim Report which was sent by DOE to Congress in mid February (See our March 1990 newsletter). However, the final report differs from the interim in several important respects.

The most important new recommendation of the Committee is the endorsement of the NOVA laser upgrade proposal from LLNL. The panel states that such a glass laser "will likely allow an ignition demonstration for a reasonable cost, and there appears to be no compelling reason to wait for other drivers to catch up." The Committee also noted that Sandia National Laboratories "has surpassed four of the five milestones established (in the Committee's Interim Report). They therefore recommended "that the light-ion program at SNL continue at the present level of effort for the next two years." In addition, the Committee recommended that construction of the NIKE KrF laser at NRL be accelerated and that the construction of the OMEGA glass laser at the University of Rochester be "started immediately".

Furthermore, they recommended that "no substantial ICF funds be used to upgrade the AURORA facility" at Los Alamos.

Both the Koonin Committee and the FPAC criticized the DOE for its overly-restrictive classification policy with respect to inertial fusion, calling on Secretary Watkins to "form a panel to review present ICF classification guidelines and to schedule future target physics declassification" (Koonin Committee).

WATKINS ORDERS CLASSIFICATION REVIEW

Speaking to the IAEA Thirteenth International Conference on Plasma Physics and Controlled Nuclear Fusion, Energy Secretary James Watkins told the group, "I have directed the Department of Energy's staff to undertake a comprehensive review of the classification of our programs in inertial confinement fusion. The goal is to eliminate unnecessary restrictions on information relevant to the energy applications of inertial confinement fusion. I have told my staff that I expect a preliminary report from them within three months. I see this review as necessary, if the U.S. government is to reassess its current policy that discourages U.S. participation in international research on inertial fusion. If inertial fusion has promise as an energy source--and I believe that it does--we should pursue that promise with the sort of cost-effective international collaboration that marks magnetic fusion efforts such as the International Thermonuclear Experimental Reactor (ITER). Experts outside the Department will play an important role in this review, to ensure that needless classification is pruned back and that a process is established for periodic reviews of the need to restrict access to information on inertial fusion."

WHY FUSION

The FPAC addressed the question of the justification for having an aggressive fusion energy development program. They said: "The Committee believes that the United States should have a comprehensive and foresighted energy policy emphasizing the development of politically secure, safe, and environmentally acceptable sources of energy, including fusion. The events occurring in the Middle East as this report is being written underscore the necessity of a policy and commitment that survive the inevitable short-term,

unpredictable crises. The social and economic development of the United States must not be constrained by an inadequate supply of affordable energy. Yet the instability in the Middle East, the increasing petroleum imports, the environmental concerns surrounding fossil energy, and the public's reluctance to accept nuclear fission energy are alarming constraints."

In addition, the FPAC states that: "There are other persuasive reasons for the Committee's strong position. Fusion is one of very few energy options that offers an essentially inexhaustible and widely available fuel supply. It is the only inexhaustible energy source that has yet to be advanced to engineering feasibility. It has the prospect of being relatively benign with respect to both worker and public safety and the production of environmentally objectionable by-products. It is now technically ready for important next steps. Research in the last few years has brought MFE close to the long-awaited breakeven, and significant progress has been made in IFE.

"The nation will have to rely on existing energy sources--coal, natural gas, petroleum, and nuclear fission, upgraded to make them as environmentally acceptable as possible--until the transition to fusion and other energy sources can be made. A timely transition to fusion, however, will occur only through a disciplined, goal-oriented energy program, recommended by the Committee, and described later in this report.

"The policy emphasizes the importance of a greater level of international collaboration. The program to obtain energy from fusion will be costly in terms of both human and financial resources. An aggressive component of international collaboration would both reduce each Nation's costs and focus the world's talent more sharply on the important issues.

"Both MFE and IFE should increase participation by industry. The ultimate objective of the fusion program is the commercialization of a new source of electrical energy by the private sector. The sensitive and difficult process of transferring the technology should begin now."

BUDGET RECOMMENDATIONS

With respect to budgets, the FPAC states that "the total

fusion energy budget, including the military ICF program and the construction of the essential facilities, would have to reach approximately \$1 billion per year in constant dollars over the period of the next seven years. Should these resources fail to materialize, the Committee has developed strategies for both MFE and IFE under constrained budgets."

MAGNETIC FUSION RECOMMENDATIONS

With respect to magnetic fusion, the FPAC states: "The Committee recommends a balanced strategy that takes advantage of the benefits of sharing costs, knowledge, and risk through international collaboration, while maintaining a strong U.S. program to benefit from foreign fusion research and development.

"The Committee recommends that the U.S. take an even-handed approach in strengthening its national and international efforts, by participating as an equal partner in the International Thermonuclear Experimental Reactor (ITER) Engineering Design Activity (EDA) and by authorizing the construction of the U.S. Burning Plasma Facility in the FY 1992 budget. The U.S. should propose to locate the ITER EDA in this country, while accepting the possibility that it could be located elsewhere.

"In addition to those major activities, the recommended MFE program would include a modest increase in the Base Program, D-T experiments in the TFTR, the design of a steady state hydrogen/deuterium plasma tokamak, and increased emphasis on low-activation materials and nuclear technology.

"The MFE program would meet the requirements of a budget reduced below that recommended by holding the Base Program roughly constant and stretching out the completion schedule for the burning plasma facility, while funding the D-T experiments in TFTR and the ITER activity. The Committee recommends that international participation in the burning plasma facility be encouraged by a firm U.S. commitment to construction in FY 1992."

INERTIAL FUSION RECOMMENDATIONS

With respect to inertial fusion, the FPAC states: "The highest priority activity is the study of target physics, leading to a demonstration of fuel pellet ignition. This research is

critical for both the defense mission and for the development of an IFE civilian energy option. The pellet ignition goal can probably be achieved by about the year 2000 with an early upgrade of the Nova laser to about one megajoule.

"The IFE energy program must develop a driver that operates reliably with high efficiency and low cost, at repetition rates of a few pulses per second. Heavy ion accelerators are currently thought to be the most promising, and the Committee recommends an enhanced program for developing this technology. Because suitable heavy ion accelerators are still in an early stage of development, we recommend that two driver candidates now supported by Defense Programs, specifically krypton-fluoride lasers and light ion accelerators, also be explored as IFE drivers. Concurrent programs should proceed in materials development; reactor design; environmental, health, and safety issues; waste disposal; and decommissioning. The effort will complement analogous work in MFE. It is assumed that the ICF program continues to receive strong support from Defense Programs. Funding to implement the new IFE program should not be taken from existing ICF Defense Program or MFE Program Budgets.

"The Committee has constructed three alternative budgets, with lower levels of funding than the recommended budget. At the lowest level, the program would focus almost entirely on target physics and the facilities required to obtain this information: Precision Nova, Omega and Nike. Krypton-fluoride laser research, light ion driver research, and target support would be done at a lower priority. All of these activities are funded by Defense Programs. Even at this lowest funding level, the Committee recommends beginning the second phase of a heavy ion driver research program and continuing the reactor studies program. The latter two items are funded by Energy Research.

"The next funding increment above this lowest case would include the design and construction of the Nova Upgrade. This facility would be authorized within the next year, and construction would start in FY 1994. Meanwhile, the target physics investigations at Precision Nova and elsewhere would continue to shape the program. If the milestones were not met or if confidence in ignition at the energy provided by the Nova Upgrade decreased, construction would be delayed or cancelled."

NEW BOOKS

Dense Plasma Diagnostics by N. G. Basov, A. A. Rupasov, A. S. Shikanov, G. V. Sklizkov and Yu. A. Zakharenkov, originally published in Russian by Nauka Publishers in 1989, will be available in English translation from Nova Publishers, New York, January 1990.

Physics of Nonneutral Plasmas by Ronald C. Davidson (635 pp) is available from Addison-Wesley (Reading, MA). It is a part of their *Frontiers in Physics* series.

Fusion: The Search for Endless Energy by Robin Herman is a popular-style book on fusion, written for the layman. It will be available in November from Cambridge University Press, 40 West 20th St., New York, 10011.

MEETINGS

October 31-Nov. 2 - Forging a New Energy Policy for the 1990's, Seventh Annual Conference of the National Association of Energy Service Companies. Embassy Row Hotel, Washington, D. C. Contact NAESCO, (202) 347-0419.

November 12-16 - APS Division of Plasma Physics Annual Meeting. Cincinnati. Contact Akira Hasegawa (201) 582-2886.

December 3-6 - International Symposium on Heavy Ion Inertial Fusion. Monterey, CA. Contact Mollie Field, LBL, (415) 486-6387 or FAX (415) 486-5401.

QUOTABLE

"International collaboration in fusion energy research has been very beneficial in the past, and promises to be critical in the future. I have been impressed with the progress that has been made through the cooperative efforts of fusion programs of different nations. As we put together a comprehensive fusion energy policy, I think it is important to maintain our momentum. In particular, you can be assured that the United States will thoroughly explore continued participation in ITER activities beyond the end of the current Conceptual Design activities."

James D. Watkins
Secretary of Energy
October 1, 1990



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

RON DAVIDSON NAMED PPPL DIRECTOR

JOHN SHEFFIELD WINS ANS ACHIEVEMENT AWARD

DAVIDSON NAMED PPPL DIRECTOR

Ronald C. Davidson has been named director of the Princeton Plasma Physics Laboratory (PPPL) effective November 1. Professor of physics at the Massachusetts Institute of Technology (MIT) since 1978, Davidson directed MIT's Plasma Fusion Center from 1978 to 1988.

Davidson succeeds Harold P. Furth as PPPL's fourth director. Before joining MIT's faculty, Davidson worked for two years at DOE's Office of Fusion Energy, where he served as director of the Applied Plasma Physics Division. While at MIT he was the first chair of DOE's Magnetic Fusion Advisory Committee (MFAC) from 1982 to 1986.

Princeton Provost Paul Benacerraf, who led the search for the new director, said "Ron Davidson brings a superb combination of experiences to this position. He has led a fusion research center at a distinguished university and therefore has the background that will enable him to enhance the working relationship between a university and a major laboratory. He also understands from an insider's point of view the functioning of the government agency responsible for energy research and development in the United States. Held in high esteem by the fusion community here and abroad, he has both the experience and the stature to pilot the leading U.S. magnetic fusion facility into the next century."

Princeton President Harold T. Shapiro said, "It is essential that the Plasma Physics Laboratory have the strong leadership Davidson can provide at this critical juncture in



Ronald C. Davidson

its history. On the one hand, DOE's 1991 budget for fusion faces cuts possibly as large as 15 percent; on the other hand, the Fusion Policy Advisory Committee (FPAC) recommends substantially increasing government spending in fusion and proceeding in fiscal year 1992 with the construction of an advanced fusion device, the Compact Ignition Tokamak. The Laboratory requires an especially astute director who can steer between the austerities mandated by the moment and an overarching vision of, and commitment to, what is best for the United States over time in terms of energy research and development. I am confident that Ron Davidson is such a person."

Davidson said, "I recognize that these are uncertain times

for fusion. However, I firmly believe that Princeton must and will continue to play a preeminent technical role in international fusion research, and an increasingly prominent role in influencing national policy in this important area. I can think of no more exciting challenge than to be director of the Princeton Plasma Physics Laboratory in the months and years ahead."

Davidson received Fusion Power Associates' Leadership Award in 1986 and has been a member of Fusion Power Associates' Board of Directors since its inception in 1979. He is a fellow of the American Physical Society, and chaired its Plasma Physics Division in 1983-84. In 1986 he also received DOE's Distinguished Associate Award.

FUSION BUDGETS

Congressional appropriations committees dealt a severe blow to the magnetic fusion program by cutting the magnetic fusion budget for the current fiscal year by \$50 million, down to a level of \$275.3 million. The House-Senate conference report cited "sever budget constraints" as the reason for the action. The report also states "In order to provide the Department with the flexibility to develop a meaningful program, the conferees are recommending that these funds be provided without further allocation between program components, projects, and activities within the fusion program."

In the same budget action the committees agreed to provide \$175 million to the inertial confinement fusion program, an amount which is \$8.2 million above the President's request level. The conference report states "The conferees agree to provide... \$8,500,000 to upgrade the OMEGA laser at the University of Rochester, \$10,000,000 to upgrade the NOVA laser at the Lawrence Livermore National Laboratory, and note that the Naval Research Laboratory program is to be funded at the level included in the budget request. Also, the request of \$10,000,000 for target development, production and delivery is included as proposed in the budget."

KILLEEN RECEIVES SPECIAL FPA AWARD

John Killeen, director of the National Energy Research Supercomputer Center at the Lawrence Livermore National Laboratory, has been presented a Special Award by vote of the Fusion Power Associates Board of Directors. The award, presented by FPA vice-president Ruth Watkins on the occasion of John's retirement from the laboratory, cites his



John Killeen

"pioneering contributions to fusion energy development." FPA Special Awards have been presented previously to Edward A. Frieman and Alvin W. Trivelpiece.

DIII-D TEAM HONORED

The ANS Fusion Energy Division has awarded the DIII-D Tokamak Design Team at General Atomics its Outstanding Technical Accomplishment Award. The Award is presented in recognition of exemplary technical accomplishment requiring professional excellence of a high caliber in the area of Fusion Science and Engineering. The award for the DIII-D team was made for their work in developing the concept for conversion of Doublet III to a large dee-shaped plasma configuration, and carrying it to a successful design, construction and commissioning. The Award was accepted by Dr. Jim Luxon and Mr. Larry Davis on behalf of the team at a luncheon at the Ninth Topical Meeting on the Technology of Fusion Energy, October 9 in Oak Brook, Illinois.

MICROWAVE TUBE TECHNOLOGY ADVANCES

A significant advance in high power microwave tube development for fusion research was recently achieved at the Japan Atomic Energy Research Institute (JAERI) in Naka,

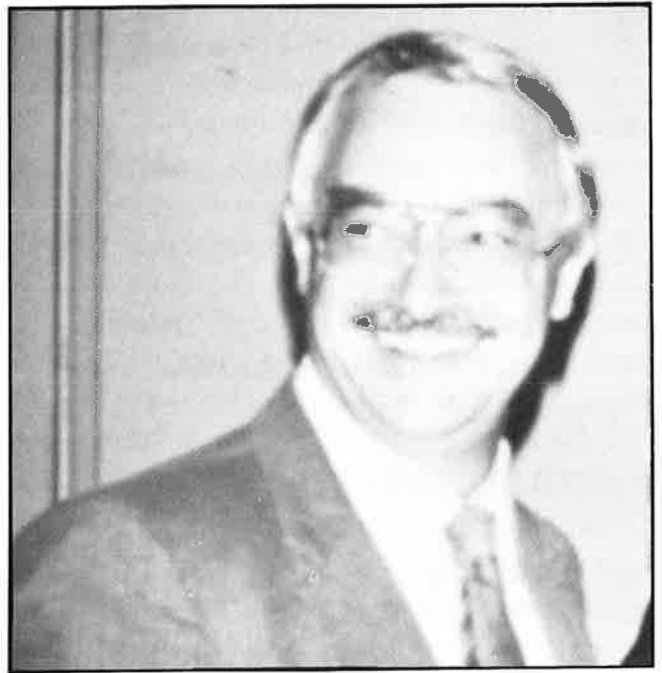
Japan, as part of a joint U.S.-Japan cooperative R&D effort being carried out by JAERI of Japan, Toshiba of Japan, General Atomics of the U.S., and Varian Associates, Inc., of the U.S.

A prototype tetrode tube set a world record for power generation by providing 1.7 megawatts (MW) of power for 5.4 second pulses at 131 megahertz (MHz), exceeding the goal of 1.5 MW for five second pulses at 130 MHz established by the U.S. Department of Energy (DOE) and JAERI to meet the next-generation requirements of their experimental fusion energy programs. Development of the tube and the recently completed tests were sponsored by the DOE and JAERI.

Designed and manufactured by Varian in San Carlos, California, the Eimac tetrode enhanced anode dissipation (2.5 MW continuous wave compared to 1.4 MW) over Varian's earlier tetrodes, which set the previous record. This advancement is especially important to researchers because it allows the tube to work in a much wider variation of load conditions, opening up a greater range of experimental possibilities. The tube also incorporates modifications resulting in reduced screen grid heating and elimination of excessive screen grid emission, which were limiting factors in earlier tests. In addition, its lower water flow requirements decrease system costs, an issue of importance in providing an economically feasible energy alternative.

SHEFFIELD WINS ANS OUTSTANDING ACHIEVEMENT HONORS

John Sheffield, director of the Oak Ridge National Laboratory's Fusion Energy Division, has been awarded the Outstanding Achievement Award of the American Nuclear Society's Fusion Energy Division. The Outstanding Achievement Award is the most prestigious award of the ANS division and is presented to an ANS member in recognition of exemplary individual achievement requiring professional excellence and leadership of high caliber in the area of Fusion Science and Engineering. A statement issued by the ANS Fusion Energy Division states that "The Award for Dr. Sheffield is made for his outstanding contributions in the areas of neutral beam injection development and fusion cost analysis. With regard to the latter area, he developed the Generic Magnetic Fusion Reactor concept that is widely used as a basis for assessing fusion opportunities and goals, for example in the ESECOM study. John has also been a



John Sheffield

leader in the development of the U.S. Toroidal Confinement Program during the 1980's and was a prime mover in the development of the recent Community Plan for the Development of Magnetic Fusion."

TRITIUM MEETING CALLS FOR PAPERS

Papers are requested for the Fourth Topical Meeting on Tritium Technology in Fission, Fusion, and Isotopic Applications to be held at the Albuquerque Convention Center in Albuquerque, New Mexico, 29 September through 4 October 1991.

This meeting will focus on the international interest in tritium technology and will continue the tradition established by the three previous meetings. As in the past, papers will be published in a special issue of *Fusion Technology* (see Vol. 14, no. 2, pt. 2a and 2b, September 1988 for proceedings of the Third Topical Meeting). Prospective authors are requested to indicate their preference for oral or poster presentation and to suggest the general topic their paper best suits. The Program Committee will then make final decisions on format and session topic for each presentation. The deadline for 400-600 word summaries is February 15, 1991.

The meeting is sponsored by Los Alamos National

Laboratory (co-sponsors: American Nuclear Society, Canadian Nuclear Society, European Nuclear Society, and Japan Nuclear Society). There will be technical sessions on the following topics: tritium processing, tritium safety; measurement and accountability; tritium properties and interaction with materials; design, operation, and maintenance of tritium systems; tritium storage, distribution, and transportation; tritium waste management and discharge control; and tritium applications. Summaries should be submitted to, and information requested of, John Bartlit, Los Alamos National Laboratory, P.O. Box 1663, MS C348, Los Alamos, NM, 87545.

PAINTER RECEIVES STUDENT AWARD

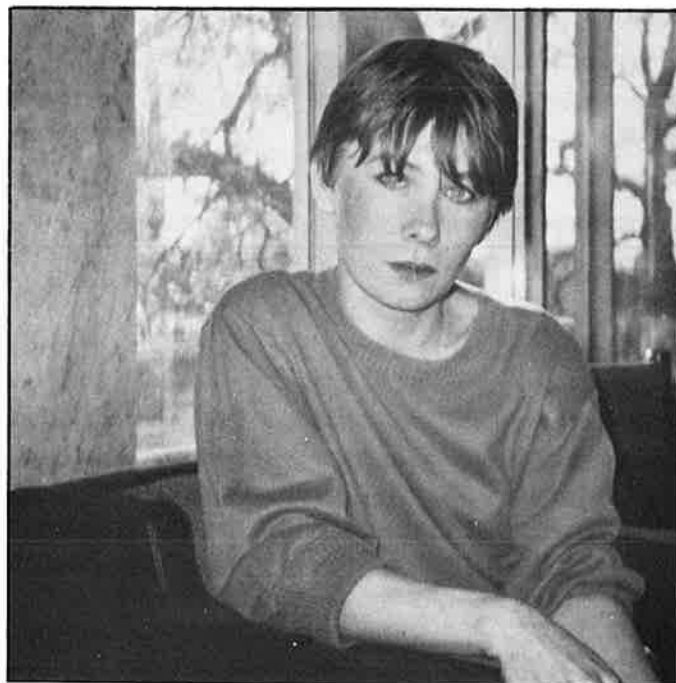
The ANS Fusion Energy Division has presented its Student Award to Scott Painter, who is completing his doctoral program at the University of Tennessee in Knoxville. The purpose of the award is to recognize significant research accomplishment by a student in the area of Fusion Science and Engineering. Painter was nominated by his co-advisor, Dr. J. F. Lyon of ORNL and Prof. P. N. Stevens of the university. His paper was entitled "Alpha-Particle Losses in Compact Torsatron Reactors."

LLNL SCHEDULES INDUSTRY BRIEFING

LLNL has scheduled a briefing for November 20 in Palo Alto for industry representatives to discuss plans for industrial participation in the International Thermonuclear Experimental Reactor (ITER) project. Persons interested in attending should contact Dr. Coleman Johnson at (415) 422-8748 for further information.

DEAN VISITS USSR

Fusion Power Associates president Steve Dean visited the Soviet Union October 10-17 at the invitations of Academicians V. A. Glukhikh and N. G. Basov. He presented an invited paper on "*Fusion Technology*" at the Fifth All-Union Conference on Engineering Problems of Fusion Reactors, October 10-12 in Leningrad. He subsequently visited the laser group at the Lebedev Institute, the heavy-ion fusion group at the Institute of Theoretical and Experimental Physics (ITEP) and the tokamak group at the Kurchatov Institute, all in Moscow.



Larissa Nikitina, member of the editorial staff for the new Journal "Plasma Devices and Operations."

NEW PLASMA JOURNAL

Gordon and Breach Science Publishers has announced a "new journal in fusion engineering". The journal will be in English and edited at the D.V. Efremov Institute in Leningrad. Acad. V. A. Glukhikh will be Editor-in-Chief and A. N. Popov will be Managing Editor. Other editors include Y. Shimomura and S. Shimamoto (Japan), Bruce Montgomery (USA), E. Salpietro (Germany), R. Aymar (France) and E. Bertolini (England). For information and a free first issue, contact STBS, P.O. Box 90, Reading, RG1 8JL, United Kingdom, or P.O.Box 786 Cooper Station, New York, NY, 10276, USA. The title of the new journal is "Plasma Devices and Operations".

CANADIANS SCHEDULE FUSION SEMINAR

The Canadian Fusion Fuels Technology Project (CFFTP) of Ontario Hydro will conduct a Seminar on Fusion Basics November 27-28 in Toronto. The seminar will be at an introductory level aimed at engineers, scientists and technical managers. The seminar fee is \$175. For further information contact Fusion Seminar Coordinator at tel. (416) 823-0200 or fax (416) 823-8020.



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

DOE TARGETS MAGNETIC CONCEPT IMPROVEMENT PROGRAMS CONGRESSIONAL CUT BLAMED

BUDGET CUTS

Faced with a Congressional cut of \$50 million from the magnetic fusion budget (see our November newsletter), the Department of Energy Office of Fusion Energy has decided to terminate essentially all of its experimental programs aimed at developing a more attractive magnetic fusion reactor concept. Instead, it will protect the budgets of its "conventional" tokamak program.

The programs to be terminated are those aimed at increasing the power density, reducing the size and improving the maintenance geometry of future fusion reactors to make fusion more likely to be acceptable to the electric utilities. Instead, DOE will focus its attention on near-term physics and technology programs.

Programs slated for "phase-out" funding during the rest of this fiscal year include the CPRF reversed field pinch facility at Los Alamos National Laboratory, the Advanced Toroidal Facility (ATF) at Oak Ridge National Laboratory, the PBX-M facility at the Princeton Plasma Physics Laboratory and the LSX facility at Spectra Technology, Inc. The CPRF is a new \$80 million facility nearing completion that holds promise for greatly increasing the power density and hence reducing the size of future fusion reactors. The ATF is a new experiment now in early operation, aimed at understanding the physics of increasing the power density in tokamak and stellarator geometries. The latter geometry is also important to the potential evolution of steady-state operation of fusion reactors. The ATF facility contains about

\$100 million of equipment. The LSX is a \$15 million experiment just recently dedicated (see our September newsletter), aimed at developing a cylindrical (as distinguished from toroidal) mechanical geometry for ease of maintenance in an electrical utility environment. An advanced concept (spheromak) experiment at the University of Maryland is also slated for termination.

Experimental programs on the DIII-D tokamak at General Atomics and the TFTR at Princeton will be maintained as the residual core of the magnetic fusion effort. Plans to do tritium experiments on TFTR, to design the Compact Ignition Tokamak (CIT) and to support the International Thermonuclear Experimental Reactor (ITER) effort will also continue.

DOE did not consult with the fusion scientific community on the restructuring of program priorities.

FPAC MEMBERS COMMENT ON CUT

Four members of DOE's Fusion Policy Advisory Committee, including its chairman, H. Guyford Stever, have signed a letter dated October 26 to Energy Secretary James D. Watkins stating, "A cut of this magnitude in any research program would be considered severe and disruptive. In the magnetic fusion program, it is tantamount to a basic policy decision ... to relegate the U.S. to a secondary role in the development of this inexhaustible and relatively clean source of energy." Furthermore, they say, "The loss of program

breadth and technical talent brought about by the proposed cut would be extremely difficult to recover. Signals sent would result in significant reductions of university and industry support. The U.S. would be sorely dependent on more aggressive and better-balanced programs overseas for essential resources and data. This cannot be in the best long-term interest of our country."

Some members of FPAC met with DOE officials on November 28 to discuss the cuts.

PLASMA PHYSICS DIVISION COMMENTS

In a letter dated November 15 to Rep. Tom Beville and Sen. J. Bennett Johnston, chairmen of the House and Senate Appropriations Subcommittees that instigated the cuts, Akira Hasegawa on behalf of the Executive Committee of the APS Division of Plasma Physics describes the magnetic fusion cut as "seriously limiting the Energy Secretary's options in his preparation of a fusion energy policy....Further, it undermines the credibility of the United States as a reliable partner in international fusion collaborations....Coming at this time of year and on top of several years of declining budgets, the \$50 million cut in FY1991 would devastate the U.S. fusion program" Hasegawa concludes, "We urge you to work with the Administration to prevent the damage that would result from this budget action in FY 1991, and initiate a sustainable national commitment to fusion beginning in FY 1992."

NEW FUSION RECORDS SET

Scientists at the Princeton Plasma Physics Laboratory working on the Tokamak Fusion Test Reactor (TFTR) achieved a world record plasma temperature of 400 million degrees Centigrade. They also produced 50 thousand watts of fusion power from deuterium fusion reactions, also a new record value. The results were announced by Dr. Dale Meade at the recent IAEA international fusion conference in Crystal City, VA.

Record values of plasma pressure relative to magnetic field pressure were also announced by scientists from the DIII-D tokamak group from General Atomics. The values achieved are now within the range believed adequate for a commercial fusion reactor.

ITER INDUSTRY BRIEFING DATE CHANGED

LLNL has postponed its planned industry briefing on ITER (see our November newsletter). The new date is January 15, 1991 in Palo Alto, CA. In announcing the change, LLNL magnetic fusion head Alex Glass said "I am convinced that by holding the briefing at a later date, we will be able to provide a more complete picture of the Department of Energy's plans for the EDA (Engineering Design Activity)." Information on the meeting can be obtained from Joan Selles, (415)422-9871.

FIRE FROM THE SUN AIRDATES

The PBS documentary "Fire From The Sun" (see our June newsletter) will air December 26 at midnight on Channel 22 in the Washington D.C. area. It will also air in the San Diego area on KPBS on December 26 at 10 PM and again on December 31 at 12 noon. Tell your friends about it. The continued airing of this program during the past six months is due to the tireless efforts of producer Michael Pack and his charming and energetic wife, Gina. To express your thanks, or to order a video of this program, contact Michael or Gina at Manifold Productions, 1438 N. Gower St, Hollywood, CA 90028, (213)462-1844.

FORSEN SPEAKS ON ENERGY

Harold K. Forsen, Senior V.P. of Bechtel Corp. and a member of Fusion Power Associates Board of Directors, participated in a December 3 national teleconference entitled "New Power for a New Century: The Potential of Alternative Sources of Energy." The discussion is part the "Man, Energy and the Environment" Series sponsored by the Jefferson Energy Foundation and moderated by Hodding Carter, III. The University of Hawaii at Manoa hosted the discussion, which was linked by satellite to other participating institutions around the Nation. Eventually PBS will incorporate the highlights of the Series into six one-hour prime-time programs.

Forsen issued the following statement: "The future and the current demand for electric energy must be met by resources which are safe, economic, environmentally acceptable and assured. Since central station power plants continue to provide the bulk of our electric generating capacity, alternatives that also satisfy these requirements should be

developed as options for the future. This suggests that the renewable and sustainable resources which include the full spectrum of solar technologies along with fission and fusion, must be considered as the principal alternatives."

ABDOU, UCKAN HONORED

The American Nuclear Society has bestowed the rank of "Fellow," the Society's highest membership grade, on Mohamed A. Abdou of UCLA and Nermin A. Uckan of Oak Ridge National Laboratory.

Mohamed's citation reads "For his outstanding contributions to fusion science and engineering and the development of fusion nuclear technology including pioneering research in fusion neutronics, blanket, and shielding analysis, and for exceptional leadership of several reactor design studies and fusion nuclear engineering research projects."

Nermin's citation reads "For her outstanding contributions to fusion plasma physics including significant work in plasma engineering, burning plasma physics, bumpy tori reactor studies, and physics support for ignition devices and tokamak engineering test reactors, and for leadership and service in the Society."

DOE SMALL BUSINESS GRANTS

The U.S. Department of Energy will issue its FY1991 Program Solicitation for proposals from small businesses on December 7. The closing date for receipt of grant applications is March 7. To receive a copy of this solicitation write SBIR Program Manager, ER-16, USDOE, Washington D.C. 20585 or call (301)353-5707.

QUOTABLES

"There are no diplomatic or military problems associated with energy. You simply establish a rapid deployment force. That may cost you a little more than developing energy sources internally, but its a lot more fun: aircraft carriers charging down the Red Sea at 30 knots, fighter planes flying over, a hundred helicopters with marines in them charging across the desert sands. That's obviously more satisfying because that's what we're doing."

Edwin E. Kintner, in
Journal of Fusion Energy
June 1983, pg.168



Mohamed A. Abdou



Nermin A. Uckan

"If the Martians were attacking, if money were no object and the military wanted a working fusion reactor by the year 2000, there is no question we could have it."

Harold P. Furth, quoted in
Fusion: The Search for Endless Energy
By Robin Herman
Cambridge University Press, 1990, pg.112

"The maintenance of large programs in alternate confinement schemes has become an unaffordable luxury if magnetic fusion is to move forward toward an energy production goal."

Robert O. Hunter, Jr.
USDOE Internal Fusion Program Plan
Spring, 1989

VIEWPOINT: ENERGY, ECONOMICS, AND MILITARY FORCE

It is said that the United States military is in Saudi Arabia because it is in our "vital interest." We are there to avoid the severe economic consequences of probable future events absent the intervention. We also are there to support an ally (Saudi Arabia) and force Iraq to relinquish another (Kuwait). And we are there to remove a potential threat to the world, Saddam Hussein.

Our relationships with Middle Eastern oil producing nations are essentially economic. They share no common features with the United States such as political structure, culture and religion. Central issues are oil price and availability. Energy and oil are essential to the world and, particularly, the United States. Energy is the lever of United States economics in food, shelter, industry, commerce and transportation, and personal freedom; the U.S. is envied by most of the world for these advantages. Thus, oil is pivotal to both global and domestic economies. Saddam Hussein cannot be permitted to control 40% of the global oil resources--particularly to fund his military ambitions which include nuclear weapons.

The history of energy/oil economics have provided us with a lengthy list of lessons learned. What is a civilized Nation and World to do?" We must finally acknowledge that the U.S. has to become more self-sufficient in energy and minimize the external costs. Structurally, minimizing the external cost of energy is difficult to accomplish. Transportation presents the highest demand for oil so we must reduce this demand and find fuel substitutes. These measures are likely to be taken, particularly the development of more fuel-efficient automobiles, and they can result in cash flow internal to our economy if properly implemented.

In the long-term, our transportation system must be based on resources other than petroleum. Likewise, the other energy-consuming sectors also must depend on non-fossil energy. Therefore, the long-term energy supplies must be based on renewables and the "inexhaustibles." These supplies will not solve our immediate problems and it will take at least a generation before they can become primary energy sources. These technologies now are either 1) unpopular (fission), or 2) not economic (solar) or 3) not demonstrated (fusion). However, they will be absolutely required in the not-to-distant future so we must now get on with solving the problems for their development and deployment.

Important remaining lessons learned are who pays for and who is to be responsible for R&D. The current generation must pay -- it can't be borrowed money. Revenues for new energy system development must come out of existing energy systems' cash flow. Likewise, neither the Public nor the Private sectors have demonstrated the institutional characteristics required for the tasks at hand. The Public sector has competing demands and the Private sector must show a near-term profit. A new institution is required, a Public/Private sector partnership which will need a National commitment. There are precedents for this.

In the best of all worlds, the market should allocate resources. For energy, particularly oil, market distortions exist; the concentration of oil demand in one part of the world and a concentration of a few, sometimes hostile, low-cost oil suppliers in another. Consequently, the United States cannot depend on global market forces when dealing with energy. The ultimate market distortion is the application of military force to an economic issue. We must move now to solve our energy dependence and minimize our economic vulnerability. We require conservation, wise utilization of our conventional domestic energy resources, and deployment of the renewable and inexhaustible energy resources.

*S. Locke Bogart
Program Manager, Energy Programs
General Dynamics Space Systems Division*