EXECUTIVE NEWSLETTER

JANUARY 1987

FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

VIEWPOINT

As a new feature in our Executive Newsletter, we will be publishing, periodically, signed editorials from members of the fusion community who wish to express a "viewpoint" on the status or direction of fusion development. Comments on policies, priorities or critical technical issues will be especially welcomed. Please limit your comments to 250 words or less. We will note that comments expressed in "Viewpoint" reflect the personal views of the author and not necessarily the view of his/her organization.

TRIVELPIECE FUTURE PLANS

Reports from usually-reliable Washington sources say that DOE Director of Energy Research Alvin W. Trivelpiece plans to leave his post at DOE in the Spring to accept the position of Executive Director of the American Association for the Advancement of Science (AAAS), replacing retiring Executive Director William D. Carey. The Washington-based AAAS is best known for its weekly publication SCIENCE and its broadly-based annual meeting. Trivelpiece has neither confirmed or denied the report.

TECHNICAL PLANNING ACTIVITY ISSUES REPORT

For the past 18 months an intensive, community-wide "Technical Planning Activity" has been in progress (see our September 1985 issue) within the magnetic fusion community, under the direction of Dr. Charles Baker of Argonne National Laboratory. A final report (ANL/FPP-87-1), supplemented by an executive summary, will be issued this month. Copies can be obtained by calling Charlie at (312) 972-4836.

The effort, commissioned by the DOE Office of Fusion Energy, had as its purpose "to assist the Office of Fusion Energy by developing a methodology for planning the national magnetic fusion program and by preparing technical planning documents in support of the strategic and policy framework of the Magnetic Fusion Program Plan (MFPP).

In their report, the TPA analysts define program elements and subelements, and develop program plans for solving the four key MFPP technical issues (Confinement Systems, Burning Plasmas, Materials, and Nuclear Technology).

The TPA report

- Identifies technical issues that must be resolved for the four key technical issues.
- Identifies program elements and subelements to resolve the technical issues.
- Develops technical plans for each program element that include research activities, experiments, and test facilities and identify decision points and milestones.
- Develops logic networks to show interdependence among the various program elements or subelements.

The report was prepared by fusion community task groups and reviewed/edited by a Steering Committee consisting of approximately 30 leaders of the community, organized into three groups: Plasma Science (headed by Jim Callen of the University of Wisconsin), Fusion Technology (headed by Mohamed Abdou of UCLA), and Fusion Systems (headed by Steve Dean of Fusion Power Associates).

MFAC PRAISES TPA EFFORT

The Magnetic Fusion Advisory Committee (MFAC), chaired by Fred Ribe (University of Washington) accepted the report of its "Subpanel 15" which reviewed the Technical Planning Activity. MFAC sent a letter dated December 9, 1986 to DOE Director of Energy Research Alvin W. Trivelpiece giving the following findings and recommendations.

"Our findings are as follows:

"1. The TPA Report is a valuable compilation of the status and program needs of magnetic fusion. Its use of logic diagrams is a valuable tool for showing the interrelationships of program elements, the coherence of the program structure, and the impacts of program decisions. Use of these diagrams, along with that of identified and defined decision points, will help to focus the technical aspects of fusion program planning and make the structure of those plans more easily grasped by those outside the community. The leadership of TPA and the many fusion community participants are to be commended for this work.

"2. The TPA Report is a valuable tool for program planning but is not intended as a plan itself. It provides a scenario and probable flow of technical progress with key decisions to reach a goal of fusion assessment in 2005, consistent with the Magnetic Fusion Program Plan (MFPP). It does not assess alternate scenarios or their impacts on resource requirements; contingencies or program responses to surprises, innovations, or failures; or the effects of variations in pace and balance. Furthermore, the resource evaluation is incomplete.

"3. The TPA finds that the MFPP goal could be accomplished on the MFPP time scale only with substantial international collaboration, based on projected U.S. fusion funding. However, should this collaboration not be successful, the information contained in the Report would also prove valuable in formulating a revised national plan.

"Our recommendations refer both to the implementation of the existing TPA report and to future TPA activities:

"1. The existing Report should be incorporated by the Office of Fusion Energy (OFE) as a planning element within the MFPP. Uses of the Report should include developing design criteria and planning options, evaluating proposals, representing the program outside the community, providing input to an international planning activity, and possible MFPP/TPA structure. The OFE, in cooperation with the community, should determine how this Report should be used and determine what additional information would be valuable.

"2. During the remainder of this fiscal year, while OFE is assessing the Report, the TPA process should develop additional scenarios for fusion development. These scenarios should study the impact of other funding situations or outcomes of major decision points, e.g., not having international collaboration on the Engineering Test Reactor (ETR) or a materials test facility, not doing the Compact Ignition Tokamak (CIT), and deferring ETR for an improved concept (tokamak or otherwise). These studies will also test the usefulness of the TPA process for evaluating the impact of differing program assumptions and should require reevaluation of the schedule and resource requirements.

"3. By the end of this fiscal year, the next appropriate steps for the TPA should be assessed. Important next steps should develop the tools for evaluating technical risks and priorities.

"4. The MFAC would welcome a report by OFE at the end of this fiscal year on its plans for utilization of the Report and for future activities of TPA."

The MFAC Subpanel 15 on TPA was chaired by Harold Weitzner of New York University.

VIDEO AVAILABLE

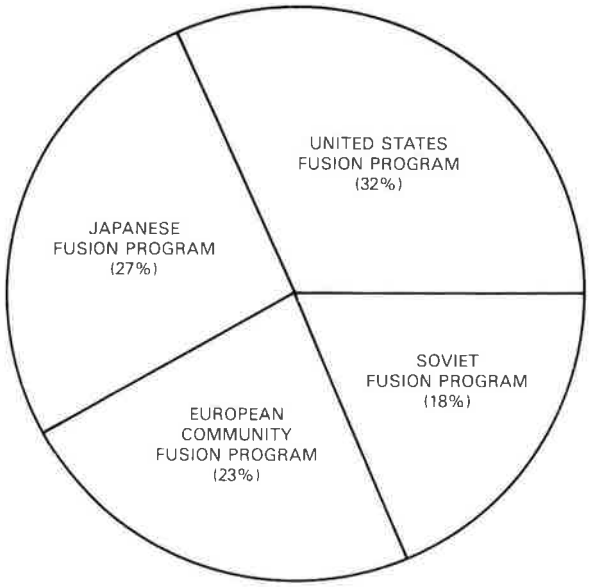
Fusion Power Associates has produced a 5-minute video entitled "Endless Energy: The Promise of Fusion." The video provides a non-technical description of the reasons for developing fusion and would be useful to introduce members of the general public to the topic. Copies can be borrowed from Fusion Power Associates for $15 to cover postage and handling.

"INTENSITY" OF WORLD FUSION EFFORT

In 1981, under a grant from the National Science Foundation, Kortman and Dean (Nuclear Technology/Fusion, July 1982) prepared "An Analysis of Potential Benefits to the United States from International Cooperation in Fusion Energy Development." As a part of that analysis a pie chart was prepared showing their judgment among the major country blocks of the "relative levels of intensity," defined as "a weighted average of program intensity criteria including: budget, personnel, technical performance, degree of mission orientation and industrial involvement." One of the authors (Dean) has recently updated the figure below.

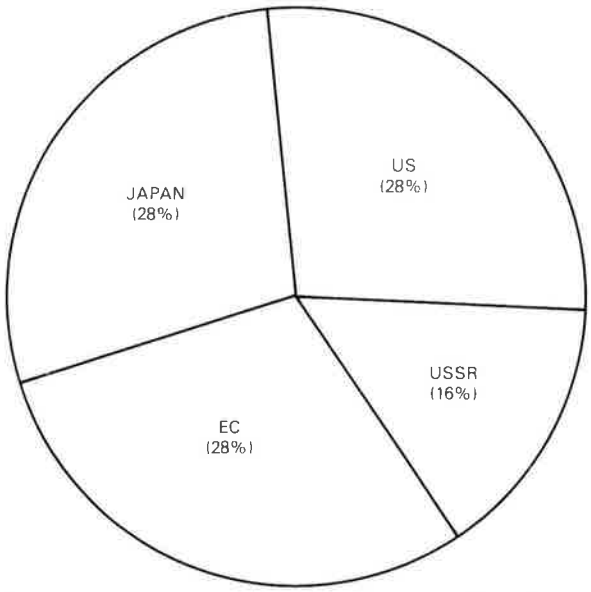
THE RELATIVE "LEVEL OF INTENSITY" OF THE VARIOUS BLOCK PROGRAMS

1981



In 1981, the U.S. program is judged highest because of its technical performance and its strength in mission-orientation and resource commitment. The Japanese program is next highest because of its mission-orientation and industrial involvement. The EC and Soviet programs are significantly lower in mission-orientation and industrial involvement.

1986



In 1986, the U.S., Japan, and EC are judged to have equal level of intensity due to successful completion of TFTR, JT-60 and JET with industrial participation. The U.S. has lessened its mission orientation and industrial involvement. The EC has increased its mission orientation and industrial involvement. In the USSR, the T-15 project has slipped in its schedule.

SOURCE: FUSION POWER ASSOCIATES

FUSION TECHNOLOGY BULLETIN

The Fusion Technology Branch, Office of Fusion Energy, DOE, is publishing Fusion Technology Bulletins describing recent important technical results. Twelve bulletins have been published to date. For example, #10 describes recent experiments on the chemical erosion of graphite (D. M. Goebel, UCLA); #11 and #12 describe materials tests of hydrogen retention and carbon-carbon composite weave materials (K. L. Wilson, Sandia/Livermore). Persons wishing to receive the bulletins should contact Marvin Cohen at (301) 353-4253.

IN MEMORIAM: HAROLD GRAD

Harold Grad, a mathematician who did pioneering work in plasma physics and fusion energy, died November 17 at his home in New Rochelle, New York. Grad, who was 63 years old, died of a heart attack. Less than two weeks prior to his death, he was awarded the 1986 James Clerk Maxwell Prize by the American Physical Society for "outstanding contributions to magneto-fluid dynamics, plasma physics and magnetic fusion energy." The citation for the Maxwell Prize went on to say, "his work expresses a scientific philosophy that serves as a model for a new generation of theoretical physicists and mathematicians." During the 1960's, Grad was frequently referred to as "the conscience of the fusion community." For twenty-five years (1956-1980), Grad served as the director of the Magnetofluid Dynamics Division of New York University's Courant Institute of Mathematical Sciences. Grad's entire professional career, spanning 40 years, was spent at the Courant Institute where, with the assistance of a group of colleagues, he was responsible for a major portion of the development of the field into what is now a relatively mature branch of physical mathematics.

During a lifetime of research in the mathematical modeling of fundamental problems in physics, Grad garnered many awards and honors. He was elected to the National Academy of Sciences in 1970. That same year he was also awarded the Boris Pregal Award by the New York Academy of Sciences for research in nuclear physics and engineering. In 1982, Grad received the Eringen Award by the New York Academy of Sciences for research in nuclear physics and engineering. In 1982, Grad received the Eringen Medal, the highest prize bestowed by the Society of Engineering Sciences.

Medal, the highest prize bestowed by the Society of Engineering Sciences.

In 1955 Grad joined the fusion program, then in its infancy under the sponsorship of the Atomic Energy Commission. In later years, Grad carried on his innovative work using mathematics to study plasma physics at the Courant Institute. He also served as an advisor to the Oak Ridge National Laboratory on fusion energy from 1964-67 and again from 1973-76. Grad was a member of the Board of Govenors of the New York Academy of Sciences from 1978-81. Over his lifetime he published more than 90 scientific papers.

Harold Grad is survived by his wife, the former Betty Miller, by a daughter, Hiliary Grad Goldberg of Newton, Mass., by a son, Michael, of New York City, and by a brother, Arthur Grad, also of New York City. Expressions of sympathy may be sent to the family c/o Malvina Harris, Courant Institute, New York University, 251 Mercer Street, New York, NY, 10012.

HEAVY ION FUSION PLAN AVAILABLE

A plan to develop an Induction Linac System Experiment (ILSE) over four to five years has been prepared "to validate the main physics and engineering issues, at about one-tenth scale of a heavy-ion fusion driver for certain key accelerator parameters." The cost of fabrication and assembly of the apparatus is estimated to be $26M. This is in addition to the currently funded base program of $5-6M per year. The planning document (PUB-5178) can be obtained from Denis Keefe at Lawrence Berkeley Laboratory (415) 486-6376.

DEAN ALABAMA LECTURES VIDEO AVAILABLE

In mid-October 1986, FPA president Steve Dean spent three days as guest lecturer at the University of Alabama. While there, he delivered two lectures and visited with faculty, students and administrators of the University. The two lectures are available on one VHS video tape of about 2 hours length. The first is a general public lecture entitled "Planning for a Fusion Energy Future." The second is a lecture to the engineering department entitled "The Status of Laser and Particle Beam Fusion." While in Alabama, Dean also gave a talk to the Birmingham section of the American Nuclear Society. There is a $15 charge to borrow the video from FPA to cover postage and handling.

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FY 1988 BUDGET

DOE requested $345.6 million for magnetic fusion in FY 1988, the same amount appropriated by Congress for FY 1987. Within the total, however, DOE is asking for $8 million to initiate line item funding for the Compact Ignition Tokamak (CIT) construction project to be built at Princeton Plasma Physics Laboratory. DOE is also asking for increases to set up an international design effort for an engineering test reactor (ETR) (See our March, September, and November, 1986 newsletters). New experimental devices are also planned at Los Alamos, Spectra Technology, Inc., Livermore, and MIT. (See our October and December 1986 newsletters). Funds for the new initiatives come primarily from closing out the magnetic mirror programs at LLNL and MIT.

DOE's weapons office is again attempting to slash the inertial confinement fusion budget, this time in order to expand their activities related to the Strategic Defense Initiative (SDI). In 1987, Congress rejected DOE's similar attempt to cut inertial fusion and expand SDI. DOE's FY 1988 request for inertial fusion is $118.5 million compared to $155 million appropriated for FY 1987.

PLASMA NEUTRON SOURCES STUDIED

At the initiative of Prof. Takaya Kawabe of the University of Tsukuba, Japan, about 40 scientists from around the world met during the recent international IAEA fusion conference in Kyoto, Japan to discuss the use of magnetically-confined fusion plasmas for use as neutron sources for materials testing. Among the participants were Prof. R. D. Ryutov of the USSR, David Baldwin of LLNL and R. S. Post of MIT. Kawabe described engineering feasibility studies in Japan of a Fusion Engineering Facility (FEF) based upon magnetic mirror geometries. Baldwin and Post described possible modifications of existing experimental mirror facilities in the U.S. for use in designing such a test facility. For more information contact Professor T. Kawabe, Institute of Physics, University of Tsukuba, Ibaraki, 305, Japan.

CHINA LASER CONFERENCE DATES CHANGED

The 1987 International Conference on Lasers, cosponsored by the Optical Society of China, Chinese Physical Society and Chinese Institute of Electronics will be held November 5-9, 1987 in Xiamen (Amoy), Fujian Province, P. R. China. This postponement from the original October dates was made to avoid overlap with the annual meeting of the Optical Society of America. For information contact Prof. Deng Ximing, P.O. Box 8211, Shanghai, China; Cable 8024, Shanghai China; Telex: 33916 CJOEC CN, or telephone 950486.

KRALL AND TRIVELPIECE BOOK AVAILABLE

The classic textbook Principles of Plasma Physics (McGraw-Hill, 1973) by N. A. Krall and A. W. Trivelpiece, which has been out of print, is now available in a soft-cover edition from San Francisco Press, Box 6800, San Francisco, CA, 94101-6800 for $22.00.

TRW WINS LLNL FREE ELECTRON LASER CONTRACT

TRW, Inc has been selected by the Lawrence Livermore National Laboratory to be the Lab's industrial partner for the transfer of induction linear accelerator free electron laser (FEL) technology to industry. TRW will also assist LLNL in developing a plan for the design and implementation of an FEL for potential use in the ground-based FEL technology integration experiment at the White Sands Missile Range in New Mexico (see our December 1986 newsletter).

ATTITUDE SURVEY

The Public Opinion Laboratory of Northern Illinois University (DeKalb, Illinois, (815) 753-0555) has completed a survey entitled "The Attitudes of Science Policy, Environmental and Utility Industry Leaders Toward Fusion." A total of 843 persons were contacted, including 508 science policy leaders, 150 environmental organizational leaders, 89 utility leaders and 96 congressional staff. Telephone interviews lasting about 25 minutes each were conducted. The results of the survey and copies of the report will be given at Fusion Power Associates annual meeting April 8-9 in Pleasanton, CA.

Among the most interesting results were:

- Sixty percent of science policy leaders but only 43 percent of utility leaders thought that fossil fuel burning was a "major problem."

- Sixty-five percent of environmental leaders, 49 percent of science policy leaders but only 24 percent of utility leaders thought that the safety of today's U.S. nuclear power plants is a "major problem."

- Fifty-nine percent of utility leaders, 51 percent of science policy leaders but only 31 percent of environmental leaders and congressional staff thought that nuclear power would be the primary energy source for the U.S. 50 years from now.

- Forty-three percent of utility leaders, 38% of science policy leaders and congressional staff and 30 percent of environmental leaders thought that "the technology used to produce nuclear power in 50 years will be based on a fusion process."

GRAD FELLOWSHIP FUND

New York University has established the Harold Grad Memorial Fellowship Fund to commemorate Harold's many contributions to plasma physics. Contributions to the fund can be sent to Cathleen Morawetz, Director, Courant Institute of NYU, 251 Mercer St. New York, NY 10012.

FPA ENGINEERING PRIZE FUND

We thank the many people and institutions listed below for their contributions to the FPA Engineering Prize Fund in memory of Professor David J. Rose. A total of $5270 has been received. Interest income from the fund will be used to provide a cash award to the recipient. If you wish to nominate someone for the award, please send us your nomination by April 15. Contributions to the fund are always welcome, also.

Contributors to the Engineering Prize Fund:

Mohamed A. Abdou
Fereydoon Abtahi
Applied Microwave Plasma Concepts
Charles Baker
Dan R. Baker
Francis F. Chen
Kevin Chen
KunMo Chung
Melville Clark, Jr.
Dan Cohn
N. Anne Davies
John and Nancy Dawson
Stephen O. Dean
Joseph N. DiMarco
Harold K. Forsen
T. Kenneth Fowler
Kenneth Gentle
Robert A. Gross
Gregory Haas
John Hancock
Willard Hobbs
Mujid S. Kazimi
Donald Kerst
Edwin E. Kintner
Edward H. Klevans
John W. Landis
Martin Marietta Energy Systems, Inc.
Maxwell Laboratories
Allan T. Mense
Ronald L. Miller
D. Bruce Montgomery
Raymond L. Murray
Ronald Parker
Y-K. M. Peng
Miklos Porkolab
Richard S. Post
John F. Santarius
F. R. Scott
Nicholas Sclufer
Arthur Sleeper
Donald A. Spong
Don and Roberta Steiner
Thomas H. Stix
Pace VanDevender
James T. Woo

PEOPLE

Major General George K. Withers, Jr., Deputy Assistant Secretary for Military Applications, a line manager at DOE responsible for inertial fusion funding, will leave DOE February 2 to become Deputy Chief Engineer of the Army Corps of Engineers. We wish him well in his new assignment.

Michael Monsler has established an office of W. J. Schafer Associates at 6140 Stoneridge Mall Road, Suite 590, Pleasanton, CA, 94566. Wayne Meier, formerly of LLNL, has joined the new office. Primary areas of interest are inertial fusion, free electrons lasers and SDI.

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MARCH 1987

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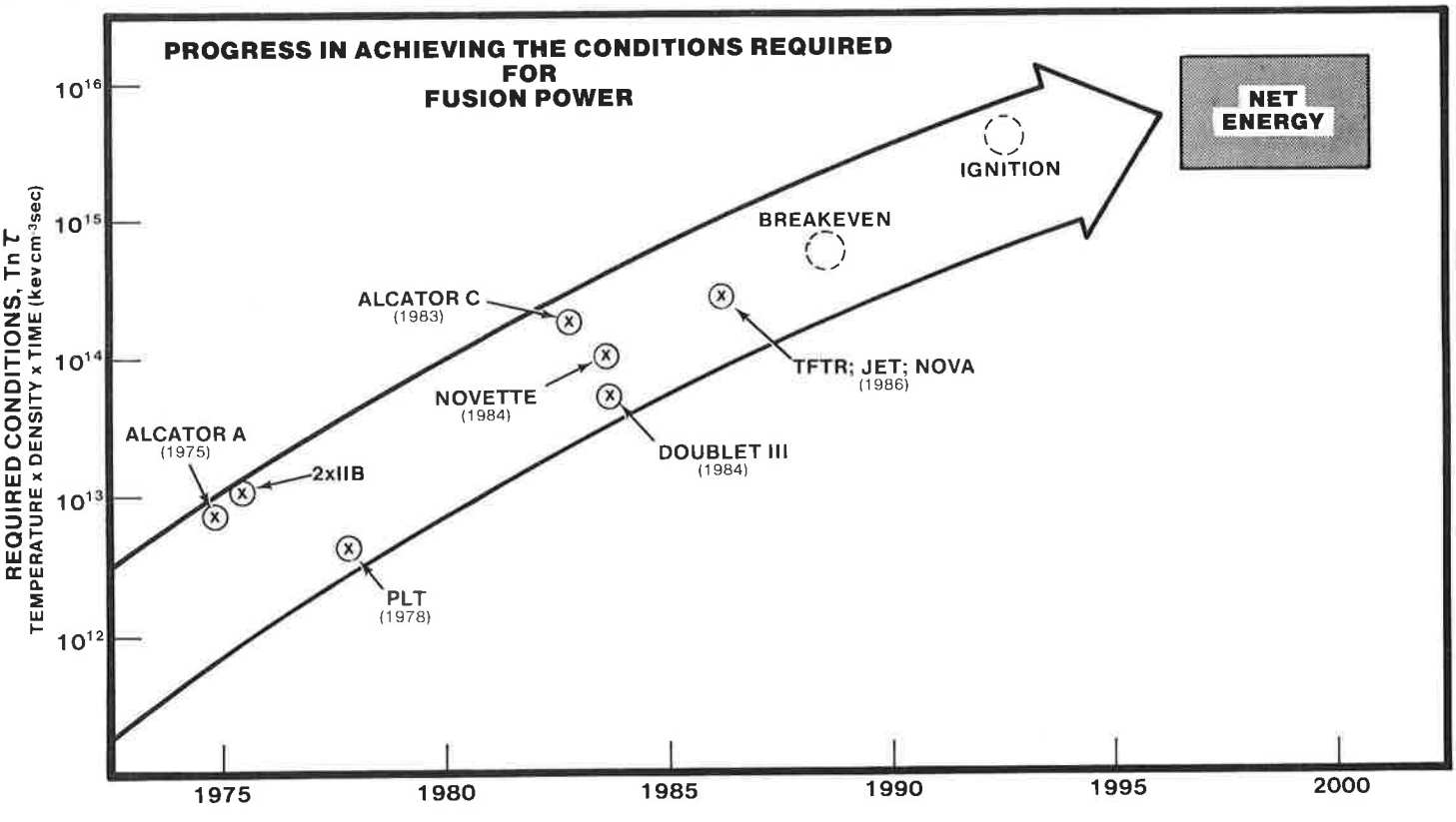
VIEWPOINT: FUSION PROGRESS

As the accompanying chart shows, progress in achieving the conditions required for fusion power has been steady. Facilities are in operation capable of achieving "breakeven," defined as a condition in which the fusion energy released equals the energy content of the plasma. Facilities are proposed for construction, capable of achieving "ignition," defined as a condition in which fusion energy is being generated at a sufficient rate to compensate for energy losses from the plasma, i.e., the fusion plasma can self-sustain its temperature without additional external energy input. Beyond that, designs are underway of facilities that can make significant quantities of fusion energy semi-continuously. These devices, which would be used for engineering testing of fusion components, could be operating by the turn of the century. In magnetic fusion strong, formal international collaboration efforts are underway to translate these technical possibilities into reality. In inertial fusion the potential is no less real, but overly cautious classification policies in the United States hampers open scientific exchange and international collaboration. In addition, the DOE has failed to request the funds necessary to capitalize on program successes or to recognize inertial fusion civilian application promise. What is needed now is a comprehensive declassification of inertial fusion activities, a fostering of the best scientific programs in both inertial and magnetic fusion, support for new facilities construction and for facilities upgrades, and initiation of a broad program of systems analysis and design studies of future fusion applications to guide the fusion research and development programs toward practical products.

Stephen O. Dean



SSC

The DOE has gotten Presidential approval to request initiation of the Superconducting Super Collider (SSC) high energy physics particle accelerator. DOE estimates the cost at $4.4 billion. In announcing the decision, Energy Secretary John Herrington said "In high energy physics, the development of the Supercollider is the equivalent of putting a man on the moon." But Daniel S. Greenberg, editor and publisher of Science Government Report, writing in the February 19 issue of the Washington Post, says that "... it would draw scarce money and genius to esoteric research remote from down-to-earth problems, particularly the nation's mounting industrial woes." He quotes Arno Penzias, a Nobel laureate in physics at Bell Laboratories as saying he "doubts the potential for new knowledge is worth the cost."

DOE has established a formal site selection process for the facility which has 10,000 superconducting magnets, is 52 miles in circumference, and costs $500 million a year to operate. Interested parties will have until August 1987 to submit proposals. A select panel of the National Academies of Science and Engineering will review the proposals and provide DOE a list of the "most excellent" sites in December. DOE will designate the preferred site by July 1988 and announce the final site selection in January 1989.

DOE has requested $35 million for the SSC in the FY 1988 budget. The facility would be operational in 1996. Those wishing to receive the Invitation for Site Proposals should write to SSC Site Task Force, Office of Energy Research, ER-22, GTN, U.S. DOE, Washington, D. C. 20545.

HIGHER TEMPERATURE SUPERCONDUCTIVITY

Several groups have reported success recently in achieving superconductivity at higher than usual temperatures. The most commonly used superconductors, niobium-titanium and niobium-tin, must be cooled to below 23° Kelvin. A group at the University of Houston, led by Paul C. W. Chu, reported superconductivity up to 40.4° Kelvin, while a group at Bell Labs placed their highest value at 38.7°K. The results are reported in a January issue of Physical Review Letters. In January also, the New China News Agency reported that a group in China had achieved 70°Kelvin and there are reports of up to 96 degrees at other labs. If such materials can be developed for practical use for large superconducting magnets, they could have a signficant impact on the economics of future fusion reactors and other large scale applications of superconductivity such as levitated trains and superconducting transmission lines. However, tests to date have not demonstrated the current carrying capacity and strength required for large-scale engineering applications.

STATUS OF INERTIAL FUSION

Copies of a report "The Status of Inertial Confinement Research" (KMSF U-1804) are available from KMS Fusion, Inc. 3863 Research Park Drive, Ann Arbor, MI, 48104. The report is based on a presentation by KMS Fusion president Alexander J. Glass to the 1986 European Conference on Optics, Optical Systems and Applications, in Florence Italy, October 21, 1986.

TOKAMAK POWER SYSTEMS STUDY

A report (ANL-FPP-86-1) summarizing the results of recent work at Argonne National Laboratory on tokamak power reactors is available from Dr. Charles Baker (312) 972-4836 of ANL. The thrust of the work is to develop less complex designs for commercial tokamak power plants. The features investigated included simplified first wall/blanket/shield designs, simplified impurity control concepts and improved maintenance features. The design incorporates higher power density/smaller size and non-induction current drive features. The capital cost of an 870 MW(e) plant is estimated at $1200/kW(e) and the cost of electricity is estimated at 32 mills/kw-hr (all in 1986 $), figures competitive with today's power plants.

INTERNATIONAL COLLABORATION PLAN

A guideline for magnetic fusion international collaboration activities (DOE/ER-0258) is available from Mike Roberts at DOE (301) 353-3068. The document discusses the range of U.S. collaboration activities in the context of the overall U.S. magnetic fusion strategy.

US/EEC AGREEMENT

On December 15 in Brussels, the U.S. and the European Economic Community (EEC) signed a formal document of agreement for cooperation in the field of fusion. The document provides a comprehensive framework for strengthening and expanding joint work on fusion. Copies of the agreement can be obtained from Dr. G. G. Leotta, EEC, 200 rue de la Loi, B-1049-Brussels, Belgium.

TRITIUM SAFE HANDLING COURSE

The Canadian Fusion Fuels Project (CFFTP) will host the popular Tritium Safe Handling Course in Toronto and Chalk River, Canada, May 4-8 and again September 21-25, 1987. For information contact Bob Stasko (416) 823-0205 or telex 06-982333.

CANADIAN NEWSLETTER

A new newsletter, entitled Fusion Canada, will soon be published describing activities and results of the Canadian national fusion program. If you would like to be on the mailing list, contact Robert Macphee, 15 Carey Road, Toronto, Ontario, Canada, M4S 1N9, (416) 484-8476.

CFFTP REPORTS AVAILABLE

The Canadian Fusion Fuels Technology Project has a large number of technical reports and product bulletins available relating to fusion fuels science and technology. For information contact Janine Niewswandt, CFFTP Information Center, 2600 Lakeshore Road West, Mississauga, Ontario, Canada, L5J 1K3, (416) 823-0200.

ENRICO FERMI AWARD

The U.S. Department of Energy invites you to nominate candidates for the 1987 Enrico Fermi Award.

The Fermi Award is bestowed not more frequently than annually with the approval of the President. It recognizes exceptional and altogether outstanding scientific and technical achievement in the development, use, or control of atomic energy (broadly interpreted), in scientific management or engineering. The Award consists of a citation(s), a gold medal(s), and a monetary prize(s) not to exceed $100,000 to any one individual but totaling $200,000 if shared.

Nominations for the next Award should be forwarded not later than April 3, 1987, to Mr. William L. Woodard, Office of Energy Research, ER-6, U.S. Department of Energy, Washington, D. C. 20585.

CALL FOR PAPERS: TRITIUM TECHNOLOGY CONF.

Third Topical Meeting on Tritium Technology in Fission, Fusion and Isotopic Applications, May 1-6, 1988, Toronto, Ontario, Canada. Sponsored by the Canadian Nuclear Society and co-sponsored by the American Nuclear Society. Papers are solicited emphasizing experience or experiments related to: (1) Tritium Processing, including fuel cycles, tritium management, equipment design studies, breeding blanket design and experimentation, hydrogen isotope separation, recovery from reactors, and reprocessing plants; (2) Tritium Safety including environmental release studies and modelling, oxidation and conversion of tritiated hydrogen to water, consequences of exposure and dosimetry, biological effects, risk analysis and release probabilities; (3) Measurement of Tritium including tritium monitoring, process measurements, accountability and inventory control, and new techniques; (4) Tritium Properties and Interaction with Materials including physical and chemical properties, corrosion, mechanical properties, radiation and hydrogen effects; (5) containment, Control, and Maintenance of Tritium Systems including laboratory and plant design, tritium waste management, remote technologies, practical experience with tritium handling, pumping and decontamination; and (6) Tritium Applications including tritium labelling, tritium tracers, commercial uses of tritium, other uses.

Deadline for 600-900 word summaries is October 15, 1987 with author notification by January 15, 1988. Final paper deadline is March 15, 1988.

For additional information please contact the Technical Program representatives, W. J. Holtslander, AECL-CRNL, Station 40, Chalk River, Ontario, Canada, K0J 1J0, (613) 585-3311 or M. L. Rogers, MRC/Mound, P.O. Box 32, Miamisburg, OH, 45342, (513) 865-3081.

CALL FOR PAPERS: ENERGY INDEPENDENCE CONF.

The first Energy Independence Conference, sponsored by the International Union of Pure and Applied Physics (IUPAP), will be on the subject of Fusion Energy and Plasma Physics. It will be held in Rio de Janiero, Brazil, from August 17-21, 1987 and will be hosted by the Brazilian Physical Society (SBF) jointly with Coordination of Post-Graduate Programs in Engineering of the Federal University of Rio de Janeiro (COPPE/UFRJ). This will be the first of a series of conferences to be held in third world countries, each one covering a different topic. The purpose of the conference is to gather the centers, government laboratories and industries to present and discuss recent results in physics with applications to the field of energy, and their possible contribution towards energy independence of third world countries. The conference will fulfill the need for a deep analysis of the perspectives on Fusion Energy and Plasma Physics Research in these countries. The status of on-going research will be evaluated and new research policies and strategies will be proposed. It will also discuss possible ways of implementing international cooperation programs and, in particular, the participation of third world countries in the worldwide effort for Fusion Energy Research.

The scope of the conference covers, firstly the presentation and discussion of new results of plasma physics and thermonuclear fusion research in areas such as tokamak, alternative magnetic confinement systems, plasma diagnostics, numerical simulations and plasma theory, and the application of plasma to industries; secondly the discussion of the perspectives of plasma physics and fusion energy programs in developing countries and re-evaluation of the participation of these countries on the worldwide fusion research efforts.

Deadlines: submission of abstracts, March 31; final papers, July 31.

For further information, write to Energy Independence Conference, COPPE/UFRJ - C.P. 68513 21945 - Rio de Janeiro, RJ-Brazil, Telex (021) 22817 UFCO-BR.

KMS PICKED FOR CONTINUED RESEARCH

DOE has selected KMS Fusion, Inc. to continue to perform inertial confinement fusion (ICF) research and development.

The Department of Energy is negotiating a three year contract with KMS that allows for two 1-year extension options after the first three years. Patrick B. Long, Chairman and Chief Executive Officer of KMS Industries said that the contract award demonstrates the Company's unique expertise and experience in the field of inertial confinement fusion. "This contract," said Long, "recognizes the contributions of KMS Fusion and its scientists to the objectives of the ICF program." KMSF is the sole supplier of the microscopic fuel targets used in the program in the United States and is the only laboratory fully equipped and able to perform experiments using cryogenically frozen fuel, one of the newest innovations in the ICF program. Long said that the new contract was also gratifying because it was won under competitive procurement.

MEETINGS

April 6-8 Annual Sherwood Theory Conference. San Diego. Contact Don Dobrott (619) 456-6452.

April 8-9 FPA Annual Meeting and Symposium. Pleasanton, CA. Contact Ruth Watkins (301) 258-0545.

April 14-16 14th Energy Technology Conference. Washington, D.C. Contact (301) 251-9250.

April 27-May 1 Conference on Lasers and Electro-Optics (CLEO). Baltimore. Contact (202) 223-0920.

May 26-29 IEEE/AVS International Symposium on Electron, Ion and Photon Beams. Woodland Hills, CA. IEEE-AVS. Contact Richard Howard (201) 949-8084.

June 1-4 IEEE International Conference on Plasma Science. Hyatt Regency, Crystal City, VA. Contact Frank Young (505) 846-6228.

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APRIL 1987

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Soviets unveil ambitious new fusion project

D-T BREAKEVEN SOUGHT

Moving with surprising speed on the construction of a new fusion experiment called T-14, the USSR announced plans to operate the new facility by the end of the year. The compact, copper-coil device is designed to use deuterium-tritium fuel and to approach fusion breakeven conditions by using adiabatic compression to raise the plasma density and temperature. Compared to the almost ten years the Soviets have taken to complete the superconducting T-15 tokamak, a device still not in operation, the new T-14 device was conceived only two years ago. The new project is located at the "Troitsk site" outside Moscow and is under the scientific direction of Prof. Valeriy A. Chuyanov of the Kurchatov Institute. Engineering of the machine is under the direction of Dr. Oleg G. Filatov of the Efremov Institute, Leningrad.

VIEWPOINT: THE POTENTIAL OF HIGH FIELDS AND ADVANCED MAGNET TECHNOLOGY

Use of high fields and advanced magnet technology could significantly accelerate fusion development. High field copper magnet technology has been used to achieve a high performance/ cost ratio in the CIT design, substantially reducing the cost of an ignition experiment. A similar potential exists for ETR and demonstration reactor concepts that use superconducting magnets.

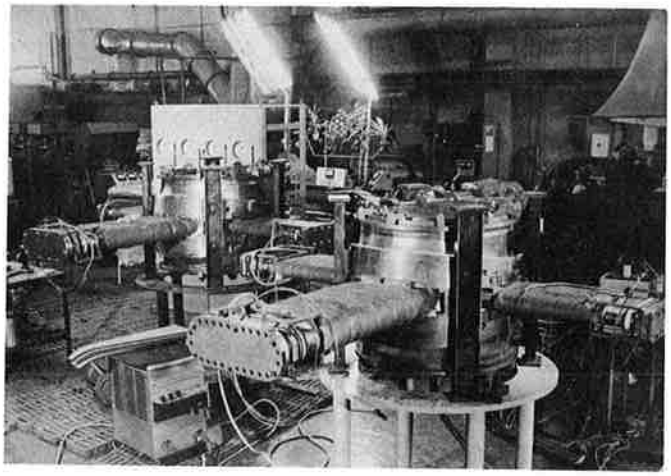
High field operation (7-12 T at the plasma) could reduce the plasma current needed to achieve the required value of $n\tau$ in ETR and demonstration tokamak reactors. Lower current would reduce current drive requirements and might also alleviate possible disruption problems. High field operation could also increase the efficiency of steady state lower hybrid current drive and might facilitate use of other current drive mechanisms. Moreover, it could decrease the required value of beta and lead to a reduced plasma volume requirement. The required superconductor current densities at high fields may well be achievable in ETR through use of Nb_3Sn technology and further improvement may be possible with more advanced superconductors.

Exciting longer term (and highly speculative) possibilities may also result from recent dramatic progress in high temperature superconductor research. Ultimately these materials might be used in such a way as to combine the relative simplicity, robustness and reduced shielding requirements of copper magnets with the minimal power requirements of high field superconducting magnets. The results could be more compact, lower cost reactors with greater maintainabiity and reliability.

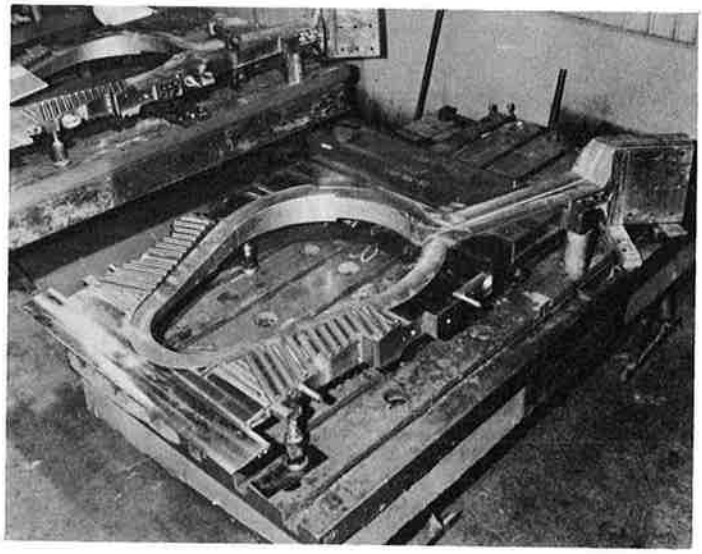
The potential of high fields and advanced magnet technology suggests consideration of a more aggressive development program in this area.

Dan

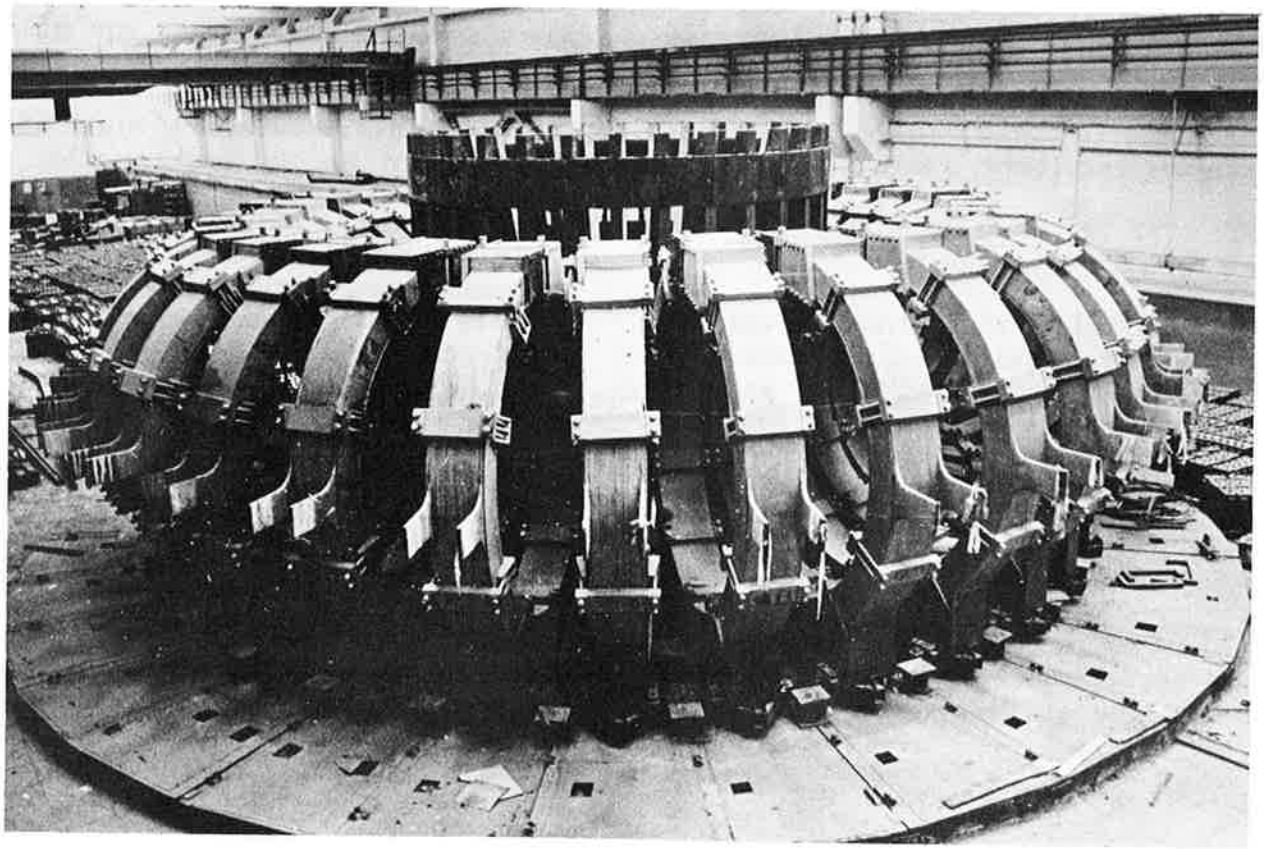
Daniel R. Cohn



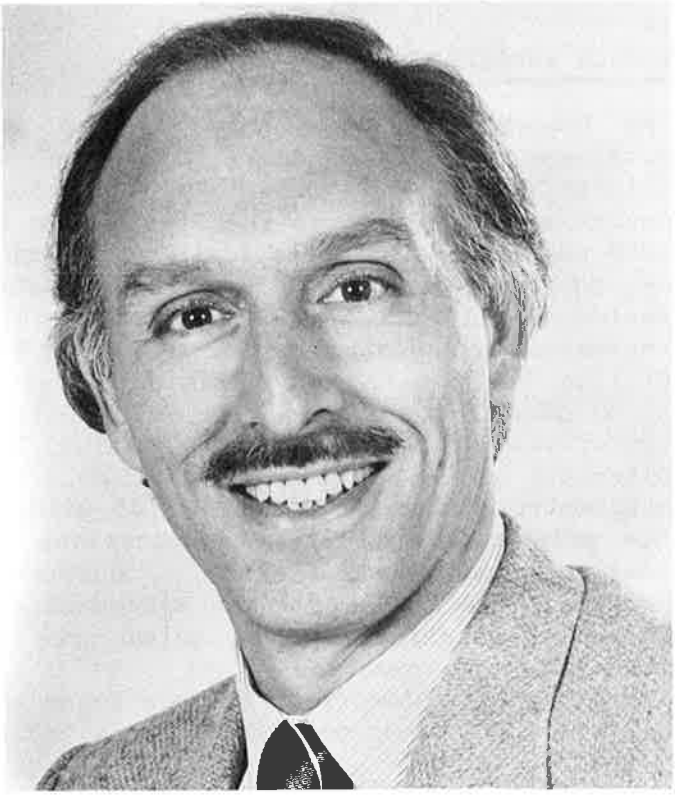
Vacuum vessel modules for T-14. Each module will receive two TF coils, one on either side of the diagnostic ports. The two angled rings on each module are titanium support rings from which the vacuum vessel (0.5 mm nickel alloy) is suspended by a series of hooks. The titanium rings, in turn, are suspended from the TF coils. The vacuum vessel sectors are explosion formed.



One of the 32 one-turn copper coils for T-14. Outer coil support shows teeth to react against over-turning moments. Scale size of the coil opening is of the order of 1/2-meter. Maximum field in the coil is 23 Tesla. Center of tokamak will be toward lower left in photo, electrical tabs at upper right will connect to inductive store below tokamak.



Mock-up assembly of coils for the inductive energy store for T-14. The tokamak itself will sit on top of this inductive coil assembly.



ROBERT W. CONN ELECTED TO NATIONAL ACADEMY OF ENGINEERING

BENJAMIN A. CARRERAS, MARTIN MARIETTA CORPORATE FELLOW

CONN ELECTED TO ACADEMY

The National Academy of Engineering has announced the election to membership of Professor Robert W. Conn of UCLA. Conn is the first person elected to the Academy solely on the basis of contribution to fusion engineering. In announcing Conn's selection, the Academy cited his "major pioneering contributions in the field of fusion engineering, fusion plasma analysis and fusion reactor design." The Academy has 1353 U.S. members and 117 foreign associates. Our congratulations to Bob on receiving this great honor, and in the process, bringing enhanced recognition to the importance of fusion engineering.

Two other persons who have had an association with fusion were also elected to the Academy. Albert Nareth, AT&T Bell Laboratories was elected. Al previously had a senior managerial position at Sandia National Laboratories overseeing inertial confinement fusion there. Also Lawrence T. Papay of Southern California Edison Co. was elected. Larry served as a member of the committee that recently reviewed the magnetic fusion program for the DOE Energy Research Advisory Board (see our November 1986 newsletter).

CARRERAS RECEIVES OAK RIDGE HONORS

The Oak Ridge National Laboratory has announced the appointment of Dr. Benjamin A. Carreras as Martin Marietta Corporate Fellow. He is the first fusion researcher to receive the honor, which is awarded to a select few scientists who have achieved widespread external recognition for their incisive technical contributions.
Corporate Fellows also advise upper management in areas of strategic laboratory initiatives. Carreras joined ORNL in 1980 and has contributed to advances in the MHD area, notably through computer modeling using the supercomputers of the National Fusion Energy Computing Network. He has been in the vanguard of developing models to explain plasma turbulence. Carreras has made major contributions to the development of several innovative stellarator confinement designs. Carreras was educated in Spain, obtaining a doctorate from the University of Valencia, and has had research appointments at Daresbury Nuclear Physics Laboratory in England, at the Junta for Energia Nuclear in Spain and at the Institute for Advanced Study Princeton University. He was recently named a Fellow in the American Physical Society.

INTERNATIONAL ETR PLANS ADVANCE

Plans for the US, USSR, Europe and Japan to collaborate on the design of a fusion engineering test reactor (see our November 1986 newsletter) took a major step forward during a meeting on March 15-16 among the four parties in Vienna. The meeting, under the auspices of the International Atomic Energy Agency (IAEA) marked the first time that all four parties had met together to discuss the collaboration. The meeting produced general agreement on the nature of the collaboration and the necessary steps to formalize the process. The IAEA, in a press release issued at the conclusion of the meeting said that "The Parties were favorably disposed to the proposal for joint conduct of conceptual design and supporting R&D for an international thermonuclear experimental reactor. The Parties reached an understanding that the proposal was a sound basis for further discussion. The four Parties will each identify their representative to a group of experts to make proposals for a common set of detailed technical objectives for the conceptual design and to prepare the basis for further consideration by the Parties."

LLNL REORGANIZES TO MEET NEW RESPONSIBILITIES

The LLNL magnetic fusion program under the direction of lab associate director T. Kenneth Fowler has re-organized to better manage its changing responsibilities with the U.S. fusion program. LLNL will be the center of gravity for the U.S. portion of the design of an international fusion engineering test reactor. Fowler is heading an informal national oversight committee for the program. In the reorganization, Fowler has named Carl D. Henning to head a group responsible for the technical aspects of the ETR program. Fowler has also established a new group under Keith Thomassen to be responsible for the new tokamak experiment at LLNL (see our December 1986 newsletter). The new experiment will be called MTX, for Microwave Tokamak Experiment. Tom Simonen is responsible for a group of LLNL scientists who are working with GA Technologies on the DIII-D project there. Within his own office, Fowler has named Dave Baldwin and Grant Logan as deputies and Fred Coensgen as his special assistant. Don Pearlstein remains head of the theory group.

FUSION BUDGETS

The Subcommittee on Energy Research and Development of the House Committee on Science, Space and Technology has recommended a $25M add-on to the President's FY 1988 request for magnetic fusion. The add-on, if enacted, would bring the magnetic fusion total to $370.6 million. The increases were designated as follows: $15 million for the Compact Ignition Tokamak, $5 million for Advanced Toroidal Facility operations at ORNL, and $5 million for alternate concepts research at LANL. The subcommittee also recommended a $5 million new program for civilian applications of inertial confinement fusion. Honorable Marilyn Lloyd (TN) heads the subcommittee. The recommendation msut be acted upon by the full committee and by the Appropriations Committees of both House and Senate before funds would become available.

FIRST PLASMA FOR CANADA'S TOKAMAK

Congratulations to Richard Bolton and his group at the Institut de Recherche d'Hydro Quebec for achieving first plasma in their new, medium-sized tokamak on the evening of March 25. The "Tokamak de Varennes" is the first major fusion experiment to be built and operated by an electric utility company. For further information on the program, call (514) 652-8701.

NEW FUSION TEXT

A new fusion textbook "Introduction to Fusion Energy" by J. Reece Roth, University of Tennessee, is available from Imprint, Inc., P.O. Box 5694, Charlottsville, VA, 22906, (804) 296-7698. The text, designed for advanced undergraduates or introductory graduate classes sells for $35.00 and also has an instruction kit available for $50.00. The text is comprehensive, containing data, graphs and references on topics ranging from basic fusion and plasma physics principles to fusion engineering and technology to fusion power plant design and future energy needs. The author and publisher have made a special effort to make the 650 page text available at a reasonable price.

EXECUTIVE NEWSLETTER

MAY 1987

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LEADERSHIP AWARD PRESENTED TO DAVIDSON

Ronald C. Davidson, Director of the MIT Plasma Fusion Center, has been selected by the FPA's Board of Directors to receive our Leadership Award for 1986. The awards, initiated in 1980, are intended to recognize individuals who have shown outstanding leadership qualities in accelerating the development of fusion. Davidson's award was presented to him at FPA's annual meeting April 8 in Pleasanton, CA. His award reads as follows:

"The Board of Directors of Fusion Power Associates presents this Leadership Award to Ronald C. Davidson in Recognition of Your Outstanding Leadership Qualities.

"Your advice is regularly sought because of the depth of your technical expertise and your skill as a committee chairman. We especially note your contributions to the direction of both magnetic and inertial fusion as chairman of the Magnetic Fusion Advisory Committee and the Sandia Particle Beam Fusion Review Committee and as a member of the National Academy Panel to review inertial confinement fusion."

Previous recipients of FPA's Leadership Awards are: 1980: Solomon J. Buchsbaum, Robert L. Hirsch, Mike McCormack, Paul Tsongas; 1981: Edwin E. Kintner; 1982: Harold P. Furth, John Nuckolls; 1983: John L. Emmett, T. Kenneth Fowler; 1984: Tihiro Ohkawa, Gerold Yonas; 1985: Evgeni P. Velikhov, Chiyoe Yamanaka.

Davidson presented the keynote speech at FPA's recent annual meeting and symposium. Copies of his address "Prospects for Fusion--the Winds of Change" are available from Fusion Power Associates.

LEADERSHIP AWARD WINNER RON DAVIDSON

FPA SYMPOSIUM DATES SET

Fusion Power Associates will host a symposium on the theme "FUSION POWER DEVELOPMENT: BREAKEVEN AND BEYOND," August 27-28 at the Princeton Plasma Physics Laboratory. Topics to be addressed will include recent results and plans for breakeven experiments on TFTR, JET and JT-60; status of design and project management for the proposed new Compact Ignition Tokamak (CIT); status of design and planning for the International Thermonuclear Experimental Reactor (ITER, formerly ETR); status of advanced alternate concepts; status and plans for achieving high pellet compression, breakeven and ignition in inertial confinement fusion; and tour of the TFTR facilities.

A feature of the symposium will be an awards dinner at which two newly established Fusion Power Associates awards will be presented for the first time.

The "Distinguished Career Awards" will honor individuals for a lifetime of distinguished accomplishments in fusion or fusion-related fields. The FPA Excellence in Engineering Prize in memory of David J. Rose will be awarded to recognize individuals relatively early in their careers, who are emerging as leaders in the area of fusion engineering.

We hope that all of our members and individual affiliates can join us for this important event.

PPPL TO HOST CIT INDUSTRIAL INVOLVEMENT SEMINAR

Princeton Plasma Physics Laboratory will host a CIT Industrial Involvement Seminar on July 23 at PPPL to describe possible industrial opportunities in the proposed Compact Ignition Tokamak, presuming the project is approved by Congress. Attendance is by advanced registration only and will be limited to a maximum of two persons per firm. Registration forms must be requested by June and returned by July. Contact Ms. Natalia Bayes (609) 683-2445.

CIT VACUUM VESSEL MAY BE PUT OUT ON BID

Princeton Plasma Physics Laboratory is soliciting expressions of interest from industry on whether they should put out a request for proposal (RFP) for a responsible contractor for the CIT vacuum vessel and related components. The contractor must be capable of providing "design, analysis, fabrication, delivery, supporting technologies research and development, and technical support for installation, assembly, and testing of the Vacuum Vessel System of the Compact Ignition Tokamak (CIT)."

"The Vacuum Vessel System consists of four (4) major subsystems: (1) the vacuum vessel, (2) the internal "first wall" seen by the plasma, (3) the plasma divertor, and, (4) the in-vessel remote maintenance. To provide an acceptable Vacuum Vessel System the successful offeror will possess outstanding expertise and experience in the following technical areas: 1. analysis, design, and fabrication of very large volume (on the order of 30 cubic meters), high vacuum (10^{-8} Torr), ultraclean, plasma containing vessels operating in high magnetic fields (8 to 10 Tesla) and subject to induced thermo-mechanical loads; 2. design and fabrication using high strength, low magnetic permeability materials such as Inconel; 3. design and fabrication using high strength organic refractory materials such as graphite and carbon fiber; 4. design and fabrication of in-vessel remote handling systems capable of installing, removing, and replacing in-vessel hardware in a tritium-laden, radioactivated environment. The successful offeror will be expected to provide technical support to, and liaison with other CIT Project team members, both at the offeror's own facilities and at PPPL in Princeton, New Jersey." Contact R. D. Templon on (609) 683-2432.

FPA FINANCIAL STATUS

	1986	1985	1984
Income			
Research	$189,938	$201,476	$214,969
Dues	90,955	108,891	97,524
Other	52,576	66,751	31,666
Total	$333,469	$377,118	$344,159
Expenses			
Research	$189,944	$201,333	$214,969
Education	47,204	80,464	52,197
Admin.	73,396	96,037	71,629
Total	$310,544	$377,834	$338,795
Assets			
Net Cash	$ 7,469	$ (4,575)	$ 13,917
Office Equity	$ 28,657	$ 17,776	n/a
Engineering Prize Fund	$ 4,270	n/a	n/a

NEW ITEM OF INTEREST

Terry Kammash and David L. Galbraith of the University of Michigan have prepared an interesting paper on the use of fusion reactors in space applications based upon a novel confinement scheme called Magnetically Insulated Inertial Confinement Fusion (MICF). MICF was invented by Hasegawa, Yamanaka, et.al. (Phys. Rev. Lett. 56, 139 (1986)). The Kammash-Galbraith paper, entitled "A Fusion Reactor for Space Applications" will appear in the July issue of Fusion Technology (ANS). For further information contact the authors at (313) 764-0205.

FINAL CALL FOR PAPERS

Abstracts of 400 words are due by June 1 for the 12th Symposium on Fusion Engineering (IEEE). For information contact Carl Henning (LLNL) (415) 422-0235, Bill Simmons (TRW) (213) 279-3551 or Manning Dandridge (Grumman) (516) 575-3539. The meeting is scheduled for October 12-16 in Monterey, CA.

EXECUTIVE NEWSLETTER

JUNE 1987

FUSION POWER ASSOCIATES

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NEW AFFILIATE

CBI Services, Inc. has become an affiliate of Fusion Power Associates. Raymond M. Coley, Contracting Engineer, will represent the company. CBI Services primarily deals in shop fabrication of metal plate structures. They are located at One Main Street, Chatham, New Jersey, 07928, (201) 635-0500. We welcome their participation in Fusion Power Associates.

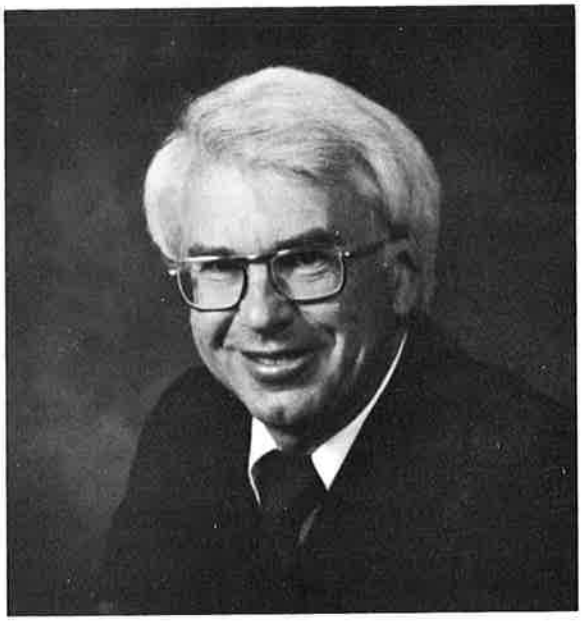
INERTIAL FUSION BUDGET

The Senate Armed Services Committee recommended $155 million for inertial fusion in FY 1988; the House Armed Services Committee recommended $149 million. The administration had recommended cutting inertial fusion from $155 million this year to $118.5 in FY 1988. Actual funding approval must await action by the Appropriations Committees.

TRITIUM PRODUCTION REACTORS

The Journal of Fusion Energy (Plenum Press, Dan Cohn (MIT), editor) has devoted two issues (December 1986 and March 1987) to papers describing the use of magnetic fusion reactors to produce tritium. The issues were produced by guest editor Ralph Moir of LLNL. The issues contain papers on feasibility, technology and economics by Moir, W. S. Neef, D. L. Jassby, J. D. Lee, R. D. Campbell, J. B. Mitchell and S. A. Frije.

There is a growing interest in the fusion community in the possible near-term application of fusion for use as a tritium production reactor. Meanwhile DOE has announced plans to seek congressional funding, in an FY 1988 supplemental funding request, to design new fission reactors for this purpose.



T. K. FOWLER, NEWLY ELECTED TO ACADEMY OF SCIENCES

FOWLER NAMED TO ACADEMY OF SCIENCES

T. Kenneth Fowler, Associate Director for the Magnetic Fusion Energy Program at Lawrence Livermore National Laboratory, was one of 60 American scientists recently elected to the National Academy of Sciences. Election to the academy is one of the highest honors that can be conferred on a scientist. There are 1,523 U.S. members and 249 non-U.S. members in the Academy. Our congratulations to Ken on this well-deserved recognition and our thanks to him for bringing scientific recognition to fusion research in the process.

CALL FOR PAPERS

The International Symposium on Fusion Nuclear Technology (ISFNT) will be held April 10-19, 1988, in Tokyo, Japan. It will be a major event for the international exchange of technical information on all aspects relating to fusion nuclear technology and for the promotion of international collaboration. The conference will provide an excellent opportunity to report on recent technical progress, discuss key issues and identify means to resolve those issues. The ISFNT is cosponsored by the Atomic Energy Society of Japan and the Japan Society of Plasma Science and Nuclear Fusion Research. Papers are sought on all aspects of fusion nuclear technology (FNT). Papers related to FNT experiments, facilities, modeling, analysis and design are encouraged. FNT issues for near-term fusion devices, as well as for commercial reactors, are included. Deadline for submission of 400-600 word abstracts: 23 October 1987. Author notification: 25 November 1987. Full-paper deadline: 10 March 1988. Abstracts should be submitted to Prof. Kenzo Miya, Nuclear Engineering Research Laboratory, University of Tokyo, Tokai-mura, Ibaraki Prefecture, 319-11, Japan; phone 011-813-(812)-2111, ext. 7421; telex 2722111 FEUT J. Telephone inquiries may be directed to the office of Prof. Mohamed Abdou at UCLA, phone (213) 206-1228.

LASER WORKSHOP

The 8th International Workshop on Laser Interaction and Related Plasma Phenomena will be held October 26-30, 1987 at the Naval Postgraduate School in Monterey, California. Presentations and discussions of selected key topics regarding powerful lasers and charged-particle beams and their interactions with plasmas up to and including extreme intensities and short (x-ray) wavelengths will be continued in the 9th meeting of this traditional series. The format will remain the same as in the previous workshops and will include: latest research results, extensive reviews of key areas, discussion of controversial views, plus speculation about future directions.

The selection of regular presentations will be based on prior submission of 500-word abstracts. However, late abstracts of extreme urgency may also be considered for a post-deadline session. The scope of the workshop can be seen from examination of past proceedings (1971-1985) published in monographs by Plenum Press, New York.

The committee for the 8th Workshop include: Prof. Heinrich Hora and Prof. George Miley, co-directors, Prof. Fred Schwirzke, local organizer. The conference fee is $350. A limited number of scholarships are available. To obtain future announcements, please contact Prof. George H. Miley, Fusion Studies Laboratory, University of Illinois, 103 South Goodwin Avenue, Urbana, Illinois, 61801.

RTNS USED FOR SUPERCONDUCTING TESTS

(Reprinted from LLNL Weekly Bulletin, 19 May 1987, article by Jon Rosell)

In its final series of experiments to test materials for future fusion reactors, the Laboratory's Rotating Target Neutron Source (RTNS) is suddenly at the forefront of superconducting physics.

Newly developed superconducting materials from around the country are being irradiated in the final series of RTNS experiments to see how new ceramic oxide materials will stand up to neutron radiation in environments close to what they might experience in either a fusion reactor or in the proposed Superconducting Super Collider.

Superconductors are materials that lose all resistance to the flow of electricity when they are cooled below a certain temperature. A fusion reactor would use superconducting magnets to contain the hot plasma of the fusion reaction, while the Superconducting Super Collider's superconducting magnets would contain the streams of protons that would move around the 52-mile circumference of the collider.

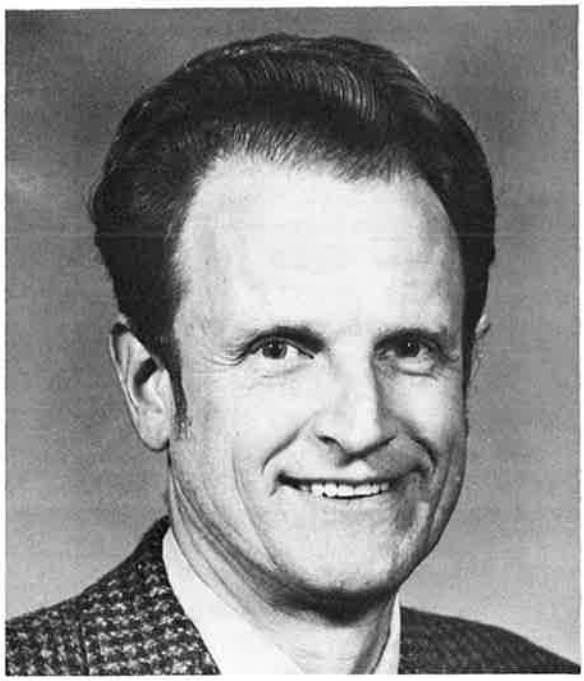
LLNL scientists are looking to see how sensitive the new superconducting materials are to radiation, according to LLNL physicist Mike Guinan, who is conducting the add-on experiments at RTNS with physicist Peter Hahn. The sensitivity of the materials is critical if they are to be

used in either a future fusion reactor with its high neutron radiation or in the Superconducting Super Collider, which will produce low levels of radiation from the streams of protons as they travel around the collider. "The new superconducting materials' good properties come from the ordered defect structure of the oxygen atoms," Guinan said. "The materials have missing oxygen atoms; but the sites are in a regular pattern." Guinan noted that this regular pattern of missing oxygen atoms may make them susceptible to damage from radiation. "We are giving the new superconducting materials a dose of neutron radiation that is equivalent to that at the magnets during the life of the proposed International Thermonuclear Test Reactor (ITER)," Guinan said.

If built the ITER could be the first facility in the world that would incorporate all elements of a magnetic fusion reactor into one integrated system. This would include both the plasma technology and the engineering technology required to utilize fusion power for useful purposes. If these new materials turn out to be extremely degraded by the radiation, then it will limit their use to applications that do not involve exposure to high levels of radiation.

John Miller, leader of the Superconducting Magnets Group for the Magnetic Fusion Energy Program, stated that "the new materials could be very useful, but they are so far below what we have now in current carrying capacity, manufacturability and strength," that it will be a number of years before they could be considered for either a fusion reactor or for the Superconducting Super Collider. But, Guinan noted, the present properties are more than adequate for use in electronic devices. "In four to five years you will see the materials used in computers. You'll see a Cray III supercomputer reduced to the size of a bread box without the elaborate cooling equipment."

The results of the current experiments won't be known until after the tests are over next month and the different physicists have had a chance to analyze the test samples.



DON DUDZIAK EDITS SPECIAL LASER ISSUE

KRF LASERS FOR FUSION SURVEYED

A special issue of the journal of Fusion Technology devoted to KrF lasers for fusion has just been published. Donald J. Dudziak, Project Leader for ICF System Studies at Los Alamos National Laboratory, is the guest editor for this issue. The issue contains the most detailed and current description of the multi-kilojoule Aurora laser facility, which is currently under construction at Los Alamos. A paper by Robert Lehmberg (U.S. Naval Research Laboratory) and Julies Goldhar (University of Maryland) describes an innovative approach for the application of induced spatial incoherence with KrF lasers. There are also three papers describing the Japanese effort in KrF lasers for fusion. Complimentary copies of this special issue are available from: Dr. Donald J. Dudziak, Los Alamos National Laboratory, P.O. Box 1663, Mail Stop F611, Los Alamos, New Mexico, 87545. Congratulations to all of the authors and Don Dudziak for a job well done!

OAK RIDGE PELLET INJECTOR SENT TO JET

Oak Ridge researchers, headed by Stan Milora, have built and sent to the Joint European Torus a pellet injector for raising the plasma density and refueling

the plasma in JET. The injector is of the "repeating pneumatic" type. The injector uses the force of hot gases to fire tiny pellets of frozen hydrogen into the JET's fuel chamber at speeds of more than 4,000 feet per second. Such high velocities are needed for the pellets to penetrate the hydrogen fuel and reach its center, where they increase the density of the fuel. The injector fires three sizes of pellets ranging from one-eighth to one-fourth of an inch in diameter. Larger pellets travel farther into the fuel ring, which is floated by electromagnetic fields. Use of different pellet sizes will allow researchers to conduct a variety of experiments. The refueling gun is designed to keep the plasma density at 100 trillion particles per cubic centimeter, the level considered necessary to maintain the fusion reaction. The JET, being built by a consortium of western European nations, is the world's largest fusion device, with a volume of 150 cubic meters.

ORNL also is providing computer control systems for the injector. The injector is an outgrowth of the Department of Energy's collaboration with the European Atomic Energy Community's fusion program.

APS STATEMENT URGES NO EARLY COMMITMENT TO SDI DEPLOYMENT

Dr. Val Fitch, President of the American Physical Society (APS), announced the release of a public statement adopted by the APS Council, the governing body of APS, that urges no early commitment to the deployment of Strategic Defense Initiative (SDI) weapons. The APS is the nation's largest organization of physicists whose members would provide the scientific foundation for SDI weaponry. The APS statement notes: "In view of the large gap between current technology and the advanced levels required for an effective missile defense, the SDI program should not be a controlling factor in U.S. security planning and the process of arms control. It is the judgment of the Council of the American Physical Society that there should be no early commitment to the deployment of SDI."

The Council's statement follows the release of a major APS study that addressed directed energy weapons (DEW), the group of particle and laser-beam systems that would form the main ultimate weapons of SDI. One of the main conclusions of the DEW Study was that, "A decade or more of intensive research would be required to provide the technical knowledge needed for an informed decision about the potential effectiveness and survivability of directed energy weapons." The current APS statement goes beyond specifid DEW issues and gives a broader, more comprehensive comment on SDI.

PEOPLE

John Holzrichter has been named deputy associate director for research for the Physics Department at LLNL. He reports to associate director John Nuckolls.

Don Grove, deputy director for technical operations at PPPL, has named several persons to leadership positions for the Compact Ignition Tokamak. They are George Sheffield (CIT Engineering), Jack Joyce (Acting Systems Engineering Manager), Charles Bushnell (CIT R&D Manager), and Ellis Simon (CIT Planning and Budget). John Schmidt is CIT Project Manager and Milt Machalek heads the CIT Administrative Group.

The Chairman of the Joint Chiefs of Staff, Admiral William J. Crowe, Jr., recenty toured the TFTR facility.

Marshall Rosenbluth is reportedly leaving the University of Texas for the Institute for Advanced Study, Princeton University. Rosenbluth declined to confirm the report.

Marvin Goldberger, recently retired president of California Institute of Technology, has become the new head of the Institute for Advanced Study at Princeton.

Sylvester R. Foley, Jr., DOE Assistant Secretary for Defense Programs, has submitted his resignation effective July 31. Since taking the post in 1985, Foley was best known in fusion circles for his unsuccessful attempts to bury the inertial fusion program. Foley's departure completes the decimation of DOE's top technical leadership. Assistant Secretary for Nuclear Energy, R. David Rossin, leaves June 30 and DOE Director of Energy Research, Alvin W. Trivelpiece, left at the end of April.

EXECUTIVE NEWSLETTER

JULY 1987

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FUSION BUDGETS

The House Appropriations Committee voted June 16 to add $16 million to the magnetic fusion budget above the President's requested level of $345.6 million. If sustained in the Senate, this would mark the first increase in magnetic fusion since FY 1984. The Committee stated that $11 million of the add-on was for the Compact Ignition Tokamak construction project at Princeton (see our February 1987 newsletter), that $4 million was to support alternative fusion concepts at ORNL and that $1 million was to be added to the support for DIII-D at GA Technologies. The Committee noted that funds were included "to participate with the European Community, Japan and the USSR to initiate the design for an engineering test reactor."

The Appropriations Committee also rejected DOE's plan to cut inertial confinement fusion (ICF) from $155 million this year to only $118.5 in FY 1988. They added $40.5 million, bringing the total ICF budget to $159 million. Holding the ICF budget to reasonable levels has been a constant battle for several years (see, for example, our February 1985, September 1985, May 1986 and November 1986 newsletters).

The budget must still be considered in the Senate, go to conference, be passed by both houses of Congress and signed by the President.

TRIVELPIECE REPLACEMENT

The White House has announced its intention to submit the name of Robert Hunter, president and founder of Western Research Corp., San Diego, to replace DOE Director of Energy Research Al Trivelpiece. Hunter gave a summary talk on excimer lasers at Fusion Power Associates' symposium "Lasers and Particle Beams for Fusion and Strategic Defense" at the University of Rochester in 1985.

DEAN, HAUBENRICH ELECTED ANS FELLOWS

Steve Dean, Fusion Power Associates, and Paul Haubenrich, Oak Ridge National Laboratory, were two of ten persons elected to the rank of "fellow" by the American Nuclear Society Board of Directors. They were presented the honor at an awards luncheon in Dallas June 9. They were cited for their "outstanding contributions to the advancement of nuclear science and engineering."

Dean's citation reads, "For his varied contributions which have had a unique impact on the United States Magnetic and Inertial Fusion Programs. Through Fusion Power Associates he is a preeminent spokesman and a unifying force in world fusion. His service on the Fusion Energy Division's Executive Committee has been of great benefit to the ANS."

Haubenrich's citation reads, "For his important contributions to both nuclear reactors and fusion technology. He was experimental physicist on the Homogeneous Reactor Test and then head of the Molten Salt Reactor Experiment. Since 1977, he has led the $150 million Large Coil Task, a major example of international cooperation in fusion."

ANS has about 15,000 members, of which 431 have been designated as fellows.

ANS FUSION DIVISION ELECTS OFFICERS

Carl D. Henning (LLNL) has been elected Vice Chair/Chair Elect of the ANS Fusion Energy Division. He will automatically succeed current chairman Robert A. Krakowski (LANL) in June 1988. The division also elected the following persons to their executive committee: Edward T. Cheng (GA Technologies), William J. Hogan (LLNL), John P. Holdren (LLNL), Gregory A. Moses (Univ. of Wisconsin), and Francois G. Prevot (CEA, France.)

MOSES HEADS JAYCOR DIVISION

Ken Moses, Division Manager of JAYCOR's Plasma Technology Division (PTD), has announced that PTD has moved to a new, larger office and laboratory facility at 3547 Voyager St., Suite 104-106, Torrance, CA, 90503. The new phone number is (213) 542-3800.

The Plasma Technology Division is developing two new diagnostic techniques for the Magnetic Fusion Energy Program, under DOE contracts. The first is a proof-of-principle experiment to demonstrate that alpha-particle ion cyclotron emission spectroscopy can be used to monitor the dynamical energy transfer from the fusion products (alpha-particles) to the confined plasma ions. In addition, it may provide information on the velocity distribution of the alpha particles. The experiment is to be performed on the Tokamak Fusion Test Reactor at the Princeton Plasma Physics Laboratory, NJ.

The second new diagnostic technique under development is gamma-ray tomography for reacting plasmas, which utilizes 16 MeV gammas to reconstruct the D-T or D-He^3 source functions to reveal the fusion reaction density profiles of an ignited plasma in cross section. Also, PTD has an ongoing DOE diagnostic development program to improve the technique utilizing spectral analysis of Zeeman splitting of emission lines from a neutral beam probe to measure the magnetic field distribution in a tokamak. To insure that the beam penetrates deeply into a tokamak plasma and to improve the signal-to-noise ratio of the magnetic field measurement, the PTD approach uses an intense neutral He beam to replace the thermally ionized alkali metal sources used by earlier researchers. The bright neutral He beam source is also a development of JAYCOR PTD scientists.

PTD is also developing a large-volume plasma neutralizer cell for negative-ion-based neutral beam systems. In this work, the density of plasma in the neutralizer cell, formed by an inductive rf discharge while sustaining severe rates of plasma loss, have exceeded the project goal of $10^{13} cm^{-3}$ by approaching $10^{14} cm^{-3}$ plasma densities.

FUSION ENGINEERING AND DESIGN PAPERS SOLICITED

Manuscripts are solicited for publication in the journal "Fusion Engineering and Design" (North-Holland Physics Publishing). Areas of interest include heat transfer, thermal hydraulics, materials behavior, vacuum technology, structural analysis, mechanical design, reactor safety, and reactor design. In addition to the regular issues, special issues have been published recently on "Engineering Aspects of the JT-60 Project" (Vol. 5, no. 1) edited by K. Tomabechi and "Thermochemical Behavior of the Fusion First Wall Subjected to Plasma Dascruption (Vol. 5, no. 2) edited by A. Akiyama and K. Miya. Papers may be submitted to any editor. Contact principal editor Robert W. Conn, School of Engineering and Applied Science, 6291 Boelter Hall, UCLA, Los Angeles, CA, 90024, for details.

INERTIAL FUSION LOOKS TO THE NINETIES

Inertial fusion scientists are scoping out a major facility for the 1990's called the Laboratory Microfusion Capability (LMC) project. No set of goals or parameters have yet been agreed upon, but the researchers are looking at possibilities in the following areas: 1) low capital and operating cost (typically a few hundred dollars per joule capital cost, or less, and of the order of $10,000 per shot operating cost); 2) good repetition rate (order of ten shots per day), 3) high peak power (order of 500-1000 TW); 4) high driver energy (order of 10-20 MJ); high yield (order of GJ); 6) adequate service life (order of 10,000 target shots).

IMPACT OF HIGH TEMPERATURE SUPERCONDUCTORS ON FUSION

A report estimating the potential impact of the recently-discovered high temperature superconductors on the cost, complexity and physics of fusion has been prepared (MIT report PFC/JA-87-16, April 14, 1987) by D. R. Cohn, J. Schwartz, L. Bromberg, and J. E. C. Williams. To obtain a copy, contact Dan at (617) 253-5524. A discussion of this topic will take place as part of the FPA symposium at Princeton, August 27-28. Contact Ruth Watkins (301) 258-0545 for registration information.

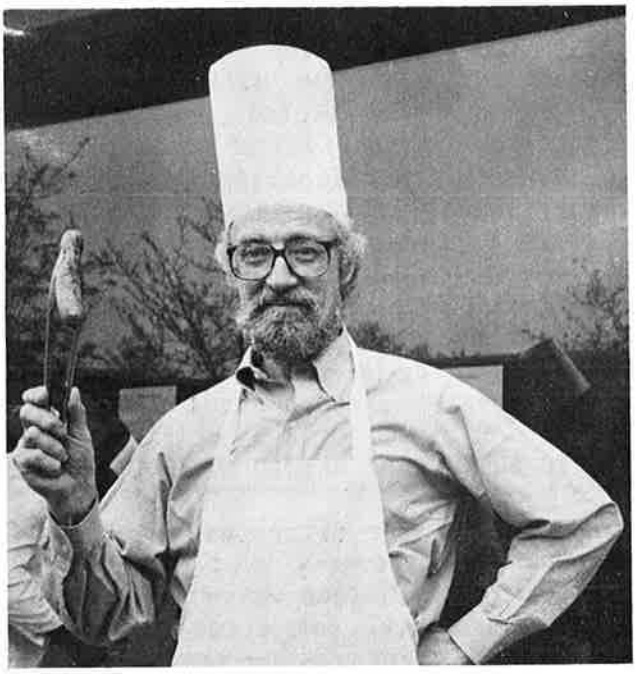
STUDENT PAPERS SOUGHT

The Honors and Awards Committee of the Fusion Energy Division of the ANS is currently considering eligible student papers for the 1987 FED Student Award for Fusion Science and Engineering. The student award consists of a Certificate of Accompslihment and a cash award of $500. Travel support (up to $500) is also provided if the student attends a meeting to present the paper and receive the award. One such possible meeting this year may include the 12th Symposium on Fusion Engineering to be held in Monterey, California, October 12-16. In addition, if a suitable fusion paper can be identified, the student will be given the opportunity to publish her/his full-length paper in Fusion Technology without a page charge. Eligibility and nomination procedures are summarized below. Further information can be obtained from and nominations sent to the new chairman of the FED Honors and Awards Committee: Professor Don Steiner, Nuclear Engineering Department, Rensselaer Polytechnic Institute, Troy, NY, 12181.

Eligibility: Nominee must be a student sometime between September 1986 and June 1987; nomination to be made by a faculty member familiar with the accomplishments; submission of seven (7) copies of a complete research paper of journal caliber, along with the nomination by August 1, 1987.

Nomination: Name and address of nominee; education (degrees with institutions, dates, and fields; present status; etc.); nomination letter by a faculty member that includes comments on students contributions to fusion science and engineering that would be recognized as significant by educators, scientists, and engineers; the creativity, novelty, and current and future importance of the accomplishment should be addressed.

The purpose of the award is to recognize significant research accomplishment of a caliber for journal publication by a student in the area of fusion science and engineering, and to encourage student involvement in future fusion energy progress.



NAME THE GNOME CONTEST

A contest is being conducted to name the person and the activity in which he is engaged, as shown in the above photo. The person having the best entry will be provided free registration at FPA's symposium August 27-28 in Princeton and an opportunity to receive good advice from the person shown in said photo. Entries must be received by FPA no later than August 15. For example, you might say that this is Harold P. Furth, director of the Princeton Plasma Physics Laboratory and keynote speaker at the FPA symposium holding a sausage. However, that answer would not win you the prize. Good luck. Decision of the anonymous judges will be final.

BEAMS '88 CONFERENCE SET

The 7th International Conference on High-Power Particle Beams (BEAMS '88) will be held July 4-7, 1988, at KfK in Karlsruhe, FRG. Authors are requested to submit tentative titles for contributed papers (indicate whether you wish to be in a poster or plenary session) to Prof. G. Kessler, P.O. Box 3640, D-7500 Karlsruhe, FRG. Telephone (07247) 82-2440.

SOVIET FUSION ENGINEERING CONFERENCE SET

The 4th All-Union Conference in Engineering Problems of Fusion Reactors will be held in Leningrad from 19-21, January 1988. Persons wishing to present papers should submit a one-page abstract by September 1, 1987 to

Dr. B. N. Zhukov, NIIEFA, Leningrad, 188631, USSR. Two-way Russian-English simultaneous translation will be provided. The conference will include the following subject areas: design of reactors and large experimental installations; plasma sources, plasma heating systems, additional plasma heating systems (neutral beams, HF, SHF); electromagnetic systems including superconducting ones; power supplies; first wall, blanket; vacuum technology, fueling, radiation safety; thermal cycles, energy conversion systems; and control systems.

ROCHESTER SETS POWER RECORD WITH MINI-LASER

Scientists at the Laboratory for Laser Energetics, University of Rochester, demonstrated a technique which can generate terawatt-level power for a trillionth of a second with a laser system that fits on a common table. A terawatt is one-trillion watts, equivalent to two times the total electric generating capacity of the United States.

The laser system employs a technique called "chirped pulse amplification" to achieve this power, and was developed by the Ultrafast Science Center team of Patrick Maine, Maurice Pessot, Donna Strickland, Steve Williamson, and Philippe Bado under the direction of Professor Gerard Mourou. The director of the Laboratory for Laser Energetics is Robert McCrory.

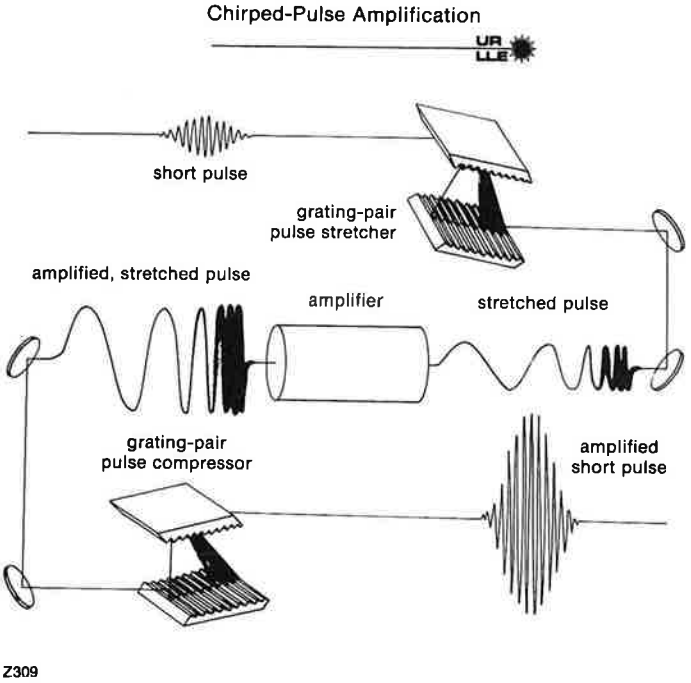
The technique generates laser pulses which are 1,000 times more intense than previously possible. Before, this scale of power could only be obtained with extremely large and complex systems. When focussed, the chirped laser beam can produce a power density greater than 10^{18} watts/cm^2, which is the highest intensity ever recorded.

MEETINGS

August

10-14 22nd Intersociety Energy Conversion Engineering Conference. Philadelphia. Contact AIAA Meetings Dept. 1633 Broadway, New York, NY, 10019

16-21 31st Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering. San Diego. Contact SPIE (206) 676-3290.



IN CHIRPED PULSE AMPLIFICATION, A SHORT PULSE OF LASER LIGHT, UPPER LEFT, IS STRETCHED AND AMPLIFIED TO INCREASE ITS INTENSITY.

MEETINGS - continued

August

27-28 Fusion Power Associates Symposium. Fusion Energy Development: Breakeven and Beyond. Princeton, NJ. Contact Ruth Watkins (301) 258-0545.

September

1-11 Course and Workshop on the Physics of Mirrors, Reversed Field Pinches and Compact Tori. Varenna, Italy. Contact E. Sindoni, Dipartimente di Fisica, 16 via Celoria, Milano, 20133, Italy.

20-23 12th Conference on the Numerical Simulation of Plasmas. San Francisco. Contact Donna Crew (LLNL), L-561, P.O. Box 5509, Livermore, CA, 94550.

21-26 10th International Conference on Magnet Technology. Boston, Contact A. M. Dawson (MIT), (617) 253-5547.

October

4-8 Third International Conference on Fusion Reactor Materials. Karlsruhe, FRG. Contact Prof. K. R. Kummerer, KfK, Postfach 3640, D-7500 Karlsruhe, FRG. Phone (07247) 82-2518.

12-16 12th Symposium on Fusion Engineering. Monterey. Contact Donna Schreiber, LLNL (415) 423-1405.

EXECUTIVE NEWSLETTER

AUGUST 1987

FUSION POWER ASSOCIATES

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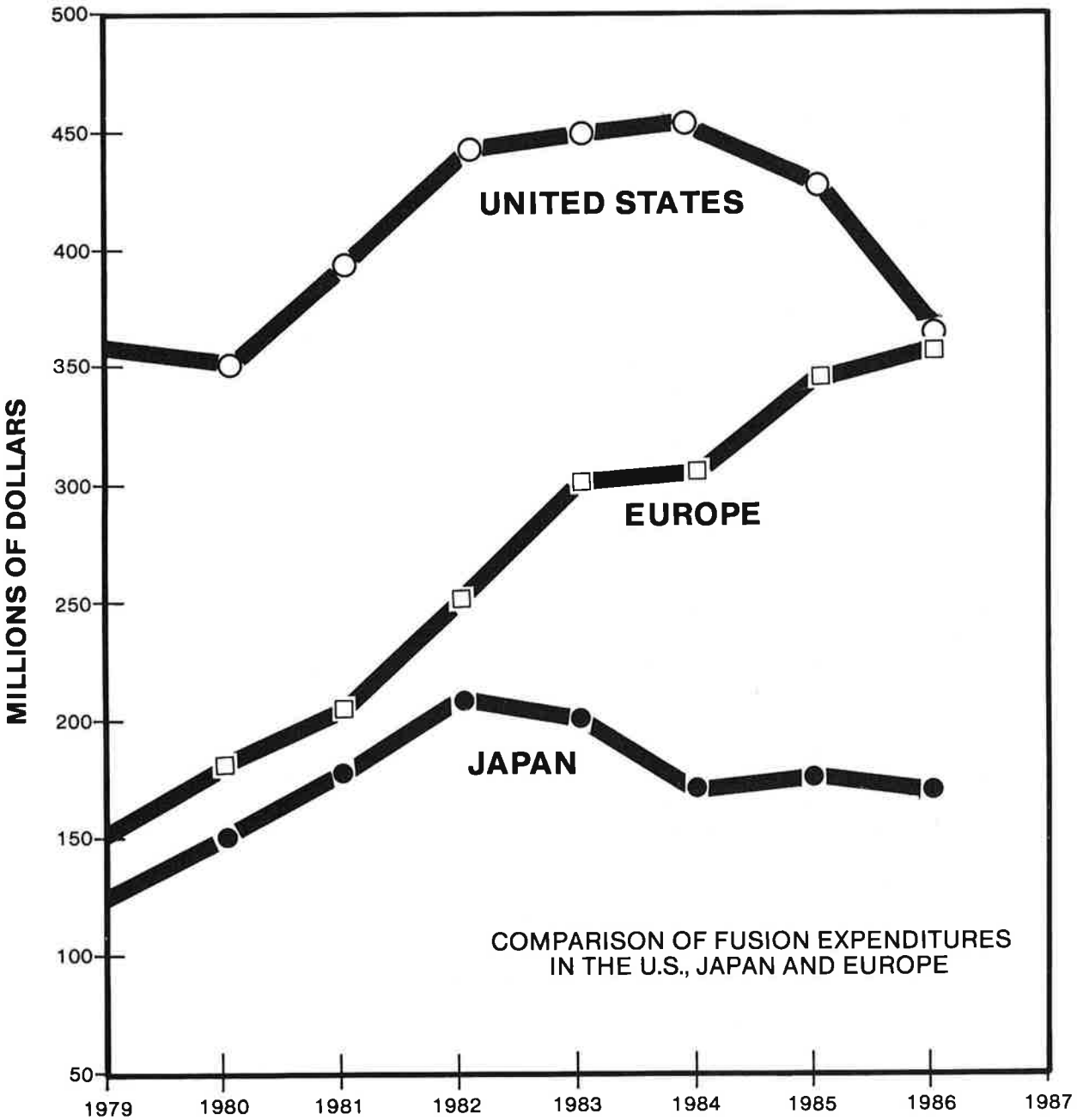
EUROPE OVERTAKES U. S. FUSION EFFORT



DURING THE 1980'S FUNDING FOR FUSION IN EUROPE HAS RISEN SO THAT IT IS NOW COMPARABLE TO FUNDING LEVELS IN THE UNITED STATES. THE JAPANESE EFFORT IS ALSO COMPARABLE IN SIZE, SINCE THE BUDGETS SHOWN FOR JAPAN DO NOT INCLUDE PERSONNEL COSTS.

GA TECHNOLOGIES SETS TOKAMAK BETA RECORD

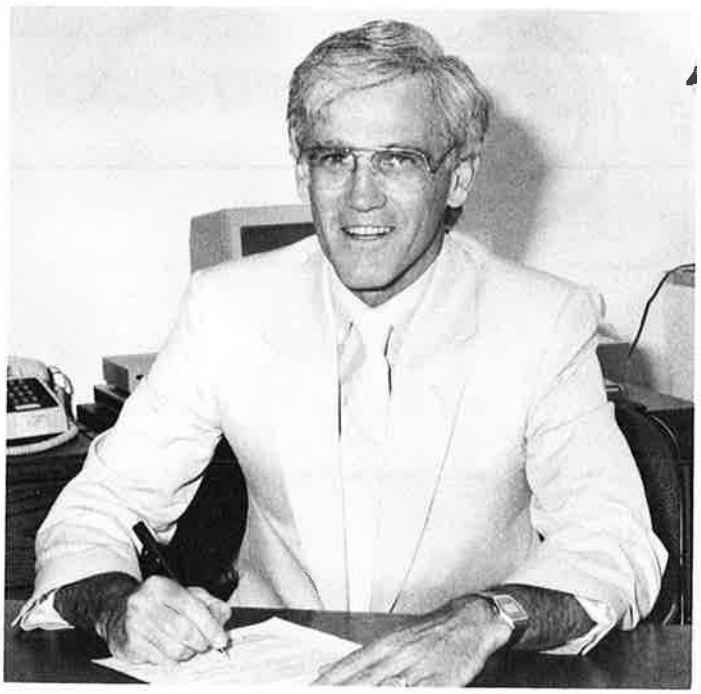
A new tokamak record for the important parameter "beta" (ratio of plasma pressure to magnetic field pressure) was reached recently in the D-III-D tokamak at GA Technologies in San Diego. A value of 6.2 percent was reached, a value fusion engineers believe the threshold of interest for a commercial fusion power reactor. Achieving higher betas has long been a goal of tokamak researchers because it implies achieving simultaneously a high plasma density and temperature relative to the strength of magnetic field required to hold the plasma away from the vessel wall. The results were achieved using 10 MW of injected hydrogen atoms into a deuterium plasma. The final plasma had an average density of $8 \times 10^{13} cm^{-3}$, a central temperature of 1 keV and was confined by a magnetic field of 0.8 Tesla. The plasma current was 1.2 MA and the plasma had an elongation of 2:1 with a single divertor.

INERTIAL FUSION TESTS SUCCESSFUL

Scientists at the Lawrence Livermore National Laboratory, using the NOVA laser, have successfully imploded a pellet in a spherically-symmetric fashion, achieving a convergence ratio of about 30. Convergence ratio is the ratio of initial to final pellet radius. A value of about 40 is believed necessary for the "high-gain" fusion yield necessary for practical applications. The results are interpreted to mean that there is no fundamental barrier to achieving the high compressions necessary for high yield. Scientists throughout the inertial fusion community are very excited about recent results in their programs and are planning for a new, higher energy facility to be operational in the early to mid-1990's (see our July newsletter).

ERRATUM

Marshall N. Rosenbluth professor at the University of Texas surprised all his colleagues by announcing that he would be moving to San Diego to accept a joint appointment at the University of California (San Diego) and GA Technologies. It had been widely reported (see our June newsletter) that Rosenbluth would be moving to the Princeton Institute for Advanced Study.



MILTON D. JOHNSON, MANAGER OF DOE'S PRINCETON AREA OFFICE

JOHNSON HEADS DOE PRINCETON OFFICE

Our congratulations to Dr. Milton D. Johnson who was recently appointed Manager for the U.S. Department of Energy's Princeton Area Office.

He will be responsible for the administration and oversight of the DOE contract with Princeton University to manage the Princeton Plasma Physics Laboratory (PPPL) and for the proposed Compact Ignition Tokamak (CIT) Project.

Dr. Johnson worked as an electrical engineer at the Lawrence Livermore National Laboratory and as a research engineer at Cornell University before joining the Atomic Energy Commission (now the U.S. Department of Energy) in 1975 as a member of the Magnetic Confinement Systems Division in the Office of Fusion Energy. In 1980, he came to the Princeton Fusion Program Office (now the Princeton Area Office) as Chief of the Engineering and Physics Branch. He was named the Assistant Area Manager for the Princeton Area Office in 1983. He received his B.S. and M.S. in Engineering from the University of Arizona and his Ph.D. (1975) in Plasma Physics from Cornell University.

PIET CHOSEN FOR FPA ENGINEERING AWARD

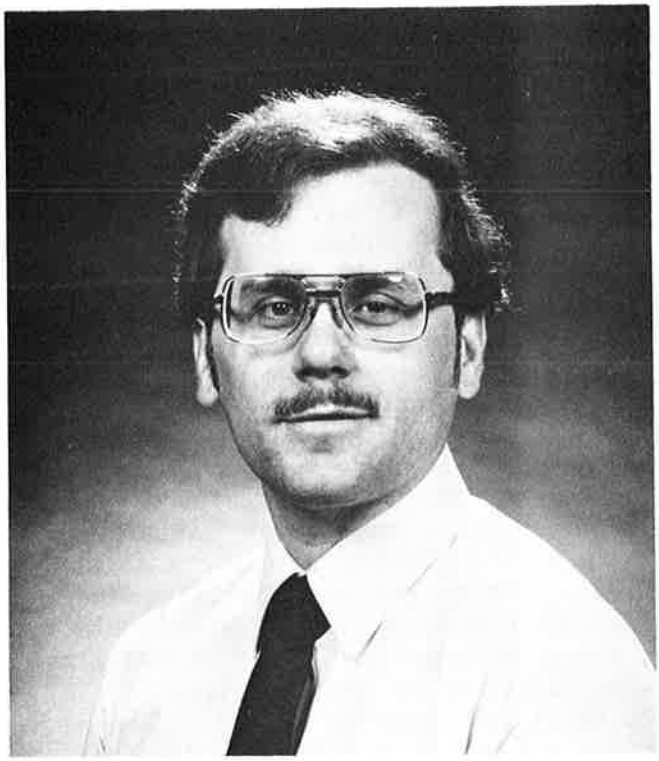
Following the untimely death in late 1985 of MIT professor David J. Rose, a pioneer of the new discipline of fusion engineering, Fusion Power Associates' Board of Directors established an award for excellence in fusion engineering in his memory. The award is to recognize and encourage fusion engineering professionals in the early part of their careers for both their technical contributions and their leadership potential. The award is being presented for the first time on August 27 at the FPA symposium in Princeton, New Jersey. The recipient is Dr. Steven J. Piet of EG&G Idaho, Inc. who will be cited for his "very important contributions to fusion safety engineering" and in recognition of his "impressive leadership qualities." Steve received his Ph.D. from MIT in 1982 under Professors M. S. Kazimi and L. M. Lidsky. His doctoral thesis was entitled "Potential Consequences of Tokamak Fusion Reactor Accidents: The Materials Impact." While a student he worked one summer each at Savannah River Laboratory, Sandia Laboratories (Albuquerque) and Argonne National Laboratory. Since 1982 he has been employed by EG&G, Idaho, Inc. at the Idaho National Engineering Laboratory. We are pleased to congratulate Steve on his accomplishments and his selection.

FPA DISTINGUISHED CAREER AWARDS

The Fusion Power Associates' Board of Directors has voted to present FPA's Distinguished Career Awards to four pioneers of the U.S. fusion effort. The awards, being given this year for the first time, are to recognize persons who have distinguished themselves by a lifetime of impressive accomplishments throughout their careers.

The awards, to be represented August 27 at FPA's symposium in Princeton, NJ, will be presented to Drs. Melvin B. Gottlieb, Donald W. Kerst, Richard F. Post, and Lyman Spitzer, Jr.

Dr. Gottlieb was director of the Princeton Plasma Physics Laboratory throughout the 1960's and 1970's. Under his direction the lab became one of the premier research centers in the world.



STEVEN J. PIET, WINNER OF FPA'S EXCELLENCE IN FUSION ENGINEERING AWARD

Dr. Spitzer was one of the founders of fusion research in the early 1950's, established the Princeton Plasma Physics Laboratory and wrote a classic text, "The Physics of Fully Ionized Gases."

Dr. Kerst, who came to fusion from the field of high energy physics accelerators, was an important contributor to "magnetic well" concepts for toroidal devices, was influential in the evolution of research at GA Technologies and has been an outstanding educator of fusion scientists at the University of Wisconsin.

Dr. Post has been an innovator, primarily in the area of magnetic mirror concepts, since the mid-1950's. His many lucid articles were instrumental in explaining both the intricacies of fusion science and the motivations for fusion research.

We are honored to have the opportunity to recognize these gentlemen for their life-long contributions to our field of research.

CHINA BUSINESS VIDEO AVAILABLE

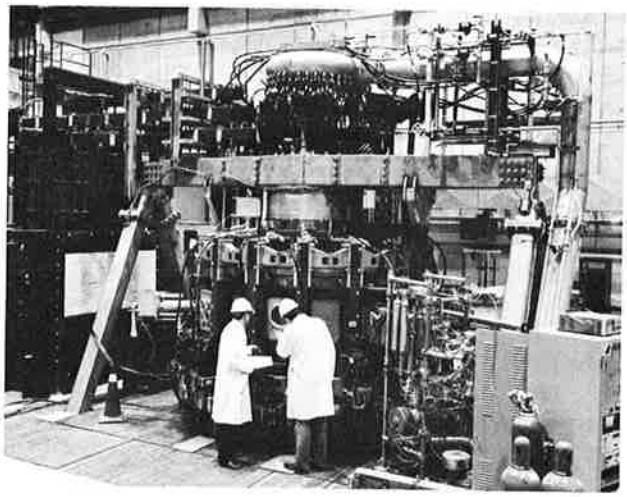
Business Week magazine has announced the availability of an "executive video" entitled "China Business Briefing" aimed at assisting companies interested in doing business with China. The two part, 75-minute video, plus a training video, describes the political, economic and cultural differences between China and the West and presents detailed case studies. A training book for senior managers accompanies the video. The video received Honorable Mention in the Business and Industry-Training category of the 1987 American Film Festival and won the Financial Times of London Award for the greatest contribution to exports of British videos. China Business Briefing was produced by Hawkshead Communications Ltd. and is being released by Direct Cinema Ltd. in association with McGraw-Hill. It is available for sale or rental. For information contact Direct Cinema Ltd., P.O. Box 69799, Los Angeles, CA, 90069-9976, phone (213) 652-8000.

TOKAMAK DE VARENNES

The Tokamak de Varennes was officially commissioned on June 17 by Mr. Marcel Masse, Minister of Energy, Mines and Resources Canada, and Mr. Guy Coulombe, President and Chief Executive Officer, Hydro-Quebec. The ceremony took place at Hydro-Quebec's research institute, IREQ, in Varennes. INRS-Energie, the Universite de Montreal, Canatom, Inc. and MPB Technologies, Inc. are also participating in the project.

The cost of designing and building the new facility was $46 million. According to the terms of the agreement setting up this federal-provincial project in 1979, Hydro-Quebec and NRC shared the financing and management on an equal basis. Some $24 million of the amount spent so far has been for equipment, with the remainder going to scientific labor costs, project design and management. At least 80% of the disbursements have been made in Canada. It is estimated that a hundred or so scientists and engineers, with an annual budget ranging from $10 to $15 million over the next five years will be coming from Canadian and foreign research centres and institutions to work at the Canadian Magnetic Fusion Centre soon to be formed to carry out the Tokamak de Varennes scientific program. Atomic Energy of Canada, Ltd. is responsible for the federal share of the financing for the activities of the Canadian Magnetic Fusion Centre. The federal funding was approved by an interdepartmental panel on energy research and development, for which the Department of Energy, Mines and Resources coordinates the granting and allocation of funds.

The official commissioning of the Tokamak de Varennes, Montreal's own fusion research device of international standing, represents the culmination of many years' effort by a team of leading Canadian scientists and engineers, as well as the starting point for a major fusion research experiment in Canada. For information contact Richard A. Bolton (514) 652-8701 or Regent Boucher (514) 652-8278.



TOKAMAK DE VARENNES

FUSION ENERGY EDUCATIONAL DEVELOPMENT SEMINAR

The seventh Fusion Energy Educational Development Seminar (FEEDS) for senior secretarial, administrative and support personnel will be held at Argonne National Laboratory and KMS Fusion, Inc. on October 20-21, 1987. The meeting will consist of non-technical presentations on the status of the fusion programs as well as tours of ANL and KMS Fusion facilities. All laboratories, universities and industries working in fusion are urged to send their senior secretaries and administrative representatives to this important meeting. Contact Ruth Watkins (301) 258-0545 for further information.

EXECUTIVE NEWSLETTER

SEPTEMBER 1987

FUSION POWER ASSOCIATES

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DOE BLINDSIDES INERTIAL FUSION COMMUNITY

Acting swiftly and without warning to the scientific community, the Department of Energy reorganized the Office of Inertial Fusion out of existence; re-creating it as a division within the Office of Weapons Research, Development and Testing. The action appears to be a departing legacy from Admiral Sylvester R. Foley who left his post as DOE Assistant Secretary for Defense Programs on July 31 (see our June newsletter). Foley had unsuccessfully tried for several years to abolish inertial fusion as a separate program at DOE. The new arrangment, scheduled to take effect October 1, will see inertial fusion reporting to office director Dick Hahn. Rick Schriever, who has headed the Office of Inertial Fusion will be Hahn's deputy and Sheldon Kahalas will head the new inertial fusion division.

On the positive side, Kahalas told the recent Fusion Power Associates symposium attendees that the DOE is now committed to maintaining a reasonable budget for inertial fusion, recognizes recent scientific successes in the program and will attempt to capitalize on them in a timely manner.

TWINING COMING BACK TO WASHINGTON

In a related development, fusion scientists will be interested to know that Bruce Twining, currently the deputy manager at DOE's Savannah River Office will return to Washington to become deputy assistant secretary for Nuclear Materials Production, the group responsible for tritium and plutonium production facilities. Bruce was previously the DOE project manager for the Mirror Fusion Test Facility and also worked in the Systems Branch of the Office of Fusion Energy.

MANISCALCO, DAUTOVICH JOIN FPA BOARD

Jim Maniscalco of TRW and Don Dautovich of Ontario Hydro have been named to fill the remaining terms of FPA Board members Peter Staudhammer and Tom Drolet, respectively. Staudhammer and Drolet have resigned from FPA's board due to changes in their career responsibilities. Their terms expire October 31, 1988. We welcome Jim and Don to our Board.

TSTA TEST RESULTS

A team of Los Alamos and Japanese scientists successfully completed two important experiments on the Tritium Systems Test Assembly (TSTA) at Los Alamos. The tests proved that tritium can be safely processed and recycled in a manner, and in amounts, comparable to what will be needed for future fusion reactors.

In the first experiment, researchers continuously operated the fuel handling systems for four days in June with 91 grams of tritium present. "Fusion reactors of the future are expected to operate continuously with about 100 grams present," said TSTA project manager, Jim Anderson. In the second test in July, the experiment operated for seven days at the 100 gram level. Hiroshi Yoshida, head of the 4-man Japanese delegation that is working at TSTA said, "TSTA is a great facility and we think we can together make major contributions to fusion technology." Also during the second test run, the researchers studied how the fuel cleanup system worked at removing impurities such as helium, methane and nitrogen. The TSTA tests are providing data not only for future fusion reactor design, but also for tritium operations for near-term tokamaks such as TFTR, JET, CIT and ITER.

The TSTA is part of an extensive collaborative fusion research program being developed on a broad front between the U.S. and Japan. In the case of TSTA, the collaboration calls for the U.S. and Japan to each contribute $10 million over the next five years to the joint project. Japan may also provide to TSTA, at a future date, a new fuel cleanup system as part of a proposed TSTA facility upgrade and the U.S. may provide a new breeding blanket interface. The TSTA collaboration is overseen by a steering committee consisting of Gene Nardella (U.S. DOE), Jim Anderson (LANL), Masashi Iizumi (deputy director of the planning office, Japan Atomic Energy Research Institute) and Yuji Naruse (chief of JAERI's Tritium Engineering Laboratory).

ZTH GROUNDBREAKING

The Los Alamos National Laboratory held ground-breaking ceremonies for the recently-authorized Confinement Physics Research Facility in which they will operate a new reversed-field pinch device called ZTH. Guests of honor included New Mexico Senator Pete Domenici, DOE acting director of energy research Jim Decker and John Clarke, head of DOE's Office of Fusion Energy.

The total cost of the facility, including ZTH, is estimated at $72.5 million. Experimental operation is targeted for FY 1991 with 2 Megamp current capability. An upgrade to 4 Megamp is planned for 1992. If successful, the 4 Megamp version is capable of producing a 4 kilovolt temperature plasma with a density-confinement time product of around $10^{13} cm^{-3} sec$, conditions comparable to many of the largest tokamaks operating today. With the recent demise of the U.S. mirror program, many researchers consider the reversed field pinch to be the major alternative to tokamaks as a concept for future fusion reactors. Studies of the reversed field pinch also elucidate important physics issues of toroidally-confined plasmas and thus complement tokamak research. A major 2 Megamp reversed field pinch is also under construction in Padua, Italy, scheduled for 1989 completion. U.S.-European cooperative efforts are underway in this important research field.

MAJOR NEW FUSION REVIEW BEGINS

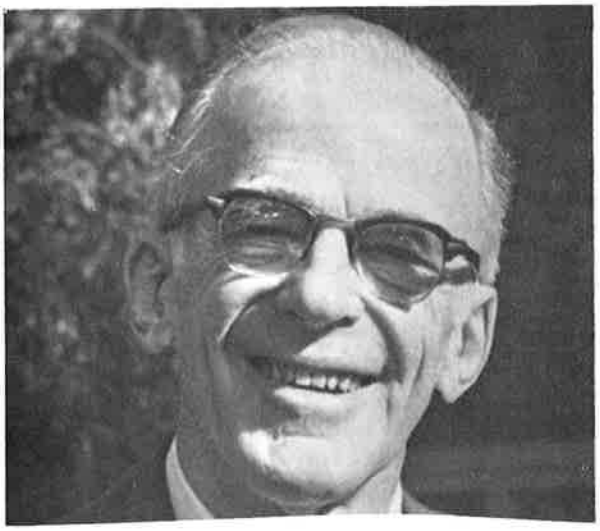
The National Academy of Sciences, through its National Research Council, has commissioned a major new fusion study, aimed at analyzing the role of fusion in U.S. R&D. The study will be carried out by a committee of about a dozen people headed by Irvin (Jack) White, president of the New York State Energy Research and Development Authority. The group has tentatively scheduled its first meeting for September 24-25 in Washington.

Another academy panel recently completed a study entitled "Outlook for the Fusion Hybrid and Tritium-Breeding Fusion Reactors." The study was chaired by John W. Simpson, formerly of Westinghouse and now retired. Copies of the study are available from the National Research Council (John Richardson or Bob Cohen), Energy Engineering Board, 2101 Constitution Avenue, N.W., Washington, D. C. 20418, (202) 334-3344.

CARRERA WINS NAME THE GNOME CONTEST

Rodolfo Carrera of the University of Texas successfully identified the photo in our July newsletter as Harold P. Furth doing a burn demonstration and saying "I can burn anything and anyone." Carrera received complimentary registration at FPA's August 27-28 symposium at Princeton on "Breakeven and Beyond." At the symposium, Carrera also described a recently-completed University of Texas study of a small, ohmically-heated tokamak ignition experiment called IGNITEX. The study was funded by the Texas Atomic Energy Research Foundation and the University of Texas and was conducted by a team headed by Marshall Rosenbluth, Herb Woodson and Bill Weldon. (Rosenbluth had the runner-up entry in our contest.)

IGNITEX would provide plasma confinement with 20 tesla magnetic field on axis for a 300 ms pulse in a tokamak having major radius of 26 cm and minor radius of 8 cm. The ultimate objective of this project, is "to design and build an experiment that can produce and control an ignited plasma in the simplest and least expensive way possible," according to the members of the design group. The authors credit Bruno Coppi of MIT for pioneering high field, ohmically-heated tokamak concepts. A proposal to continue the design effort is pending at DOE.



ALVIN W. TRIVELPIECE, EXECUTIVE OFFICER OF THE AAAS AND A FOUNDER OF FUSION POWER ASSOCIATES PRESENTED FPA'S DISTINGUISHED CAREER AWARDS TO MELVIN B. GOTTLIEB (upper left). OTHER RECEPIENTS WERE DONALD KERST (upper right), RICHARD F. POST (lower left), AND LYMAN SPITZER, JR. (lower right). FPA'S BOARD OF DIRECTORS ALSO PRESENTED A SPECIAL AWARD TO TRIVELPIECE FOR HIS MANY CAREER ACCOMPLISHMENTS

JT-60 HITS 100 MILLION DEGREE TEMPERATURE

JT-60, the major tokamak in Japan, has reached central ion temperatures exceeding 100 million degrees. Using only 1 Megamp of the machine's 3 Megamp capability, JAERI scientists heated the hydrogen plasma using 20 Mw of neutral beam injection. The peak plasma density was 5 x 10^{13}cm^{-3}. In a separate experiment, scientists also succeeded in maintaining the 2 Megamp current using 3 Mw of lower hybrid current drive. JAERI is hoping to achieve breakeven conditions in hydrogen late this year or early next year.

PBFA-II REACHES MILESTONE

The Particle Beam Fusion Accelerator, PBFA-II, at Sandia National Laboratories recently achieved one of its major milestones by synchronizing all 36 modules to within a 13 nanosecond first to last timing asynchrony. The goal of the facility was to achieve less than 20 nanoseconds. The results permit the researchers to concentrate their efforts on beam development, including beam focussing.

GILLELAND JOINS LLNL

John Gilleland has joined the Lawrence Livermore National Laboratory as managing director for the U.S. Engineering Test Reactor design. Gilleland was formerly with GA Technologies. In announcing the appointment, Ken Fowler stated that "It is the intention of the Laboratory to nominate John as the U.S. ITER Managing Director when and if the ITER design study is officially launched, probably early in calendar 1988." ITER is the name given to the "International Thermonuclear Experimental Reactor" project, a coordinated design study that would be jointly carried out by teams from the U.S., USSR, Europe and Japan (see our April newsletter.)

HERRINGTON PROPOSES PETROLEUM RESEARCH INSTITUTE

Secretary of Energy John Herrington has proposed the formation of a petroleum research institute "to provide a means for the petroleum industry to marshall its resources in pursuing research that could significantly increase domestic oil production during the rest of this century and beyond. Herrington indicated that the federal government might provide money to assist in the creation and initial funding for such an institution with permanent funding coming from a federally-collected surcharge on oil production.

FPA VIDEO AVAILABLE

Fusion Power Associates has completed a 7-minute non-technical introduction to fusion entitled "Endless Energy: The Promise of Fusion." The video can be rented ($20) or purchased ($40) from FPA and is ideal for visitors, Board of Directors meetings or just to show your relatives and friends. You might also use it to introduce a talk or lecture or to lend to schools or civic groups. It is available on VHS, Beta or 3/4". A slightly more technical version will be available in 35 mm slide form in a few months.

CIT INDUSTRIAL OPPORTUNITIES

In addition to selecting an industrial contractor for the Vacuum Vessel and related components (see our April newsletter) Princeton Plasma Physics Laboratory will also issue a Request for Proposal in September for systems engineering support for CIT. About a 10 person effort will be sought. Watch for the CBD announcement or call Princeton for details. Princeton is also in the process of selecting an Architect-Engineer for the conventional facilities.

MEETINGS

October

4-8 Third International Conference on Fusion Reactor Materials. Karlsruhe, FRG. Contact Prof. K.R. Kummerer, Kfk, Postfach 3640, D-7500 Karlsruhe, FRG. Phone (07247) 82-2518.

5-6 Business Opportunities in SDI. Key Bridge Marriott, Arlington, VA. Sponsored by Pasha Publications, 1401 Wilson Blvd., Suite 910, Arlington, VA, 22209. Contact Fred Shear (800) 424-2908 or (703) 528-1244.

20-21 Seventh Fusion Energy Educational Development Seminar (FEEDS). For administrative and secretarial personnel. Sponsored by Fusion Power Associates, Argonne National Laboratory and KMS Fusion. At Argonne October 20 and KMS on October 21. Contact Ruth Watkins (301) 258-0545.

26-30 International Workshop on Laser Interactions and Related Phenomena. Naval Postgraduate School, Monterey, CA. Contact George Miley or Chris Walker (217) 333-3772.

November

2-6 34th National Vacuum Symposium. Anaheim, CA. Contact Marion Churchill, AVS, (212) 661-9404.

2-6 Meeting of the Division of Plasma Physics, APS. San Diego, CA. Contact Igor Alexeff (615) 974-4367.

15-19 American Nuclear Society. Los Angeles. Contact (312) 352-6611.

EXECUTIVE NEWSLETTER

OCTOBER 1987

FUSION POWER ASSOCIATES

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GRASSROOTS FUSION GROUP FORMED

A group of professional people from Monterey have formed an organization called 21st Century Energy to advocate making fusion energy available early in the twenty-first century. Three members of their Board of Directors attended the recent Fusion Power Associates symposium in Princeton. Among their near-term goals the group lists "to ensure that all Presidential candidates are fully informed about the progress of fusion research and development and convinced of the urgency to speed up the process." Persons wishing more information should contact them at P.O. Box 285, Pacific Grove, CA, 93950 or call Frank Keillor at (408) 649-5609.

MFAC ENDORSES TRITIUM IN TFTR

The Magnetic Fusion Advisory Committee (MFAC) has transmitted to DOE the report of its panel XVII on "The Scientific and Technical merit of Deuterium-Tritium Operation in TFTR." The panel, chaired by Dave Baldwin of LLNL, concluded that "D-T operation makes the best programmatic use of the TFTR facility," that "this operational experience would be a significant step in the qualification of PPPL for CIT," and that "Roughly speaking, the value $Q \sim 0.5$ is a breakpoint in the nature of the scientific/technological benefit of D-T operation in TFTR." The panel noted that TFTR had not yet reached this level of performance but expressed optimism that it would soon do so. In transmitting the report to DOE, MFAC chairman Fred Ribe, speaking for MFAC, recommended that "DOE proceed with the D-T operation of TFTR" stating that "Major delays to enhance the physics performance of TFTR would not justify the additional cost and the loss of timely experience with tritium operation." For further information contact Dr. Phil Stone at (301) 353-3734.

TECHNOLOGY TRANSFER POLICIES TO BE REVIEWED

DOE's recently-appointed Acting Assistant Secretary for Defense Programs, Troy E. Wade II, has directed the DOE Office of International Security Affairs (OISA) "to conduct an in-depth study" that will "define the scope of DOE technology innovation, transfer, and security interests, explain the interrelationship among these interests, describe existing programs and activities which support these interests, identify their impact on one another, and itemize pertinent factors to be taken into consideration before taking actions that may affect these programs."

Wade notes that "Through legislation and executive directives, the U.S. Government has recently sought to accelerate the transfer of federally funded technology to the private sector in order to, among other objectives, forestall the erosion of U.S. technological leadership," and states that this study is needed to clarify two opposing viewpoints: one asserts that "many current practices to transfer technology expose it to detrimental foreign exploitation." The other is that "many current practices to withhold technology are believed by some to discourage innovation."

In ordering the study, Wade told OSIA "to contact the various DOE program offices, field offices, national laboratories, and contractors involved with technology innovation, transfer and security."

NEW BECHTEL SOFTWARE COMPANY FORMED

Bechtel has announced the formation of Bechtel Software, Inc., headed by John Lucas, president. The company will be offering "state-of-the-art software products that have already been used successfully on Bechtel projects around the

world." For further information contact the company at 289 Great Road, Acton, MA, 01720 (617) 635-0580.

AFFORDABLE RATES

If you are visiting the DOE headquarters area and are looking for a good corporate rate, try the ECONO LODGE, (800) 446-6900 or (301) 963-3840. They are located at 18715 North Frederick Avenue, Gaithersburg, MD, 20879, across the street from Fusion Power Associates. You can get our corporate rate of $37, which includes continental breakfast, by mentioning our name when you book your reservations. The rooms are newly renovated and all have king or queen size beds.

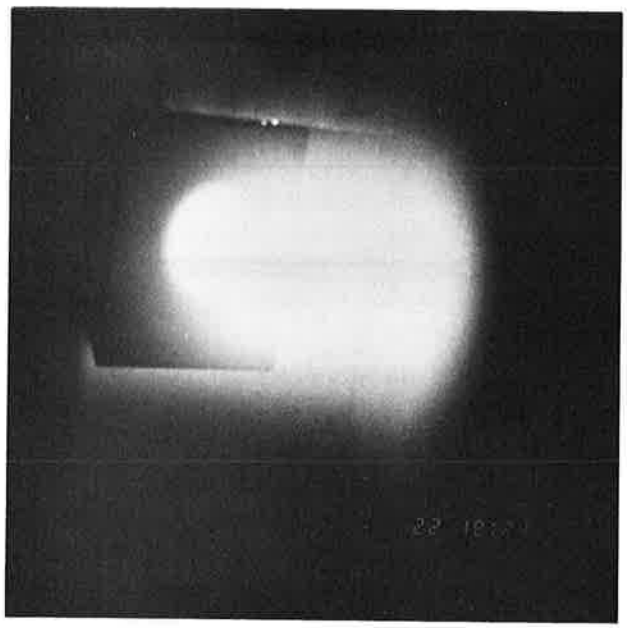
PEOPLE

Congratulations to Bruno Coppi who will receive the Maxwell Prize from the American Physical Society Division of Plasma Physics during the meeting November 2-6 in San Diego.

Ron Davidson has taken over as plasma and fluid physics editor of "Physics Letters A" journal (North-Holland). Ron urges fusion scientists to publish important new results in the journal. Contact Ron at MIT Plasma Fusion Center, NW 16-202, 167 Albany Street, Cambridge, MA, 02139 (617) 253-8102. Ron has also indicated his desire to step down as director of the Plasma Fusion Center to devote more time to research and teaching. Suggestions of candidates to replace Ron should be sent to Richard S. Post at MIT for transmittal to the search committee.

James Holtz has been named deputy assistant director for the Advanced Lasers Program at LLNL. Jim has been working in the Laser Isotope Separation Program. He will manage several defense-related programs, including the Free Electron Laser Optical Program, and the DARPA-supported Solid State Laser Project.

Wilhelm B. Gauster has been named Manager, Exploratory Nuclear Power Systems Department, at Sandia National Laboratories. He was instrumental in setting up and managing Sandia's program in high heat flux materials for fusion.



TEST ON SANDIA ION BEAM FACILITY

SANDIA TESTS MATERIALS FOR FUSION

Using the Sandia Ion Beam Facility, technology is being developed for testing thermal shock resistance and active heat removal for use in fusion energy devices, which would see power fluxes on their internal components greater than 2 kW/cm^2.

The target testing program has begun. A total of six targets were tested during May and June. The hydrogen ion beam has a capability to illuminate test targets up to 22 cm in diameter with a total power of 800 kW. This translates into a heat flux of more than 4 kW/cm^2. The facility also incorporates a sophisticated sample cooling system, a novel, yet rugged, radio frequency ion source and a large vacuum target chamber for testing full size fusion components.

The first series of tests involved a redesign of internal wall tiles for the Doublet III-D tokamak in San Diego. The first target exploded at 3.5 seconds under a fairly moderate heat load of 500 w/cm^2. The tile was a brazed composite of graphite and inconel. The remaining 4 tiles in this testing series included 2 new designs fabricated from 3 different materials.

For further information contact J. G. Watkins at Sandia National Laboratories, Albuquerque.

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NOVEMBER 1987

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OTA FUSION STUDY ISSUED

The congressionally-chartered Office of Technology Assessment (OTA) has issued its long-awaited study of fusion (see our January 1986 newsletter). Copies of the study entitled "Starpower: The U.S. and International Quest for Fusion Energy," can be requested from Dr. Gerald Epstein, Energy and Materials Program, Congressional Office of Technology Assessment, U.S. Congress, Washington, D. C, 20510.

In its findings, the OTA analysis states:

> ɔeriments now built or proposed should, r the next few years, resolve most of major remaining scientific uncertainties regarding the fusion process. If those experiments do not uncover major surprises, it is likely--although by no means certain--that the engineering work necessary to build an electricity-producing fusion reactor can be completed successfully."

The study also finds that:

> "International collaboration cannot substitute for a strong domestic research program. If the domestic program is sacrificed to support international projects, the rationale for collaboration will be lost and the ability to conduct it successfully will be compromised."

The 250 page study, which contains many useful figures and tables, is an elegant, in-depth, well-written analysis of the many facets of fusion research. Fusion Power ɔociates congratulates the study leaders, ɜld L. Epstein and Dina K. Washburn, for .r very impressive accomplishment.

ITER STUDY SITE SELECTED

Representatives of the U.S., USSR, Europe and Japan, meeting recently in Vienna, agreed that the Max Planck Institute for Plasma Physics in Garching, Federal Republic of Germany, would serve as the central site for the joint design team for the International Thermonuclear Engineering Reactor (ITER). ITER is to be the focal point for international collaboration in fusion and could lead to the construction of a multi-billion dollar fusion engineering test device in the 1990's (see our April 1987 newsletter). The project is an outgrowth of the Reagan-Gorbachev summit meetings (see our November 1986 newsletter).

FPA ELECTS DIRECTORS, OFFICERS

The representatives of Fusion Power Associates' member organizations have elected four persons to serve three-year terms on FPA's 18 member Board of Directors beginning November 1. They are John Landis (Stone and Webster Corp.), Terry Liddy (KMS Fusion, Inc.), Kenneth L. Matson (PSE&G Research Corp.) and David Overskei (GA Technologies, Inc.). Landis and Matson have been current members of our Board. Liddy and Overskei are new members. We welcome their participation.

The FPA Board has elected the following persons as officers of FPA for two-year terms beginning November 1. Harold Forsen (Chairman of the Board), Christian C. Bolta (Vice Chairman), Stephen O. Dean (President), Gerald L. Kulcinski (Vice President, Research), Ruth Watkins (Vice-President, Administration and Finance, and Secretary-Treasurer).

The Board also appointed Robert Botwin (Grumman Corp.) to serve the remaining term of Renzo Caporali (Grumman Corp.).

ASME FORMS FUSION GROUP

The Advanced Energy Systems Division of the American Society of Mechanical Engineers (ASME) is forming a technical committee to address the mechanical engineering aspects of fusion energy systems, including both magnetic and inertial confinement concepts.

Within the ASME, technical committees provide the means for communication of technical developments between engineers, scientists, and others with common interests. Their primary activities include organizing and presenting technical sessions at ASME conferences and topical symposia; submitting and reviewing technical papers for publication in ASME journals or symposium volumes; and representing the technology within the Society as well as to government and the general public.

Interested individuals are encouraged to contact: Sunil K. Ghose, Bechtel National, Inc., P.O. Box 3965, San Francisco, CA, 94119. An individual need not be a member of ASME to belong to a technical committee, but must be a member in order to become one of its officers. Please indicate your area of interest and whether you are willing to serve as an officer of the committee.

NEWS FROM KMS

KMS Industries, Inc. announced that approximately 35%, or $3,206,000 of its operating revenues during the first 6 months of 1987 came from non-fusion sources compared to 25%, or $2,540,000 in 1986. In addition to its primary fusion activities the company is also active in areas such as aerospace systems, biotechnology, laser system technology and instrumentation.

KMS Fusion, Inc. announced that the Office of Naval Research has awarded it a $2,000,849 contract entitled, "Provide Computational Support for the Boeing Free Electron Laser Program." Dr. Stephen B. Segall, who has headed free electron laser (FEL) research at KMS Fusion for nine years, will be the principal investigator. Under this contract, which will run from July 1987 to June 1990, three-dimensional computer codes will be used to model the operation of the Boeing FEL project. Boeing will use this information to identify ways to improve the performance of i FEL.

KMS Fusion also announced that the National Science Foundation has awarded it a $40,000 Small Business Innovative Research (SBIR) award for the development of new techniques in computational fluid dynamics. The co-investigators for this award are Dr. Joseph F. McGrath and Mr. Stephen B. Wineberg. In this research, new techniques will be developed for converting the equations of fluid flow, which govern the flow of water around a ship's hull and air over an airplane's wing, into numerical form suitable for digital computation. The method proposed was developed by a Swedish mathematician, Dr. Claes Johnson, who also serves as a consultant to KMS Fusion.

The company has also received, from the Strategic Defense Initiative Office, a $70,000 Phase I Small Business Innovation Research (SBIR) contract for "RED DEVL: Red Dioxetane-Energized Vapor Laser." The company will perform research aimed developing a chemically powered las capable of generating visible light. D Kenneth Marsh and Dr. Allen Twarowski ar the co-investigators on the award, which will run from August 1, 1987 to February 1, 1988. The contract will be administered by the University of California.

The company also has received from the Los Alamos National Laboratory a $78,000 contract for "Laser Interaction Research." The project, which will be directed by Dr. Roy R. Johnson, will use KMS Fusion's Chroma Laser. The 2000 joule output energy capability of this laser makes it one of the most powerful in the United States. In this research, laser pulses that last from 10 to 100 microseconds will be fired at aluminum targets. The impulse delivered to the target by the laser light will then be measured and characterized. The primary goal of this research is to establish an experimental data base on impulse coupling so that scientists can develop mathematical models to predict the performance of laser systems larger than Chroma. The larger systems are currently in the desi stage; prediction of their performance wi make it possible to modify them, if necessary, before the systems are built.

REPORTS AVAILABLE

Autumn 1987 issue of Engineering, a ornell University quarterly provides an formative description of plasma physics research at Cornell. The report covers fusion, and space applications and includes a description of the applications of relativistic electron beams. The Winter 1987 issue will contain the second of the two-part series on these activities. Copies can be requested from David Hammer, Director, Laboratory for Plasma Studies, Cornell University, Ithaca, NY, 14850.

The 1986-1987 Annual Report of the Canadian Fusion Fuels Technology Project can be obtained from Don Dautovich, Program Manager, CFFTP, 2700 Lakeshore Road West, Mississauga, Ontario, Canada, L5J 1K3.

The 1986-1987 Annual Report of the MIT Plasma Fusion Center can be obtained from Ron Davidson, Director, MIT Plasma Fusion Center, 167 Albany Street, Cambridge, MA, 02139.

e Executive Summary of an Oak Ridge ort entitled "Progress in Stellarator/ .iotron Research: 1981-1986" ORNL/TM-10482) can be obtained from Margaret Nestor Johnson, ORNL, Bldg. 9104-3, Rm. 11, P.O. Box Y, Oak Ridge, TN, 37830. The full report will also be available soon.

A University of Wisconsin Report (UWFDM-730) entitled "The Moon: An Abundant Source of Clean and Safe Fusion Fuel for the 21st Century" by G. L. Kulcinski and H. H. Schmitt can be obtained from G. L. Kulcinski, Dept. of Nuclear Engineering, University of Wisconsin, 1500 Johnson Drive, Madison, WI, 53706. The report is a written version of a paper presented at the 11th International Scientific Forum on Fueling the 21st Century, held in Moscow, September 26-October 6, 1987.

The National Research Council has released a study entitled "Advanced Fusion Power: A Preliminary Assessment." The study was ıested by the Air Force Studies Board to ·ess the potential of fusion for space ver and propulsion. Copies can be requested from Vernon H. Miles, director, Air Force Studies Board; National Research Council, 2101 Constitution Ave., N.W. Washington, D. C. 20814.

NEW COMPUTATIONAL JOURNAL

The American Institute of Physics has announced the issuance of a new bimonthly journal entitled Computers in Physics. Bob Borchers of the Lawrence Livermore National Laboratory is the editor. The journal has news sections, feature articles and technical papers. It also describes new products and carries advertisements. A complimentary copy of the premier issue (Nov./Dec. 1987) can be requested from Alexander Wolfe, AIP, 335 East 45th Street, New York, NY, 10017.

MAGNET TESTS COMPLETED AT OAK RIDGE

Scientists and engineers from the U.S., Europe and Japan have completed tests on the $180 million International Fusion Superconducting Magnet Test Facility at Oak Ridge, National Laboratory. The collaboration was organized through the International Energy Agency.

Over an 18-month period, six experimental magnet coils--three from the U.S. and three of non-U.S. manufacture--were tested extensively to determine their operating limits. In the final (September 3) test, all six coils showed they could operate well beyond their original design goals.

The six D-shaped coils, each 20 feet tall and weighing about 40 tons, reached peak magnetic fields of 9 tesla--180,000 times the earth's natural magnetic field. The design goal was 8 tesla. The force on each coil in the final test exceeded 5,000 tons.

"No other magnets this large--in terms of size, weight, or stored energy--have achieved such a high field strength. All of our goals have been achieved," said Paul N. Haubenreich, manager of ORNL's Large Coil Program and the U.S. project officer.

"Another result of the program," he added, "is that the industries and laboratories involved developed capabilities for designing and building superconducting magnets. Also significant for the future

of fusion is this demonstration that the development of high-tech hardware can be achieved efficiently through international collaboration."

The experiment marks the first time that four countries have contributed different versions of the same equipment to a fusion hardware experiment and collaborated in tests to evaluate equipment performance, reliability, and economics. The four countries are the United States, Federal Republic of Germany (acting for EURATOM), Japan, and Switzerland.

With ORNL as the lead laboratory, the U.S. Department of Energy supported development of the three U.S. coils. These were designed and constructed primarily by General Dynamics Convair Division, General Electric Company, and Westinghouse Electric Corporation.

The EURATOM coil was designed and built by Siemens in West Germany under the leadership of the Nuclear Research Center at Karlsruhe. The coil of the Japan Atomic Energy Research Institute was designed and built by Hitachi under the guidance of the Tokai laboratory. Brown Boveri Company designed and built the Swiss coil in cooperation with the Swiss Institute of Nuclear Research.

Five of the magnets tested at ORNL have superconducting filaments made of niobium-titanium. The Westinghouse magnet employs niobium-tin. This magnet also differs from the other five in its support structure, using bolted aluminum plates rather than a stainless steel external case.

Liquid helium was used to cool the conducting materials by two different methods. In three coils, helium at 15 times atmospheric pressure was forced to flow through channels in the conductors. In the other three, conductors were immersed in a bath of helium that filled the structural shell.

Preliminary analysis of test results shows that:

- Both methods of cooling--forced-flow or bath--are practical for large coils; each has distinctive advantages that now be evaluated; and

- Niobium-tin conductors could perform at full potential by eliminating manufacturing flaws that limited the performance of this material.

Analysis of all the test data and comparative evaluation of the features of the six coils will require several more months. A joint technical report by the participants, comparing performance and reliability of different designs and manufacturing procedures, is expected in the spring of 1988.

HEAVY-ION FUSION ASSESSMENT COMPLETED

A two-year "Heavy Ion Fusion Assessment" report has been completed and will be published in a special February 1988 issue of the ANS journal Fusion Technology. The study concludes that heavy ion fusion can be achieved at a cost comparable to ot inertial and magnetic fusion meth Copies of the report can be requested f Donald Dudziak, Mail Station F6111, L Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545.

FPA PROCEEDINGS AVAILABLE

Copies of past Fusion Power Associates' symposia are available from FPA for $20 per copy as follows:

1983: "The Readiness and Reasons for An Accelerated Fusion Development Program."

January 1985: "The Search for Attractive Fusion Concepts."

April 1985: "Lasers and Particle Beams for Fusion and Strategic Defense."

April 1986: "Fusion Energy Development: An International Effort."

Proceedings of our two 1987 symposia are in process and will be available so

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NEW AFFILIATES

United Engineers and Constructors, Inc. has become a corporate affiliate of Fusion Power Associates. Their address is P.O. Box 8223, Philadelphia, PA, 19101. Dr. Gregory F. Pavlenko will represent the company. He can be reached at (215) 422-4383.

Uranium Pechiney has become a corporate affiliate of Fusion Power Associates. Their address is B.P. Tour Manhattan, Cedex 21, 92087 Paris La Defense, France. Mr. Robert Faron will represent the company. He can be reached at 47.62.88.00.

We welcome the participation of our new affiliates in our activities.

SBIR TIME AGAIN

The Department of Energy has announced its sixth annual solicitation for the Small Business Innovation Research (SBIR) program. Approximately 100 firms will receive contracts of up to $50,000 "to explore the feasibility of their ideas, with up to $500,000 available in a second phase for those ideas with the highest potential to meet the SBIR program objective." Twenty-nine areas of interest have been listed by DOE, including three in the fusion area: plasma diagnostics, plasma confinement systems technology and fusion energy systems. Closing date for receipt of proposals is January 22, 1988. Awards are limited to firms having 500 employees or less. For further information contact SBIR Program Manager, U.S. DOE, Washington, D. C. 20545 or phone (301) [illegible]-5707.

NATIONAL GEOGRAPHIC VIDEOS

The National Geographic Society has commissioned a new educational film on fusion. The project is expected to take about a year to complete. Fusion Power Associates is consulting with National Geographic on the project. National Geographic has many videos and films for sale or rent, including a 22-minute treatment entitled "Lasers" and a treatment entitled "Nuclear Energy: The Question Before Us." For a complete catalog contact National Geographic Society, Educational Services, Dept. 87, Washington, D. C. 20036 or call (800) 368-2728.

FUSION CANADA

The United States and Canada have recently signed a formal Memorandum of Understanding to cooperate in the field of fusion. DOE's Mike Roberts told us that the U.S. now has formal government cooperative agreements in fusion with all major countries or blocks of countries working in fusion. The U.S.-Canada agreement does not authorize any specific new joint projects at this time but is an "umbrella agreement" under which a wide variety of tasks can be authorized in the future, according to Roberts.

Canada also recently renewed its formal Memorandum of Understanding to cooperate in fusion with Japan. The agreement, which lasts until March 31, 1989, covers tritium technology, tokamak research and "other research and technology areas, which are recognized as being of mutual benefit." Dr. David Jackson, Director, National Fusion Program, signed the agreements for Canada.

The National Fusion Program (NFP) coordinates and supports fusion development in Canada. NFP was established to develop Canadian fusion capability, in industry and in research and development centres. NFP develops international collaboration agreements, and assists Canadian fusion centres to participate in foreign and international projects. NFP is managed for Canada by Atomic Energy of Canada Limited. Federal funding is provided by the Department of Energy, Mines and Resources through the Panel on Energy Research and Development.

FUTURE MEETINGS

January 10-17 O-E LASE '88 , Los Angeles. Contact (206) 676-3290.

January 19-21 4th All Union Conference on Engineering Problems of Fusion Reactors, Leningrad. Contact B. N. Zhukov, NIIEFA, Leningrad, 188631, USSR

February 11-15 AAAS Annual Meeting. Boston. Contact (202) 326-6450.

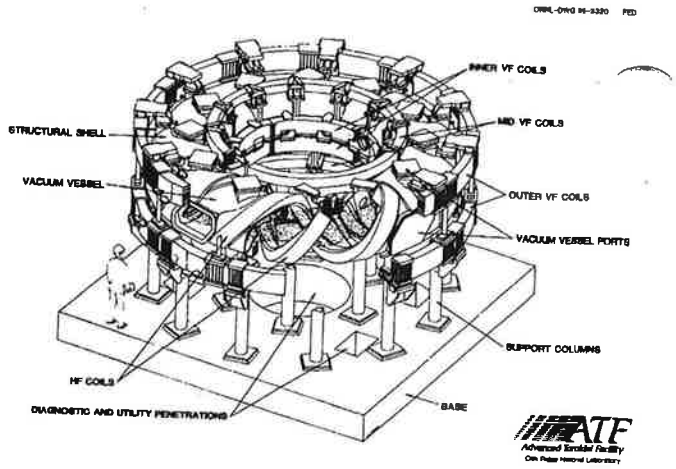
May 31-June 3 32nd International Symposium on Electron, Ion and Photon Beams, Fort Lauderdale. Contact Evelyn Hu (805) 961-2368.

June 6-8 15th IEEE International Conference on Plasma Science, Seattle. Contact Loren Steinhauer (206) 827-0460.

July 4-7 7th International Conference on High Power Particle Beams, Karlsruhe, FRG. Contact G. Kessler, BEAMS '88, KFK, P.O. Box 3640, D-7500, Karlsruhe, FRG.

August 21-25 Applied Superconductivity Conference, San Francisco. Contact Carl Henning, L-644, LLNL, Livermore, CA, 94550.

September 20-26 Energy China 88, Beijing. Contact SHK International Services, Ltd., 22/F, 151 Gloucester Road, Hong Kong. Telex: 89587 SHKIS HX, ATTN: Ms. Amy Lam.



SCHEMATIC OF ATF AT ORNL

ATF COMPLETED

The Advanced Toroidal Facility (ATF) at Oak Ridge National Laboratory was completed in early December. First plasma is scheduled for early January. ATF is designed to study the role of well and shear, second stable region of beta, the role of electric fields in confinement, and steady [illegible] effects. This program of experiment theory is part of a broader program w[illegible] includes research at Auburn and Colorado Universities, NYU, PPPL, and the Universities of Texas, Washington and Wisconsin. In turn, the U.S. stellarator program is part of a collaborative world program involving Australia, the EEC, Japan, and the Soviet Union.

ATF is an advanced stellarator known as a torsatron. Stellarators, like tokamaks are toroidal devices; however, in a stellarator, both toroidal and poloidal confining fields are generated by external magnets and do not depend on electric currents within the plasma to aid confinement. As a result, the magnets are more complicated than those of a tokamak. The absence of plasma current in a stellarator enables steady-state operation to be achieved without the need for current drive. Electric utilities would prefer future fusion reactors to operate steady-state, rather than pulsed, to ensure a reli[illegible] source of power. Initially the ATF p[illegible] will be heated by neutral beams. Late[illegible] is planned to add several megawatts of either ion or electron resonsance heating.