



FUSION POWER ASSOCIATES

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JAPAN CONSIDERS MAJOR FUSION STEP

U.S. "NEW INITIATIVE" IDEAS MULTIPLY CAMPBELL SUCCEEDS STORM AT LLNL

JT-60 "SUPER UPGRADE"

Scientists at the Japan Atomic Energy Research Institute (JAERI), working in collaboration with engineers at Hitachi, Toshiba, and Mitsubishi industries, are engaged in a "preliminary design study" of a large, steady state tokamak device to make "maximum utilization" of the existing JT-60 facility. The device aims for achieving plasma conditions in deuterium of 5 times higher than the "equivalent DT breakeven" levels characteristic of today's largest tokamaks, like JET and TFTR.

Unlike today's flagship tokamaks, the "JT-60 Super Upgrade" would use superconducting coils, thus facilitating the achievement of steady state conditions in the plasma. The 4.3 m design envisages 10 Megampere of plasma current, 60 MW of 500 keV negative ion beam current drive, and high heat load divertor plates. Low activation material, such as titanium or aluminum alloy, "is chosen as the best candidate material for the water-tank type vacuum vessel."

The proposal calls for operation of the device in 1998. U.S. scientists, reviewing the design, estimate the cost at around \$1 billion. The design was described at a post-deadline poster session at the American Physical Society annual meeting of the Division of Plasma Physics, November 8. Further information may be requested from Dr. Masayuki Nagami, Tokamak Program Division, Department of Fusion Plasma Research, Naka Fusion Research Establishment, Japan Atomic Energy Research Institute, Naka-Machi, Naka-Gun, Ibaraki-Ken, Japan; Tel. 0292-95-3111, ext.3320; FAX 0292-95-3364.

U.S. NEXT STEP PROPOSALS PROLIFERATE

Following the U.S. Department of Energy's unexpected decision not to proceed with the Burning Plasma Experiment (BPX), that was the cornerstone of the U.S. fusion policy described in the DOE's own National Energy Strategy (See our October 1991 newsletter), proposals for what to do next, instead of BPX, are proliferating. Advocacy group workshops were held at MIT and LLNL in October and November, followed by a national New Initiatives Workshop at the University of Wisconsin, December 9-11. A common feature of all the proposals is long pulse/steady state physics. There the similarity ends, however. Some proposals are based on copper magnets; others on superconducting magnets. Some use deuterium; others are "upgradable" to tritium. Some consider steady state to be the main or only "advanced" feature; others look for advanced confinement features.

The process of defining a successor project to the abandoned BPX is being coordinated by a "national task force" chaired by John Sheffield of Oak Ridge National Laboratory. The main advocacy groups that have surfaced so far are at MIT, LLNL, GA, ORNL, and PPPL. These groups are also teamed in various combinations on variants of the designs. The next national task force general workshop is scheduled at the University of Texas, January 29-31. However, various specialized workshops are also being scheduled, such as a workshop on edge modelling and current drive at LLNL January 14-16, and a bootstrap current workshop at PPPL tentatively set for January 21. In addition, the Fusion Energy Advisory Committee (FEAC) has set up a panel, co-chaired by Dave Baldwin

(LLNL) and John Sheffield (ORNL), to review the issue of what the U.S. should be doing absent BPX. This panel will meet for the first time at PPPL on January 6-7. The plan is for this panel to operate in parallel with the activities of the new initiatives task force and for the whole process to come to a head at the March meeting (possibly April) of the whole FEAC. FEAC meets next at the Sheraton Hotel Pleasanton, CA, February 5-6. That meeting will consider the report of its first subpanel, co-chaired by Rulon Linford (LANL) and Harold Weitzner (NYU), on what should be the U.S. position on design features of ITER.

JAPANESE GROUP PROPOSES ITER CONSTRUCTION SITE

The "Committee of Fusion Energy Development in Hokkaido" has a published 14-page booklet entitled "Fusion Energy on Earth: Best Site of International Thermonuclear Experimental Reactor (ITER) is East Area of Tomakomai, Hokkaido!" The proposal states "For success of EDA (Engineering Design Activities), it is important to perform the design adequate for construction site, in addition to the machine design. It thus is required to decide the construction site soon during the EDA phase." For further information, contact the committee's chairman, Prof. Toshiro Yamashina, Hokkaido University, Tel. 011-716-2111, ext. 6660; FAX 011-717-4745.

ITER-RELATED ACTIVITIES

The U.S. ITER Home Team, headed by Alex Glass of LLNL, has scheduled an Industry Briefing on Opportunities in the ITER Engineering Design Activities for January 8 at the Hyatt Regency Hotel at the Dallas/Fort Worth Airport. They have also prepared an information packet. Interested parties should contact Mrs. Joan Selles at LLNL, Tel. (510)422-9871; FAX (510)423-4145.

The information packet states that "there will be opportunities in ITER for both institutional and individual involvement." Included is a questionnaire "regarding interest by individuals in your organization for a potential assignment to either the international Joint Central Team (with co-centers in Naka, Japan; Garching, Germany; or San Diego, California) or to the U.S. Home Team."

The four party (Europe, Japan, "Soviet Union", and U.S.) international agreement authorizing a 6-year EDA (Engineering Design Activity) phase is expected to be signed

in January or February. If you are interested in participating in ITER, now is the time to establish contact and the appropriate channel is through the U.S. Home Team if you are a U.S. participant.

ITER will also be the major topic of discussion at the next public meeting of the Fusion Energy Advisory Committee (FEAC). This will occur February 5-6 at the Sheraton Hotel, Pleasanton (near Livermore), CA. For information contact Debbie Jananivich at LLNL, Tel. (510)423-1415; FAX (510)423-2395.

The next national meeting to discuss technical aspects of ITER design will be held February 19-20 at LLNL. Contact Chuck Flanagan at ORNL (615)576-5480; FAX (615)576-5436.

DOE CONTINUES SNAIL PACE ICF POLICY

Despite strong endorsements of the nation's inertial confinement fusion program over a year ago from the National Academy of Science ICF Review Panel and the Fusion Policy Advisory Committee (FPAC) (See our October 1990 newsletter.), DOE continues to drag its feet on the implementation of their recommendations, despite statements from energy secretary James Watkins that he endorsed the panel reports.

Specifically, the DOE is attempting to delay the next major step in ICF, the Nova Upgrade laser. In a letter to LLNL director John Nuckolls, DOE Assistant Secretary for Defense Programs Richard Claytor states "I have explored all the issues of the Nova Upgrade and, in light of the severe budgetary constraints, I believe it is prudent to defer approval to proceed with the conceptual design at this time." The action is one more example of the DOE's unwillingness to commit to necessary future facilities. Indeed, in the same letter, Claytor states "I share your views regarding the importance of this project for maintaining nuclear competence and a nuclear weapons effects capability and as a means for investigating weapons physics issues within Defense Programs. I further recognize the importance of such a facility for eventual civilian power production with inertial fusion."

DOE has also not established the inertial fusion advisory committee called for over a year ago in the Academy and FPAC reports. FPA president Steve Dean inquired October 30 of Admiral Watkins "of your intentions on this

matter, in particular whether and when you intend to establish such an advisory committee." In reply, Dean receive a letter dated December 12 from DOE Undersecretary John Tuck stating "Consistent with the Secretary's commitment to the Congress, the process has been initiated to establish a Federal Advisory Committee for the ICF program. The necessary documentation has been prepared and is in the process of coordination in order to meet the statutory requirements for establishment of such a committee. It is anticipated that solicitations for membership nominations on the committee may commence in early 1992."

DOE has also not taken action to declassify significant portions of the ICF program as called for by the Academy and the FPAC over a year ago. In a separate letter to Admiral Watkins, dated October 30, Dean also inquired "on your intentions and expectations with respect to the time when we can expect a new classification policy on inertial confinement fusion from the Department," pointing out that "in your address to the IAEA conference on Plasma Physics and Controlled Nuclear Fusion over a year ago, and again in a speech at the Princeton Plasma Physics Laboratory last May, you indicated your belief that inertial confinement fusion was overclassified, that this was hampering international collaboration in the field, and that you were moving rapidly towards significant declassification action." In response, Dean received a letter dated November 21 from George L. McFadden, director, Office of Security Affairs, stating "ICF classification policy is currently under review. This policy review involves both energy and nuclear nonproliferation issues and, therefore, requires extensive interagency and international coordination. I expect a more detailed response can be provided to you in December 1991." No further correspondence has been received.

ICF AWARDS GIVEN

The organizers of the Tenth International Workshop on Laser Interaction and Related Plasma Phenomena have established an award entitled the "Edward Teller Medal for Achievements in Fusion Energy." The first set of four awards were presented during the November 11-15 conference in Monterey. The recipients were N.G. Basov, John H. Nuckolls, Chiyo Yamanaka and Heinrich Hora. Fusion Power Associates Leadership Awards have been presented previously to Nuckolls (1982) and to Yamanaka (1985). Basov was the recipient of Fusion Power Associates Distinguished Career Award in 1990.



Mike Campbell

CAMPBELL NAMED AS ACTING LLNL ICF HEAD

Mike Campbell has been named acting deputy associate director for inertial confinement fusion (ICF) at the Lawrence Livermore National Laboratory (LLNL), succeeding Erik Storm who has held that position since 1984. Storm has been named deputy associate director for lasers where he will work with associate director Jim Davis in "the global management of the Laser Directorate." A laboratory announcement states that Campbell will assume his duties "in an acting capacity, and the position will be posted." Mike has been serving as principal deputy program leader for ICF since 1990. Jeff Paisner, since January 1989 deputy AD for Laser Technology, will assume the spot vacated by Campbell.

PILOT PLANT PROGRESS REPORT PUBLISHED

The first progress report from the study group considering the possibility and mission for a near-term fusion pilot plant (See our November 1991 newsletter) has been published and is available from Fusion Power Associates. The study group consists of Steve Dean (FPA), Charlie Baker (ORNL), Dan Cohn (MIT), Don Dautovich and Bill Morison (Ontario Hydro).

A significant development in the study has come from the recognition that capital cost (and thermal power) can be significantly reduced if one considers driven reactors operating close to breakeven, rather than ignited devices.

Since a primary objective of the pilot plant is to gain operating experience with a fusion reactor making continuous high grade heat, it was recognized that this objective can be achieved even if the facility is a net consumer of electricity. This allowed us to consider designs having demountable copper magnets, rather than superconducting ones, further reducing costs.

An additional exciting aspect of the pilot plant concept has been the simultaneous rise in popularity at MIT and ORNL of concepts for near-term steady state physics devices and also for neutron generators for technology testing based on the same philosophy and technology used in the pilot plant study. If near-term decisions are made to build physics and technology devices, based on driven copper-magnet tokamaks, then the pilot plant becomes a natural extension.

NEW TECHNOLOGIES

Varian Associates has developed the world's most powerful non-relativistic magnetron, which at 60 Megawatts is ten times greater than previous magnetrons. Dubbed the VMS-1873, the magnetron is part of an Army-sponsored development of a transmitter array consisting of multiple phase-locked, S-band magnetrons that will have a total energy of one kilojoule per one microsecond pulse. The VMS-1873 has a greater than 60 percent efficiency at moderate voltage -- less than 120 kV. The devices have potential civilian applications for driving high gradient accelerators, pumping high power lasers, separating isotopes and transmuting nuclear waste. For further information, contact Laurie Alire at (415)424-5781.

Scientists at Los Alamos National Laboratory have produced a high-current electrical tape made from new high temperature superconducting ceramic material. The tapes electrical properties are sufficiently advanced that it can be tested for significant practical application, such as a coil in an electromagnet. The work, carried out in collaboration with American Superconducting Corp., used a technique called "powder-in-tube" to fabricate the tape from a silver tube. The silver tape allows some flexibility so that cracking does not occur when the tape is bent. A continuous 130 foot length of tape has been produced and short sample tests showed a critical current density of 9,300 amperes per square centimeter at 35 degrees Kelvin in an external field of two Tesla. For information contact John R. Gustafson (505)665-7777.

RESOURCES AVAILABLE

Lecture transparencies from the Madison Summer School on Plasma Turbulence and Transport, which was held August 19-23, 1991, are available. The 710 page set is priced at \$45 to cover duplicating, binding and mailing costs, checks payable to "TTF Transport Workshop". The lecturers were J.D. Callen (UW), B.A. Carreras (ORNL), P.H. Diamond (UCSD), Ch. P. Ritz (UTx), R.E. Waltz (GA), and P.W. Terry (UW). The set can be ordered from Barbara Griffith, Center for Plasma Theory and Computation, University of Wisconsin, 1500 Johnson Drive, 519ERB, Madison WI 53706-1687.

The Ontario Hydro Canadian Fusion Fuels Project has produced a 20 minute videotape about its R&D programs, its activities, its industry and university affiliations, and its role in Canada's National Fusion Program. Copies may be requested from the Information Coordinator, Tel. (416)855-4711; FAX (416)823-8020.

FPA ANNUAL MEETING AND SYMPOSIUM

Fusion Power Associates Annual Meeting and Symposium will be held April 9-10 at the Hilton Hotel, Pleasanton, CA. Topics to be covered will include potential industrial opportunities in the Nova Upgrade, ITER and "new initiative" tokamak projects. A tour of the Nova laser at Livermore will be included. More detail on the meeting will be forthcoming in the near future.

QUOTABLE

"The current energy policy of the United States government reflects a degree of neglect of all of the dimensions of the energy problem -- technological, environmental, economic, political -- as well as an underappreciation of the ways in which energy, the environment, the economy, domestic tranquility, and international security are intertwined. As a nation, we are underinvesting in energy efficiency and in new energy technologies, underrating the environmental and political costs and risks of the existing patterns of energy supply and use, shrinking from the use of appropriate economic incentives to guide needed change, and missing chances to turn environmental and political necessity into economic opportunity."

John P. Holdren
Congressional Testimony
July 17, 1991



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SMALL FUSION TECHNOLOGY TEST FACILITY GAINS IN FAVOR

LENGTHY ITER PHYSICS TESTING PHASE PROJECTED TOM JAMES NAMED DOE ITER TECHNICAL DIRECTOR

TECHNOLOGY TESTING ISSUE

After the DOE abandoned plans to build a burning plasma experiment (see our October 1991 newsletter), fusion technologists began to worry that the proposed International Thermonuclear Experimental Reactor (ITER) would become more of a physics test facility than an engineering test reactor. In presentations to Fusion Energy Advisory Committee (FEAC) Panel 1, which is reviewing the U.S. stance on ITER design issues (see our January 1992 newsletter), it has become clear that a lengthy (approaching ten years) period of largely physics studies is expected before ITER would become available for dedicated nuclear technology testing. According to a plan advocated by the ITER director-designate, Paul-Henri Rebut, a separate decision to upgrade ITER would be required to prepare for this "second phase" of ITER. If ITER begins operation in 2005, as currently planned, then dedicated nuclear technology testing would not commence in ITER until nearly 2020, since a 2-4 year shutdown for the upgrade is projected between phases. Nuclear data would not then be available to meet the DOE's announced goal of operating a fusion demonstration reactor by 2025.

U.S. nuclear technology interests, spearheaded by Prof. Mohamed Abdou of UCLA, told the FEAC panel that they wanted a smaller (50 MW compared to ITER's 1000 MW), earlier, dedicated nuclear technology test facility. Several groups, including Fusion Power Associates, MIT, and ORNL, have suggested that a small (50 MW), driven

(as opposed to ignited), steady-state tokamak could be built for about \$1-2 billion (see our January 1992 newsletter).

The concept of proposing a technology test tokamak, in parallel with ITER, has become quite popular with the members of the FEAC Panel 1 and, judging from letters received by the panel, with many members of the fusion community at large. Under what FEAC panel 1 has dubbed the "Parallel Machine Scenario," the second phase of ITER would become a systems integration demonstration lasting only a few years, using the technology developed in the smaller technology facility, rather than proceeding with a lengthy and expensive nuclear technology testing phase as now planned. Under this scenario the nuclear data required for DEMO would be obtained 10-15 years earlier than under "ITER-only" scenarios.

The FEAC Panel 1 will present its findings to the full FEAC at a meeting February 5-6 in Pleasanton, CA.

TOM JAMES NAMED TO US ITER POST

Thomas R. (Tommy) James has been designated to head ITER programmatic activities by Office of Fusion Energy director N. Anne Davies. In that capacity, Tommy will oversee the U.S. technical implementation of the ITER engineering design activities (EDA), including U.S. participation in the ITER Joint Central Team and the U.S. Home Team. James was previously responsible for the BPX project activities, reporting to Confinement Systems

Division director John Willis. His experience with DOE construction projects goes back many years.

In a memo dated January 2, 1992, Dr. Davies announced that James would have the title "ITER Technical Director" and would head up an "interim" matrix organization, pending a more formal reorganization which would provide James with staff and line responsibility.

WATKINS RETREAT

On December 17-18, Secretary of Energy James Watkins took part in an unprecedented two-day retreat in Leesburg, VA, with DOE laboratory directors, DOE field office managers, and senior DOE officials, including Office of Energy Research director William Happer (see our December newsletter). The agreements reached at the meeting are summarized in a DOE document entitled "Report on DOE Planning Meeting with Laboratory Directors, Assistant Secretaries and Field Office Managers." For a copy, contact Antoinette Joseph, director of the Office of Field Operations Management, Office of Energy Research, USDOE, Washington, DC, 20585.

The only statement dealing directly with fusion is as follows. "With input from the laboratories, the DOE will take the lead in developing and proposing the framework for international participation in the construction and operation of major research facilities. ITER (International Thermonuclear Experimental Reactor) should receive priority as a test case."

Two other agreements of interest in the report are the following. (1) "All of DOE should affirm a commitment to technology transfer as a fully-integrated mission of DOE programs and laboratories for the purpose of enhancing their commitment to U.S. competitiveness." (2) "DOE should streamline the CRADA (cooperative research and development agreement) process and all DOE processes which relate to industry."

CONGRESSIONAL HEARINGS SCHEDULED

The Committee on Science, Space, and Technology, Subcommittee on Energy, chaired by Rep. Marilyn Lloyd (D-TN) will hold authorization hearings on the DOE's FY 1993 fusion budget request February 20, 9:30 AM, Room 2318, Rayburn House Office Building. Both DOE and non-governmental witnesses will be heard. For information,

contact Frank Murray (202) 225-2884.

The Committee on Appropriations, Subcommittee on Energy and Water Development, chaired by Rep. Tom Bevill (D-AL) will hold appropriations hearings on budget requests for the Office of Energy Research (including fusion) on March 4 at 10:00 AM in Room 2362 of the Rayburn Building. Only government witnesses will be heard at that time; non-government witnesses will be scheduled later. For information, contact Aaron Edmondson (202) 225-3421.

ITER INDUSTRY BRIEFING

The U.S. ITER Home Team held an "Industry Briefing" on January 8 in Dallas. About 50 industry representatives attended. Attendees were provided overviews by Tom James (DOE) and Alex Glass (U.S. Home Team Leader, LLNL) and were given briefings on industry opportunities in design activities, engineering and technology development. Glass emphasized that DOE had given him "guidelines" that required him to "prepare U.S. industry to bid on the construction of the ITER facility." The guidelines stated that "the U.S. Home Team should establish contracts with industrial firms to participate in technology development in the major industrial areas"; that "component development of scalable models for the major R&D tasks assigned to the U.S. should be contracted to industry wherever practicable"; and that "where national laboratories have unique facilities necessary for component development and/or testing, these facilities will be made available to industry for ITER-related testing and other purposes." He also announced that he was forming an ITER Industry Council (IIC) under the auspices of Fusion Power Associates.

Glass stated that he did not yet know which technology areas would be assigned to the U.S., nor did he yet know what fraction of the U.S. ITER budget would be provided to the Joint Central Team as opposed to the U.S. Home Team. The U.S. ITER budget is projected to grow from \$41M this year to \$60M in FY 1993.

Charles Baker of ORNL, ITER Technology Manager for the U.S. Home Team, told the group that for technology R&D, "selected national laboratories will act as contracting organizations for DOE and the U.S. Home Team." He said that these labs would issue RFP's (requests for proposals) during the next several months for "multi-year contracts in each of several technology areas." He said the U.S. would

seek work in all technology areas, with an expressed priority preference for responsibility for magnets, plasma facing components, and blankets. MIT, Sandia, and Argonne, respectively, would be responsible for issuing RFP's in these three areas. ORNL, which would have responsibility for the assembly, maintenance, and containment structures areas, intended to issue its RFP in the April/May time frame, Baker said. Glass indicated that he hoped to have industry teams under contract by the end of September.

Persons who were unable to attend the briefing may request copies of the briefing materials from Joan Selles, ITER Project Office, LLNL, Tel. (510) 422-9871; FAX (510) 423-4145.

FEAC AND NEW INITIATIVE MEETINGS

The Fusion Energy Advisory Committee (FEAC) will hold a public meeting on March 18-19 at the Princeton Plasma Physics Laboratory, Princeton, NJ. The primary activity at the meeting is expected to be consideration of the report of FEAC Panel 2, which is considering what new experiment should the U.S. propose as a "new initiative" to replace the BPX (see our October 1991 newsletter). The FEAC would also be expected to hear an interim report from a new Panel 3 that will be set up at the February 5-6 meeting. Panel 3 is expected to be charged to review the DOE fusion policy on the support of "alternate concepts" and tokamak concept improvement.

The "new initiative" National Task Force (see our November 1991 newsletter) continued to oversee a seemingly continuous series of meetings and workshops on technical issues during January. A general meeting of the National Task Force to take stock of the situation was held January 29-31 in Austin, TX, and another one is expected to be scheduled in late February at UCLA.

FY 1993 BUDGET REQUESTS

As part of his \$1.52 trillion FY1993 budget request to Congress, President Bush has asked for \$359.7 million for fusion energy, an increase of \$22.6 million and for \$195 million for inertial confinement fusion within the DOE defense programs, an increase of \$0.2 million.

The request for magnetic fusion includes \$60 million for support of the International Thermonuclear Experimental Reactor (ITER) program, \$80 million for operations of the

Tokamak Fusion Test Reactor (TFTR), \$41 million for the Doublet III-D tokamak, \$20 million for design of a "new initiative" tokamak (as a replacement for the cancelled BPX project), and \$19.6 million for plasma theory. Only \$2.4 million is requested for systems studies of future fusion power plants.

The request for inertial confinement fusion (ICF) includes \$117.7 million for glass laser ICF research, primarily at LLNL and the University of Rochester. In addition, the University of Rochester would receive \$13.1 million for continuation of the Omega laser upgrade project. This would bring to \$42.2 million the total allocated so far for that \$64 million construction project. Nova Upgrade at LLNL continues in a design and development category, with no firm commitment indicated for construction.

The ICF request also includes \$11 million for gas laser ICF research at LANL and NRL. The NIKE KrF laser at NRL is expected to operate in FY1994. Funds in the amount of \$30 million are requested for pulsed power ICF research, primarily at the Sandia National Laboratories. A request for \$15.6 million is included for supporting activities, primarily to "support a private target fabrication contractor." A team led by General Atomics and Schafer Associates recently won a contract for this activity, replacing long-time ICF support contractor KMS Fusion, Inc.

ICF DECLASSIFICATION UPDATE

Fusion Power Associates has been attempting (see last month's newsletter) to find out what has happened to the declassification actions on ICF promised by Energy Secretary Watkins in a speech to the International Atomic Energy Agency fusion conference 16 months ago. FPA president Steve Dean received a letter dated January 14, 1992 from DOE Under Secretary John C. Tuck stating that a declassification study conducted by the Deputy Assistant Secretary for Military Application has "been reviewed by the DOE senior advisory committee on classification policy. The resulting recommendations include not only technical issues directly related to inertial fusion energy, but also nuclear nonproliferation policy issues. The above recommended policy changes have been coordinated with a number of U.S. Government departments and agencies. In addition, we are currently involved in sensitive international discussions of these energy and nonproliferation issues."

Fusion Power Associates has learned that the U.S. State Department is embarrassed by the fact that DOE secretly carried out a series of underground nuclear tests in Nevada for several years aimed at understanding the potential of achieving energy gain from inertial fusion pellets, while at the same time the DOE had an obligation to share information with the Japanese on the peaceful uses of underground nuclear explosions. During this same time period, the Japanese were freely publishing the results of laboratory experiments that the Department of Energy considered classified in the U.S. Not wanting to face up to this transgression of international protocol, the U.S. State Department has sought to tie up the inertial confinement classification issue in the morass of its nonproliferation policies, so far successfully. Observers believe that whatever ICF declassification action ultimately, if ever, comes out of DOE will be trivial and will duck the issue of the release for international scientific scrutiny of the data from DOE's secret underground ICF experiments.

GENERAL ATOMICS SEEKS FUSION CONTRACT WITH RUSSIA

The General Atomics Company, San Diego, CA, is seeking to negotiate a contract with the Kurchatov Institute, Moscow, which would provide support to Russian scientists to perform experiments on the T-10 tokamak. Sources say that the cost of doing research in the former Soviet Union is about one one-hundredth of the cost of doing similar research in the U.S. U.S. laboratories are being encouraged by the DOE to explore ways of providing support to Soviet laboratories, although no one seems to know at the moment what procurement regulations apply to the transfer of funds.

MEETINGS

18-19 March - Fusion Energy Advisory Committee public meeting, Princeton Plasma Physics Laboratory. Contact Prof. Robert Conn, UCLA, (310) 825-1613.

6-8 April - Sherwood Fusion Theory Conference, Santa Fe, NM, Contact Alan Glasser, LANL, (505) 667-7723.

9-10 April - Fusion Power Associates Annual Meeting and Symposium, "Future Opportunities in Fusion Power Development," Pleasanton, CA. Contact Ruth Watkins FAX (301) 975-9869.

FUSION ARTICLES IN PHYSICS TODAY

Two excellent articles on fusion appear in the January issue of Physics Today, the monthly publication of the American Physical Society. The first, entitled "Progress Toward a Fusion Reactor", is written by J. Geoffrey Cordey, Robert J. Goldston and Ronald R. Parker. The second, entitled "Stability and Transport Processes in Tokamak Plasmas", is written by James D. Callen, Benjamin A Carreras and Ronald D. Stambaugh. A picture of the Tokamak Fusion Test Reactor graces the cover of the issue.

ANS REQUESTS AWARD NOMINATIONS

The American Nuclear Society Fusion Energy Division requests nominations for three awards. The Outstanding Technical Accomplishment Award is for "exemplary technical accomplishment requiring professional excellence of a high caliber in the area of fusion science and engineering." The Outstanding Achievement Award is for "exemplary individual achievement requiring professional excellence and leadership of high caliber in the area of fusion science and engineering."

Nominations should be sent by March 27 to Prof. Don Steiner, RPI, Nuclear Engineering & Engineering Physics Department, Tibbits Avenue, Troy, NY, 12180-3590.

Nominations for the 1992 Student Award should also be sent by March 27 to Prof. Steiner. The nominations should be accompanied by 7 copies of a complete research paper of journal caliber. The winner will present the paper at the Tenth Topical Meeting on the Technology of Fusion Energy, June 7-12, 1992 in Boston. Travel support (up to \$500) will be provided and page charges will be waived for publication of the paper in Fusion Technology.

QUOTABLES

"Think you can or think you can't. Either way you will be right."

- Henry Ford

"If you can dream it, you can do it."

- Walt Disney



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SENATE ENERGY BILL SUPPORTS FUSION

ADVISORY COMMITTEE REPORTS TO DOE CONCEPT IMPROVEMENT PANEL FORMED

SENATE PASSES ENERGY BILL

By an overwhelming margin, the U.S. Senate has passed a "comprehensive energy bill" (S.2166) aimed at codifying key elements of the DOE's National Energy Strategy. The bill contains a title (XIII) on "Research, Development, Demonstration and Commercialization Activities" and, within that title, there is a section (13112) instructing the Secretary of Energy to "carry out a research, development, and demonstration program on fusion energy that is structured in a way that will lead to commercial demonstration of the technological feasibility of fusion energy for the production of electricity after the year 2010." The bill requires the Secretary to "prepare a comprehensive management plan for research, development and demonstration of fusion energy, including milestones and schedules for technology development and estimates of budget and program management resource requirements."

In the House of Representatives, similar legislation is being pursued (H.R. 776) by Rep. Philip Sharp, chairman of the Energy and Power Subcommittee of the Committee on Energy and Commerce. At the present, time the House bill does not contain a fusion section.

ADVISORY COMMITTEE REPORTS TO DOE

At its February 5-6 meeting, the Fusion Energy Advisory Committee (FEAC) received the report of its "Panel 1," charged with reviewing the U.S. position on the "appropriate scope and mission of ITER." The committee then sent its recommendations to DOE director of Energy Research

William Happer in a letter dated February 14. Copies of the letter are available from Fusion Power Associates. The letter and the accompanying panel report will be published by UCLA in the near future. To request a copy of this report, contact Prof. Robert Conn at (310) 825-4544; fax (310) 825-2599.

The letter states that "FEAC views ITER and its Engineering Design Activity (EDA) phase as a central element of the U.S. magnetic fusion program. Further, we strongly reaffirm the importance of integrated nuclear testing as a key part of the ITER mission." The letter says that "The cancellation of BPX has, however, compromised the pace and scope of the U.S. program." FEAC told Happer that "The absence of BPX increases the technical risk of meeting the goals for fusion energy as stated in the National Energy Strategy (NES)."

In their letter, the committee says "The necessity of using ITER for the first detailed investigations of high-Q and ignited burning plasmas will extend the phase of ITER dedicated mainly to such physics issues. This first phase is now estimated to take as much as 10 years in which case it would not be completed until about 2015." The letter says that "Additional complementary activities dedicated to acquiring part of the nuclear testing data would permit shortening the ITER test program. FEAC recommends that a study of the feasibility of such a complementary program be undertaken with a view toward making the 2025 DEMO goal more realistic."

Addressing ways to lower the overall costs and shorten the schedule for ITER, the letter recommends "that the U.S. begin the necessary preparations leading to the earliest possible site selection and commitment to the construction of ITER."

Commenting on the role of industry, the letter states that "DOE procurement practices should be examined to assure a leadership role for U.S. industry." In addition, the letter states that the "DOE should develop a plan that deliberately includes a broader and more integral industrial participation in the fusion program. This plan should encourage the development in industry of both technical and programmatic expertise and should allow for the continuity of this expertise over the long term."

The FEAC recommended that the base Development and Technology program and the fusion materials development program be strengthened beyond what is required for ITER in order to prepare for an orderly flow from ITER to DEMO. Specifically, the FEAC recommended that "DOE initiate a process that will lead to construction of a 14 MeV neutron source to test and qualify such materials."

FEAC PANEL 1 REPORT

The recommendations of the FEAC discussed above were based on the report of its Panel 1 and were largely consistent with it. Panel 1 was co-chaired by Rulon Linford (LANL) and Harold Weitzner (NYU).

In its report, Panel 1 emphasized that the ITER activities "must be coupled with a strong national program that addressed other DEMO-related tasks in addition to ITER tasks. We emphasize that the U.S. program goals, as stated in the National Energy Strategy, would not be achieved if complementary activities to ITER were not carried out."

The panel considered three "scenarios" to accomplish the programmatic objectives of ITER and found that "all the scenarios provide an acceptable means of meeting the programmatic objectives." The first scenario, called the "unified scenario of physics and nuclear testing," is basically the original ITER plan to move rapidly to nuclear testing. The second scenario, called the "sequenced scenario of physics and nuclear testing," is one, currently popular in Europe, which commits to the physics phase of ITER and allows for an upgrade decision later for nuclear technology testing. The third scenario, called the "parallel-machine

scenario," provides for commitment to an ITER-class burning plasma physics machine in parallel with a smaller, dedicated nuclear technology test machine (see our February newsletter). After its physics phase, the ITER would be used for integrated testing of blankets developed on the smaller machine but would not be used for extensive nuclear testing. Although the panel found all three scenarios to be acceptable, they pointed out that the third scenario had the potential to shave 10-15 years off the schedule for achieving the database required to proceed with a demonstration reactor.

CONCEPT IMPROVEMENT PANEL SET

The Fusion Energy Advisory Committee (FEAC) has received a letter from DOE director of Energy Research William Happer asking for "recommendations on a U.S. concept improvement program, including relative priorities and taking into account ongoing and planned work abroad." In response, FEAC chairman Bob Conn has established "FEAC Panel 3" with a reporting date of late May. FPA president Steve Dean will chair the panel; Barry Ripin of the Naval Research Laboratory is vice-chairman. The panel plans a meeting March 11-12 in Washington, D.C. Persons wishing to interface with the panel should contact Fusion Power Associates (FAX 301-975-9869).

The letter asks for recommendations for "a policy and selection criteria to help guide our program choices on concept improvements within our goal-oriented program strategy. The overall policy question is whether, given the demands of the mainline tokamak program and current budget constraints, we should encourage and fund proposals on concepts other than tokamaks. Within the concept improvements area, what priorities should be given to exploratory tokamak improvement proposals, like the compact toroid fueling and helicity current drive that are now under small scale investigation? Should the priority be higher for U.S. alternate concept activities that connect to major significant international programs or for unique U.S. activities? Under what conditions and within what criteria should concepts that have little connection to tokamaks, or to other major international programs, be considered?"

Other Panel 3 members are: Don Batchelor, Klaus Berkner, Bill Ellis, Ken Gentle, Stan Kaye, Grant Logan, Earl Marmar, Gerald Navratil, Norman Ness, Tihiro Ohkawa, Dick Siemon, Don Steiner, and Harold Weitzner.



Dr. Paul L. Ziemer (right), the U.S. Department of Energy's Secretary for Environment, Safety and Health, presents a 1990 National Safety Council Award of Honor to TFTR Safety Corodinators. From the left are Roland Snead, Jim Gorman, Fred Simmonds, Jr., Pat Shangle, and Carl Bunting.

TFTR WINS SAFETY AWARD

The Tokamak Fusion Test Reactor (TFTR) project at Princeton Plasma Physics Laboratory has been awarded the National Safety Council's 1990 Award of Honor, in recognition of the staff's safety record for the period November 2, 1987 through December 31, 1990. During this time, the TFTR personnel logged 1.6 million employee-hours without an occupational injury requiring staff to remain away from work. The award was presented by Dr. Paul L. Ziemer, DOE Assistant Secretary for Environment, Safety and Health.

HEAVY ION FUSION ADVOCATED AT CERN

Nobel Laureate Carlo Rubbia gave a two hour colloquium to a packed house at the CERN high energy physics laboratory in Geneva, Switzerland on January 23. The title of the colloquium was "Inertial Fusion: A Possible Contribution of Accelerator Technology to the World's Energy Problem?" In a comprehensive presentation, Rubbia described the fundamentals of inertial fusion, characteristics of heavy ion accelerator drivers and reactor concepts. He

emphasized the impending heavy ion fusion work planned with the SIS/ESR accelerator facilities at GSI, Darmstadt, Germany. A group consisting of individuals from CERN, Frascati, and Germany are designing a new accelerator capable of producing high gain from an inertial fusion pellet. Former U.S. fusion director Amasa Bishop attended Rubbia's talk and sent Fusion Power Associates a set of Rubbia's 120 vugraphs. We will be happy to duplicate and mail a set to interested parties for a fee of \$20 to cover the cost of duplication and mailing. We thank "Am" for taking the initiative on this. Friends of the Bishops can contact them at Les Acacias, 1261 Genolier, Switzerland.

IAEA FUSION MEETING IN GERMANY

The 14th IAEA International Conference on Plasma Physics and Controlled Nuclear Fusion Research is scheduled for September 30-October 7, 1992, in Wurzburg, Germany. Persons wishing to attend the conference must be nominated by their respective governments. A "Participation Form" is available for this purpose from the IAEA in Vienna or from designated government agencies. U.S. parties should contact Dr. David Crandall, USDOE, FAX

(301) 903-2791. Preference is given to people who are presenting papers at the conference. Synopses of proposed U.S. papers must be received by Crandall by April 10. Persons working in inertial fusion in the U.S. should also contact Gary Chenevert at DOE, phone (301) 903-3397.

ELECTRICITY GROWTH CONTINUES

In 1990, electricity sales rose 2.2 percent (weather-corrected, 2.7 percent) above the 1989 level. Growth in electricity sales averaged 3.1 percent per year from 1985 to 1990. Since 1973, growth has averaged 2.7 percent per year. Fusion Power Associates has estimated that if demand growth continues at an average of 2 percent per year, approximately \$5 trillion dollars will be required in capital expenditures for new baseload power plants during the first 50 years of the next century, an average of \$100 billion per year. If all these plants are based on the burning of coal, as currently now seems to be the only planned-for option, U.S. coal production would have to increase from the current level of about 1 billion tons per year to about 5 billion tons per year. The National Coal Council projects an increase in U.S. coal production to a rate of just under 2 billion tons per year by the year 2030.

LANL PATENTS NEW MATERIAL

In January, researchers at the Los Alamos Scientific Laboratory received a patent for compositions of high-temperature structural silicide materials and for methods for making the compositions. The materials combine the desirable qualities of ceramics, such as high-temperature strength, corrosion resistance, low density and low thermal expansion, with the high-temperature ductility and fracture resistance of metals. The researchers dispersed silicon carbide, a ceramic, throughout a matrix material of molybdenum disilicide, an intermetallic (two-metal) compound comprising molybdenum and silicon atoms. The resulting product, a molybdenum-disilicide-alloy-matrix composite, had eight times the high-temperature strength of molybdenum disilicide by itself, said John Petrovic of the LANL Ceramic Science and Technology Group. Petrovic said that the materials possess significant potential to meet the demands of advanced high-temperature structural applications in the range of 1200-1600 degrees Celcius and are cost-effective to manufacture compared to other advanced materials, such as silicon-based ceramic materials.

DEAN SPEAKS TO MISSOURI TEACHERS

FPA president Steve Dean gave a banquet speech February 23 to 2000 Missouri science teachers at a state convention sponsored by the Missouri Department of Elementary and Secondary Education. Dean's topic was "The Politics of Energy Policy and Its Impact on Future Global Energy Needs." He also gave a seminar on February 24 to about 75 of the teachers on the topic "Fusion Power: Status of Global Development." The seminar was part of a special session on nuclear energy organized by Bill Miller and Gayla Neumeayer of the University of Missouri.

MEETINGS

March 18-19 - DOE Fusion Energy Advisory Committee Public Meeting. PPPL, Princeton, NJ. Contact Debbie Lonsdale (301) 903-4941 FAX (301) 903-2791.

March 30-April 3 - Tenth International Conference on Plasma Surface Interactions in Controlled Fusion Devices, Monterey, CA. Contact Walter Bauer (510) 294-2994; FAX (510) 294-3231.

April 6-8 - International Sherwood Fusion Theory Conference. Santa Fe, NM. Contact Alan Glasser (505) 667-7723.

April 9-10 - Fusion Power Associates Annual Meeting. Hilton Hotel, Pleasanton, CA. Contact Ruth Watkins (301) 258-0545; FAX (301) 975-9869.

May 20-21 - DOE Fusion Energy Advisory Committee Public Meeting, UCLA, Los Angeles, CA. Contact Debbie Lonsdale (301) 903-4941 FAX (301) 903-2791.

May 11-15 - Advanced Tritium Safe Handling Course. Toronto. Contact Canadian Fusion Fuels Technology Project (416) 855-4725; FAX (416) 823-9644.

QUOTABLES

"Passion, more than logic, leads to change."

Student
Mills College, CA

"Modern living has become wrapped up in non-essentials."

Unknown



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NEW U.S. TOKAMAK ENDORSED

FUSION INDUSTRIAL POLICY PROMISED ITER INDUSTRY COUNCIL FORMED

FEAC ENDORSES NEW TOKAMAK

At its March 18-19 meeting, the DOE's Fusion Energy Advisory Committee (FEAC) agreed to advise DOE Director of Energy Research William Happer to proceed with a "Steady State Advanced Tokamak" (SSAT) as a FY 1994 construction project. The device is estimated to cost "about \$500 million in as-spent dollars." The project replaces the "Burning Plasma Experiment" (BPX) as the next major step in the U.S. magnetic fusion program. DOE unexpectedly withdrew its support of BPX last September due to budget problems (See our October 1991 newsletter). FEAC states that it believes the device proposed can be built within the above cost constraint provided it makes use of the existing TFTR test cell and equipment at PPPL.

The FEAC recommendation was based on reports of the "New Initiative Task Force" and FEAC "Panel 2" which were charged with reviewing options (See our October 1991 and February 1992 newsletters).

The SSAT recommended by FEAC would have at least a 1000 sec pulse, with machine capability of ultimately achieving true steady state, and would incorporate "advanced tokamak features." Among the advanced features recommended are (1) high beta (e.g., second stability regime) with enhanced confinement, (2) a high fraction of self-sustained (bootstrap) current, and (3) disruption control. The "common thread" identified by FEAC in these advanced features is "control of the current profile" for times longer than the natural relaxation time scale. Among

the technologies to be developed for true steady state in the device, FEAC singles out "power and particle handling technologies," and "efficient current drive and current profile control technologies."

On a separate matter, FEAC also stated that the highest priority elements in the confinement systems program should be full D-T operation in TFTR and a strong DIII-D program in support of ITER and tokamak physics improvements. They suggested that DOE deal with the relative priorities among the other elements of the confinement systems program via a separate charge to FEAC or a separate review process.

The FEAC also recommended that DOE prepare a plan for the nuclear technology phase of fusion development by identifying a "nuclear-capable site" as a candidate site for the construction of ITER and other fusion nuclear facilities.

FEAC PANEL 2 REPORTS

The FEAC recommendations described above followed the report of its "FEAC Panel 2" co-chaired by David Baldwin of LLNL and John Sheffield of ORNL. Panel 2 states that the SSAT could meet the cost constraint using either superconducting or resistive magnets. In addition to the SSAT, the panel also reviewed two other candidate projects, using resistive magnets, that had in later phases requiring upgrades at additional cost, the feature that they could use D-T fuel. One of these was called the Steady Burn Experiment (SBX) and the other was called the Burning

Plasma Experiment-Advanced Tokamak (BPX-AT). The panel chose SSAT over these two designs because of cost considerations and because the burning plasma portions of the missions of these latter designs overlap in part the mission of ITER. However, the panel felt that "a lower level of design effort should also continue" on these proposals because "they do provide provocative concepts for future consideration, depending on whether ITER proceeds to construction, the degree of nuclear testing planned if it does, etc." (See our February 1992 newsletter).

NEW INITIATIVE TASK FORCE REPORTS

FEAC and its Panel 2 relied heavily on the report of the New Initiatives Task Force, chaired by John Sheffield of ORNL. The Task Force took as its charge (See our November 1991 and January 1992 newsletters) to provide "oversight and guidance to a community-wide effort to develop concepts and design approaches for a new experimental device in the \$400M-class (total project cost, constant FY 1992 dollars) which will (i) investigate improvements in the tokamak concept aimed at demonstrating a plasma regime that will extrapolate to a more economically attractive DEMO, (ii) support the ITER project, and (iii) provide a scientific focus to maintain program vitality." They say "The consensus of the Task Force is that advanced-tokamak operation in steady state is the most important mission for the new device. A minimum initial pulse length of the order of 1,000 seconds would be appropriate, and inherent steady-state and high-duty-factor capabilities are highly desirable." The Task Force also states "There is also considerable support, but falling short of a consensus in the Task Force, for limited D-T operation in advanced-tokamak regimes, even at a modest increment in cost, provided the primary mission is not jeopardized." "However," the Task Force says, "a capability either for higher-performance moderate-pulse D-T operation, corresponding to Q greater to or about equal to 5, or for extended-pulse high-duty-factor D-T operation at Q of about 1, cannot be achieved within a \$400M-class device." Copies of the Task Force report can be requested from John Sheffield at ORNL, tel. (615) 576-0988; fax (615) 576-7926.

ORNL URGES FUSION NUCLEAR SITE

During the "Public Comment" portion of the March 18-19 FEAC meeting, Bill Fulkerson, Associate Director for Advanced Energy Systems, Oak Ridge National Laboratory (ORNL), presented a talk entitled "The ORNL Point of

View on the Direction of the U.S. Fusion Program." Fulkerson stated that fusion "is not yet set up to pursue (the) goal (set out in the DOE National Energy Strategy). Fusion is a nuclear technology, but we have no nuclear qualified site at which to focus the U.S. development of the technology." He stated "If you ask what is the most important next step the U.S. Program should take, we at ORNL would argue that it be to find and establish a nuclear qualified site to point the program to its goal." He said the FEAC should "consider going much further and recommend making this site also the home for the next major facility built by the U.S. Program. This facility should be a Nuclear Technology Machine. It is what Ron Parker (MIT) calls the Steady Burn Experiment (SBX), what John Sheffield (ORNL) calls the Small Fusion Development Plant and it is related to what Steve Dean (FPA) calls a fusion pilot plant."

Fulkerson described the mission of the machine he had in mind: "It is a steady state device operating with Q of about 1, and it would be as small as possible while achieving reactor conditions at which to test systems such as the divertor, the breeding blanket, heat recovery, remote maintenance, waste management, etc. It would be a small nuclear machine, but it would have most of the pieces of a reactor. It would permit testing these technologies at smaller scale than would likely be possible with ITER and doing experimentation earlier and with U.S. industry taking the lead and reaping the benefits." Fulkerson described a two-phased approach to constructing the nuclear facility, with the first (non-nuclear) phase to cost \$600-700 million, and the second (upgrade to nuclear) phase to cost an additional \$200-400 million.

Fulkerson urged the FEAC to "recommend to DOE that a major national competition be launched not only to find the best site but also to build the Nuclear Technology Machine on it. Part of that competition should be to include the management team in the proposal. The private sector should be involved in the leadership."

DOE PREPARING FUSION INDUSTRIAL POLICY

At the March 18-19 FEAC meeting, DOE Office of Fusion Energy director N.Anne Davies announced that they were preparing a fusion industrial participation policy in response to a previous recommendation of FEAC (See our March 1992 newsletter). Dr. Bennett Miller, a consultant to DOE,

is preparing a draft report to DOE on a time schedule of a few months. FPA president Steve Dean met with Miller on March 16. Miller presented his plan for preparing the report at the FEAC meeting. Persons wishing to share their views with Dr. Miller can contact him at (301)299-2884.

FPA ELECTS NEW BOARD MEMBERS

Fusion Power Associates By-Laws provide that the Board of Directors may elect up to 5 additional directors from outside our membership. Recently the FPA Board elected the following three individuals to three-year terms effective April 1, 1992: John F. Clarke (Associate Director, Global Studies Program, Battelle Pacific Northwest Laboratories), Robert L. Hirsch (Vice President, Washington Office, EPRI), and Erik Storm (Deputy Associate Director for Lasers, LLNL). We appreciate their willingness to serve on our Board.

FUSION FY 1994 DOE BUDGET GUIDANCE

The DOE Office of Energy Research recently issued guidance to its field offices and major laboratories to assist them in preparing their proposals for work in FY 1994. For fusion the memo states that the goals of the National Energy Strategy provide the basis for the guidance: "Develop Fusion as an Energy Option." All Energy Research programs are asked to provide a planning case for a flat budget, without inflation, and a planning case for a budget including 3.6% inflation. In addition several programs, including fusion, are asked for a third planning case with real growth above inflation. In the case of fusion, a planning case is requested "with a target for real growth of about 9% above FY 1993." The guidance states "At this level, the program would be above the SEAB (Secretary of Energy Advisory Board) minimum program option. Funding for TPX (Tokamak Physics Experiment, also called SSAT) should be included . . . and ITER should be fully supported. Budget growth above inflation for the 1995-1998 out-years should be limited to 5%. The planning should clearly indicate the phase-out of TFTR and transition to ITER and TPX programs."

KATYA GOLUBCHIKOVA VISITING FPA

Ms. Katya Golubchikova, administrative assistant to Acad. Boris Kadomtsev of the Kurchatov Institute, Moscow, is visiting Fusion Power Associates for about 4 months. She arrived March 5. At the Kurchatov she has responsibilities for international exchange arrangements, including ITER.



Ms. Katya Golubchikova

While in the U.S. she will be meeting with many persons in the fusion program with interests in these areas, including DOE and laboratory personnel. She attended the March 18-19 FEAC meeting and visited with PPPL personnel. She will be attending FPA's annual meeting April 9-10 in Pleasanton and will then spend two weeks with the SAIC team responsible for making arrangements for the arrival of non-U.S. participants in the ITER Joint Central Team in San Diego. We expect that she will also attend the ANS Fusion Topical Conference in Boston June 7-11.

ITER INDUSTRY COUNCIL FORMED

U.S. ITER Home Team Leader Alex Glass has formed a 13-member ITER Industry Council (IIC). FPA president Steve Dean is a member of the council. The group held its first meeting March 3 in Washington. The purpose of the Council is to advise the U.S. Home Team Leader on "policy issues relating to industrial participation in the ITER project." The charter for the IIC states that the IIC will advise the Home Team Leader on problems arising from government organizational conflict of interest regulations and on "matters relating to contracting procedures, solicitations, cost-sharing, and other topics relating to contracting policy." The IIC "is excluded from any involvement in specific procurement decisions." The charter states that "The IIC will also provide guidance to the Home Team Leader concerning the energy relevance of the proposed ITER design, and of the technology development carried out under ITER funding. The IIC will provide

comment regarding all aspects of industry involvement in ITER, and suggest alternative strategies where appropriate.

The chairman of the IIC is Harold Forsen of Bechtel. According to the minutes of the first meeting, the Council "agreed that the plan proposed by the Home Team Leader (See our February 1992 newsletter) was satisfactory, with a few modifications." The council "expressed concern that industry would still be perceived as being subservient to the laboratories in the proposed arrangement, and recognized that it would be up to the Home Team Leader to ensure that industry would assume the lead role in design, manufacture, and testing of prototype technology." The council "urged the Home Team Leader to ensure that the industrial participants in the technology tasks were involved in the integrated design activities as well, in order to provide all participants with an understanding of fusion system requirements." The Council "called for a broader role for industry in the whole MFE program, not just ITER." They "suggested that the industry teams formed in response to the technology RFP's should also be involved in the core program Development and Technology activities."

DOE ISSUES NES UPDATE

The Department of Energy has issued a report entitled "National Energy Strategy: One Year Later" which they say "sets forth the considerable progress the Administration has made in implementing the Strategy since it release." The fusion section, however, is a misleading characterization of the events of the past year. The report states that "The Administration's commitment to secure, environmentally safe, long-lasting sources of energy for the future can be seen in the increased funding for the fusion energy programs." The report falsely states that the FY 1993 request for \$360M represents "a 25 percent increase since the National Energy Strategy was published in 1991." The magnetic fusion budget in FY 1990 was \$331M, compared to the FY 1993 request (exclusive of \$9M for inertial fusion energy that was previously budgeted under Basic Energy Sciences) of \$351M. This represents a total percentage increase of 6% over 3 years, far less than inflation. DOE arrives at their 25% figure by accounting artifacts having to do with transferring monies in and out of the magnetic fusion budget in FY 1991 for small business and educational set-asides and transferring the inertial fusion energy program from Basic Energy Sciences to the Office of Fusion Energy. The first "real" budget request following the publication of the National Energy Strategy is FY 1993 compared to FY

1992, wherein the Office of Fusion Energy would receive a 6.7% increase over the FY 1992 figure of \$337M. The NES update report also glosses over the fact that they recently pulled the plug on the Burning Plasma Experiment (See our October 1991 newsletter), while acknowledging no impact on the overall fusion schedule.

PEOPLE

Everet Beckner has been named Principal Deputy Assistant Secretary of Energy for Defense Programs. From 1986-1990, he was vice-president for Weapons Programs at Sandia National Laboratories and, since 1990, he has been on special assignment to DOE/HQ as Special Science Advisor to the Secretary for Weapons Programs.

Greg Moses has been named Dean of Research at the University of Wisconsin. Greg was previously a Professor of Nuclear Engineering, and worked extensively on inertial fusion reactor studies.

MEETINGS

May 20-21 - DOE Fusion Energy Advisory Committee Public Meeting, UCLA, Los Angeles, CA. Contact Debbie Lonsdale (301) 903-4941; fax (301) 903-2791.

May 31-June 3 - Edison Electric Institute annual convention, "Charting the Future Course." Columbus, OH. Contact Nancy Hill (202) 508-5541.

June 7-12 - Tenth Topical Meeting on the Technology of Fusion Energy (held jointly with the annual meeting of the American Nuclear Society). Boston, MA. Contact Nermin Uckan (615) 574-1354; fax (615) 576-7926.

QUOTABLE

"The government cannot simply now rewrite history to retell events as it wishes they had unfolded."

Judge J. Frederick Motz
U.S. District Court
Quoted in SCIENCE
29 November 1991, p.1290



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FUSION ENGINEERS TO MEET JUNE 7-11

SAIC READIES ITER SITE U.S. ITER TEAM SEEKS INDUSTRY BIDS

NEW AFFILIATE

Advanced Physics Corporation has joined Fusion Power Associates as a Corporate Affiliate. Dr. Bogdan Maglich, President and Chief Scientist, will represent the corporation. Advanced Physics Corporation advocates the development of colliding beam fusion systems using advanced fusion fuel cycles. Dr. Maglich can be reached at 1050 University Tower, 4199 Campus Drive, Irvine, CA 92715; tel (714) 854-6919; fax (714) 854-3065.

FUSION ENGINEERS TO MEET IN BOSTON

The Tenth Topical Meeting on the Technology of Fusion Energy will take place June 7-11 at the Marriott Copley Place in Boston as part of the annual meeting of the American Nuclear Society. Persons wishing to attend the conference can register at the door or in advance. Contact ANS, fax (708)352-6464. FPA president Steve Dean is General Chairman of the meeting; Nermin Uckan of ORNL is Technical Program Chairman.

The technical program includes over 160 papers. During the opening plenary session on "The Atom and Human Values," former director the DOE Office of Fusion Energy, John F. Clarke will present a talk, "Global Scale Energy Technology in the Environmental Context." On Monday evening, June 8, there will be a special evening forum, "Plans and Strategy for U.S. Technology Program:

Relationship to ITER." Charles C. Baker of ORNL will moderate the session, which will include Mohamed Abdou, Dale DeFreece, Bob Dowling, Sam Harkness, and Keith Thomassen. Earlier that afternoon, in another plenary session, Jim Decker, deputy director of the Office of Energy Research, DOE, will make a presentation, "Role of Fusion in DOE Energy Policy." That session will also include invited talks by Ron Parker, Erik Storm, Bob Conn, and John Holdren.

On Tuesday afternoon, June 9, there will be a special session, "Status and Directions for Next Generation U.S. Magnetic Fusion Experiments," moderated by DOE Office of Fusion Energy director N. Anne Davies. Invited talks in that session will be given by Ron Davidson, John Sheffield, Alex Glass, Steve Dean, and Bob Conn. On Wednesday morning there will be a set of invited papers, with international participation, on the status of the ITER project.

INDUSTRY BIDS SOUGHT FOR ITER

The U.S. ITER Home Team, under the direction of Alex Glass, is making arrangements for the participation of U.S. industry in the technology R&D for ITER. Notices have begun to appear in Commerce Business Daily which require industry responses for potential contracting opportunities. These contracting opportunities will be managed by several different DOE prime contractors: Oak Ridge National

Laboratory will issue Requests for Proposals (RFP's) for work on Assembly and Maintenance and Containment Structures; Argonne National Laboratory will issue an RFP in the area of Shielding and Blankets; Sandia National Laboratories will issue an RFP in the area of Plasma Facing Components, and MIT will issue an RFP in the area of Magnets. For additional information, contact the following persons: Charles Baker (ORNL) tel (615)574-1940; Richard Mattas (ANL) tel. (708) 972-8673; Wilhelm Gauster (SNL) tel. (505) 844-1522; Bruce Montgomery (MIT) tel. (615) 253-5552.

RUSSIAN BACKS ANEUTRONIC FUSION

Academician Nikolay G. Malishev, "State Advisor on Science and Higher Education of the Russian Federation," has sent letters to Rep. George Brown and Presidential Science Advisor Alan Bromley stating that after a "high level technical conference organized by the Russian Academy of Science," that "Fusion experts from several leading Russian and USA institutes have concluded that, while not without risk, the aneutronic concepts are scientifically sound." The letter cites concepts advocated by "the University of California at Irvine and Advanced Physics Corporation," and states that scientists from the High Current Electronics Institute at Tomsk, the Institute of the Electrophysics at Ekaterinburg, the Kurchatov Institute, the Budker Institute, and the Institute for Theoretical and Experimental Physics have expressed interest in working with the Americans in the effort." The letter states that "the American proposal is to have about 100 Russian scientists work on the program in Russia, with the exchange of 5 scientists between the two countries." The letter ends with the statement "I wish to emphasize that the Government of Russian Federation supports the pursuit of an alternative approach to fusion and this project, that originated from working scientists, in particular. Such a program would also help in the transfer of defense oriented pulsed power technology to civilian application. We would very much appreciate your help in its realization."

PACK JOINS USIA

Michael Pack, producer of the PBS fusion documentary "Fire from the Sun" has joined the U.S. Information Agency as Director of the Worldnet Television and Film Service in the Bureau of Broadcasting, Washington, D.C. The Bureau of

Broadcasting is the newly reorganized international radio and television arm of the USIA, and includes Worldnet, the Voice of America, and the Office of Cuba Broadcasting. Worldnet, the television and film service, currently transmits 24 hours of programming each week to 228 reception sites at U.S. embassies, cultural centers, and cable and broadcast systems worldwide.

In announcing the appointment, USIA director Henry Catto said, "Michael will add a new dimension of creativity and energy which will stimulate an already exciting agency to even better efforts."

Michael was previously founder and president of Manifold Productions, with offices in Los Angeles and New York. His wife, Gina, will continue to operate Manifold Productions, which is currently working on an update of their 1988 documentary "America's Political Parties," and a new documentary on trends in higher education. Michael can be reached at Worldnet, 601 D Street NW, Room 5000, Washington D.C., 20547, tel. (202) 501-7806, fax (202) 501-6664.

ITER ARTICLE IN SCIENTIFIC AMERICAN

The April issue of Scientific American contains an article "The International Thermonuclear Experimental Reactor," by Robert W. Conn, Valery A. Chuyanov, Nobuyuki Inoue and Donald R. Sweetman. The article describes the ITER political process and the machine design, and states "Its ability to generate more than 1,000 times the power of current fusion reactors will make ITER the penultimate experiment in the quest for a practical device of this kind. The scientific and engineering knowledge gained from ITER should lead to the demonstration of a fusion reactor power station, perhaps within the next three decades." Reprints of the article can be requested from Bob Conn, fax (310) 206-4832.

SAIC PREPARES SAN DIEGO ITER SITE

A group of SAIC employees, under the direction of Maurice Sabado, is preparing the office building in San Diego for occupancy by the ITER Joint Central Team. The task includes preparing the offices, installing computer and communications equipment, and preparing relocation arrangements for up to 200 scientists from around the world

who will be working together in San Diego for the next 5-6 years on the ITER engineering design. ITER director-designate Paul-Henri Rebut has made several visits to the site; the first "permanent" occupants are expected to arrive this summer. Russian scientist Valery Chuyanov is expected to become a deputy to Rebut and to be the formal head of the San Diego site. Other deputies to Rebut are expected to be Ron Parker (head of the Garching site), an unidentified European (head of the Naka site), and Y. Shimomura, principal deputy, located at the San Diego site.

DOWLING ANNOUNCES PLAN TO RETIRE

Bob Dowling, Director, Development and Technology Division, Office of Fusion Energy, has announced that he plans "to retire in third quarter of 1992," from his career at the Department of Energy "after 35 years of government service." He has been in his present position since 1980. Previously, since 1970, Bob had been in the AEC/ERDA/DOE Civilian Reactor Development Program, where he had key responsibilities for the development of all the reactor components for the Fast Flux Test Facility (FFTF). He started his government career in 1957 with Admiral Rickover in the Naval Reactors Program, where he was project engineer for the development of fission cores for nuclear submarines. We wish Bob well in his "retirement."

FPA PROCEEDINGS PUBLISHED

The proceedings of Fusion Power Associates June 25-26, 1991 annual meeting and symposium "Fusion Facilities Planning for the 1990's" has been published as a Special Issue of the Journal of Fusion Energy, December 1991. It should be available in your technical libraries. Individual subscriptions to the Journal can be obtained by contacting Plenum Press, 233 Spring Street, New York, NY 10013; fax (212) 807-1047. The proceedings contains numerous articles, including the keynote address "The Quest for Fusion Energy," by Grumman CEO Renso Caporali.

UNIVERSAL VOLTRONICS EXPANDS

Universal Voltronics Corp. has signed a letter of intent to acquire KeyTek Instrument Corp., a manufacturing company located in Wilmington, MA, with annual revenues of \$9 million. KeyTek is a leading designer, developer, and manufacturer of instruments and systems that simulate the



SAIC Readies ITER Site in San Diego: l. to r. Tom James, DOE; Cecilia Jirón, SAIC; Jim Magnuson, SAIC; Tom Dillon, SAIC; Paul-Henri Rebut (ITER Director-Designate); Moira McGrain, SAIC; Maurice Sabado, SAIC; Bob Price, DOE

effects of pulsed electromagnetic interference and power interruptions. These products are used by a wide variety of companies throughout the world to test the ability of their components and systems to withstand short-duration, high-energy pulses caused by lightning or electrostatic discharge, power disturbances caused by power interruptions or power surges, and high-frequency transients caused by power switching. Universal Voltronics designs and manufactures high-voltage power conversion systems for scientific and energy research, industrial, medical, and defense applications. It is a subsidiary of Thermedics Inc. and Thermo Electron Corp. and is a Corporate Affiliate of Fusion Power Associates.

Universal Voltronics also recently won a \$3.5 million contract from Argonne National Laboratory to supply four high voltage modulator systems for the Advanced Photon Source, a DOE project scheduled to begin operation in 1996. For further information on Universal Voltronics and its products, contact Barry Ressler, President, UVC, 27 Radio Circle Drive, Mt. Kisco, NY, 10549, tel. (914) 241-1300.

PLASMA DEVICES JOURNAL COMPLETES FIRST YEAR

The journal *Plasma Devices and Operations* (see our November 1990 newsletter) has completed Volume 1, consisting of four issues during 1991. The journal is published by Gordon and Breach Science Publishers and is edited by a team of people at the D.V. Efremov Institute, St. Petersburg, Russia, under the direction of V.A. Glukhikh (editor-in-chief) and A.N. Popov (managing editor). Individual and corporate subscriptions are available. Contact Gordon and Breach as follows: In the U.S., 1-800-545-8398; in the U.K., fax 44-734-568211. In Japan, contact Yohan Western Publications, 3-14-9 Okubo, Shinjuku-ku, Tokyo 169.

ELECTRIC CARS ON THE WAY?

Westinghouse Electric Corp. and Chrysler Corp. announced March 3 that they will develop an electric car for commercial use in the late 1990's. The vehicle should be able to travel twice as far and at twice the speed of electric cars under development by other leading manufacturers, the companies said. (Source: USCEA newsletter "INFO", March 1992).

Meanwhile, DOE has instituted a "jointly-funded, four year, \$260 million research project to develop a new generation of batteries that would make electric vehicles widely available by the year 2000." The government funds would be provided to the U.S. Advanced Battery Consortium (USABC), a partnership among Chrysler, Ford and General Motors, with support from the electric utility industry.

MEETINGS

May 19-21 - Public meeting of DOE Fusion Energy Advisory Committee, UCLA, Los Angeles, CA. Contact Debbie Lonsdale, tel. (301) 903-4941, fax (301) 903-2791.

May 25-29 - Ninth International Conference on High Power Particle Beams, Mayflower Hotel, Washington DC. Contact: "Beams '92", fax (202) 404-8110.

May 31-June 3 - Sixtieth Annual Edison Electric Institute Convention, Hyatt Regency, Columbus OH. Contact: EEI, fax (202) 508-5360.

June 7-11 - Tenth Topical Meeting on the Technology of Fusion Energy. Marriott Copley Place, Boston MA. Contact: Nermin Uckan, fax (615) 576-7926.

June 8-12 - Fourteenth International Cryogenic Engineering Conference, Kiev, Ukraine. Contacts: Mrs E.L. Briich in U.S., fax (614) 424-5263; Mrs. V. Lokteva in Kiev, fax (044) 2680486.

June 28-July 3 - International Workshop on Muon Catalyzed Fusion, Uppsala, Sweden. Contact: P. Froelich in Sweden, fax 46-18-502402.

September 27-October 1 - Prospects for Heavy Ion Fusion, Crete, Greece. Contact: Dr. Josip Hendelkovic, Fax (France) 33-88-36-69-87.

September 30-October 7 - Fourteenth IAEA International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Wurzburg, Germany. By invitation. U.S. Contact: David Crandall, U.S. DOE, Fax (301) 903-2791. Others contact local Government fusion officials.

QUOTABLES

"Lindbergh's view on trading risk for rewards would be considered anathema in today's America where a risk-free existence is considered a birthright."

Mark R. Twombly
AOPA Pilot Magazine
May 1992

"I believe the person who says winning isn't everything has never won anything."

Reebok TV commercial, 1992



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FEAC ENDORSES INNOVATIONS PROGRAM

CONN, KULCINSKI RECEIVE LEADERSHIP AWARDS

ROCKWELL JOINS FPA

Rocketdyne Division of Rockwell International Corp. has joined Fusion Power Associates as an Affiliate. R. M. Mucica, Director, AI Land Power Programs, will represent the company. He can be reached at 6633 Canoga Avenue, Canoga Park, CA, 91303, tel. (818) 718-3460. We welcome their participation in Fusion Power Associates.

CONN AND KULCINSKI RECEIVE FPA LEADERSHIP AWARDS

The Fusion Power Associates Board of Directors has voted to present its 1992 Leadership Awards to Prof. Robert W. Conn of UCLA and Prof. Gerald L. Kulcinski of the University of Wisconsin. The awards were presented on June 8 by FPA president Steve Dean in Boston at the ANS Tenth Topical Conference on Fusion Technology. The awards were presented to Conn and Kulcinski in recognition of their outstanding leadership qualities and of their "pioneering and continuing contributions to the vision of future fusion reactor design which provide essential guidance to all fusion research and development." In presenting the awards, Dr. Dean also noted their contributions to the education of a generation of fusion design engineers and their broad influence on all aspects of fusion development.

The FPA leadership awards were established in 1980 to recognize individuals who have shown outstanding leadership qualities in the development of fusion as an energy source.



Dr. Robert W. Conn

Dr. Gerald L. Kulcinski

FEAC ENDORSES INNOVATIONS PROGRAM

The DOE's Fusion Energy Advisory Committee (FEAC) is advising DOE Director of Energy Research William Happer to reverse its 1990 decision to focus all effort on the tokamak concept (see our December 1990 newsletter). The decision was taken at the May 19-21 FEAC meeting at UCLA based on the report of FEAC Panel 3 on concept improvement policy (see our March 1992 newsletter).

The FEAC was responding to a request from Happer to "recommend a policy and selection criteria to help guide program choices on concept improvements within our goal-oriented program strategy." Happer stated: "The overall policy question is whether, given the demands of the mainline tokamak program and current budget constraints, we should encourage and fund proposals on concepts other than tokamaks."

In its response, FEAC noted that "the tokamak has emerged as the most scientifically successful." Consequently, FEAC recommended that "DOE's policy should be based on the recognition that tokamak concept improvement programs are essential and should receive the highest priority." However, FEAC stated, "It is also true that uncertainties remain in the extrapolation of the tokamak to a competitive commercial reactor. As long as such uncertainties remain, a non-tokamak fusion concept program, at some level, should be supported as a matter of policy. FEAC recommends that DOE retain the flexibility to test some non-tokamak concepts at intermediate scale when warranted by their technical readiness and promise as a reactor. In deciding when and what to fund in this area, DOE should coordinate its decisions with those of other countries active in the same concept area."

FEAC also suggested to Happer that "a small but formal and highly visible periodic competition be established to foster new concepts and ideas that if verified would make a significant improvement in the attractiveness of fusion reactors. Priority should be given to testing concepts, which are well-founded scientifically, at the small scale, proof of principle level. Projects funded under such a program should be limited in duration (e.g., 3-5 years) so that eventually the program has turnover. Resources for this program could eventually grow to a few percent of the annual program budget. Given that any individual new program will be relatively small in size and cost, collaborations with international efforts should not be a requirement."

FEAC also recommended that "DOE consider the benefits of operating the LSX field-reversed configuration (FRC) facility in order to determine the validity of its physics principles" and that "the U.S. should maintain a small theoretical and experimental RFP (Reversed Field Pinch) effort, including some level of collaboration with the European and Japanese RFP efforts."

FEAC stated that "The broader principles of policy and the specific suggestions we have made provide a balance between a strong mainline program and attention to other concepts. We believe this policy regarding concept improvement is appropriate even in the case of substantial budget changes." Copies of the FEAC letter and Panel 3 report may be requested from Terry Davies (310) 206-4854, Fax (310) 206-4832.

BROAD SUPPORT FOR PLASMA SCIENCE SOUGHT

In its letter to DOE Director of Energy Research William Happer, the Fusion Energy Advisory Committee stated that "Fusion and other applied plasma areas require that there be some level of basic research in plasma science." They recommended to Happer that "you use your influence to achieve an increase in basic plasma science research supported by offices in Energy Research such as the Office of Fusion Energy and the Office of Basic Energy Sciences. We also urge you to work for coordination and increased plasma science research from other agencies such as the National Science Foundation, the Office of Naval Research, and the National Aeronautics and Space Administration. Together, these offices and agencies can assure that a national basic research effort in plasma science is maintained."

NEW FEAC PANEL ESTABLISHED

A new panel (Panel 4) has been established by the Fusion Energy Advisory Committee (FEAC) "to provide input to FEAC on priorities in the toroidal confinement program." The new panel, chaired by David Baldwin (LLNL) and co-chaired by Harold Weitzner (NYU), will also "address U.S. policy regarding the stellarator, including the possible restart to ATF (the Advanced Toroidal Facility at Oak Ridge National Laboratory), in the context of the world effort to develop an optimized fusion reactor of the tokamak/stellarator type." FEAC called the stellarator "a well-developed alternative magnetic fusion concept that is closely related to the tokamak." The report of the panel to FEAC is expected by the end of September.

STEVEN ZINKLE RECEIVES FPA EXCELLENCE IN FUSION ENGINEERING PRIZE

The FPA Board of Directors has awarded its 1992 Excellence in Fusion Engineering Award to Dr. Steven J. Zinkle of Oak Ridge National Laboratory. In presenting the award June 8 in Boston, FPA president Steve Dean commended Zinkle for the "outstanding initiative, creativity and leadership you have shown in the seven years since you received your Ph.D. from the University of Wisconsin and the significant technical contributions you have made to the fundamental understanding of irradiation damage in fusion reactor candidate materials during that time."

The FPA Excellence in Fusion Engineering Award was established in 1987 in memory of MIT professor David J. Rose to recognize individuals early in their careers who have shown outstanding technical accomplishment and leadership potential in the field of fusion engineering.

VANDEVENDER AND LINFORD RECEIVE DOE LAWRENCE AWARDS

Fusion scientists J. Pace VanDevender (Sandia National Laboratories) and Rulon K. Linford (Los Alamos National Laboratory) are among six recipients of the Department of Energy's E. O. Lawrence Awards. The awards were established in 1959 to honor the memory of Dr. Ernest O. Lawrence, inventor of the cyclotron. The awards are given to individuals who are relatively early in their careers and have made meritorious contributions to the development, use or control of atomic energy.

Dr. VanDevender was cited for his leadership of the inertial confinement fusion program at Sandia and for numerous contributions to the science and technology of pulsed power systems.

Dr. Linford was cited for his leadership of the magnetic confinement fusion program at Los Alamos and for his scientific and technical contributions to the development of field-reversed and spheromak fusion configurations.

LANDIS WINS COONLEY MEDAL

John W. Landis, senior vice president of Stone and Webster Engineering Corporation and a member of Fusion Power Associates Board of Directors, has been awarded the Howard Coonley Medal by the American National Standards Institute. The award recognizes John's many contributions to the development of voluntary standards in the energy industry. In a congratulatory letter, Secretary of Energy James D. Watkins stated "The Howard Coonley Medal recognizes your service to the Nation as the driving force behind the development of consensus standards for the application and regulation of nuclear power. Your leadership in forging these standards was instrumental in development of a safe and reliable commercial nuclear power industry."

We also congratulate John on this honor and thank him for his support of fusion development in general and of Fusion Power Associates, in particular.



Dr. J. Pace VanDevender Dr. Rulon K. Linford

FEAC PANEL 3 REPORTS ON CONCEPT IMPROVEMENT POLICY

The Fusion Energy Advisory Committee's recommendations on fusion concept improvement (see earlier article, this issue) was based on a report from its Concept Improvement Panel (Panel 3). The panel was chaired by Steve Dean and co-chaired by Barry Ripin. Other members of the panel were: D. Batchelor, K. Berkner, W. Ellis, K. Gentle, S. Kaye, G. Logan, E. Marmor, G. Navratil, N. Ness, T. Ohkawa, R. Siemon, D. Steiner, and H. Weitzner. The panel reached the following findings, which were reported to the full FEAC at its May 19-21 meeting.

1. A breakdown in communications occurred between DOE fusion program managers and the fusion research community in the Fall of 1990 when DOE decided to narrow the program to tokamaks. A negative consequence of that decision is the widespread impression that DOE has postured itself to be unreceptive to new ideas. It is important to reverse this impression.
2. The time scale of the fusion program dictates the importance of concept improvement. Science and technology thirty years hence will certainly be far different from what we might envisage today. Programs, like fusion, that will continue over such periods, must retain breadth and flexibility to incorporate changes that will certainly accrue.
3. Among the many magnetic fusion confinement concepts, the tokamak has emerged as the most scientifically successful concept. However, uncertainties remain in the extrapolation of the tokamak to a competitive commercial energy source. Fusion reactor design studies indicate that

improvements are required in both the physics and technology of tokamaks.

4. As a general principle, we find (as stated eloquently by the ESECOM panel), "Although research priority should reward the more successful fusion confinement and technology options, it is essential not to concentrate so heavily on a single line of development (no matter what the budget) that better concepts cannot continue to be developed for improved second-generation configurations."

5. Though less advanced than the Tokamak, Stellarators offer an alternative approach to solving some of the needed improvements in the tokamak. The issue for the U.S. fusion program is to formulate a Stellarator policy in the context of the World effort to develop an optimized toroidal-field-dominated fusion reactor of the tokamak/stellarator type, while continuing to provide technical data and insights to the tokamak program.

6. The DOE decision to eliminate support for non-tokamak concepts was based, in part, on the philosophy that, even if the research were successful, no funds would be available to develop the concept to its next, more-expensive stage; thus it would be best not to begin. A change in the current policy would require that DOE retain the flexibility to test some non-tokamak concepts at intermediate scale, when their technical readiness and promise so-warrants.

7. A program as large and as long-range as fusion must find mechanisms for encouraging innovation. A small, but formal and highly-visible annual competition to foster new ideas, modelled after the IR&D programs of large institutions, is a mechanism that could serve this purpose.

8. In addition to the science and technology in direct support of a confinement concept, the fusion program should maintain some level of support for "basic" plasma science and forefront technology that provide the underpinnings of "fusion" plasma science and fusion technology.

VARIAN NEGOTIATES RUSSIAN AGREEMENT

Varian Associates in Palo Alto, California, and Gycom, of Nizhny Novgorod near Moscow, have signed an agreement for the transfer and development of Russian high-power

microwave tube (gyrotron) technology. Gyrotrons are used primarily in advanced science research applications such as fusion energy projects and particle accelerators.

Varian is the world leader in the design, development, and supply of advanced gyrotron tubes. Gycom, a recently formed Russian consortium headed by the director of the Institute of Applied Physics, Andre Gaponov-Grekhov, represents one of the world's most advanced gyrotron design, development, and manufacturing capabilities.

Officials from both organizations said the agreement includes licenses allowing the first transfer of highly sophisticated Russian pulsed-tube technology to a U.S. company. They noted that the Russian technology closely complements work under way at Varian, and said the transfer of such leading-edge expertise should pave the way for faster and lower-risk development and production of continuous wave, higher power gyrotrons in the U.S.

Richard Born, Vice President and General Manager of Varian's Microwave Power Tube Products business, pointed out that the agreement also marks another industry first. He said the arrangement establishes a continuing business relationship between the two organizations which not only provides for development of new generations of gyrotrons, but allows the supply of critical components for their manufacture from Russian sources.

NOTE ON NEWLY-BORN

Susan Kinkead Acree, formerly Director of Public Affairs for Fusion Power Associates, gave birth to a daughter, Nicole Marie, on May 8 in Guatemala. Susan is currently Director of Public Information for Central America and Panama, U.S. Department of Agriculture Animal and Plant Health Inspection Services.

U.S. mail can be sent to Susan at USDA, APHIS-IS, Unit 3319, APOOAA, 34024. International mail can be sent to 13 Avenida 13-133, Zona 10, Oakland, Guatemala. Her phone number is 335097 (home) or 313186 (work), preceded (in the U.S.) by dialing 011-5022.

Congratulations John and Susan!



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DOE READIES DECLASSIFICATION - BUT WILL WITHHOLD CRITICAL DATA

PRINCETON PREPARES FOR TRITIUM TEST

ICF DECLASSIFICATION SET

Two years ago, Energy Secretary James Watkins told an international audience (see our October 1990 newsletter) that he had "directed the Department of Energy's staff to undertake a comprehensive review of the classification of our programs in inertial confinement fusion (ICF)," with the goal "to eliminate unnecessary restrictions on information relevant to energy applications." He said, "I have told my staff that I expect a preliminary report from them within three months. I see this review as necessary, if the U.S. government is to reassess its current policy that discourages U.S. participation in international research on inertial fusion."

The Department has now completed the preparation of new "classification guidelines" which will declassify most of the existing U.S. research on the designs of the small pellets that are used as targets for the high power laser and particle beams. In preparing the new guidelines, the DOE sought and received concurrence from other U.S. agencies (Defense Department, State Department and National Security Council) and from other nuclear weapons countries (France and the United Kingdom). DOE completed its own review about one year ago.

Although the DOE has still not officially issued the new guide, there is some pressure to issue it soon, due to the preparation of papers for the upcoming major international biennial fusion conference sponsored by the International

Atomic Energy Agency, September 30 - October 7 in Wurzburg, Germany. It was at the previous conference in this series that Secretary Watkins made his remarks on ICF classification in his keynote address. In that address, Watkins stated "If inertial fusion has promise as an energy source, and I believe it does, we should pursue that promise with the sort of cost-effective international collaboration that marks magnetic fusion efforts such as the International Thermonuclear Experimental Reactor (ITER)."

CRITICAL DATA TO REMAIN CLASSIFIED

Under the new, soon-to-be-issued, ICF classification guidelines DOE will continue to keep secret the data it obtained by imploding ICF pellets with radiation from underground nuclear weapons tests. Even the existence of those tests were kept secret until they were revealed in a front page story by William J. Broad in the New York Times on March 21, 1988 (see our April 1988 newsletter).

DOE subsequently confirmed the existence of the test program (Code-named "Halite-Centurion"), stating "Underground tests in Nevada have allowed demonstration of excellent performance, putting to rest basic questions about the feasibility to achieve high gain."

DOE has refused to permit any disclosure of the quantitative aspects of the test results, a policy that is expected to continue under the new classification guidelines.

Commenting on this aspect of the new classification policy, FPA president Steve Dean stated that "DOE has taken two years to bake half a loaf."

ICF ENERGY STUDIES CAUGHT BY CLASSIFICATION QUAGMIRE

For the past two years, the DOE's Office of Fusion Energy has been funding inertial fusion reactor design studies with two competing industrial teams (see our July 1990 newsletter). The studies, led by McDonnell Douglas Missile Systems Company and by W.J. Schafer Associates respectively, are each focused on the designs of both a Krypton-Fluoride-driven and a heavy-ion-driven ICF reactor. The studies, just-completed, have been carried out on an unclassified basis, using guidelines provided by DOE. However, during a routine review of the final reports by the DOE Office of Classification, both reports were stamped "Secret - Restricted Data" and copies were confiscated. Most of the scientists who worked on the studies did not hold DOE clearances and, consequently, DOE decided that it could not tell them which parts of the studies were classified.

Attempts to "sanitize" the reports were partially successful, and summaries of the studies were presented at the recent American Nuclear Society Tenth Topical Conference on the Technology of Fusion Energy, in Boston. These summaries, including an overview by Dave Crandall of DOE, are contained in the proceedings, published in the May 1992 issue of the ANS journal "Fusion Technology."

Ebasco Services, KMS Fusion, Ontario Hydro Canadian Fusion Fuels Project, Spar Aerospace, TRW and UCLA were members of the McDonnell Douglas team. Bechtel, General Atomics, Textron and the University of Wisconsin were part of the Schafer Associates team.

ICF ENERGY BOOK PLANNED

The International Atomic Energy Agency (IAEA) has commissioned the preparation of a book to be titled, "Energy from Inertial Fusion." Chapters in the book will be written by experts from around the World. The purpose of the book is to describe inertial fusion power plant characteristics and design principles, and to describe the engineering and technical developments needed to make inertial fusion power a reality.

Preparation of the book is being coordinated by the IAEA's Advisory Group on Inertial Fusion Energy, composed of J. Coutant (Centre d'Etudes de Lemeil, France), W.J. Hogan (LLNL, USA), S. Nakai (Inst. of Laser Engineering, Osaka Univ., Japan), V.B. Rozanov (P.N. Lebedev Inst., Russian Federation), and G. Velarde (Inst. of Nuclear Fusion, Spain). The book is expected to become available early in 1993. Contact David Banner, Division of Physical and Chemical Sciences, IAEA, PO Box 100, A-1400, Vienna, Austria; Fax: 234564.

TFTR PLANS TRITIUM TEST

Scientists at the Princeton Plasma Physics Laboratory (PPPL) are making preparations for the introduction, scheduled for November, of a "small" (1000 Curie) amount to tritium into the Tokamak Fusion Test Reactor (TFTR). The brief test is designed to acquire information and experience leading up to the planned major series of tritium experiments, scheduled to begin in September 1993.

This represents a two month schedule slippage from earlier plans and is due to a DOE decision to use the TFTR tests as a "guinea pig" for a first application of their new, formal safety review procedures to energy research facilities. In spite of the small amount of tritium involved, and the single shot nature of the test, DOE has established a lengthy and complicated series of "preparedness checks" and "operational readiness reviews" that must be passed before they "authorize" the use of tritium in the tests.

Beginning in late July, PPPL will undergo a "contractor Operational Readiness Review", conducted for DOE by nine outside experts over a three to four week period. Following that report, the DOE will conduct a "governmental Operational Readiness Review" (optimistically scheduled to begin in late September). Following that, the DOE Office of Nuclear Safety and the DOE Office of Environment, Safety, and Health will "double check" the DOE governmental Operational Readiness Review. Also, an "oversight function" will be performed by the DOE's Princeton Area Office, Chicago Operations Office, and Office of Energy Research. A similar series of reviews will be required again before the major experiments begin in September 1993. During those tests, PPPL plans to have 50,000 Curies (5 grams) of tritium on site. Citing the difficulty of dealing with DOE regulations these days,

scientists at Princeton noted that DOE briefly ordered the shutdown the Tritium Systems Test Facility at Los Alamos after a leak of only 0.4 Curies occurred.

DOE also held a series of public meetings in Princeton this Spring to describe the TFTR D-T Environmental Assessment. At those meetings, PPPL scientists told the public that the "worst possible accident, which was probabilistically incredible," in which half of the total inventory was released to the environment as tritiated water (HTO), would cause a dose to a person standing at the site boundary comparable to the annual natural radiation dose in the area.

CANADIAN FUSION PROGRAM TO INCREASE 50 PERCENT

The government of Canada has approved a new five-year federal funding term for the National Fusion Program at a constant annual funding level during the period which is 52% higher than in the previous five-year period. News of the increase was released by the office of the Hon. Marcel Danis, federal Minister of Labour, who said, "By supporting fusion research and development, Canada is also promoting industrial expansion. The technologies developed through the Canadian fusion program are already being used in other sectors of industry."

The provinces of Ontario and Quebec provide matching funds to complement the funds from the National government. Canada conducts fusion research at two key centers: Centre Canadien de Fusion Magnetique (CCFM), near Montreal, and the Canadian Fusion Fuels Technology Project (CFFTP), near Toronto. The total combined funding for the Canadian fusion program will be approximately \$30 million annually.

NASA FUSION STUDY REPORT AVAILABLE

A NASA report, entitled "Fusion Energy for Space Missions in the Twenty-First Century" is available from its author, Dr. Norman R. Schulze (NASA HQ, Code QE, Washington, D.C., 20546; phone 202-453-1554). The lengthy report has technical depth, extensive data and many references. One of the conclusions of the report is that the Field Reversed Configuration (FRC) is a leading candidate to fulfill NASA requirements for space applications.

OLEG FILATOV RECEIVES FPA AWARD

Dr. Oleg Filatov, of the D.V. Efremov Institute, St. Petersburg, Russian Federation, received the Fusion Power Associates "Excellence in Fusion Engineering Award," during the ANS Tenth Topical Conference on the Technology of Fusion Energy in Boston on June 10. The award was presented by FPA president Steve Dean on behalf of the FPA Board of Directors. Dean noted Filatov's many contributions to magnet design and to national and international fusion reactor studies, including ITER. Filatov has recently been designated Russian "Home Team Leader" for ITER. He is the first person outside of the U.S. to receive the award, which was established by FPA in 1987 to honor the memory of MIT professor David J. Rose.

ANS FUSION ENERGY DIVISION AWARDS

The American Nuclear Society Fusion Energy Division presented three awards at its Tenth Topical Conference in Boston, June 7-11.

George Miley (University of Illinois) received the Division's "most prestigious award," the Outstanding Achievement Award. The award was presented by Awards Committee chairman Don Steiner, who cited Miley for "his many significant contributions in research and education." He is the editor of the ANS journal "Fusion Technology," has supervised more than 40 Ph.D. theses, authored 2 books and is noted for his research on advanced fusion fuels and concepts.

Douglas E. Post (Princeton Plasma Physics Laboratory) received the Outstanding Technical Accomplishment Award, for "his exemplary accomplishments in leading the ITER Physics Team and the entire ITER Physics Design effort." Steiner said that "Doug accomplished this difficult task with mastery of the relevant physics and with enormous personal dedication."

Lance L. Snead, who recently received his Ph.D. from the Rensselaer Polytechnic Institute, was presented the Student Award for best student paper submitted to the meeting. His paper was entitled "Development of SiC Composites for Fusion."

FUSION POWER ASSOCIATES AWARDS

Leadership Awards

The Leadership Awards are presented by the Fusion Power Associates Board of Directors to those individuals who have shown outstanding leadership qualities in accelerating the development of fusion.

Recipients are:

- 1980 S. J. Buchsbaum
R. L. Hirsch
M. McCormack
P. Tsongas
- 1981 E. E. Kintner
- 1982 H. P. Furth
J. H. Nuckolls
- 1983 J. L. Emmett
T. K. Fowler
- 1984 T. Ohkawa
G. Yonas
- 1985 E. P. Velikhov
C. Yamanaka
- 1986 R. C. Davidson
- 1987 M. N. Rosenbluth
- 1988 J. F. Clarke
- 1989 P-H. Rebut
- 1990 B. B. Kadomtsev
- 1991 B. Coppi
- 1992 R. W. Conn
G. L. Kulcinski

Distinguished Career Awards

Distinguished Career Awards are presented to those individuals who have made distinguished, lifelong career contributions that directly or indirectly have benefitted fusion. Recipients are:

- | | | | |
|------|---|------|---|
| 1987 | M. B. Gottlieb
D. Kerst
R. F. Post
L. Spitzer, Jr. | 1990 | N. G. Basov
T. Sekiguchi |
| 1988 | K. Husimi
D. Palumbo
R. S. Pease | 1991 | H. K. Forsen
J. W. Landis
R. L. Sproull
H. G. Stever |
| 1989 | F. H. Coensgen
D. J. Grove
F. L. Ribe | | |

Excellence in Engineering Awards

This award was established in memory of Professor David J. Rose to recognize those individuals in the early part of their careers who have shown outstanding technical accomplishment and leadership potential in the field of fusion engineering. Recipients are:

- 1987 Steven J. Piet
- 1988 Michael A. Ulrichson
- 1989 David Ehst
Y-K. Martin Peng
- 1990 Wayne Reiersen
- 1991 John Santarius
- 1992 Oleg Filatov
Steven J. Zinkle



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FUSION AGREEMENT SIGNED

DEDICATED WORLD FUSION EFFORT LAUNCHED

TRW REJOINS FPA

TRW, Inc. has rejoined Fusion Power Associates as a full voting member. Dr. James A. Maniscalco will represent the company. He can be reached at TRW, One Space Park, E1/2041, Redondo Beach, CA, 90278; tel. (310) 813-2524; fax (310) 814-6403. We welcome TRW's participation in Fusion Power Associates.

ITER AGREEMENT SIGNED

After 18 months of bureaucratic negotiation, the European Community, Japan, Russian Federation and United States agreed to a \$1.2 billion, six year effort to design ITER, the "International Thermonuclear Experimental Reactor." The design effort, which includes technology R&D, will be undertaken under the auspices of the International Atomic Energy Agency (IAEA), headquartered in Vienna, Austria.

The signing ceremony was held in Washington on July 21. Energy Secretary James D. Watkins signed for the U.S., along with Ambassador Andreas van Agt for the Commission of the European Communities; Minister Hiroshi Hirabayashi, Deputy Chief of Mission in the Embassy of Japan; and Victor Mikhailov, Minister of Atomic Energy, Russian Federation. Hans Blix, director-general of the IAEA presided over the ceremony.

Watkins called the agreement "a milestone in the development of a safe, environmentally sound energy source for the next century." van Agt said that the effort is a "model" for future scientific collaborations on large projects. A video of the half-hour signing ceremony is available on loan from Fusion Power Associates.

Co-centers have been established in San Diego (US), Naka (Japan) and Garching (Germany). Scientists and design engineers should begin arriving at the centers during the last quarter of this year. The first order of business for the venture, called the "ITER EDA" (for Engineering Design Activities) is a meeting of the managing body, the ITER Council, scheduled for mid-September. That body will officially launch the project by appointing the ITER director, expected to be Paul-Henri Rebut, currently the director of the JET project in Europe. The ITER Council will be formally headquartered in Moscow and be headed by Academician E.P. Velikhov. Rebut will be resident at the San Diego co-center.

It is anticipated that the ITER Council will also appoint Y. Shimamura of Japan to be principal deputy director to Rebut at the San Diego co-center, where he will be responsible for design integration. Rebut is also to have three other deputy directors. These are expected to be V. Chuyanov of the Russian Federation, (located in San Diego and responsible for the nuclear department and buildings); R. Parker of the U.S. (located in Garching and responsible for in-vessel components); and M. Huguet of Europe (located in Naka and responsible for out-of-vessel components).

Technical staff at the co-centers is expected to grow to about 25 persons at each co-center during the next year, reaching a steady-state number of about twice that within 3 years. The exact number of technical and support staff doing design at the co-centers vs. the amount of effort on R&D in the home countries is still to be determined. Each

of the parties to the agreement has established a "home team" to carry out requested technology R&D. The respective "home team leaders" are R. Toschi (Europe), S. Matsuda (Japan), O. Filatov (Russian Federation), and A. Glass (U.S.).

INDUSTRY BIDS SOUGHT

The U.S. ITER Home Team will issue a Request for Proposals (RFP) through the Lawrence Livermore Laboratory for "Engineering Design and Related Services for the Engineering Activity of the International Thermonuclear Experimental Reactor (ITER)." Organizations wishing to receive the RFP should contact Edwin Cassidy, LLNL, 7000 East Avenue, P.O. Box 5012, Mail Stop L-650, Livermore, CA, 94551. The July 29 Commerce Business Daily announcement (2966067) states that a "subcontractor is sought to support the U.S. ITER Home Team effort in the design of the ITER facility, and for assisting in the execution of other Fusion Reactor Design Studies. Tasks will involve assignments for individuals as well as groups. Activities may involve full or fractional-time assignment."

This RFP is the last of six RFP's to be issued under the auspices of the U.S. Home Team. Others have previously been issued (and submission dates have closed) for technology development in the areas of magnets, plasma facing components, shielding/blankets, and assembly/maintenance, and containment structure.

VARIAN SETS NEW GYROTRON RECORD

Varian Associates, Palo Alto, has set a new world record for high power gyrotron operation by producing over 500 kilowatts in a two second pulse at 110-GHz. "This milestone marks Varian's progress toward the goal of one Megawatt continuous-wave operation," says Bob Alper, product manager, High-power Tubes.

The 110-GHz gyrotron is being developed under contract to the Lawrence Livermore National Laboratory for the DOE fusion program. Varian had set another record previously, operating a 140-GHz tube at 400 kilowatts for half a second.

TFTR TRITIUM TEST CORRECTION

According to Princeton Plasma Physics Laboratory deputy director Dale Meade, the 1000 curie tritium test in TFTR scheduled for this November, and reported in our July newsletter, will be conducted in the TFTR storage and



Dr. Oleg G. Filatov (left) receives Excellence in Fusion Engineering Award from FPA President Steve Dean (See article from July newsletter)

delivery system and not in the TFTR device itself. The purpose of the tritium introduction will be to test the equipment and the tritium cleanup system.

FUSION SPINOFFS AT PPPL

For the past several years, fusion researchers at the Princeton Plasma Physics Laboratory have been developing electron cyclotron resonance (ECR) plasma discharge techniques for etching complex patterns and depositing semiconducting or insulating films onto semiconductors, in their Plasma Processing Research Group. Joe Cecchi, who heads the group, says that the technique "offers numerous potential processing advantages over other etching techniques, including reduced damage to the silicon substrate and to the devices being etched. Our main objective is to investigate generic ECR issues that will increase understanding and allow us to develop and transfer the appropriate technology to industry."

In January 1992, Cecchi also was named the director of the New Jersey SEMATECH Center of Excellence for Plasma

Etching, one of eight Centers of Excellence sponsored by SEMATECH around the country. About half the work of the Center is carried out at PPPL, with other work carried out at Rutgers, the David Sarnoff Research Center, the New Jersey Institute of Technology and Stevens Institute of Technology, all members of the New Jersey Consortium for Surface Processing. The Center's work is carried out in close collaboration with a number of companies, including Applied Materials, AT&T, Drytek, IBM, Intel, Motorola, Texas Instruments, and SEMATECH itself.

In May, a "Topical Research Conference in Plasma Etching" was held at PPPL, attracting eighty participants representing nine semiconductor manufacturing companies, four manufacturers of plasma etching equipment, eight universities, two national laboratories, and six SEMATECH Centers of Excellence. According to Cecchi, "During the conference, technology transfer-oriented presentations on state-of-the-art issues in plasma etching were given. These included etch tools and processes, damage and contamination, diagnostics, and modeling." Many of the diagnostics were also developed as part of the fusion program, according to Cecchi.

SUPERCOMPUTED SUPER TOKAMAK (SST)

Fusion scientists from ten research institutions banded together to make a winning proposal as part of the "Grand Challenges" competition sponsored by the U.S. Department of Energy and the White House Office of Science and Technology Policy. Their proposal is to make a complete computer model of a tokamak plasma and to use this model to do experiments on the computer instead of in the laboratory. The proposal to develop a "Numerical Tokamak" was one of six winning proposals selected from fifty submitted (none of the others being in fusion).

Steve Jardin, deputy head of the Princeton Plasma Physics Laboratory Physics Department and one of the prime-movers of the proposal effort, says "A comprehensive computer model of a tokamak plasma will save us millions of dollars in the development of a fusion reactor by allowing us to design and fine-tune experiments without building and operating as much expensive hardware." W.W. Lee, head of the Gyrokinetic Simulation group at PPPL notes that problems that take 1-2 weeks on today's fastest computers would take only a few hours on the new generation of "massively parallel" supercomputers like Thinking Machines Company's CM5, which will be used for the tokamak project



*Joe Cecchi and Jim Stevens of PPPL
examine a silicon wafer prior to plasma etching*

beginning this fall at Los Alamos National Laboratory.

In addition to PPPL, the other institutions involved in the project are the California Institute of Technology Jet Propulsion Laboratory, Cornell University, General Atomics, University of Texas Institute of Fusion Studies, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, National Energy Research Supercomputing Center, Oak Ridge National Laboratory, and UCLA.

TRITIUM SAFE HANDLING COURSE SET

The Canadian Fusion Fuels Project will offer its basic Tritium Safe Handling Course at Chalk River Laboratories, Ontario, Canada, October 19-23, 1992. The course consists of lectures, hands-on experience with tritium, and tours of tritium facilities. Tuition is \$2985 US. Contact: Course Coordinator, fax (416)823-9644.

ERRATA

In our last newsletter, we listed names of all those who have received FPA Leadership, Distinguished Career, and Excellence in Engineering awards. Unfortunately the name of Erik Storm, recipient of our Leadership Award in 1991, was inadvertently left out. We are embarrassed by our mistake. Because we want the page to be an accurate historical reference, we are reproducing the entire page again in this newsletter.

FUSION POWER ASSOCIATES AWARDS

Leadership Awards

The Leadership Awards are presented by the Fusion Power Associates Board of Directors to those individuals who have shown outstanding leadership qualities in accelerating the development of fusion.

Recipients are:

- 1980 S. J. Buchsbaum
R. L. Hirsch
M. McCormack
P. Tsongas
- 1981 E. E. Kintner
- 1982 H. P. Furth
J. H. Nuckolls
- 1983 J. L. Emmett
T. K. Fowler
- 1984 T. Ohkawa
G. Yonas
- 1985 E. P. Velikhov
C. Yamanaka
- 1986 R. C. Davidson
- 1987 M. N. Rosenbluth
- 1988 J. F. Clarke
- 1989 P-H. Rebut
- 1990 B. B. Kadomtsev
- 1991 B. Coppi
E. Storm
- 1992 R. W. Conn
G. L. Kulcinski

Distinguished Career Awards

Distinguished Career Awards are presented to those individuals who have made distinguished, lifelong career contributions that directly or indirectly have benefitted fusion. Recipients are:

- 1987 M. B. Gottlieb
D. Kerst
R. F. Post
L. Spitzer, Jr.
- 1988 K. Husimi
D. Palumbo
R. S. Pease
- 1989 F. H. Coengsen
D. J. Grove
F. L. Ribe
- 1990 N. G. Basov
T. Sekiguchi
- 1991 H. K. Forsen
J. W. Landis
R. L. Sproull
H. G. Stever

Excellence in Engineering Awards

This award was established in memory of Professor David J. Rose to recognize those individuals in the early part of their careers who have shown outstanding technical accomplishment and leadership potential in the field of fusion engineering. Recipients are:

- 1987 Steven J. Piet
- 1988 Michael A. Ulrichson
- 1989 David Ehst
Y-K. Martin Peng
- 1990 Wayne Reiersen
- 1991 John Santarius
- 1992 Oleg Filatov
Steven J. Zinkle



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FUSION ADVISORY COMMITTEE ADDRESSES PROGRAM PRIORITIES

PRIORITIES MEETING SET

The DOE's Fusion Energy Advisory Committee (FEAC) will meet in public session September 22-23 to discuss fusion program priorities under a variety of possible future budget scenarios. The meeting will take place at the Ramada Renaissance Hotel at Washington-Dulles International Airport in the Dulles A Conference Room. Public comment periods will be provided for on the agenda.

The FEAC will be responding to a "charge" letter dated June 22 from DOE Director of Energy Research William Happer, in which he asks for "recommendations on strategic program planning" under "three different out-year funding assumptions: starting with the FY 1993 House Appropriation Mark of \$331M for magnetic fusion, (A) 5 percent real growth; (B) level funding, i.e., with only inflation; (C) flat, without inflation." Happer stated: "Within these assumed cases, which program elements should be enhanced, protected, reduced, or eliminated and on what schedule? In all cases the primary goal should be maximum progress toward a Demonstration Power Plant. I am asking for your best technical judgment on how to structure the magnetic fusion program within these different funding assumptions, but without change in the basic goal of demonstrating fusion power and within the basic assumption of strong international collaboration."

In preparation for its response, FEAC constituted a "Panel 5", consisting of FEAC members and others from the scientific community, which met in brainstorming sessions during the last week of July. A set of draft

recommendations from Panel 5 will provide the starting point for the September FEAC meeting.

For information on attendance at the September meeting, contact Debbie Lonsdale at DOE, (301)903-4951; fax (301)903-2791.

HAPPER RESPONDS TO FEAC 3

In a letter dated June 12, 1992, the Fusion Energy Advisory Committee (FEAC) advised DOE's Director of Energy Research William Happer on a concept improvement policy (see our June newsletter). In response, Happer has written a letter dated July 22 to FEAC chairman Bob Conn stating: "I note particularly your recommendations that 'tokamak concept improvement programs are essential and should receive the highest priority' and 'a non-tokamak fusion concept program, at some level, should be supported as a matter of policy.' It is our intention to follow these recommendations."

Happer also stated: "The extent of funding for this broader range of activities will depend both on technical review and available budget. We are delaying decisions on how to implement the specifics of your recommendations regarding fusion concept improvement until we have clarification of near-term budgets and the Fusion Energy Advisory Committee's recommendations on overall magnetic fusion priorities (to be reported in September)."

Happer also stated: "I also note your recommendation that I seek 'to achieve an increase in basic plasma science

research' within Energy Research and other agencies. I agree that it is important to maintain a strong basic research effort in plasma science, and I will seek to improve our program in this area, taking into account our other needs, budget limitations, and programs in other agencies."

WATKINS: IN OR OUT?

At the Republican National Convention in mid-August, President Bush let it be known that he intended to "shakeup" his Cabinet as part of a more aggressive domestic strategy during his hoped-for second term. White House staff then leaked to the press a list of Cabinet officers who would not be around for a second term. On the list was Energy Secretary James Watkins. Watkins aide Polly Gault promptly denied that Watkins was in any trouble at the White House. The President was silent on the matter. According to Gault, Watkins has let it be known to the President that he would not stay on for a full term, but would be available for a few months into the term. Watkins addressed the Convention on Tuesday, praising President Bush for his National Energy Strategy, saying that it was a "comprehensive, balanced approach to energy production and energy efficiency."

GENERAL DYNAMICS MAGNETS TESTED

A 300 foot string of superconducting dipole magnets for the Superconducting Super Collider (SSC) were successfully tested at the SSC Laboratory in Waxahachie, Texas six weeks ahead of schedule. The magnets were assembled by engineers and technicians from General Dynamics Corporation working at Fermilab. Those same individuals are now readying the General Dynamics facility in Hammond, Louisiana for eventually producing the magnets. Similar preparatory work is ongoing at the Westinghouse Corporation plant in Round Rock, Texas. A team from Westinghouse assembled dipole magnets at Brookhaven National Laboratory which will be used by the SSC Laboratory for other tests. President Bush visited the magnet test site on July 30. Secretary Watkins said "The achievement demonstrates the competence of our SSC management team and the strength of the scientific and industrial personnel associated with this project."

House and Senate conferees are meeting this month to try to resolve the FY 1993 appropriation for SSC. The House voted earlier to kill the project; the Senate voted to provide \$550 million. In arguing for the project, Senator J. Bennett

Johnston called the SSC "the most important scientific project in America." It is estimated that since the House voted to kill the project, about 100,000 letters were sent to members of the House and Senate. One letter was signed by 21 Nobel Laureates and over 2000 scientists. The presidents of many universities, as well as industry CEO's also sent letters. Senator Dale Bumpers, an opponent of SSC, called the effort "the most intense lobbying I have seen since the Panama Canal Treaty."

FUSION FACILITIES DIRECTORY AVAILABLE

Fusion Power Associates is now taking orders for the new 1992-1993 edition of its very popular Fusion Facilities Directory. Shipments will begin in late September. The Directory contains names and phone/fax numbers for fusion personnel in the U.S. and Canada. It also contains organization charts and local travel information and maps for fusion sites.

We believe that every person working in fusion, especially secretaries, will find this edition essential to the efficient operation of their office. The cost of the Directory is \$20 per copy plus shipping and handling. To place your order, contact Ruth Watkins at FPA, Fax (301) 975-9869.

PEOPLE

Inertial fusion reactor design expert *Bill Hogan*, from the Lawrence Livermore National Laboratory, will spend six months in Moscow starting in mid-October. He will be working at the new International Science and Technology Center, where he will be reviewing proposals from former Soviet weapons researchers for work on civilian R & D. The Center has a budget of \$75 million, contributed equally by the U.S., European Community and Japan. He expects to make several trips back to the U.S. during this period.

John Bartlit has been named the Group Leader for the Tritium Science and Technology Group at Los Alamos National Laboratory.

Fusion safety expert *Jim Crocker*, of EG&G Idaho, will retire at the end of September. Jim brought his expertise in fission reactor safety to bear on fusion and contributed to many fusion systems studies, including the ESECOM study. He has been an active member of the American Nuclear Society and Fusion Power Associates and has played a key role in

organizing the IAEA series of Technical Committee Meetings on Fusion Reactor Safety. *Doug Holland* is currently Manager of the Fusion Safety Program at INEL.

Fred Dylla, a fusion physicist at PPPL from 1975 to 1990, is the 1992 president-elect of the American Vacuum Society. He is now Head of the Superconducting Radio-Frequency Technology Department at the Continuous Electron Beam Accelerator Facility in Newport News, Virginia.

In Memoriam: *Prof. Winfried Schmidt*, Head of the KfK Numerical Physics Branch, Karlsruhe, Germany, died in a traffic accident on August 13. He is survived by his wife, Uta, and four adult daughters. Prof. Schmidt was a frequent participant in the activities of Fusion Power Associates. Expressions of sympathy can be sent to Mrs. Uta Schmidt, Bunsenstr. 20, D-7500 Karlsruhe 1, F.R. Germany.

FOSSIL FUEL USE INCREASING

According to the Energy Information Administration (EIA), world demand for crude oil is expected to grow by about 2 percent in 1992 and about 3 percent in 1993, while U.S. domestic production is expected to drop by 210,000 barrels per day in 1992 and by 280,000 barrels per day in 1993. Also, gasoline prices are expected to rise in the U.S. by 3 to 5 cents per gallon this winter due to the Clean Air Act's requirement that, beginning in November, about 30 percent of the gasoline sold in the U.S. must be oxygenated.

Use of natural gas is projected to increase by as much as 5.5 percent in 1993 if normal weather patterns occur, with much of the growth expected to occur during the first quarter of 1993. This follows an anticipated increase of 3.5 percent in 1992. Electricity demand is projected to increase by about 4 percent in 1993, according to the EIA.

TRITIUM TESTS SUCCESSFUL

The Tritium Systems Test Assembly (TSTA) at Los Alamos has completed 25 days of continuous operation, the longest continuous operation of the TSTA integrated loop to date. This test will provide valuable data to the ITER fuel cycle data base, as well as data for the planned tritium runs in TFTR at Princeton. The tests included the 4-column, interlinked cryogenic distillation system operated in series with fuel cleanup systems. A wide range of impurities were removed from the simulated plasma exhaust gas.

The lengthy operation of the integrated loop accomplished several major milestones for the fifth year of the US-Japan Annex IV Agreement on the jointly-funded, jointly-operated project. The agreement has been extended for an additional 2 years.

On May 25-26, Mr. Shozo Shimomura, president of the Japan Atomic Energy Research Institute, visited the TSTA facility for the first time. He was accompanied by M. Iizumi, H. Terada, A. Kanai, and K. Kawata, also of JAERI. Los Alamos scientists express their appreciation to JAERI staff members who have been working at Los Alamos: T. Hayashi, K. Hirata, M. Inoue and J. Nakamura.

U.S. ITER PROGRESS REPORTED

The U.S. ITER Home Team, under the direction of Alex Glass, has issued its latest quarterly progress report, dated July 1992. Persons wishing to receive these reports and/or to receive the newsletter "U.S. ITER NEWS" should contact U.S. ITER Home Team Project Coordinator Chuck Flanagan, fax (615) 576-5436.

The first meeting of the new international ITER Council will take place September 10-11 in Vienna, Austria. Academician E.P. Velikhov will chair the Council; M. Yoshikawa will be co-chairman. Other members of the Council are: P. Fasella and C. Maisonnier from the European Community, N. Cheverev from Russia, K. Atarahi from Japan, and Jim Decker and Anne Davies from the U.S. The Council meeting will formally launch the ITER Engineering Design Activities (EDA) by appointing the project director, Paul-Henri Rebut and his key deputies.

MEETINGS

The American Physical Society Division of Plasma Physics will hold its annual meeting November 16- 20 in Seattle, Washington at the Westin Hotel. For information, contact Tom Jarboe at (206) 685-3427.

The annual meeting of the American Association for the Advancement of Science will be held February 11-16, 1992, in Boston, MA. Contact Rolf Sinclair, fax (202) 357-7994.

FUSION POWER ASSOCIATES MEMBER AND AFFILIATE REPRESENTATIVES

MEMBERS

Babcock and Wilcox <i>Floyd Anderson*</i>	General Dynamics Space Systems Division <i>Richard Hora*</i>	Science Applications International Corp. <i>William Grossmann*</i>
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FUSION PRIORITIES RECOMMENDED

ITER COUNCIL MEETS

SEAB ENDORSES FUSION NEXT STEP

FPA ANNUAL MEETING DATES SET JANUARY 28-29

ITER COUNCIL MEETS

Following the signing of the ITER (International Thermonuclear Experimental Reactor) agreement by representatives of the U.S., Russia, European Community and Japan (see our August newsletter), the first order of business was the convening of the ITER Council. The first meeting of that governing body was held in Vienna, Austria on September 10-11. At the meeting the Council appointed, as expected, Paul-Henri Rebut to be ITER Director. Rebut, who is currently director of the highly successful Joint European Torus (JET) project in Europe (see our December 1991 newsletter), will reside at the ITER Co-Center in San Diego. The Council also approved four ITER Deputy Directors: M. Huget (who will head the Co-Center in Japan), Y. Shimomura (who will reside at the Co-Center in San Diego), V. Chuyanov (who will head the Co-Center in San Diego) and R. Parker (who will head the Co-Center in Germany).

The Council also appointed the chairs and members of the ITER Management Council, Technical Advisory Council and two Special Working Groups. M. Yoshikawa will head the Management Council; Paul Rutherford will head the Technical Advisory Committee. Each of the parties has a Home Team Leader, who also serves on the Management Advisory Committee: Alex Glass (U.S.), R. Toschi (EC), S. Matsuda (Japan), and O. Filatov (Russia).



ITER Director Paul-Henri Rebut

Special Working Group 1 (chaired by D. Ryutov) will review the detailed technical objectives of ITER, along with technical approaches, to determine the best practical way to achieve the programmatic objectives of ITER.

Special Working Group 2 (chaired by M. Roberts) will propose to the Council guidelines for implementing the way task assignments should be made to national Home Teams and to draft "Protocol 2." Protocol 2 is a set of operational

agreements for the EDA, including the consequences for inadequate task performance and the detailed functions and responsibilities of the Council, the Director and the Management Advisory Committee.

The ITER Council is chaired by E. Velikhov. Other members are N. Cheverev (Russia), P. Fasella and C. Maisonnier (EC), M. Yoshikawa and K. Okimura (Japan), and J. Decker and Anne Davies (U.S.).

U.S. ITER INDUSTRY COUNCIL

U.S. ITER Home Team Leader Alex Glass has formed an ITER Industry Council (IIC) to advise him "on policy issues relating to industrial participation in the ITER project," including "the energy relevance of the proposed ITER design and of the technology development carried out under ITER funding." Dr. Harold Forsen, Bechtel National Inc., chairs the Council. FPA president Steve Dean is a member of the Council. The Council held its second meeting July 10 at the new Washington offices of the Electric Power

Research Institute. The Council provided the following advice: "(1) The IIC was concerned that ITER will only be a physics experiment, and that this would not justify the cost of the machine, and will not fulfill its mission to establish the technical feasibility of fusion power. (2) The IIC wants to ensure that any information developed either by the Joint Central Team or the other Home Teams will be made available to U.S. industry. The U.S. ITER Management will consider the best approach to ensure that information is collected, documented, and distributed in a timely fashion. (3) The IIC expressed concern about Dr. Rebut's announced intent to carry out fabrication and assembly of large components at the ITER site, once it is chosen. They were concerned that this would limit the participation of industry in learning how to manufacture critical components of fusion reactors at full scale, and create redundant Central Team infrastructure." Copies of the Record of ITER Industry Council Meeting, July 10, 1992, are available from Fusion Power Associates.



Attendees at July 10 meeting of ITER Industry Council. Standing: Richard Dean (General Atomics), Douglas Post (PPPL), Charles Flanagan (ORNL), Joseph Miller (TRW), Samuel Harkness (Westinghouse), Robert Iotti (Ebasco), Joseph Bell (McDonnell Douglas), Charles Baker (ORNL), Alex Glass (LLNL), N. Anne Davies (DOE), Robert Weber (Grumman), James Doggett (LLNL), Henry Bartoli (Burns and Roe); Kneeling: Steve Dean (FPA), Tom James (DOE), Harold Forsen (Bechtel). Members of the Council not in attendance: Floyd Culler (EPRI), Richard Hora (General Dynamics), John Landis (Stone and Webster), and Chester Lob (Varian Associates).

PRIORITIES RECOMMENDED

The DOE's Fusion Energy Advisory Committee (FEAC) met September 22-23 to provide recommendations on magnetic fusion energy program priorities. Four different budget profiles were considered (see our September newsletter). In two cases there was budget growth, one case was flat and one case declined at the rate of inflation.

In all cases considered, the FEAC recommended that the highest priority be given to participation in the ITER Engineering Design Activities (EDA) at a level consistent with the international ITER EDA agreement and to the completion of deuterium-tritium experiments in the Tokamak Fusion Test Reactor (TFTR) by the end of FY 1994.

In a "reference budget scenario" (one in which there was 5% real growth from the level recently approved by a House-Senate conference committee for the FY 1993 budget), the FEAC urged the initiation of a new tokamak construction project (the Tokamak Physics Experiment, TPX; see our April newsletter) to be operating by the year 2000 at the Princeton Plasma Physics Laboratory. They also recommended upgrading the DIII-D tokamak at General Atomics and restarting the Advanced Toroidal Facility (ATF) at Oak Ridge National Laboratory. In addition, they recommended operating the Alcator C-MOD tokamak at MIT through FY 1995, while curtailing operation of the PBX-M tokamak at Princeton. They also recommended enhancing the fusion materials development program, including the beginning of construction of an internationally-funded 14 MeV neutron source in the FY 1996 time frame. In addition, they recommended a modest enhancement of the technology base program and the continuation of studies of ways to shorten the time required to obtain the nuclear data required for the design of a fusion demonstration power plant. Furthermore, the FEAC recommended that research aimed at concept improvement should be maintained and that research on a broad range of applied plasma physics should not be reduced relative to the present level.

In a budget case approximately \$20 million higher than the reference case, the FEAC recommended that a U.S. fusion nuclear site selection study should be carried out and that the U.S. ITER EDA effort should be enhanced beyond the minimum required by the international agreement. They also recommended that research in applied plasma physics,

concept improvement, operation of mid-sized tokamaks and technology development be moderately enhanced.

In the flat (no real growth) budget case, significant delays were projected for the TPX and materials development programs.

In the declining budget case, the TPX is indefinitely postponed, the materials development program is further delayed and a delay is introduced into the schedule of the DIII-D upgrade.

SEAB ENDORSES FUSION NEXT STEP

The Secretary of Energy Advisory Board (SEAB) Task Force on Energy Research Priorities (see our October 1991 newsletter) met September 24 and reaffirmed its support both of moving ahead with a next generation fusion experiment and for 5% real growth in the fusion budget. The experiment, a "\$500 million class" tokamak called the Tokamak Physics Experiment (TPX) would be located at the Princeton Plasma Physics Laboratory (PPPL). The experiment would study plasma confinement in advanced configurations and operate in steady-state conditions, rather than the typically pulsed operation of today's experiments. If approved by DOE and Congress, the device could operate in the year 2000. The project is envisaged to be a National Facility even though it is located at PPPL. A National Council has been formed, reporting to PPPL director Ronald Davidson, to provide "oversight." According to its charter, the Council will "participate in decisions relating to programmatic aspects of TPX, including its mission, technical scope, and cost and schedule, and it will provide advice on the management and execution of the TPX Project." Prof. Stewart Prager of the University of Wisconsin will chair the Council. FPA president Steve Dean is a member of the Council. Other members are David Baldwin (LLNL), Robert Conn (UCLA), Gerald Navratil (Columbia U.), Miklos Porkolab (MIT), Paul Rutherford (PPPL), John Sheffield (ORNL), and Richard Siemon (LANL). The Council has had one meeting to date.

FEAC GETS NEW CHARGES

At its September 22-23 meeting the FEAC received two new charges from the DOE. In one, it was asked "to evaluate the Neutron Interactive Materials Program of the Office of Fusion Energy." DOE asked: "Given budget constraints, is our program optimized to achieve these goals for DEMO,

as well as to support the near-term ITER program?" DOE requested a response by February 1993. FEAC member Klaus Berkner was appointed chairman of "FEAC Panel 6" to prepare a draft response to this charge. He will present an interim report at the December FEAC meeting (dates not yet scheduled).

In a second charge letter, DOE requested FEAC to "provide its views on the inertial fusion energy (IFE) program of Energy Research," and "to consider the nature and extent of an IFE program." DOE requested a response by April 1993. Ron Davidson was appointed chairman of "FEAC Panel 7" to prepare a draft response to this charge. He will also present an interim report at the December FEAC meeting.

FPA REPS CHANGES

We would like to welcome the participation of new representatives for some of our Affiliates:

Norman L. Ledebor replaces Conrad Aas, who has retired, as Northern States Power's representative to Fusion Power Associates.

Howard Shaffer of the Westinghouse Science and Technology Center replaces Arthur McGuigan as the Westinghouse representative to Fusion Power Associates.

Gregory Naumovich replaces George Ulrich at the Everson Electric Company.

FPA ANNUAL MEETING

Fusion Power Associates Annual Meeting and Symposium will be held January 28-29 at the San Diego ITER Co-Center. The theme of the symposium will be "Fusion: An International Venture." Topics to be covered will include the ITER effort, other potential international fusion ventures, the emerging international effort in inertial confinement fusion and the status and prospects for both magnetic and inertial fusion. Details will be forthcoming in a future mailing.

OIL AND GAS RESERVES DECLINE

U.S. crude oil proved reserves dropped by 6 percent in 1991 while dry natural gas reserves dropped by 1.3 percent. Energy Information Administration Administrator Calvin Kent noted that this was the largest oil reserves decline since 1977. The decline in oil reserves of 1,572 million barrels,

leaves the U.S. with proven reserves of 24,683 million barrels. The U.S. is currently producing crude oil at a rate of 2,512 million barrels a year.

LASER CONFERENCE PLANNED IN 1993

The Eleventh International Workshop on Laser Interaction and Related Plasma Phenomena is scheduled to take place October 25-29 of next year at the Naval Postgraduate School in Monterey California. Prof. George Miley of the University of Illinois is director of the workshop organizing committee. Fusion Power Associates has been one of the regular sponsors of this series of workshops. The international organizing committee includes H. Hora, F. Schwirzke, N. Basov, R. Dautray, S. Eliezer, A. Guenther, M. Key, R. McCrory, P. Mulser, S. Nakai, B. Ripin, S. Singer, E. Storm, G. Velarde, and C. Yamanaka. Abstracts are due May 1, 1993. For information contact Chris Stalker, Workshop Secretary, University of Illinois Fusion Studies Laboratory, Urbana, IL, 61801, FAX (217) 333-2906.



University of Illinois Prof. George Miley (L) and FPA president Steve Dean (c.) discuss inertial confinement fusion with Sadao Nakai, director of the Institute of Laser Engineering, Osaka University.

QUOTABLE

"If the fusion program is to maintain continuing popular support, fusion advocates must find innovative approaches to the development of fusion energy, leading to smaller machines, shorter development times, lower development costs and commercially attractive concepts."

John Nuckolls, Director
Lawrence Livermore National Laboratory
April 9, 1992 FPA Annual Meeting



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LIGHT ION FUSION "BREAKTHROUGH"

BICKERTON, BISHOP, GLUKHIKH, MORI RECEIVE DISTINGUISHED CAREER AWARDS

LIGHT ION FUSION ADVANCES

Don Cook, leader of the Light Ion Fusion group at Sandia National Laboratories in Albuquerque, reported dramatic progress in improving the focusing of proton and lithium ion beams for inertial confinement fusion. The advance was termed a "breakthrough" by Steve Younger of Los Alamos National Laboratory, who summarized the major ICF results reported at the IAEA Fourteenth International Conference on Plasma Physics and Controlled Nuclear Fusion Research, 30 September - 7 October in Wurzburg, Germany.

The horizontal divergence of a lithium ion beam was reduced by a factor of two over previous best results, down to a value of 18 milliradians. The improvement was accomplished by increasing the ion emission area and the length of the anode-cathode gap, a technique that computer simulations predicted would reduce the divergence-enhancing coupling between an early-time diocotron instability and the ion beam. Scientists at KfK in Karlsruhe, Germany and Cornell University have also successfully reduced divergence in proton beams using these techniques. Sandia's goal is to eventually reduce the beam divergence to about 12 milliradians.

The peak values of beam intensity achieved so far in the Particle Beam Fusion Accelerator (PBFA II) at Sandia are 5 TW/cm² for protons and 1 TW/cm² for lithium. An immediate goal of the experiments is to increase lithium beam intensity to 3 TW/cm² by adding vertical focusing,

a level which would allow target implosion experiments at the 1000 TW/gm level. A longer-term goal of the project is to raise the intensity of a 30 MeV lithium beam to about 120 TW/cm², which would provide the approximately 6000 TW/gm required for ignition of a pellet.

JET RESULTS

Scientists from the Joint European Torus (JET) have reported achieving a world record value of the fusion "triple product" ($nT\tau$) of $9 \times 10^{20} \text{ m}^{-3}\text{keVs}$. The triple product is the product of the plasma peak density, peak ion temperature and global energy confinement time and is a measure of the thermal fusion power potential of the plasma. A triple product of only about four times higher than that achieved in JET would be required in an operating fusion power plant. The results were obtained in deuterium plasmas using about 15 MW of input beam power.

JET scientists also reported experiments in which two of the sixteen neutral beam injectors were used to inject tritium while the remaining beams injected deuterium, resulting in an 11% tritium mixture. Over a 2 second period, 2 MJ of fusion energy was released, with peak power reaching 1.7 MW. About half the fusion energy released is estimated to come from fusion in the thermal plasma at temperatures of 15-20 keV; the other half comes from fusion of the injected tritium beams striking

deuterium in the plasma. The JET scientists calculate that, if a 50-50 mixture of tritium and deuterium had been used, slightly more fusion would have been produced than would have been required to produce and sustain the plasma ($Q = 1.07$). In their energy balance, JET ignores that portion of the input beam power that is not deposited in the plasma. If one balanced the total estimated fusion power against the total input beam power, the ratio would be 0.64.

JET scientists also reported a fascinating experiment in which they reversed the direction of the plasma current at the end of the cycle in order to study the feasibility of operating a tokamak in an alternating current (AC) mode. Two cycle discharges were successfully produced at the 2 MA level, with dwell times between cycles varying from 50ms to 6s. JET primary discharges are typically about 15s long.

TFTR RESULTS

Scientists from the Tokamak Fusion Test Reactor (TFTR) at the Princeton Plasma Physics Laboratory reported maximum triple products of 4.3×10^{20} , about half those achieved in JET, with ion temperatures of about 26 keV. Confinement time enhancements of about three times higher than the ITER physics scaling model were achieved and bootstrap currents of up to 65% of the total current were observed. Combined neutral beam injection and ion cyclotron heating systems were employed at power levels up to 33 MW and 8 MW, respectively, in separate discharges and up to 27 MW and 5 MW, respectively, simultaneously. An instantaneous D-D fusion reaction rate of 10^{17} reactions/s with an injection power of 33 MW was observed. Preparations are in progress to begin experiments using tritium in TFTR in late 1993, continuing for about one year.

DIII-D RESULTS

The DIII-D tokamak at General Atomics, though smaller than JET or TFTR, has nevertheless reached triple product values of 2×10^{20} . Experiments have been carried out in DIII-D with up to 3 MA plasma current, 20 MW neutral beam power and 1.7 MW each of electron cyclotron and ion cyclotron resonance frequency power. Central electron and ion temperatures of 7 and 17 keV, respectively, have been achieved in separate experiments. After boronization of the vacuum vessel, DIII-D scientists achieved energy confinement times up to 3.6 times higher than those assumed for the design of ITER. Experiments with current profile

control have allowed access to the so-called "second stability" regime of plasma confinement. Central and average beta values of 44% and 11%, respectively, have been achieved. Bootstrap currents up to 50% have been observed.

TELLER ON CLASSIFICATION

In the "Forum" section of the National Academy of Sciences magazine *Issues in Science and Technology* (Fall, 1992), physicist Edward Teller writes: "Our keeping of secrets has often misled and confused our own people but has been ineffective in denying information to our enemies or competitors. I make a proposal, hoping that it may help to start a fruitful discussion. Let us pass a law requiring all secret documents to be published one year after their issuance. This would of course eliminate long-term secrecy and might also deter unnecessary classification of documents, because the original invocation of secrecy might be subject to criticism and even ridicule when the documents are published. There might be very special cases where secrecy of longer duration is needed. I suggest that an extension of secrecy require action at the highest level - for instance, special authorization by the president. Such extension, in turn, might be given on a year-to-year basis in order to make sure that long-term secrecy not be applied except for truly important reasons." In 1991, the Federal government classified over 7 million documents. The Defense Department estimated that the cost of "protecting" classified information in industry alone is over \$14 billion.

VELIKHOV HONORED BY GA/UCSD

Academician E. P. Velikhov, vice president of the Russian Academy of Sciences and director of the Kurchatov Institute, has been awarded the 1992 General Atomics - University of California at San Diego Scientific Achievement Award. Acad. Velikhov was recognized for "his leadership role in international cooperation for the development of controlled fusion energy" and for his "extraordinary contributions to the advancement of science and technology, to the formulation of scientific policy and to international cooperation in science and technology development." He is the fourth recipient of the award, which consists of a cash stipend and a \$10,000 scholarship in his name to a department of his choice at UCSD. GA chairman, Neal Blue, said "Dr. Velikhov has been the driving force behind the establishment of the ITER program, which will result in the design of a reactor harnessing fusion energy." Dr. Velikhov was the recipient of Fusion Power Associates 1985 Leadership Award.



V. A. Glukhikh



R. J. Bickerton



T. Tamano and S. Mori

DISTINGUISHED CAREER AWARDS: BICKERTON, BISHOP, GLUKHIKH AND MORI

The Board of Directors of Fusion Power Associates is pleased to announce the recipients of its Distinguished Career Awards for 1992. These awards, established in 1987, are presented to individuals who have made distinguished, lifelong career contributions to science, technology or management that provide the basis for the successful development of fusion as a practical energy source. The awards were presented by FPA president Steve Dean at the IAEA fusion conference in Wurzburg, Germany on October 7 to: **Roy J. Bickerton, Amasa S. Bishop, V.A. Glukhikh, and S. Mori.**

Dr. Bickerton, recently retired as deputy director and head of the heating and theory department of the JET Joint Undertaking, is one of the world's leading experts on fusion physics. Dr. Bishop was the first director of the U.S. fusion program (1953-56) and served again as director 1964-69. During the 1970's and 1980's, he was Director of Environment for the United Nations' Economic Commission in Geneva. Academician Glukhikh is the director of the D.V. Efremov Institute of Electrophysical Apparatus in St. Petersburg, Russia. He has been responsible for the construction of Soviet fusion devices and for Russian participation in ITER. Dr. Mori was vice president of the Japan Atomic Energy Research Institute and is currently president of the Institute for Environmental Sciences in Tokyo. Under his leadership Japan became one of the world's leading countries in fusion development.

KILLEEN PREPARES PERSONAL RETROSPECTIVE

John Killeen, first director of the Magnetic Fusion Energy Computer Center, who was sidelined by a stroke in 1990, has prepared a "personal retrospective" on the history of magnetic fusion computing. The paper was presented on John's behalf by David Anderson at a special session of the Theory of Fusion Plasmas Workshop in Varenna, Italy, where Killeen was honored for his lifetime contributions to the numerical formulation of plasma dynamics. Killeen, his wife and two daughters attended the conference.

In his report, which cites 59 references, Killeen traces the applications of computers to plasma science, beginning with his first associations with the fusion program at LLNL in the late 1950's. He describes the evolution from ideal MHD to resistive MHD in the 1960's and the evolution of two dimensional non-linear codes in the 1970's. He describes the development of 3-D MHD codes in the 1980's and also the treatment of non-Maxwellian plasmas. Finally, he discusses the evolution of the Computer Center as computers became more powerful throughout the period.

Persons wishing to request a copy of the report can write to John c/o David Anderson, LLNL, PO Box 5509 L-561, Livermore, CA, 95616; FAX (510)422-0435.

ICF ARTICLES PUBLISHED

Two excellent, very readable articles summarizing the current status of inertial confinement fusion research appear in the September issue of *Physics Today*, the journal of the

American Institute of Physics.

The first, entitled "Progress Toward Ignition and Burn Propagation in Inertial Confinement Fusion" is written by John Lindl, Bob McCrory and Mike Campbell. The article describes the requirements for both direct and indirect drive implosions and states: "Significant elements of the work presented here were carried out under classified Department of Energy programs and have only recently been declassified." (ed. note: The work described was declassified about 2 years ago and is not the broader declassification actions described as "imminent" in our July newsletter; those declassifications have still not occurred.) The authors conclude: "With the continued success of the technical program on Nova, the construction and subsequent experimental program at the Omega Upgrade and other facilities, and the proposed construction of the Nova Upgrade, it should be possible to achieve ignition and fusion burn propagation soon after the turn of the century."

The second article, entitled "Energy From Inertial Fusion" is written by Bill Hogan, Roger Bangerter and Jerry Kulcinski. The article describes the range of power reactor design studies that have been carried out for inertial fusion concepts. The authors conclude: "Inertial fusion energy's potential for low-cost development makes it an attractive fusion option. The inertial fusion energy community is prepared to take the next steps - demonstrating ignition and gain, developing a reactor driver and choosing a reactor technology - when the country determines it can afford to do so."

PEOPLE

David Baldwin has been named Associate Director for Energy at the Lawrence Livermore National Laboratory. The position encompasses and expands his previous responsibilities as Associate Director for Magnetic Fusion, and will include Nuclear Systems Safety and Engineering, and other existing energy programs.

Tom Palmieri has left his post as chief of the nuclear energy branch at the Office of Management and Budget (OMB) after 14 years to accept a position as manager of the strategic program development office at Sandia National Laboratories in Albuquerque.

Nancy Milton, OMB budget examiner for DOE's nuclear energy programs, including magnetic fusion, for the past

three years has returned to the U.S. Geological Survey as assistant chief geologist for the Eastern region. She will oversee their research centers east of the Mississippi river.

Dieter Sigmar has been named Acting Director of the Plasma Fusion Center, taking over the responsibilities of **Ron Parker** who is on leave of absence to head the ITER Co-Center in Garching, Germany.

Teruo Tamano has been named Director of the Plasma Research Center at the University of Tsukuba in Japan. He spent many years as a leading scientist at General Atomics in San Diego.

Ken Tomabechi has become a Research Advisor to the Central Research Institute of Electric Power Industry in Tokyo. After his retirement as Director General of the Naka Fusion Research Establishment of the Japan Atomic Energy Research Institute several years ago, he headed up the international three year ITER conceptual design activity.

Paul Gilman has joined the OMB as Associate Director for Energy and Natural Resources, Energy and Science. Previously he was an assistant to DOE Secretary James Watkins and, earlier, was an aide to New Mexico senator Pete Domenici.

Karl Erb has been confirmed by the Senate as the Associate Director for Physical Sciences and Engineering of the White House Office of Science and Technology Policy (OSTP).

Tom James has been named Acting Director of the Division of Development and Technology, DOE Office of Fusion Energy. He replaces **Bob Dowling** who has retired.

QUOTABLE

"The purpose of diplomacy is to prolong the crisis. Diplomats and bureaucrats may function differently but they achieve exactly the same result."

Mr. Spock
STAR TREK TV Series

"A lover doesn't figure the odds."

Jalaloddin Rumi
12th Cent. Persian Poet



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US CONGRESS PASSES FUSION LAW JAPAN ISSUES FUSION POLICY

KAW EXHORTS FUSION SCIENTISTS US ITER INDUSTRIES PICKED

PUBLIC LAW 102-486: FUSION BY 2010

On October 24 President Bush signed into law (Public Law 102-486) the "Energy Policy Act of 1992." Section 3114 of the Act directs the Secretary of Energy to "conduct a fusion energy 5-year program, in accordance with sections 3001 and 3002 of this Act, that by the year 2010 will result in a technology demonstration which verifies the practicability of commercial electric power production." The Act also states that "within 180 days after the date of enactment of this Act, the Secretary shall prepare a comprehensive management plan for the fusion energy program. The plan shall include specific program objectives, milestones and schedules for technology development, and cost estimates and program management resource requirements." The Act authorizes \$339.7 million for FY 1993 and \$380 million for FY 1994.

Copies of the fusion section of the Act are available from Fusion Power Associates. Copies of the entire Act may be requested from the US Senate Documents office: (202) 224-7701.

FUSION POLICY OF JAPAN

The Atomic Energy Commission of Japan has issued a "National Policy for Promoting Fusion Research and Development." An english translation of the report can be requested from Dr. Hiroshi Kishimoto, Naka Fusion Research Establishment, JAERI, Naka-machi, Naka-gun, Ibaraki-ken 311-01, Japan, FAX: 0292 95 1549.

The report notes that in 1975 "the Atomic Energy Commission of Japan laid down the 'second phase' basic program of fusion research and development, which set out the national policy for fusion research and development in Japan," and states that "the Atomic Energy Commission has recognized that its major goals have been attained" and "that the efforts until now "have established a sufficient scientific and technological basis to implement the next step, to be called the 'third phase' program." The report states that "In the third phase program, the personnel and budgetary requirements will be much greater than those of the second phase program." It states that "The principal objectives of the fusion research and development in the third phase are the achievement of the self-ignition condition, the realization of a long burn and the formation of the reactor technology basis required for the prototype fusion reactor development."

The policy report states that "international collaboration with a wide scope is essential to reducing the risks and demands and improving the efficiency of the research and development. Especially since there are calls for positive contributions of our country to the international community in the basic research fields, international collaboration should be pursued actively with effective utilization of our research resources. On the other hand, emphasis should also be placed upon the further development of the domestic research basis as well as on the consolidation of

the infrastructure necessary for international collaboration and the effective introduction of achievements obtained through international efforts into the domestic activities."

The policy states that "A tokamak fusion experimental reactor is to be developed to play a central role in attaining the goals of this phase of the research and development." In addition, the report states, "Research and development of non-tokamak devices should be carried out continuously as such devices are expected to develop a confinement capability superior to that of tokamaks and also to contribute to the tokamak research itself." The report calls for an extensive program of technology development and reactor design, including the development of "high power drivers with high energy conversion rates and high repetition rates" for inertial confinement fusion.

KAW URGES FUSION SPEEDUP

"At a time when our technical accomplishments world wide are excellent, and our experiments are producing beautiful results, we are less than ambitious in our requests for funding. When we should be running, we are barely crawling." So spoke Prof. Predhiman K. Kaw, director of the Institute for Plasma Research in India, in giving the prestigious Artsimovich Memorial Lecture to several hundred leading fusion scientists at the Fourteenth IAEA Conference on Plasma Physics and Controlled Nuclear Fusion, in Wurzburg, Germany on September 30.

Kaw said that fusion was being given low priority for government funding because fusion scientists have allowed everybody to tacitly assume that there is no urgency to develop fusion technology, that even if it is developed, it will be too expensive, and that fusion scientists should be allowed 50 years or more to develop and perfect the technology before putting fusion to commercial use. "I believe that each one of these premises is faulty and would like to share my thoughts with you," Kaw said.

After presenting energy statistics from around the globe, Kaw stated, "My conclusion is that the energy scene in the developing world is far from comfortable. The worst scenario is one where these countries are forbidden to burn coal because of environmental constraints, cannot buy oil/gas because it is too expensive and cannot use nuclear power because of safety issues and international safeguards. So what do they do then? It is obvious that there is urgency to develop a new technology like fusion."

He also presented data on the costs of fossil and nuclear fission energy technologies, compared to estimates of fusion cost of electricity, and concluded that the uncertainties were such that one could not conclude that fusion would be more expensive.

Finally, he urged that the fusion community, "after working on the problem for 35 years," should not go around saying that "we still need 50 years to exploit fusion as a commercial technology." He said, " We must realize that the perfection of a technology only occurs by competition in the market place. There is no way that fusion systems can be perfected in the quiet of the laboratories. We thus need to build real life systems as soon as possible and then let them improve by competition." He urged the fusion community to "define a new goal which I would like to put down as follows: We must bring fusion systems to a level such that fusion power is considered as a credible energy alternative on the fastest, technically realistic, time-scale. We must demonstrate generation of fusion electricity as early as possible and show that it is environmentally better than the other competing energy sources."

With adequate funding, Kaw stated that he believed that "We could have a demonstration power plant as early as the year 2015. We must make this the goal of the world fusion programme." He estimated the world-wide cost of the development at "around US \$50 billion over 20 years." This is the equivalent of 1 cent per gallon of gas over less than 5 years, he said. "Thus the total cost of fusion development is not so large that the world cannot comfortably bear it. It is simply a question of convincing the right people. But if we have to convince others, we must first convince ourselves and then speak with conviction," Kaw said.

Copies of Kaw's talk are available from Fusion Power Associates.

US INDUSTRIES SELECTED FOR ITER

Working through several of its major laboratories, the U.S. Department of Energy is in the process of contracting with several U.S. industries to provide support for the International Thermonuclear Experimental Reactor (ITER) project (see our August, September and October newsletters). Three of six major support contractor teams have been chosen; the selection of two more is imminent.

The team of General Dynamics and Westinghouse Electric Corporation has been chosen by MIT as the primary industrial contractor for U.S. research and development on superconducting magnets for ITER. Under contracts "that will be phased in over time," the team will "design, manufacture and test coil components." DOE estimates that "the cumulative value of the contracts . . . could reach \$25 million" over the next 6 years, "depending on the share of these (magnet) activities assigned to the U.S. Home Team by the Joint Central Team."

A team led by McDonnell Douglas, including Westinghouse, the University of Wisconsin and the University of Illinois, has been chosen by Argonne National Laboratory to be the U.S. industrial contractor for ITER "first wall/blanket/shield systems." The team will "design, manufacture and test scale-model ITER modules of these systems." DOE estimates the cumulative value of the contracts in this area to be \$10-15 million over a six year period, depending on the share of these tasks allocated to the U.S. by the ITER Joint Central Team.

A team led by Rockwell International Corporation, including General Atomics and CIMCORP Precision Systems, Inc., has been chosen by Oak Ridge National Laboratory to be the U.S. industrial contractor for ITER remote handling and maintenance. The team will "conduct concept development, design, manufacturing and test activities for remote handling tooling and systems." DOE estimates the cumulative value of the contracts in this area to be \$4 million over a six year period, depending on the share of these tasks allocated to the U.S. by the ITER Joint Central Team.

Contract negotiations are underway with Pitt-Des Moines Steel by Oak Ridge National Laboratory for responsibility in the area of ITER vacuum vessel and containment structures. The selection of a contractor by Sandia National Laboratories for the development of high heat flux plasma-facing components is imminent. An additional request for proposals is expected soon from the Lawrence Livermore National Laboratory for a contractor to perform design and systems integration support.



Prof. Nathaniel J. Fisch

FISCH WINS APS AWARD

Prof. Nathaniel J. Fisch, of Princeton Plasma Physics Laboratory, has been named the 1992 winner of the Award for Excellence in Plasma Physics by the American Physical Society. He was recognized "for pioneering theories which correctly predicted that radio-frequency waves can be used to generate continuous electrical currents in tokamak devices."

FUSION OFFICE REORGANIZES

DOE Director of Energy Research William Happer has announced a reorganization of the Office of Fusion Energy, which is headed by Dr. N. Anne Davies. The Development and Technology Division (D&T) has been abolished and a new division, the International Thermonuclear Experimental Reactor and Technology (I&T) Division has been established. The new division will be headed by Mr. Thomas James.

The Applied Plasma Physics Division has been abolished and the Advanced Physics and Technology (AP&T) Division has been established. The re-named division will continue to be headed by Dr. David Crandall. As part of the reorganization, several long-term technology areas have been transferred to AP&T Division from the old D&T Division, including low activation materials research, fusion reactor studies and environmental/safety research.

Also, Dr. Davies announced the appointment of Ira Adler to be her deputy. For the past three years he has served as director of the Office of Management within the Office of Energy Research.

Dr. Davies has also announced that Dr. Charles Baker of ORNL will succeed Dr. Alexander Glass of LLNL as U.S. Home Team Leader for ITER, effective November 3. Dr. Glass continues his responsibilities as Laboratory Associate Director at LLNL.

GRUMMAN WINS ACCELERATOR MAGNET AWARD

Grumman Corporation has signed a \$42.7 million contract with the DOE's Brookhaven National Laboratory to build 373 superconducting dipole magnets for the Lab's Relativistic Heavy Ion Collider (RHIC) accelerator. The new facility is scheduled to operate in 1997 to study fundamental processes of nuclear physics.

INERTIAL FUSION SPINOFF

Researchers at the Lawrence Livermore National Laboratory have developed a lighter than air foam for use in inertial confinement fusion pellets. The foam is called "seagel" (safe emulsion agar gel) and is composed primarily of agar, a

seaweed derivative often used as a thickening agent in food. Once the agar is extracted, dissolved in water, combined with special solvents and emulsifiers, and freeze-dried in a partial vacuum, the resulting foam weighs 1.1 milligrams per cubic centimeter, or about 10 percent less than room-temperature air at 50% relative humidity. The foam is fragile in its lighter-than-air composition. But when produced in higher densities, it can support thousands of times its own weight and can be machined like wood. The material could be used as a substitute for balsa wood, and used, for example as supertanker insulation or sound-deadening insulation. A number of companies have expressed interest in using the material as low-cost, biodegradable packaging and insulation products. Drug companies are also interested in it as an encapsulant for medications because of its ingestibility and time-release properties. For further information, contact Dr. Robert L. Morrison at LLNL, (510)422-6332.

QUOTABLE

"In my judgment, the scientific benefits of the SSC relative to those to be gained from other research opportunities do not justify its cost, and I would cancel the project."

John M. Deutch,
in MIT Technology Review,
November/December, 1992



DOE Lawrence Award winners pose with DOE Secretary James Watkins and Director of Energy Research William Happer. (l. to r. Peter Schultz, Zachary Fisk, Richard Fortner, Rulon Linford, Watkins, Richard Smalley, J. Pace VanDevender and Happer)