



FUSION POWER ASSOCIATES

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ENERGY BUDGETS THREATENED

FUSION FORUM PLANNED MARCH 28 IN DC

BUDGETS THREATENED

In their "Contract with America" proposal, House Republicans proposed to cut spending at the Department of Energy by \$2.14 billion over five years, including a reduction in the budget for magnetic fusion by 50%. Not to be outdone, President Clinton announced a plan to cut spending at the Department of Energy by \$10.6 billion over five years, including a reduction of \$1.2 billion in "applied research programs." Other cuts promised by DOE within the \$10.6 billion included \$4.4 billion from "environmental management," \$3.0 billion from "strategic realignment, indirect cost reductions, and facility transition," and \$2.0 billion from privatization of the Naval Petroleum Reserves and the sale of highly enriched uranium.

News stories accompanying the announcements frequently mentioned fusion as one of the targeted programs for possible reductions. The Washington Post, for example, reported on December 14 that the DOE "has proposed closing a Princeton University nuclear fusion research laboratory that has yet to find a way to generate inexhaustible energy." This erroneous report prompted Under Secretary Charles Curtis to issue a press release, also dated December 14, stating simply "The Department of Energy has not proposed that the Princeton Plasma Physics Laboratory be closed." When asked, the lead author of the original article reportedly stated, "I did not write that part of the story." The next day, another reporter, Clay Chandler, writing in the Post, stated that DOE would "seek \$1.1 billion in savings from its applied scientific research programs, including fusion energy." In later interviews, DOE emphasized that no decisions had been made on

cutting the fusion program and that the specifics of where DOE would cut were dependent on further review and analyses of a variety of options.

The best information we have at press time is that President Clinton will propose a budget for fusion for FY 1996 which is at the same level as the FY 1995 budget, pending a review of fusion by the President's Committee of Advisors on Science and Technology (PCAST). That review is reported to be going to begin in a few months under the direction of Prof. John Holdren (University of California at Berkeley).

Meanwhile fusion remains on the hit list of Rep. John Kasich (R-OH) who heads the Budget Committee in the House. In the Senate, more moderate views seem to prevail, with Sen. Pete Domenici (R-NM) chairing the Budget Committee. However, Senate majority leader Bob Dole has been quoted as advocating abolishing the whole Energy Department, saying "I don't see any useful purpose it serves. It can be wrapped into something else."

COMMITTEE CHAIRS NAMED

Republicans have named the chairs of major committees of Congress, including those dealing with fusion. Rep. John Myers (R-IN) will head the Appropriations Subcommittee on Energy and Water Development; Tom Beville (D-AL) will be ranking minority member. Rep. Bob Walker (R-PA) will head the Science Committee; George Brown will be the ranking minority member. In the Senate, Sen. Mark Hatfield will head the full Appropriations Committee as well as the Subcommittee on Energy and Water Development;

Sen. J. Bennett Johnston will be the ranking minority member. Sen. Frank Murkowski (R-AK) will head the Senate Energy Committee; Sen. J. Bennett Johnston will be ranking minority member.

FUSION FORUM PLANNED

The fusion community will sponsor a "Fusion Forum" during the afternoon of March 28 in the Caucus Room of the Cannon House Office Building in Washington DC. The Forum will consist of a large number of fusion exhibits and a reception, following the format of the highly successful Forum held last year. Institutions wishing to participate in the Forum should contact Ms. Marion Stav at General Atomics, tel (619)455-2493; fax -2496; e-mail stav@gav.gat.com

Whether your institution is participating or not, please stay abreast of plans for the Forum and invite your Congressperson to attend.

SCIENCE CHAIRMAN COMMENTS

Incoming chair of the newly-named House "Science Committee," Bob Walker (R-PA), held a news conference December 14 in which he provided a variety of views, including comments on fusion energy. Walker indicated that he would hold full Committee hearings in January to receive testimony from "relevant cabinet members," asking them "to look at the next Century and tell us what they think their various agencies and departments should be doing to prepare us for the new economy and the new culture." Walker stated that he would like to "engage in a dialogue with the American people, with the science community and with my colleagues which reasserts the value of science as a means for bringing our country a future of sustained growth, built on new discoveries and based upon improved technologies that are derived from those new discoveries." He criticized past policies that he felt represented government attempts to over-direct science programs, stating "This committee will actively contrast and demonstrate the difference between the kind of freedom and opportunity that can be built in society as opposed to a command and control sort of idea of government involvement in the scientific arena." He cited DOE programs in climate change, fusion energy and technology transfer as examples of programs he wanted to question, but said he "would reserve judgment on them." Referring to these programs, Walker said, "In my view "unbiased science is not something that is used to confirm a

political agenda . . . unbiased science does not consist of coming up with preconceived answers or confirming someone's pork barrel projects." Specifically on fusion, Walker said, "I think we need to take a look at the money we have been spending in the fusion area. It's certainly an area that we have to look at in hearings. The Department of Energy may be coming up with some recommendations in that area. What we can't afford to do is to have massive cost overruns in that program. It is a program where there has been a lot invested over a period of years. And I think it now needs to be examined very, very carefully in light of a lot of budget constraints that we are going to have." Asked whether he was thinking of shutting down the fusion program, Walker said, "I am not prepared to make that kind of judgment."

EPRI FUSION PANEL ISSUES REPORT

The Electric Power Research Institute (EPRI) Fusion Panel, chaired by Jack Kaslow, Executive Director, EPRI Northeast Region, has issued its report, "Criteria for Practical Fusion Power Systems." The report states that while the "development of practical fusion power systems is still years away . . . yet early awareness of what will be required in an eventual real-world application can help ensure that crucial applications issues are addressed as the technology develops, thereby contributing to the speed and economy of the development process." The report states that the panel found three characteristics to be "of overarching importance." They were (1) Economics, (2) Public Acceptance, and (3) Regulatory Simplicity. The panel said that "It is not practical to assign values to these criteria" because "the world of tomorrow will be different," and because "there are potential tradeoffs among many of the factors." Each of these three criteria is discussed in detail in the report. For example, the report states, "To compensate for the higher economic risks associated with new technologies, fusion plants must have lower life-cycle costs than competing proven technologies available at the time of commercialization," and they provide a list of 11 factors that "can help to minimize these costs." The report points out that "Public Acceptance" means more than just environmental attractiveness; it also includes safety attributes and the attractiveness of fusion as a domestic and international business enterprise. Copies of the EPRI report are available from Fusion Power Associates or from Dr. Tom Schneider, EPRI, fax (415)855-2287.

DOE SENDS CONGRESS ITER SITE PLAN

On November 21, Energy Secretary Hazel O'Leary issued an "Interim Report to the Congress on Planning for International Thermonuclear Experimental Reactor Siting and Construction Decisions." Congress had been asking DOE for such a plan for the last two years. Secretary O'Leary states that "the Department will be better able to provide complete responses once the ITER Interim Design Report has been completed and the parties have accepted it." She notes that the Interim Design Report is expected at the end of July 1995.

The report to Congress notes the international character of the ITER project and states that "the ITER Parties have been sensitive to each other's concerns regarding major decisions," and states that "it is important for the United States to maintain a coordinated and collaborative process with the other ITER Parties." The report states that, since "each of the four Parties is likely to be able to produce an attractive, acceptable site," the DOE prefers an approach called "Party First," meaning that the Host Party is "chosen at the outset rather than having a Host site selected from proposals made by the Parties." After selecting the Host country for ITER, the Host country "would then use a domestic site selection process to select an appropriate site that meets the requirements agreed upon, subject to acceptance by the other ITER Parties." The report states that such an approach "would save each of the Parties from assuming the considerable costs of conducting site selection processes." DOE estimates the cost of such a process in the U.S. to "be in the range of \$10-\$40 million."

The report discusses issues associated with a U.S. site selection process should the U.S. be chosen as the Host Party. It says that DOE "has identified three potential options for conducting a domestic competition:" (1) an open competition, (2) one limited to Federal sites, and (3) one limited to DOE sites. The report expresses no preference among these options, but lists "advantages" and "disadvantages" of each option. The report notes that "The Department is currently leading an interagency process to establish a United States position on an appropriate approach for siting ITER."

Copies of the report are available from Dr. Michael Roberts, DOE Office of Fusion Energy, fax (301)903-1233.



LLNL Director Bruce Tarter

TARTER NAMED LLNL DIRECTOR

The Board of Regents of the University of California has named Bruce Tarter director of the Lawrence Livermore National Laboratory. Tarter has been acting director since the resignation of director John Nuckolls last April. Tarter first came to LLNL as a summer intern in 1962, when he worked on magnetic fusion. Later, in 1967, he received his Ph.D. in physics from Cornell University, returned to the laboratory where he has spent his career primarily on the theoretical physics aspects of nuclear weapons design and astrophysical phenomena.

In an interview with the laboratory newspaper, "Newslines," Tarter said that LLNL "is the finest applied science institution the country has." He called LLNL "a place where large-scale applied science has flourished, where high-risk, high-payoff ideas have been encouraged and nurtured, and where multidisciplinary teams have successfully executed programs of high national priority."

DOE PLANS MAJOR REORGANIZATION

Energy Secretary Hazel O'Leary has launched a major exercise aimed at producing a plan to reorganize the DOE by May 1995. The reorganization is intended to bring the DOE organization into better alignment with its "five business lines," according to O'Leary. The so-called "business lines" were identified earlier in a DOE Strategic

Plan dated April 1994. They are (1) Science and Technology, (2) Industrial Competitiveness, (3) Energy Resources, (4) National Security, and (5) Environmental Quality. DOE has contracted with a management consulting firm, Marshall Group, Inc., to guide teams of DOE employees, contractors, and outside consultants through the process. Secretary O'Leary indicated that she expected the process to "strip out layers of management," and result in a leaner, stronger Department. She appealed to DOE employees to cooperate fully with the exercise by "openly working together, focused on the goal, but respecting individuals." DOE currently has about 20,000 employees and a contractor workforce of about 140,000.

ELECTRICITY DEMAND REMAINS STRONG

Defying widespread predictions of 2% growth curves, electricity demand increases remain higher. The Energy Information Administration has just issued the Electric Power Annual 1993, a 187 page comprehensive compilation of statistics for the year 1993. It shows that the electric power industry generated nearly 4% more electricity in 1993 than in 1992, or 3,197 billion kilowatt hours. Installed generating capacity in the U.S. stood at a record 700 Gigawatts in the utilities, complemented by an additional 55 Gigawatts available from non-utility power producers. The report also indicates that the U.S. was a net importer of electricity, importing 39 billion kilowatt hours, while exporting 11 billion kilowatt hours. Copies of the report may be requested from the EIA at (202)586-8800.

FPA FUSION INDUSTRY CONFERENCE

Fusion Power Associates Fusion Industry Stakeholders Conference has been rescheduled from the original dates in March (see our November 1994 newsletter) to June 14-15 in Washington DC. The conference will be held at the L'Enfant Plaza Hotel. The conference will highlight the technical contributions that industry is making to fusion development, with emphasis on TPX, ITER and NIF. Further information will be mailed as it becomes available. Contact Ruth Watkins at FPA.

PEOPLE

Ralph Jacobs, director of New Technology Initiatives at LLNL, has been elected a Fellow of the American Physical Society.

Dana Isherwood and *Dick Post*, LLNL, have been elected

Fellows of the American Association for the Advancement of Science.

Donald Monticello and *Michael Zamstorff*, PPPL, have been elected Fellows of the American Physical Society.

Jim Turner, who worked for a time in the DOE Office of Fusion Energy, has been named manager of DOE's Oakland Operations Office.

MEETINGS

Jan 24 DOE Public Meeting/Workshop on NIF and Non-Proliferation. Oakland, CA. Contact USDOE (202)586-3012.

Jan 30 Repeat of Jan 24 DOE Meeting on NIF and Non-Proliferation. Washington DC. Contact USDOE (202)586-3012.

Mar 6-9 U.S.-European Transport Task Force Workshop. Marina del Ray, CA. Contact Dorothy Tate, ORNL, tel (615)574-1311, fax 576-7926.

Mar 8-9 17th Industrial Liaison Program Conference, UC-Berkeley College of Engineering. Berkeley, CA. Contact (510)642-6611.

Apr 3-5 1995 International Sherwood Fusion Theory Conference. Lake Tahoe, NV. Contact Mona Alford, LLNL, fax (510)423-3484.

Apr 24-28 12th International Conference on Laser Interaction and Related Plasma Phenomena. Osaka, Japan. Contact Prof. K. Nishihara, fax 81-6-877-4799; e-mail lirpp@ile.osaka-u.ac.jp

May 28-Jun 3 Fifth Topical Meeting on Tritium Technology in Fission, Fusion and Isotopic Applications. Lake Maggiore, Italy. Contact Ms. G. Siluri, fax 39-332-789165; e-mail g_siluri@cen.jrc.it

Jun 14-15 Fusion Power Associates Fusion Industry Stakeholders Conference, L'Enfant Plaza Hotel, Washington, DC. Contact Ruth Watkins tel (301)258-0545, fax (301)975-9869.

Jul 17-21 Cryogenic Engineering Conference. Columbus, OH. Contact Linda Wise, fax (303)499-2599.



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SPHERICAL TORUS: COMING OF AGE?

SMALL-SCALE TESTS SHOW PROMISE

SEAB SETS FUSION REVIEW DATE

The Secretary of Energy Advisory Board Task Force on Strategic Energy R&D (see our November 1994 newsletter) has tentatively set Tuesday morning April 25 in Washington DC as the time when they will hear presentations on DOE's fusion and renewable energy programs. The meeting is expected to be held at the L'Enfant Plaza Hotel. Speakers have not yet been selected. The Task Force is charged by Energy Secretary Hazel O'Leary with reviewing the Department's "portfolio" of energy R&D programs and to advise the Secretary on whether the Department has "established reasonable priorities" among the programs. The Task Force has so far received only overviews of the nuclear, fossil, efficiency, renewable and fusion energy programs and has received more detailed briefings on the nuclear, coal, oil and gas programs. A briefing on energy efficiency programs is scheduled February 28. The Task Force is chaired by Daniel Yergin, president, Cambridge Energy Research Associates. FPA president Steve Dean is a member of the Task Force. For further information on the activities of the Task Force, contact Charles Billups, fax (202)586-3497.

THE SPHERICAL TORUS

A sphere is an object shaped like a ball, whereas a torus is an object shaped like a doughnut. Perhaps more importantly, from a fusion power source point of view, a sphere only has equipment around its periphery whereas a torus has equipment threading its center. Consequently, geometrically speaking, a "spherical torus" seems like a contradiction in terms. This fact did not discourage Oak Ridge National Laboratory scientist Martin Peng from so-



Dr. Martin Peng

namely the magnetic configuration he has been advocating for several years, a configuration he sees as a natural evolution of the tokamak torus towards a smaller, cheaper fusion concept (Nuclear Fusion, Vol.26, p.769, 1986).

The spherical torus is still basically a torus, but one which has been "squeezed" inward from the outside circumference, making the hole in the doughnut smaller and the whole object more resembling a sphere. The approach to "sphericity" is measured by a parameter called the "aspect ratio," which is the ratio of the radius of the torus to the radius of the plasma. As shown in Figure 1, the first tokamak, T-3 in Russia, had an aspect ratio of 8, whereas

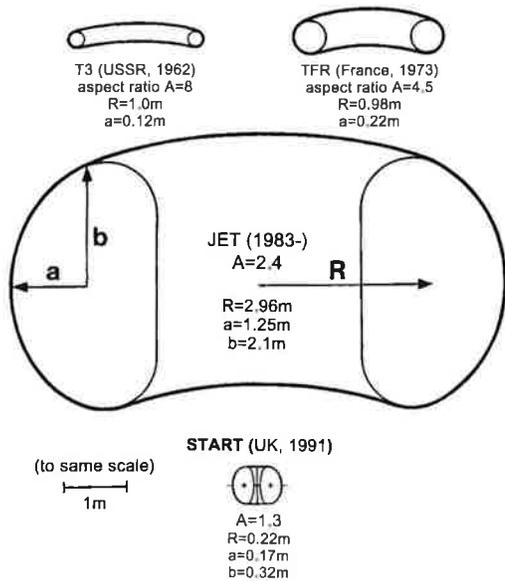


Figure 1: Relative sizes and aspect ratios of tokamak facilities

the JET has an aspect ratio of only 2.4. A spherical torus (ST), as shown by the bottom diagram in Figure 1, typically has an aspect ratio about half that of JET, and more closely resembles a sphere than the others. Peng noted from empirical scaling laws being developed by the tokamak physics community that such a configuration might have attractive fusion performance, while at the same time having lower cost due to smaller size and the predicted ability to sustain higher plasma pressure with lower magnetic field at lower aspect ratio. Many scientists have been skeptical that the favorable scaling seen at larger size would continue to be seen if taken to the extremes advocated by Peng. Also, engineers worried about the more intense heat and neutron fluxes that would impinge on the magnetic structures, a problem that led Peng to conclude that the spherical torus should plan on using conventional rather than superconducting magnets. The use of superconducting magnets has long been doctrine in most magnetic fusion circles. "Might the cost savings of smaller size more than make up for the higher costs of operating conventional magnets?" reasoned Peng. Data is just now beginning to emerge on the ST concept from a few small experiments around the world: the START experiment at Culham, England, the CDX-U at Princeton, the HIT at the University of Washington, and the TS-3 at the University of Tokyo.

RECENT EXPERIMENTS

A little over 3 years ago, scientists at the Culham Laboratory, led by Alan Sykes, with collaborations from the

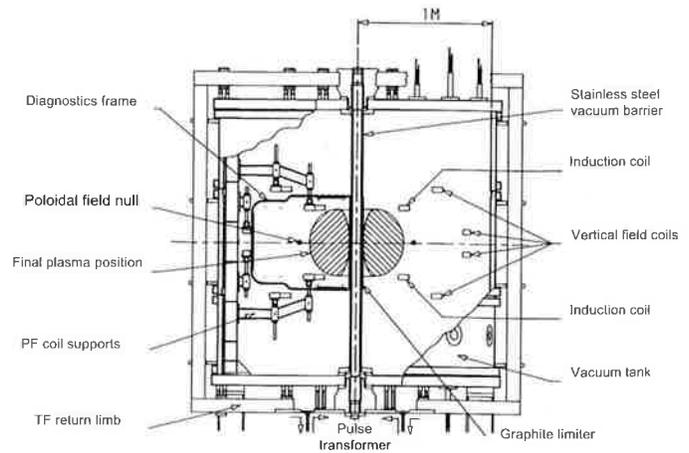


Figure 2: Cutaway drawing of START

U.S., Russia, and Brazil, began operation of a small experiment called START (Small Tight Aspect Ratio Tokamak). A cutaway drawing of the START facility is shown in Figure 2. A major feature of the results obtained thus far, as reported at the recent IAEA fusion conference in Spain, is the absence of plasma disruptions. Such disruptions have been a major limiting factor in the performance of higher aspect ratio tokamaks. The plasmas have also been observed to be vertically stable without active feedback. Confinement of the plasma is estimated to be twice as good as would be predicted by extension of empirical models developed in the higher aspect ratio tokamak program. The START plasmas are ohmically-heated with currents in the 100-250 kA range and pulse lengths in the 5-50 ms range. Plasma temperatures are in the 150-600 eV range for densities in the $3 \times 10^{18} \text{ m}^{-3}$ to 10^{20} m^{-3} range, although temperatures of over 1 keV have been observed in low density discharges.

Experimental results on efficient methods of plasma startup and the MHD properties of ultra-low aspect ratio (1.05 - 1.5) tokamaks were also reported at the IAEA conference by scientists using the CDX-U at Princeton and the TS-3 at Tokyo University, both with positive results. Scientists at the University of Washington, using the HIT (Helicity Injected Tokamak) also recently demonstrated the use of coaxial electrodes to initiate and sustain the plasma current in a low aspect ratio configuration.

Scientists are preparing proposals for next generation spherical torus facilities in the U.S. at the University of Texas (El Toro Gordo or "ETG") and at Princeton (National Spherical Torus Experiment or "NSTX"). A proposal for a new facility at Culham is also in preparation (Mega-Amp

Spherical Tokamak or "MAST"). A major uncertainty in all these designs is whether the observed good performance will be maintained as the plasma temperature is raised. Calculations of plasma performance in this configuration are difficult and unreliable at present. A major advantage of the ST concept is the relatively low cost of the proposed test facilities. ST advocates believe that the scientific uncertainties can only be resolved by operating facilities at the 1 MA level, hence the proposals for new facilities.

The ST concept lends itself to several potential future facilities of interest, including neutron sources for materials development, fusion pilot plants, and commercial demonstration power plants. For further information, contact Martin Peng at ORNL fax (615)576-7926.

SENATOR JOHNSTON TO RETIRE

Senator J. Bennett Johnston (D-LA) has announced his intention to retire from the U.S. Senate when his current term expires in two years. Johnston has served in the Senate for 22 years and has been a leader in energy policy legislation throughout his tenure. He chaired the Senate Energy Committee and was chair of the Energy and Water Subcommittee of the Senate Appropriations Committee. He has been a strong advocate of nuclear power and was a strong advocate of the Superconducting Super Collider (SSC). Although he has generally been supportive of the need to develop fusion, he has been impatient with the long timescale for practical fusion power plant development. In recent years he has criticized the Administration for what he perceived to be their unwillingness to commit to the construction of the International Thermonuclear Experimental Reactor (ITER). For the past two years he has been instrumental in preventing the U.S. from proceeding with a next generation fusion facility, the Tokamak Physics Experiment (TPX), citing the lack of commitment of the Administration to ITER. In the last session of Congress, he succeeded in getting the Senate to pass a fusion authorization bill which threatened massive cuts in fusion funding unless ITER proceeded into construction. The bill was not adopted in the House.

FUSION STAKEHOLDERS

Mark your calendar to participate in the Fusion Forum, March 28, and the Fusion Industry Stakeholders Conference,



Dr. John Gilligan

June 14-15, both in Washington, DC. This is a critical year for all fusion stakeholders to make their presence felt in Washington!

GILLIGAN NAMED ASSOCIATE DEAN

John Gilligan, professor of nuclear engineering at North Carolina State University, has been named Associate Dean of Engineering at the school. Prof. Gilligan formed and became director of the plasma and fusion program at NC State in 1983. He became director of Graduate Programs in nuclear engineering in 1986 and was promoted to Professor in 1990. He is an internationally recognized expert in plasma physics and fusion energy technology, with emphasis on plasma-materials interactions. He is a past chair of the ANS Education Division and former member of the IEEE Plasma Sciences Executive Committee. He is founder and has been editor of the ANS Nuclear Engineering Education Sourcebook since 1986. He was Technical Co-chair for the 1994 ANS Topical Meeting on Fusion Technology and is Chairman of the 1998 IEEE International Conference on Plasma Sciences to be held in Raleigh. He was presented with the 1989 Alcoa Research Achievement Award and has been an Individual Affiliate of Fusion Power Associates since our inception in 1979. In his new role, he will be the Chief Academic Officer for over 7000 undergraduate and graduate students in the College of Engineering at NC State. Congratulations John!

JAPAN-ARGENTINA PLASMA AGREEMENT

A memorandum for cooperation was signed between Japan and Argentina on December 14, 1994 to form a "mini-project" for plasma technology transfer from Japan to Argentina. The project, which officially starts on March 1, 1995 and lasts for three years, will involve the transfer of equipment to Argentina for plasma processing of titanium coating of cutting tools and will involve the exchange of personnel for training purposes. The agreement is an outgrowth and upgrade of a previous technology transfer agreement that began in 1991. The leader and coordinator for the project is Prof. Takaya Kawabe, University of Tsukuba. Mr. Nobuyuki Morino, Hitachi, Ltd., has been a key participant in the cooperation. After completion of the project, a further upgrade is envisioned which may include ion implantation technology. Prof. Kawabe is working to include other countries in this type of cooperation with Japan through the United Nations University. Interested parties should contact Dr. Kawabe by e-mail: kawabe@sakura.cc.tsukuba.ac.jp or fax (81)298-53-4324.

PCAST TO REVIEW FUSION

The President's Council of Advisors on Science and Technology (PCAST) will begin a review of the DOE fusion program sometime during the next few months. The review will be chaired by University of California, Berkeley, professor John Holdren. Neither the exact timing for beginning and completing the review, nor the scope of the review has yet been determined. DOE is seeking an early date for the review in order to phase its input into the FY1997 budget process this summer and as guidance to Congressional Appropriations Committees for FY 1996. Dr. Gerald Garvey, Assistant Director for Physical Sciences at the Office of Science and Technology Policy (OSTP), is responsible for setting up the review process. He hopes the review can be completed in June, but other PCAST sources believe this date to be uncertain.

COMMITTEES FORMED IN CONGRESS

The House Science Committee, chaired by Bob Walker (R-PA), will divide into four subcommittees: Basic Research, Energy and Environment; Space and Aeronautics; and Technology. All DOE programs except weapons will be under the jurisdiction of the Energy and Environment Subcommittee, which will be chaired by Dana Rohrabacher (R-CA). Other Republican members of the Subcommittee are Harris Fawell (IL), Curt Weldon (PA), Roscoe Bartlett

(MD), Zach Wamp (TN), Lindsey Graham (SC), Matt Salmon (AZ), Thomas Davis (VA), Steve Largent (OK), Barbara Cubin (WY), Mark Foley (FL), Steven Schiff (NM), Bill Baker (CA), Vernon Ehlers (MI), and Steve Stockman (TX). Democratic members are Jimmy Hayes (LA), David Minge (MN), John Olver (MA), Mike Ward (KY), Michael Doyle (PA), Tim Roemer (IN), Bud Cramer (AL), James Barcia (MI), Paul McHale (PA), Eddie Johnson (TX), Lynn Rivers (MI), and Karen McCarthy (MO). George Brown (D-CA), ranking minority member of the full committee and Bob Walker are ex-officio members of all subcommittees.

The House Appropriations Subcommittee on Energy and Water Development, chaired by John Myers (R-IN), has the following members. Republicans: Hal Rogers (KY), Joe Knollenberg (MI), Frank Riggs (R-CA), Rodney Frelinghuysen (NJ), Jim Bunn (OR); Democrats: Tom Beville (AL), Vic Fazio (CA) and Jim Chapman (TX).

In the Senate, Pete Domenici will chair the two key subcommittees dealing with fusion: Senate Energy Subcommittee on Energy R&D and Senate Appropriations Subcommittee on Energy and Water. Details of Senate Committees will appear in next month's newsletter.

QUOTABLES

"In short, we need to rekindle in the scientific community a new sense of patriotism. That their work is funded by ordinary taxpayers -- the checkout clerk at the grocery store or a machinist on the assembly line at GM. It is not an entitlement, it is not always guaranteed.// And people will expect to see results -- not necessarily immediately, or so that every idea leads instantaneously to the marketplace. But that their basic research is part of a continuum of excellence to solve problems with new ideas and new theories.// This new scientific patriotism also means having the willingness to collaborate more with industry."

Barbara Mikulski (D-MD)

"Science is an investment, not an expense."

Rep. Steve Stockman (R-TX)
C-Span, Jan. 1995



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CLINTON BACKS NEW FUSION PROJECTS

TPX AND NIF CONSTRUCTION REQUESTED

CLINTON BUDGET REQUEST

President Clinton's FY 1996 budget request, sent to Congress on February 6, includes funds to begin construction of two new, key fusion projects, the Tokamak Physics Experiment (TPX) and the National Ignition Facility (NIF); the first as a part of the civilian energy research program and the second as part of the defense program.

TPX, to be built as a National facility located at the Princeton Plasma Physics Laboratory at an estimated cost of \$742 million, is designed to demonstrate that fusion conditions can be maintained continuously in a relatively modest-sized device. It is projected to operate in 2001.

NIF, a National facility likely to be located at the Lawrence Livermore National Laboratory at an estimated cost of \$1.1 billion, is designed to demonstrate the use of a large laser to ignite small pellets containing fusion fuel. It is one of several proposed facilities aimed at maintaining relevant skills at the Nation's weapons laboratories in the absence of underground nuclear testing. NIF is projected to operate in 2002.

Scientists view TPX and NIF as essential facilities to demonstrate the physics basis of magnetic and inertial confinement fusion, respectively. Magnetic and inertial confinement fusion represent two different, but complementary approaches to the eventual use of fusion for power production and other purposes. Fusion Power Associates president Steve Dean will testify in support of these projects before the Subcommittee on Energy and Water Development of the House Appropriations Committee on March 28 at 2:30 PM.

BUDGET DETAIL

President Clinton's FY 1996 budget request for magnetic

fusion is for \$366 million, compared to an FY 1995 expenditure of \$364.7 million. Included in the request is \$62.1 million for TPX (\$12.2 million for conceptual design and \$49.9 million for engineering design and construction) and \$82 million in support of design and R&D for the International Thermonuclear Experimental Reactor (ITER) project. The request also provides \$127.3 million for other tokamak experiments (including TFTR, DIII-D, and Alcator C-MOD); \$22 million for materials and other technology development; \$49 million for theory, computation and small scale experiments (a decrease from this year's \$54.8 million); and \$7 million for the pursuit of heavy ion accelerator development for inertial confinement fusion energy applications (compared to this year's \$8.5 million).

Clinton's budget request for inertial confinement fusion for defense programs is for \$240.7 million compared to an FY 1995 expenditure of \$176.5 million. Included in the request is \$61 million for the NIF (\$23.6 million for conceptual design and development and \$37.4 million for engineering design and construction). The request also provides \$102.5 million for the Indirect Drive program (compared to \$93.4 million this year); \$18.2 for the Direct Drive program; \$8 million for the KrF Laser program; \$26.8 million for the Light Ion program; \$16.3 million for Capsule Development and other programs; and \$7.9 million for capital equipment.

OTA REPORTS ON FUSION

At the request of Rep. George Brown (D-CA), the Office of Technology Assessment of the U.S. Congress has been reviewing the role of TPX and Alternate Concepts in the U.S. fusion program. Study leader Robin Roy presented a summary of the report at a hearing before the House Committee on Science, Subcommittee on Energy and Environment, on February 15. The 80 page report and a 4 page summary were released at that time. Copies of the

4 page summary are available from Fusion Power Associates. Inquiries about availability of the full report should be addressed to Karen Larsen, Office of Technology Assessment, fax (202)228-6336. OTA indicates that the summary can be accessed through the World Wide Web at <http://www.ota.gov>

The report states that TPX "would provide a focus for U.S. fusion research after TFTR retires in 1995, and that experience building major systems such as superconducting magnets could give U.S. industry an edge in competing to construct ITER. More importantly, TPX would provide advances ultimately needed for a tokamak power plant." The report asserts, "TPX's value to the fusion energy program could increase if ITER's schedule is delayed by several years." It says, "the present scheduling overlap (between TPX and ITER) makes it impossible to take full advantage of TPX results in the design and construction of ITER." An article in Nature (February 2, 1995, p. 375) quotes Congressman Brown as saying "We should examine that (the possibility of a delay in ITER) with our international partners. I can foresee a pause of three to five years." The same article quotes ITER director Robert Aymar as saying, "It (a delay) is completely out of the question."

The OTA report notes that, "Over the past decade the fusion energy program was narrowed to focus on the tokamak primarily for budgetary rather than technical reasons." The report states that, "There is a widely held view that this narrowing of the fusion energy program was premature and did not reflect the benefits of pursuing alternate concepts."

The report states that, "Decisions for TPX and alternate concepts research must be made in the context of three critical questions facing the fusion energy program. First, what is the potential role of the fusion energy program in meeting long-term energy needs, and what level of research effort is justified by that role? (Second), what goals for the fusion energy program could be accomplished under scenarios of flat or declining budgets? (and) third, can cost-sharing through international collaboration in fusion energy research be more effectively pursued?" OTA indicates that, "this paper does not examine the rationale for the overall fusion energy program," and states that the other questions are also "beyond the scope of this background paper."

The report does state that "Congress will face tough decisions about budget priorities for the fusion energy program over the next few years, as current plans for pursuing the tokamak imply a doubling or more from fiscal year 1995's funding of \$373 million." It notes that "By far the greatest single budgetary requirement for the fusion energy

program over the next decade will come from ITER, if current plans are pursued." It notes that "Despite congressional requirements in the Energy Policy Act of 1992, as of December 1994, DOE has not issued a strategic management plan for the fusion energy program by which the program's promise can be judged," and notes that "without substantial funding increases, the program will have to change significantly from the current direction and new goals will have to be set."

NEWS FROM ATLANTA

The American Association for the Advancement of Science (AAAS) held a session on "Recent Progress Toward Controlled Thermonuclear Power" during its annual meeting in Atlanta, GA, on February 19. Princeton Plasma Physics Laboratory director Ron Davidson described the world record 10.7 Megawatts of fusion power produced in the Tokamak Fusion Test Reactor (TFTR), (see our December 1994 newsletter). TFTR has produced a fusion power density in the core of 2.8 Megawatts/m³, exceeding the original design goal of 1 Megawatt/m³, he said. Davidson also described plans for the construction of the Tokamak Physics Experiment (TPX).

In a front page article in the San Diego Union, February 20, David Graham, reporting from Atlanta on the AAAS meeting, indicated that fusion pioneer scientist Marshall Rosenbluth believed that the future of fusion research is in jeopardy, quoting him as saying, "It's a tragedy that the country has decided it may not put its money behind these scientific challenges. The country has lost track of the fact that energy will be a problem." The paper also quoted U.S. ITER Home Team Leader Charles Baker as saying operation of ITER, currently scheduled for 2005 may not happen until 2010. "Delay is now inevitable," Baker is quoted as saying. Referring to both TPX and ITER, Rosenbluth is quoted as saying, "It is not clear whether any of these actually will be built."

SAN DIEGO UNION EDITORIAL

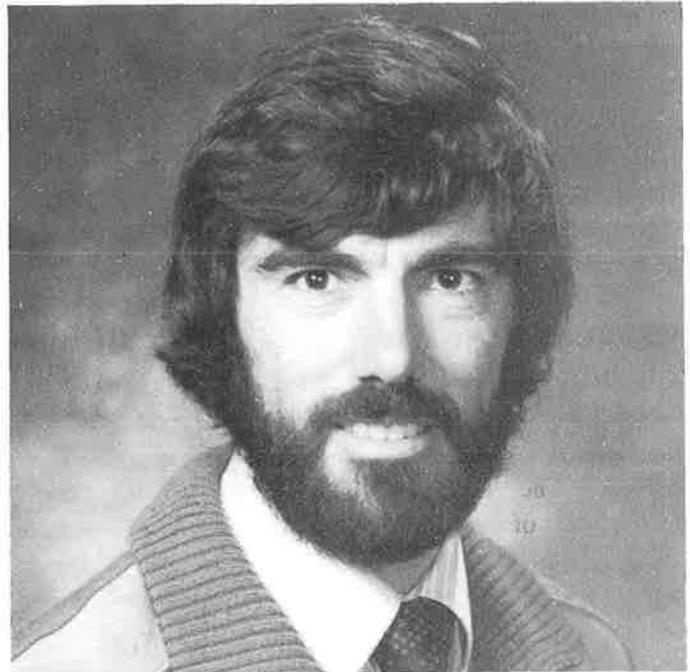
In its lead editorial February 23, entitled "Look to the Future--Nuclear Fusion Must Be Made a Budget Priority", editors of the San Diego Union write that "the long-term impact of today's decisions is rarely of concern to elected officials. The growing indifference in Washington to fusion energy research is a good example." They write, "The challenge for the future will be to conserve energy, to improve energy efficiency and, above all, to develop new energy sources. That's why nuclear fusion is so important." After discussing the problems of continued reliance on fossil fuels, the editorial concludes, "Developing fusion as a viable energy source is an extremely important scientific project."

President Clinton and Congress must embrace their responsibility to future generations and provide the funding necessary to support robust fusion research The annual amount the federal government spends on fusion research is just one-tenth of 1 percent of the amount spent on energy consumption in the United States. That's a tiny investment for an immense need that's getting closer all the time."

NIF AND NON-PROLIFERATION

Following a "workshop" in September to discuss public policy issues associated with the construction of the National Ignition Facility (NIF), (see our October 1994 newsletter), the DOE has embarked on a series of public hearings on some of the issues identified at the workshop. One of those, "NIF and Non-Proliferation" has been the subject of a series of public hearings on the subject held on January 24, January 30 and March 9. Dozens of speakers have appeared to express opinions against the construction of NIF, arguing, basically, that a facility that provides insights into nuclear weapons physics, and will also be open to international use, will promote nuclear proliferation. Some speakers oppose NIF as a subterfuge for artificially keeping up employment levels at the weapons laboratories, or simply on the grounds of keeping federal spending on a downward trend.

FPA president Steve Dean is scheduled to speak at the March 9 meeting to express a positive view. "NIF is a timely and necessary experiment to establish the scientific principles of inertial confinement fusion, a technology that has numerous commercial benefits, including eventually the development of a commercially competitive energy source," Dean said. He noted that the principles of nuclear weapons design have been widely available to all nations for a long time and do not require the physics that will be established in the NIF. "Proliferation policy should be based on the control and inspection of fissionable material and related equipment, not based on suppressing scientific investigations of the fusion process," Dean said. Dean noted that the JASONS, a prestigious scientific study group, had considered the proliferation issues associated with the NIF last summer and had concluded, "The NIF technology is not a nuclear weapon, cannot be adapted to become a nuclear weapon, and demands a technology sophistication far more advanced and difficult than required for nuclear weapons." The JASONS noted that "the NIF is an extremely sophisticated challenge, not one which could conceivably be undertaken by, or be useful to, a potential proliferator. The necessary physics for simple weapons design of a type useful to third-country proliferators is already declassified." The JASONS stated that "The more open the research program



Dr. Michael J. Saltmarsh

of NIF, the better the U.S. will be able to blunt the concerns about its contribution to proliferation." Dean said he endorsed the views of the JASONS.

SALTMARSH TO HEAD FUSION AT ORNL

Michael J. Saltmarsh has been named Director of the Fusion Energy Division and the Fusion Program at the Oak Ridge National Laboratory (ORNL). Mike has been working at Oak Ridge since 1968. His fusion research activities have included leadership roles in the ISX tokamak and the ATF stellarator experiments. He was an associate director of the Fusion Energy Division from 1989 to 1992. Since then he has been Director of the Office of Planning and Management at ORNL. He received his B.A. and Ph.D. in nuclear physics from the University of Oxford in 1966.

"GREEN SCISSORS" TARGETS FUSION

A coalition of 20 public interest groups, led by the National Taxpayers Union and Friends of the Earth has circulated to Congress a document called the "Green Scissors Report," recommending reductions or elimination of 34 government programs, claiming savings to the taxpayers of \$33 billion. The report targets water projects, highways, public land studies, foreign aid projects, agriculture program federal flood and disaster insurance, and energy research and development programs, including fusion. They call for the elimination of the Tokamak Physics Experiment, a move they say will save \$2.2 billion. The report questions the commercial potential of the tokamak concept, the relative emphasis on tokamaks vis-a-vis alternate concepts, and the

projected amount of radioactive waste from fusion reactors using the DT reaction. For "expert" opinion on these matters they recommend contacting Anna Aurilio, (202)546-9707; Jill Lancelot, National Taxpayers Union, (202)543-1300; Tom Schatz, Council for Citizens Against Government Waste, (202) 467-5300; Bill Magavern, Public Citizen, (202)546-4996; or Scott Denman, Safe Energy Communications Council, (202)483-8491.

HEAVY ION PROJECT AUTHORIZED

The DOE Office of Fusion Energy has authorized the fabrication of the Elise heavy ion accelerator at the Lawrence Berkeley Laboratory at a total cost of \$25.9 million. The facility is essentially the electrostatically focused part of the ILSE accelerator, which it is hoped the Elise will eventually evolve into. ILSE is designed to provide a proof-of-principle test of the accelerator physics required for eventual commercial applications of inertial fusion energy. Dr. Joe Kwan has been designated as project manager. For further information contact Dr. Roger Bangerter, FAX (510)486-5392.

DOE SOLICITS TOROIDAL INNOVATIONS

The DOE Office of Fusion Energy is seeking proposals for "innovative experiments in toroidal magnetic confinement systems." The notice, published in the January 4, 1995 issue of the Federal Register, p. 449, states that the proposals "may be either to continue research on existing experimental devices or to start new experimental projects." The notice states that DOE is "interested in applications for innovative research that have the possibility of leading to improved toroidal magnetic fusion power plants (this includes tokamak based power plants with improved performance). Proposals are due June 1. For further information, contact Dr. Ronald Blanken at (301)903-3306 or through internet:ronald.blanken@mailgw.er.doe.gov

TELLER AWARDS ANNOUNCED

The Awards Committee of the 12th International Conference on Laser Interaction and Related Plasma Phenomena (to be held April 24-28 in Osaka, Japan) has announced names of the 1995 Edward Teller Medal recipients. They are E. Michael Campbell (LLNL), Robert L. McCrory (U. of Rochester), Gennady A. Kirillov, (Arzamas-16, Russia), and George H. Miley (University of Illinois). The awards were established in 1989 to recognize "pioneering research and leadership in the use of lasers and ion particle beams to produce unique high-energy density matter for scientific research and for controlled thermonuclear fusion." The awards will be presented by Dr. Teller at the conference in Osaka.

GALVIN REPORT ENDORSES NIF

On February 1, the DOE Secretary of Energy Advisory Board Task Force on Alternative Futures for the Department of Energy Laboratories, issued its much anticipated report. The Task Force, chaired by Robert Galvin, Chairman of the Executive Committee of Motorola, Inc., recommended "proceeding with the National Ignition Facility (NIF) as a research facility, prioritized with respect to other major research investments." The Task Force said that "NIF will provide a unique means for doing very important experiments involving extremely high temperatures in condensed matter physics and it thus will make it possible to maintain expertise in one of the areas of physics fundamental to modern nuclear weapons design. Similarly, the data and theory it will produce will contribute uniquely to science generally and to astrophysics in particular." The Task Force also said, "NIF is a risk (as are most major research projects), but on balance the Task Force supports its construction."

The Task Force addressed many other issues, including the importance of DOE funding for energy. The Task Force said that "Energy is so central to the vitality of our dynamic country that it has to be a priority concern as an ongoing national strategic issue. It may be legitimately referred to as an issue of importance to our general long-term national security." The report states that "the development of clean, sustainable, alternative forms of energy will be essential as projected fossil fuel supplies dwindle and environmental constraints mandate a dramatic switch in fuel sources in the next century."

PEOPLE

David Crandall has left his position as Director, Advanced Physics and Technology Division, Office of Fusion Energy to become Director, Office of the National Ignition Facility, Defense Programs, at the U.S. Department of Energy.

Thomas R. James has retired from his position as Director, ITER and Technology Division, Office of Fusion Energy, DOE, to become Deputy U.S. ITER Home Team Leader, University of California at San Diego.

Keith Thomassen has stepped down from his positions as Principle Deputy Associate Director for Energy and Deputy Associate Director for Magnetic Fusion Energy at LLNL, to devote full time to his position as Program Director for the Tokamak Physics Experiment.

E. Bickford Hooper has been appointed Acting Deputy Associate Director for Magnetic Fusion Energy at LLNL.



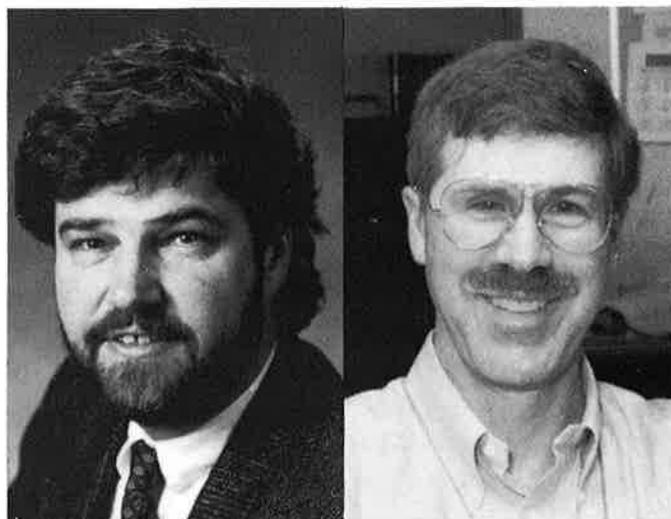
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PRESIDENT'S ADVISORS REVIEWING FUSION CONGRESS THREATENS MANY PROGRAMS CAMPBELL, LINDL RECEIVE LAWRENCE AWARDS

CAMPBELL, LINDL HONORED BY DOE

The Department of Energy has selected two inertial confinement fusion scientists, Mike Campbell and John Lindl, to be among the recipients of its prestigious E.O. Lawrence Award. The awards were established in 1959 to recognize outstanding contributions in the broadly defined field of atomic energy. The award consists of a gold medal and \$10,000. Campbell, an experimentalist, and Lindl, a theoretician, are being honored for their distinguished leadership in helping to propel the still relatively young discipline of laser-driven inertial confinement fusion to the forefront of physics research. Lindl received his Ph.D. from Princeton University in 1972; Campbell received his Ph.D, also from Princeton, in 1976. Six other scientists will receive the awards from DOE at a ceremony to be scheduled in the near future.



Mike Campbell

John Lindl

PCAST REVIEW BEGINS

The long awaited (see our February newsletter) review of fusion policy by the President's Council of Advisors on Science and Technology (PCAST) has begun. As anticipated, the review will be chaired by Prof. John Holdren of the University of California at Berkeley, a member of PCAST. The first meeting of the review committee was held in Washington March 29, following the regular meeting of the full PCAST on March 27-28. The review is to be completed in June.

The review was requested by Congress last year. In establishing the review committee, Presidential Science Advisor Jack Gibbons, noted that there would be a tremendous increase in demand for energy in coming

decades, due primarily to increased population in less developed nations and said "In order to accommodate this demand for energy and to limit the adverse global environmental impacts of energy use in all nations, new technologies for electrical power generation will be required. In the twenty-first century, increasing attention must be devoted to developing energy sources that can supply large quantities of electricity in an environmentally sustainable manner. It is within this context that the role of fusion and other energy supply technologies should be evaluated."

The review committee is charged "to conduct a review that identifies the technical and policy tradeoffs and budgetary requirements for at least four different options for structuring the magnetic fusion program. The committee should proceed from the assumption that eliminating the fusion program is not an option under consideration." The

four options given are labeled (1) "Build TPX and join next ITER phase;" (2) "Build TPX. Do not join next ITER phase;" (3) "Do not build TPX. Join next ITER phase;" (4) "Do not build TPX. Do not join next ITER phase." The charge states that "the committee may consider other options if it chooses to do so."

The charge states that "the role of the supporting base research program should be discussed for each option under consideration, including the subjects of materials research needs and alternatives to tokamak fusion concepts. The committee should discuss pros and cons, and tradeoffs between options under consideration, but ultimately should either recommend a preferred option, or suggest a ranking of the options under consideration." The charge tells the committee to take into consideration the DOE's tight financial situation, including an announced plan to cut overall energy funding over the next five years, and to take into account the ongoing activities of the "Yergin Task Force, which has been charged with reviewing the Department's portfolio of applied energy R&D programs." (See our November 1994 and February 1995 newsletters)

Other members of the PCAST Fusion Review Committee are: Norman Augustine (Lockheed Martin), Robert Conn (UCSD), Lawrence Papay (Bechtel), Stewart Prager (U. Wisconsin), Andrew Sessler (LBL), Robert Socolow (Princeton U.), Charles Vest (MIT), and Lillian Wu (IBM).

CONGRESS TAKES AIM

The House Budget Committee voted on March 16, to direct DOE to begin "terminating" the agency in FY 1996, as part of a proposed \$190 billion (over 5 years) spending reduction package. The committee report appended a non-binding set of possible programs to be cut, including "the international fusion program, the neutron source reactor, solar and renewable energy, biological and environmental research, environmental restoration and waste management, technology transfer, and the precollege education program."

In a February 15 hearing, Rep. Dana Rohrabacher (R-CA), chair of the Science Committee's Subcommittee on Energy and Environment, stated, "We must decide if the modest success shown (in fusion) for the billions spent is worth billions more required to continue the program for at least another 30 years. Fusion was also flagged as a funding issue at a March 9 hearing before the House Appropriations Subcommittee on Energy and Water Development and at a

March 14 hearing of the Senate Appropriations Subcommittee, chaired by Sen. Pete Domenici (R-NM). Domenici said "Clearly fusion is going to be on the table in a big way." He stated that "if we go with fusion, it will go up and up and up, and we're not going to have money for other things."

FUSION INDUSTRY WRITES CONGRESS

Chairman John Landis, on behalf of the 16 companies comprising the Fusion Industry Council, U.S. (FICUS), wrote to all members of the House Committee on Science, "to express once again our strong support for continued federal funding of the national fusion energy program." Landis said, "We believe that even during a period of stringent budget reduction, Congress must continue its leadership role in funding long-term energy research and development. If the United States falls further behind other industrial nations in this vital area, it will suffer considerable economic damage which will adversely affect the living standards of future generations of its citizenry." Landis stated that even though the members of FICUS "do not expect fusion energy to become a substantial source of revenue and profits in the near future, they are willing . . . to continue to assign substantial portions of their technical and human resources to the program if the federal government provides the 'critical mass' of funding required." Copies of the FICUS letter are available from Fusion Power Associates.

DEAN WRITES SCIENCE COMMITTEE

In a letter dated March 7 to all members of the House Committee on Science, FPA president Steve Dean urged the Committee "to authorize the full amount requested for fusion energy research in the FY 1996 DOE budget request," saying, "Fusion research is an investment in our country's future and may be critical to our economic and political strength in the long run." Noting that "the fusion program has made steady progress, commensurate with the funding provided over the years," Dean said that "scientists are confident that this source of energy can be harnessed for use on earth. But this is difficult research and it is well known that completion of the task will take decades." Dean noted that "the governments of Japan and Europe are actively engaged in this research. It is important the U.S. show a similar commitment." Copies of Dean's letter are available from Fusion Power Associates.

FUSION'S LAST CHANCE

Congress is showing every signs of taking a "meat-ax" to hundreds of federally-funded programs, including fusion. Over half the U.S. Congress is newly elected since 1990 and have little historical perspective. Most people working in, or just supportive of, fusion have never contacted their congressperson to express an opinion on anything!

If you have never contacted your congressperson to express your opinion that they should support fusion research, this may be your last chance to "wake up" and exercise your rights as a citizen and voter.

Write your congressperson NOW! Do not assume that because you work for a large institution that your institution is lobbying for fusion. Fusion is way down the list of important subjects at most large institutions. Exercise your right as a private citizen to express your opinion to your congressperson.

Also, you should think about sending a contribution to your congressperson along with your letter. They appreciate support from their constituents as it helps to compensate their campaign costs. Please give them your support.

Many federal programs are going to be killed this year. Do not assume that your letter won't make the difference. It very well may.

FPA PLANS FUSION INDUSTRY STAKEHOLDERS CONFERENCE

Fusion Power Associates is organizing a Fusion Industry Stakeholders Conference in Washington DC Thursday-Friday June 15-16. (Note the dates have been shifted by one day from previous announcement due to a misunderstanding with the hotel.)

The purpose of the conference is to showcase industrial contributions and participation in fusion development. The preliminary program and registration materials are being mailed out with this newsletter. For further information contact Ruth Watkins at Fusion Power Associates.

PORKOLAB NAMED MIT DIRECTOR

Prof. Miklos Porkolab has been named director of the MIT Plasma Fusion Center, succeeding Ronald Parker, who is on



Prof. Miklos Porkolab

leave serving as deputy director of the ITER project and director of the ITER co-center in Garching, Germany. Miklos has been associate director of the fusion center since 1991. As a professor in the MIT Department of Physics, he has led several pioneering experiments in radio-frequency heating and non-inductive current drive on tokamak devices at MIT. In 1986, he shared the American Physical Society's Excellence in Plasma Physics Award. There are about 315 researchers associated with the Center, including 23 faculty and senior academic staff, 70 graduate students, 22 undergraduate students, 97 research scientists and engineers, 43 visiting scientists, and 30 administrative and support staff. Prof. Porkolab came to MIT in 1977 after 10 years at the Princeton Plasma Physics Laboratory. He is a fellow of the American Physical Society and vice-chairman of the University Fusion Association.

FUSION FORUM BIG SUCCESS

The national fusion community, under the leadership of General Atomics and Princeton University, hosted an exhibit and reception at the Cannon House Office Building March 28 for congresspersons and congressional staff (see our January newsletter). Thirty laboratories, industries and universities, including Fusion Power Associates, had exhibits. Almost 200 persons attended, including approx. 60 Senators, Representatives, and/or their congressional staff.

FPA ANNUAL MEETING SET FOR SEPTEMBER 7-8; JOINT MEETING WITH CANADIAN NUCLEAR SOCIETY

Fusion Power Associates annual meeting and symposium will be held September 7-8 at the Radisson Hotel, Montreal Canada. The symposium will be sponsored jointly with the Canadian Nuclear Association and Society. The theme of the symposium will be "Status and Prospects for Fusion Power Development." Details on program and registration will be provided at a later date. Canadian participants should contact Sylvie Caron, Canadian Nuclear Society, for registration information, fax (416)979-8356, and Guy LeClair, CCFM, fax (514)652-8625, for program information. Others contact Ruth Watkins at Fusion Power Associates.

ITER UPDATE

The ITER Engineering Design Activities (EDA) began in July 1992 and lasts for 6 years. Therefore, this summer the EDA will be at the halfway point. The U.S. has a fully operational Home Team, headed by Charlie Baker, with 22 industrial firms, 10 laboratories, and 12 universities participating.

An interim design report and cost estimate are scheduled to be completed in June. The ITER Technical Advisory Committee (TAC) will begin reviewing this report in May, with a final, formal, review scheduled for July. The ITER Council will formally review the report at its meeting July 27-28 in San Diego.

The ITER Council had previously accepted a \$5.6 billion (1989 dollars) cost estimate for ITER capital construction costs. This capital cost estimate will be updated, based in the interim design report. Estimates for additional construction phase costs for engineering design, R&D and management are also being developed. The U.S. has been using a \$10 billion order of magnitude estimate (1994 dollars) as a rough planning budget level for all elements of the ITER construction phase.

The ITER Council contact persons from the four parties have been meeting periodically to develop planning options and process for making international decisions on siting and construction. They will make a progress report at the July ITER Council meeting. The ITER Council has also set up a Special Review Group (SRG) to work closely with ITER Director Robert Aymar on ITER construction site

requirements. The SRG will also make a report at the July ITER Council meeting.

PEOPLE

David Overskei is leaving his position as vice president in charge of fusion at General Atomics. He will join SAIC in LaJolla April 6.

Tom Simonen will become acting head of the General Atomics fusion program.

Clair Max has been named Director of University Relations at LLNL. She will report to LLNL Deputy Director for Science and Technology **Bill Lokke**.

MEETINGS

April 18-21 - American Physical Society Meeting, Washington, DC. Fusion Sessions April 20-21. Contact APS Meetings Dept. (301) 209-3286, e-mail [ATHERLY @aps.org](mailto:ATHERLY@aps.org)

April 25 - DOE SEAB R&D Task Force. Public meeting on Fusion and Renewable Energy, Washington, DC. Contact Bob Marlay (DOE), fax (202)586-5342 or Steve Dean at Fusion Power Associates.

April 24-28 - 12th International Conference on Laser Interaction and Related Plasma Phenomena. Osaka, Japan. Contact Prof. K. Nishihara, fax 81-877-4799.

May 8-12 - Advanced Tritium Safe Handling Course. Toronto, Canada. Contact Maryann Zito, fax (905)823-8020.

May 28-June 3 - Tritium Technology in Fission, Fusion and Isotopic Applications. Lake Maggiore, Italy. Contact Ms. G. Siluri, fax 39-332-789165; e-mail [G_Siluri @ cen.jrc.it](mailto:G_Siluri@cen.jrc.it)

June 15-16 - Fusion Industry Stakeholders Conference (note date change). Washington, D. C. Contact Ruth Watkins at Fusion Power Associates

July 17-21 - Cryogenic Engineering Conference. Columbus, OH. Contact Linda Wise, fax (303)499-2599.

Sept. 7-8 - Fusion Power Associates Annual Meeting and Symposium; Joint Meeting with Canadian Nuclear Society. Montreal. Contact Ruth Watkins at FPA.



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PRESIDENT'S ADVISORS URGE INCREASED R&D

LIGHT ION FUSION REVIEW SCHEDULED

PCAST PETITIONS PRESIDENT

In the face of mounting momentum in Congress to cut government spending on research and development, the President's Council of Advisors on Science and Technology (PCAST) issued a statement dated March 28, saying "In the face of mounting pressure to reduce science and technology spending, PCAST supports our national commitment to maintain a robust R&D portfolio. The President must promote this investment as essential for our nation's long term prosperity and security."

The PCAST said: "Funding for science and technology programs is our nation's most fundamental investment in our future and our children's future. Investments in both fundamental scientific research and technology development, in partnership with industry and our universities, will yield returns in productivity gains, more and better jobs, and lower-cost ways to protect our environment and national security. Studies have shown that up to half of America's growth in productivity since World War II -- and related improvements in quality of life -- is directly attributable to advances in technology; we can expect science and technology to continue to improve our quality of life in the future only if we support sufficient R&D funding."

The statement went on to say: "In the debate over national spending priorities, we must take time to assess carefully the impact of proposed cuts on our Nation's ability to maintain world-class science and technology. U.S. spending on non-defense R&D as a percentage of gross domestic product falls far short of similar investments being made by our closest competitors, fueling concerns that we could be

eclipsed by countries that continue to support technology R&D if our commitment wanes or remains stagnant. We must lead the pack or lose the race -- and the jobs that go with it."

PCAST also established a working group to review the U.S. magnetic fusion program (see our April newsletter). That group met on March 29 in Washington, on April 6-7 in San Diego, on April 24 in Washington and on April 25 in Princeton. Additional meetings are planned May 17-18 at MIT, and June 12-14 in San Francisco, with a final report to be presented at the next full PCAST meeting in Washington June 29-30. Fusion Power Associates president Steve Dean was asked to meet privately for one hour with the PCAST Fusion Working Group on April 24.

Copies of the PCAST March 28 statement can be obtained from the White House Office of Science and Technology Policy (contact Rick Borchelt, 202-456-6018) or from Fusion Power Associates.

ICFAC SETS LIGHT ION FUSION REVIEW

The DOE Inertial Confinement Fusion Advisory Committee (ICFAC) will meet at the Sandia National Laboratories in Albuquerque, June 8-10. The primary purpose of the meeting is to review progress in the Light Ion Fusion program (see our December 1994 newsletter). In his charge to the Committee, DOE Assistant Secretary for Defense Programs Vic Reis asks the ICFAC to "evaluate progress of the light-ion ICF program in responding to the terms and milestones of its technical contract," and to "comment on performance of the Sandia National Laboratories ICF

program in relation to the findings and recommendations of the ICFAC final report of April 13, 1993."

Reis also asks the ICFAC to "provide findings and recommendations on the appropriate direction of the light-ion ICF program in supporting the goals of the Science-Based Stockpile Stewardship program; (to) evaluate progress of the target physics program in relation to the Nova technical contract; (to) provide findings and recommendations on the appropriate direction of the target physics program to diminish uncertainties of target performance in the National Ignition Facility; (and to) comment on the technical merit and feasibility as well as programmatic applicability of a hydrogen fluoride laser driver program for ICF in relation to the Science-Based Stockpile Stewardship program."

Persons wishing to attend open sessions of the ICFAC meeting should advise Marshall Sluyter at DOE, (202)903-5491 and also contact Stephanie Torres at Sandia, (505)845-3656.

FUSION SCIENTISTS TESTIFY

Several members of the fusion community testified March 28 to the Subcommittee on Energy and Water Development of the House Committee on Appropriations. They included Steve Dean (Fusion Power Associates), Bob Conn (UCSD), Ron Davidson (PPPL), Jim Drake (U. Md. on behalf of the University Fusion Association), Bruce Montgomery (MIT), Stewart Prager (U.Wisc. on behalf of APS Division of Plasma Physics), and Ned Sauthoff (PPPL on behalf of the IEEE).

Dean traced the history of fusion promises and accomplishments relative to the funding requested and subsequently provided over the past 20 years. He indicated that this analysis "shows that there has been progress commensurate with the funding provided." He commented that "It is important that the overall budget for fusion not be allowed to decline further." He said, "Fusion and other advanced energy technologies are absolutely necessary for the survival of advanced industrial civilization. The money invested in fusion now is a modest and prudent investment to ensure a high standard of living for future generations." He noted that "the science is still evolving and the technological challenges are still formidable," but that "scientists are confident that a practical fusion power plant can be developed."

Davidson stated, "Well before the middle of the next century, the world faces an energy deficit of extraordinary proportions." He stated, "Energy is fundamental to an acceptable quality of life, and the requirements of the developing world are not to be denied. By any measure, the world must find new sources of energy in the coming decades -- sources that will augment the inevitable increase in reliance on solar, renewables and nuclear fission," Davidson noted that the Tokamak Fusion Test Reactor had produced "world-record levels of up to 10.7 million watts of fusion power in November, 1994." He remarked that "With these historic experiments, I believe that the development of fusion energy has moved into a new era." He commented that "International review of these results has convinced researchers of the feasibility of fusion." He said that people around the world "have a sense that fusion is real, and that it works." Davidson said that the proposed Tokamak Physics Experiment (TPX) "is a critical step in the domestic fusion program because it will address key physics and engineering issues that will lead to more compact and economical commercial fusion reactors."

Conn said that "Short of building new machines, it's hard to show you more dramatic results than what the program has recently produced." He related how American companies, "using knowledge of the plasma state developed in fusion research . . . invented, developed, and produced new and superior equipment" that allowed the U.S. to "recapture the lead" in producing higher quality microelectronic chips. He remarked, "We're ready now to start construction on a new national U.S. tokamak which will enable further optimization of the fusion power plant design"

Drake stated that "The U.S. presently imports about 50% of our yearly oil consumption at a cost of about \$100 billion." He noted that "The annual cost of the fusion program is less than 0.4% of the annual cost of our oil import bill and the cost of importing oil in the future will escalate to far higher levels. Thus the investment in this program is dwarfed by the potential benefits." He said that "The maintenance of our present standard of living will require the development of alternative methods of central power generation." He indicated that "The Fusion Energy Research program has historically been a high-quality, broad-based research program in plasma science and technology," (and that) "Scientists at universities have historically played a major role as a source of innovative ideas and experiments which has been the key to maintaining the high quality of the program."

He said, "The success of the TFTR experiment has shifted the primary uncertainty in the fusion program from whether a sustained fusion reaction in a laboratory can be produced to whether the tokamak concept can become economically viable. The near term goals of the program should reflect this overriding issue by addressing more directly whether an economically attractive reactor can be constructed. We recommend a two-pronged strategy: the first involves a vigorous program to improve the economic viability of the tokamak concept and the second involves the continued exploration of other confinement schemes." He remarked that "The attempt to fund the ITER Engineering Design Activities on a flat budget is squeezing Universities out of the program at a time when ideas from university scientists are critically needed for improving the fusion reactor concept." He commented, "substantial additional funds should not be committed to the design (of ITER) until a national commitment has been made to the construction phase. If such a commitment is not made, the ITER project should be deferred so that the remainder of the program is not irreparably damaged."

Montgomery described many "spinoffs" from fusion research. He indicated that technologies that had developed in fusion were being used today in many other applications, such as plasma processing of semiconductor chips.

Prager noted that "The fusion program has given birth to a new branch of science -- plasma physics. This field produces results of deep scientific value, and immediate and vast application. The scientific value extends to astrophysics, complex systems, chaos, turbulence, scientific computing, chemistry and materials science. The technological applications include development of new computing techniques, high power microwave sources, high power lasers, high frequency radio sources, advanced defense systems, new materials, superconducting magnets, hazardous waste removal, smaller and more powerful computer memory chips, new communication techniques, and the ability to observe dynamic processes in living cells at high spatial resolution." Prager indicated, "The annual expenditure on fusion is less than one-thousandth of the annual expenditure on energy." He remarked that "The fusion program has already contributed disproportionately to deficit reduction. The budget has been about halved in the past decade. To leave future generations a secure and timely energy source requires an increase in funding." He said that "There is little, if anything, that is more important

than leaving the upcoming future generations a secure energy source and clean environment."

Sauthoff noted that "The IEEE is a transnational professional society whose 320,000 members live and work in more than 130 countries throughout the world," and that the IEEE had 240,000 U.S. members. He remarked that "Reliable and affordable electrical power is essential for the United States to sustain and increase its productivity and economic competitiveness and to support a high quality of life for its population." He said that "IEEE-USA firmly supports fusion research and development and believes fusion should be developed as a significant element within a portfolio of long term electrical energy generation technologies because of fusion's potential as an inexhaustible and environmentally attractive energy source. A stable government commitment to the long term development of fusion power is essential to exploit domestic and international fusion advances and to remain among the leaders in strategically important areas." He commented, "The fusion program should include an appropriate balance of ignited plasma studies such as in TFTR and ITER, fusion technology programs, tokamak concept improvement as in the current base program and the planned TPX, inertial fusion energy such as in the National Ignition Facility, alternate concepts and basic plasma studies."

Copies of various testimonies should be requested from the authors.

WALKER RESPONDS

Responding to a March 7 letter from FPA president Steve Dean (see our April newsletter), House Science Committee chairman Robert Walker wrote Dean a letter dated March 23, in which he said "I share your enthusiasm for the potential promise of fusion energy. The current Federal Fusion Energy Program has made considerable progress towards realizing the promise of fusion energy with its magnetic fusion tokamak effort. However, it appears that commercial energy production from such a source is at least forty years away and will require the expenditure of tens of billion of dollars." He said, "I also favor a practical, sensible, long-term lean approach. This may mean less Federal dollars, but it does not mean we should abandon the program." Copies of Walker's letter are available from Fusion Power Associates.

PROCEEDINGS AVAILABLE

The proceedings of Fusion Power Associates symposia of January 1993 and September 1994 have been published in the September 1994 issue of the Journal of Fusion Energy. The theme of the 1993 symposium was "Fusion: An International Venture." The 1994 symposium was entitled "Future Facilities, and the Role of Industry in Fusion Power Development." The September issue of the journal also contains a report "Criteria for Practical Fusion Power Systems" of the EPRI Fusion Panel and the reports of FEAC Panel 6 (on Materials) and FEAC Panel 7 (on Inertial Fusion Energy).

FPA BOARD MEMBERS ELECTED

Fusion Power Associates member representatives have elected three persons to the FPA Board of Directors for three year terms effective April 1, 1995. They are Charles Weber (Babcock & Wilcox), William Robinette (TRW), and Anthony Favale (Northrop Grumman). They join the following Board members, whose terms expire at a later date: Richard Bolton (Hydro-Quebec), Stephen Dean (FPA), Don Dautovich (Ontario Hydro), John Davis (McDonnell Douglas), William Ellis (Raytheon), John Gilleland (Bechtel), William Grossmann (SAIC), John Landis (Stone & Webster), Chet Lob (Varian), and Wayne Meier (Schafer Associates).

As provided by the By-Laws, the elected Board has appointed five directors from non-member organizations. Appointed for three year terms, effective April 1, 1995, are: Floyd Anderson (F.N. Anderson & Associates), John Clarke (Battelle), Robert Hirsch (consultant), John Sheffield (ORNL), and Jack Kaslow (EPRI).

There is currently one vacancy on the FPA Board, due to the recent resignation of David Overskei (General Atomics), who has left GA to join SAIC.

PEOPLE

Tihiro Ohkawa, fusion pioneer and long-time leader of the fusion program at General Atomics, has announced his retirement as of April 30. He will remain on the GA Advisory Board.

John Sheffield has been named Director for Energy Technology Programs at ORNL.

Carl Henning has been named Special Assistant for Laboratory Administration, in the Office of the President, University of California.

FORUM UPDATE

Thirty-six Senators and Representatives and about 150 congressional staff attended the Fusion Forum on March 28.

MEETINGS

June 15-16 - Fusion Industry Stakeholders Conference. Washington, DC. Contact Ruth Watkins at Fusion Power Associates.

Aug 14-18 - Introduction to Fusion Technology for the Practicing Engineer. University of Tennessee Short Course. Instructors: Tom Shannon, John Haines, John Galambos. Contact T.W. Kerlin. FAX (615)974-0668; e-mail salmon@utkvx.utk.edu

Aug 14-18 - MHD Phenomena in Plasmas. University of Wisconsin Short Course. Instructors: J.D. Callen et al. Contact Barbara Griffith. FAX (608)262-6707; e-mail griffith@engr.wisc.edu

Sep 6-9 - International Symposium on Heavy Ion Inertial Fusion. Princeton Plasma Physics Laboratory. Contact Tom Fessendon. FAX (510)486-5392.

Sep 7-8 - Fusion Power Associates Annual Meeting and Symposium: "Status and Prospects for Fusion Power Development;" Joint Meeting with Canadian Nuclear Society. Montreal. Contact Ruth Watkins at FPA.

Sep 25-29 - Seventh International Conference on Fusion Reactor Materials. Obninsk, Russia. Contact V.M. Chernov. FAX (095)230 23 26; e-mail icfrm7@ippe.obninsk.su

Sep 30-Oct 5 - 16th Symposium on Fusion Engineering (including mini-course on blanket technology). Champaign, IL. Contact Laurie Wink. FAX (217)333-9561; e-mail laurie_wink@ceps.uiuc.edu

Oct 16-20 - Seventh International Workshop on Atomic Physics for Ion-Driven Fusion. Madrid, Spain. Contact F. Minguez. FAX 31-1-3363002; e-mail minguez@denim.upm.es



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ITER APPROACHES MAJOR MILESTONE BALDWIN JOINS GA, FPA BOARD FUSION ON THE WEB

ITER MILESTONE

The International Thermonuclear Experimental Reactor (ITER) project has reached the mid point of the six year commitment of the parties (Europe, Japan, Russia, U.S.) to design the world's first fusion experimental reactor. A major milestone, set for the project by its governing body, the ITER Council, is to complete an "Interim Design Report, Cost Review, Safety Analysis and Report on Site Requirements" in June 1995. Based upon the expected completion of the report this month, the project's Technical Advisory Committee (TAC) will conduct an "Interim Design and Cost Review" July 2-8. This will be followed by a review of the project by its Management Advisory Committee July 9-10. Following these reviews, an assessment of the status of the project will be made by the ITER Council at a meeting in San Diego July 26-28.



Dr. David E. Baldwin

FUSION ON THE WEB

Wanderers on the World Wide Web can access information on fusion using the address "<http://www.foe.er.doe.gov>" which will take you to the DOE Office of Fusion Energy home page, maintained by John Willis. There you can readily click to topics such as Fusion Energy Overview, More About Fusion Energy, Fusion & the Environment, and P.K. Kaw's 1992 Artsimovich Memorial Lecture. A click on Fusion Power Associates will call up information on FPA, including information on our activities, newsletter and participation. A click on other listed laboratories and universities around the world will send you on to their locations, with seemingly endless supplies of information. From the Office of Fusion Energy home page you can also transit directly to The White House, if you wish, or browse around other parts of DOE and the DOE Office of Energy Research.

BALDWIN JOINS GA, FPA BOARD

Dr. David E. Baldwin has joined General Atomics as Senior Vice President, Fusion Group, effective May 15. He has also joined the Fusion Power Associates Board of Directors.

Dave comes to GA from the Lawrence Livermore National Laboratory, where he was Associate Director for Energy. He came to Livermore as Associate Director for Magnetic Fusion Energy in 1991 from his previous post as Director of the Institute for Fusion Studies at the University of Texas. From 1970 to 1988, Dave was a theoretical physicist in the fusion program at LLNL. He received his Ph.D. in physics from MIT and spent several years at Yale University before joining LLNL. He can be reached at General Atomics at (619)455-2490; fax -2496; e-mail: baldwin@gav.gat.com

BUDGET CUTTING FRENZY

The budget cutting frenzy in Washington continues to mushroom. House-Senate conferees have agreed to cut approximately \$16 billion from the current fiscal year which ends September 30. The action cuts fusion by \$7.5 million (splitting the difference between the Senate's desire to cut \$15 million and the House intention not to cut fusion at all). The bill, as currently written, may be vetoed by the President. Several fusion scientists signed a letter to the conferees urging them "to recede to the House position during conference deliberations." Signing the letter were Bob Conn (UCSD), Steve Dean (FPA), Miklos Porkolab (MIT), Bill Stacey (Georgia Tech), Ron Davidson (PPPL), James Drake (UFA), and Tom Simonen (GA). Copies of the letter can be obtained from Fusion Power Associates.

John Landis, "on behalf of the sixteen companies that comprise the Fusion Industrial Council - United States (FICUS), of which I am current chairman," wrote to the chairs of the House and Senate Appropriation Subcommittees dealing with fusion, to say that the "proposed (FY 1995) cuts in the fusion energy budget not only will slow technical progress to an unacceptable level but also will undo the crucial organizational progress that has been made." He urged the conferees "to accept the House position on FY 1995 fusion funding during the forthcoming conference deliberations - that is, no recision." Copies of Landis' letter are available from FPA.

Meanwhile, even larger cuts are envisioned by Congress for FY1996. The House has passed a budget resolution which assumes a 25% reduction in energy R&D as part of a process to begin abolishing the Department of Energy. The Senate has passed a budget resolution which assumes a 50% cut in energy programs. Majority Leader Bob Dole has said he favors abolishing the DOE. While these assumptions are not binding in detail on the appropriations committees, they are used to set the allocations (i.e., budget ceilings) within which the appropriations committees must act.

Now is the time to contact your own Congresspersons to make your views known on national spending priorities. "Speak now or forever hold you peace!"

IEA SEES ENERGY PROBLEMS

In its World Energy Outlook, issued in late April, the International Energy Agency (IEA) estimates that world

demand for energy will rise by between 35% and 45% over the next 15 years, compared to 1992. U.S. dependence on oil imports will approach 70% (from today's 50%), the report said. Carbon dioxide emissions are estimated to rise 10% by the year 2000 and 40% by 2010.

GIBBONS SPEAKS TO AAAS

Speaking to a Policy Colloquium of the American Association for the Advancement of Science (AAAS) April 12 in Washington, Presidential Science Advisor Jack Gibbons asked rhetorically whether next year's speaker would "be able to say that 1995 was the year America ceded leadership in science and technology to foreign competitors, or that America retained and bolstered its lead? That the 104th Congress shut the door to a Federal role in supporting critical technology research and development, or that Congress renewed the science and technology partnerships vital to American economic, environmental, health and national security?" Gibbons characterized the present mood of "some in Congress" as wanting to "cut government seemingly at any cost." He characterized the Administration's plans as a "commitment to cutting the deficit, while boosting overall productivity and investing for the future." Gibbons called science and technology "the engine of growth in jobs, the economy, and our quality of life." He called the current budget cutting frenzy in Congress "a short-term strategy that will lead to the Nation having eaten its seed corn for the future." Copies of Gibbons speech should be requested from the Office of Science and Technology, fax:(202)456-6021.

FUSION PRESENTED TO SEAB TASK FORCE

The DOE Secretary of Energy Task Force on Strategic Energy R&D (Yergin Task Force, see our November 1994 and April 1995 newsletters) met on April 25 to receive presentations on the DOE's fusion and renewable energy programs. Presentations on fusion were made by DOE Office of Fusion Energy director N. Anne Davies, retired Grumman Corp. CEO Joe Gavin, Columbia University professor Gerald Navratil, and John McCann of Consolidated Edison. During the public comment portion of the meeting, others spoke out in favor of fusion, including John Landis (FICUS chairman), Bill Ellis (Raytheon Engineers and Constructors, Ned Sauthoff (IEEE), Marshall Loring (Varian Associates), Keith Thomassen (LLNL), and Rush Holt (PPPL).

Gavin stated that he had four points to make: "(1) We have not had a far-sighted, national energy policy and we need one; (2) Energy is a dominant factor in our future and for our national security; (3) DOE has much that not only deserves support but also warrants more aggressive execution; and (4) We are not now in a Cold War; we are in a fiercely contested economic struggle that we cannot afford to lose." Copies of Gavin's complete statement are available from Fusion Power Associates.

Landis stated that the sixteen companies that comprise FICUS "have devoted crucial resources to the development of fusion energy for many years. They have done this primarily at their own expense because they believe that this energy source is one of only two or three that can satisfactorily meet mankind's long-term energy needs." He stated that "We in FICUS believe that even during a period of stringent budget reduction, Congress must continue its leadership role in funding long-term energy research and development." Copies of Landis' presentation are available from FPA.

Davies told the Task Force that fusion had become heavily internationalized and that this "is a strength of the program." Although this results in some "loss of flexibility," and "a great deal of management attention," she said that "We have judged that these weaknesses are far outweighed by the benefits." The SEAB Task Force is scheduled to deliver its final report to the Department of Energy June 13.

CANADIAN TECHNOLOGY SUCCESS

A new Tritium Purification System (TPS), designed by the Canadian Fusion Fuels Project and built in Toronto, has recently become operational of the Tokamak Fusion Test Reactor (TFTR) at Princeton. The system takes the exhaust gas from TFTR, separates out the unused tritium, and sends it back to TFTR as fuel. Since 1993, used tritium has routinely been shipped back to DOE's Savannah River Site from which it originally came in its pure form. The new system allows a reduction in the number of tritium shipments between New Jersey and South Carolina. About 40 grams of tritium have been shipped to and from the site since 1993, whereas only 5 grams are allowed to be on site at any time. Minimizing tritium shipments to and from the laboratory increases safety by reducing the amount of tritium on the roads and by keeping tritium in its least hazardous, elemental form. With the introduction of the TPS, TFTR becomes the first fusion device to recycle its



TFTR Tritium Purification System team:

R. Scillia, P. LaMarche, S. Raftopoulos, J. Langford, and J. Anderson

own tritium. A similar system is being designed for the International Thermonuclear Experimental Reactor (ITER).

VARIAN GYROTRON SETS WORLD RECORD

Varian Associates, Inc., recently established a new world record in millimeter-wave power generation by operating a 110-GHz gyrotron oscillator at over 350 kilowatts of nominal output power for a 10-second duration, thereby doubling the previous record set by Toshiba of 5 seconds duration. The new Varian tube also has an operating efficiency of 33%. "Varian's goal is to produce a gyrotron capable of delivering one megawatt continuous-wave power production," according to gyrotron team leader Marshall Loring. The tube is the latest addition to a family of gyrotrons built by Varian for DOE-sponsored fusion energy research since the company became involved in fusion research in 1976. Varian's previous record-breaking developments have included 400 kilowatts at 0.5 seconds duration at 140 GHz, 300 kilowatts at 2.0 seconds duration at 110 GHz, and over 100 kilowatts continuous-wave at 110 GHz for several hours. Varian Associates, Inc. is a diversified, international, high-technology company, headquartered in Palo Alto, Ca, with annual sales in excess of \$1.5 billion. For further information, contact Bill Evans, (415)424-4504; e-mail: bill.evans@grc.varian.com

NSF RECOGNIZES PLASMA PHYSICS

The National Science Foundation has belatedly recognized the growing importance of plasma physics to society by renaming its atomic, molecular, and optical sciences branch the Atomic, Molecular, Optical and Plasma (AMOP) Branch. For information on submitting proposals, contact Barry Schneider, (703)306-1808, or Thomas McIlrath, (703)306-1807, at NSF.

APS DEBUNKS DANGER OF EM FIELDS

The Council of the American Physical Society has taken the unusual action of issuing a statement entitled "Power Line Fields and Public Health." The statement says that "The scientific literature and the reports of review by other panels show no consistent, significant link between cancer and power line fields." Furthermore, the APS Council says, "No plausible biophysical mechanism for the systematic initiation or promotion of cancer by these power line fields has been identified." The statement says the "the preponderance of the epidemiological and biophysical/biological research findings have failed to substantiate those studies which have reported specific adverse health effects from exposure to such fields." The statement says, "These unsubstantiated claims, however, have generated fears of power lines in some communities, leading to expensive mitigation efforts, and, in some cases, to lengthy and divisive court proceedings. The costs of mitigation and litigation relating to the power line-cancer connection have risen into the billions of dollars and threaten to go much higher. The diversion of these resources to eliminate a threat which has no persuasive scientific basis is disturbing to us. More serious environmental problems are neglected for lack of funding and public attention, and the burden of cost placed on the American public is incommensurate with the risk, if any." A background paper by David Hafemeister is available through the APS HomePage at <http://aps.org> or phone (805)756-2205.

PEOPLE

Don Dautovich has been named Manager of Isotope Technologies and Corporate Programs at Ontario Hydro Technologies.

Robert Staasko has been named Manager of Isotope Technologies and Program Manager of the Canadian Fusion Fuels Project, reporting to Don Dautovich.

Robert Shock has been named Acting Associate Director for Energy at LLNL.

Keith Thomassen has resumed his responsibilities as Deputy Associate Director for Magnetic Fusion Energy at LLNL. Keith will also continue to function as Program Director for TPX, on assignment to PPPL from LLNL.

Kathryne Thorpe has left General Atomics, Washington Office, to join SAIC. She will continue to be based in Washington.

MEETINGS

In addition to the meetings listed in our May 1995 newsletter, the following meetings should also be noted:

Jul 17-21 - Cryogenic Engineering Conference. Columbus, OH. Contact Linda Wise, fax (303)499-2599.

Aug 8-18 - La Jolla Summer School on Plasma Physics and Technology, La Jolla, CA. Contact La Jolla International School of Physics, fax (619)454-2679

Sep 6-8 - 2nd IEA International Workshop on Beryllium Technology for Fusion. Jackson Lake Lodge, WY. Contact Glen Longhurst, fax (208)526-0528; e-mail: gxl@inell.gov

Sep 11-15 - Basic Tritium Safe Handling Course. Chalk River, Ontario. Contact Maryann Zito, fax (905)823-8020.

Nov 6-10 - Annual Meeting of the APS Division of Plasma Physics. Louisville, KY. Contact APS Meetings Department, (301)209-3286; e-mail meetings@aps.org

QUOTABLE

"Any sensible person knows you have to make prudent investments to get ahead. But the government doesn't. We're dominated by fools."

Rep. George E. Brown, Jr. (D-CA)
Quoted in NY Times, May 22, 1995

"During the last four decades, the Federal Government has spent nearly \$1 trillion on civilian research and development, laying the basis for a powerful wave of prosperity that has touched most facets of American life."

William J. Broad
New York Times, May 22, 1995



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PCAST PANEL ENDORSES FUSION SEAB TASK FORCE SAYS ENERGY R&D IMPORTANT TO NATION'S FUTURE PROSPERITY

PCAST PANEL REPORT

The President's Council of Advisors on Science and Technology (PCAST) Panel on the U.S. Program of Fusion Energy Research and Development (See our April 1995 newsletter) has released the Executive Summary of its report. In a June 16 memorandum releasing the Executive Summary and sending it to members of Congress "for your information and review," the President's Science Advisor Jack Gibbons stated that "The Panel's principal findings and recommendations can be summarized as:

- * Fusion R&D is an important investment in developing a needed new energy source, sustaining a strong U.S. science base, and building international collaboration.
- * Demonstrated plasma ignition and burn is the next major scientific priority.
- * A reduced program funding at \$320M/yr over the next decade can preserve essential ingredients of the domestic program and international collaboration, albeit at a slower rate of progress.
- * With deeper cuts to the program, key priorities would be lost, all resources go to termination costs and the domestic program; progress toward an energy goal is imperceptible."

The panel, which was chaired by Prof. John Holdren (University of California at Berkeley and PCAST member), stated that "U.S. (fusion) funding has been crucial to a productive, equitable, and durable international collaboration in fusion science and technology that represents the most important instance of international scientific cooperation in history as well as the best hope for timely commercialization of fusion energy at affordable cost." The panel noted that the combined efforts of Europe

and Japan "already total more than three times the corresponding effort here" and stated "we believe there is a strong case for the funding levels for fusion currently being proposed by the U.S. Department of Energy." They acknowledged, however, that "Although the program just described is reasonable and desirable, it does not appear to be realistic in the current climate of budgetary constraints" They then described a U.S. program that would operate for the next ten years at a constant funding level of \$320M/yr (\$46M/yr less than the current funding level). The panel described a program that might be carried out at such a level, stating that "it entails hard choices and considerable pain, including straining the patience of this country's collaborators in the international component of the fusion effort But we believe it is the best that can be done within budgets likely to be sustainable in the current climate, and the least that can responsibly be done to maintain a modicum of momentum toward the goal of practical fusion energy."

The panel described the impact of a much lower budget "of about \$200M/yr," saying it "would leave room for nothing beyond the core program of theory and medium-scale experiments . . . no contribution to an international ignition experiment or materials test facility, no TPX, little exploitation of the remaining scientific potential of TFTR, and little sense of progress toward a fusion energy goal. These severe consequences . . . are too high a price to pay for the budgetary savings involved."

They concluded, "We urge, therefore, that the Administration and the Congress commit themselves firmly to a U.S. fusion R&D program that is stable at not less than

\$320 million per year." Copies of the Executive Summary and Gibbons memorandum are available from Fusion Power Associates.

HOUSE SUBCOMMITTEES AX FUSION

Just prior to the release of the PCAST panel Executive Summary, the House Science Committee Subcommittee on Energy and Environment (Chaired by Dana Rohrabacher) and the House Appropriations Committee Subcommittee on Energy and Water (Chaired by John Myers) marked up the FY1996 fusion program budget request at \$229 million, a reduction from the Presidents request level of \$363 million. The House is expected to move the DOE appropriations bill rapidly. Senate markups are expected to occur sometime in July. The important markup in the Senate will come from the Senate Appropriations Committee Subcommittee on Energy and Water Development. The republican members of that subcommittee are: Pete Domenici (NM), chairman, Mark Hatfield (OR), Thad Cochran (MS), Slade Gorton (WA), Mitch McConnell (KY), Robert Bennett (UT), and Conrad Burns (MT). Democratic members of the subcommittee are J. Bennett Johnston (LA), Robert Byrd (WV), Ernest Hollings (SC), Harry Reid (NV), Bob Kerrey (NB), and Patty Murray (WA). Persons wishing to express their opinions on fusion should contact the above and, if you are not from their state, contact your own senators and ask them to express their views to the above subcommittee members. If you need help with addresses, phone or fax numbers, contact Fusion Power Associates.

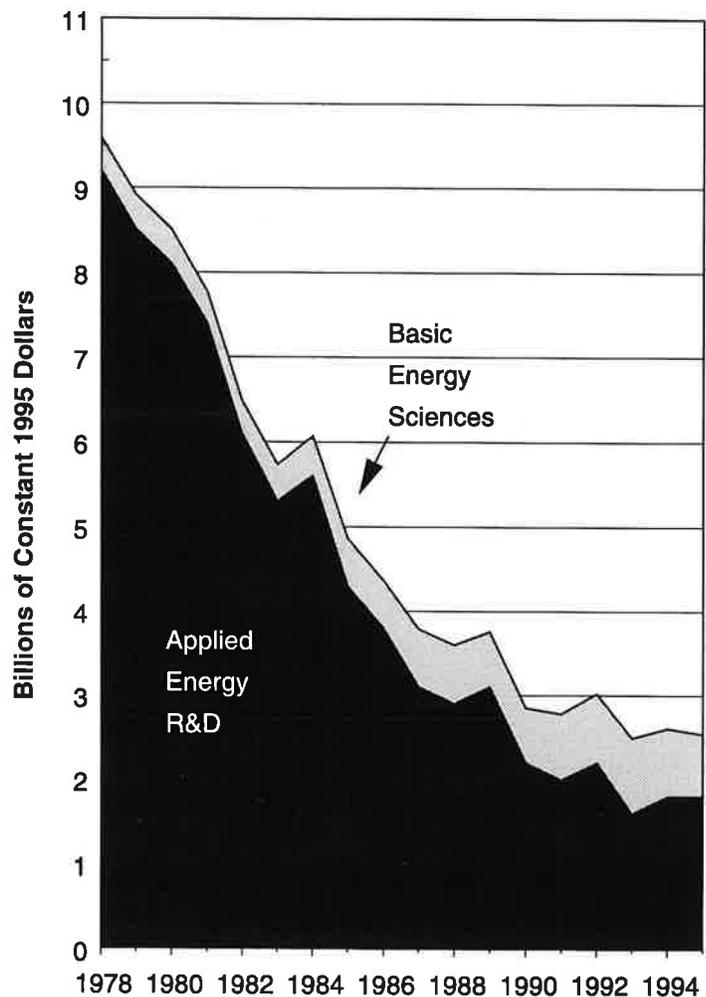
SEAB TASK FORCE REPORTS

The DOE Secretary of Energy Advisory Board Task Force on Strategic Energy R&D (See our November 1994, April 1995 and June 1995 newsletters), chaired by Daniel Yergin (President, Cambridge Energy Associates), issued its report at a press conference on June 13. The Task Force concluded that "Federal support for energy R&D is essential to our Nation's future well being, contributing to economic growth, security, environmental quality, and competitiveness in the international marketplace." In submitting the report to Energy Secretary Hazel O'Leary, Yergin stated that while the DOE R&D program "has had its flaws," the programs supported by DOE "are generating billions of dollars worth of annual consumer energy savings and new business opportunities, and playing an important role in job creation." Fusion Power Associates president Steve Dean was a member of the Task Force.

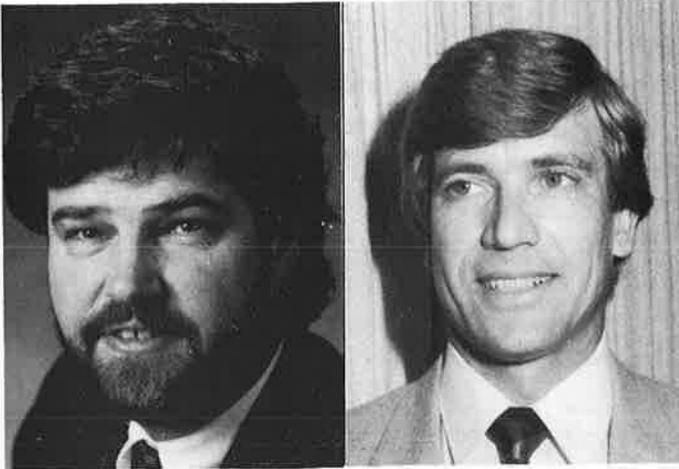
The report cautioned that proposed deep cuts in federal energy R&D programs "would not be prudent, given the strategic importance of energy to the Nation" and that energy R&D is needed "to help mitigate the severe economic risks of possible disruptions in the Nation's future energy supplies."

"DOE's R&D programs can be made more efficient," said Yergin, "but the wholesale demolition of those programs would not only hurt America's energy position but also contribute to a 'brewing R&D crisis' in the United States -- the result of simultaneous cutbacks in federal R&D program, and retrenchment and refocusing of private sector R&D." The Task Force noted that energy R&D funding by DOE had already been reduced by 75% in constant dollars since 1978 (See figure).

DOE Energy R&D Funding



Source: U.S. Department of Energy.



E. M. Campbell

D. O. Overskei

"Federal energy R&D is currently only about one-half of one percent of the Nation's annual energy expenditures," Yergin said, "Given the importance of energy to our economy and national security, and considering the major cuts that have already hit energy R&D, this is not the time to be abruptly cashing in our energy R&D stocks. The dividends from these investments will be critical to our future standard of living and are part of the inheritance for the next generations."

The Task Force concluded, "Our Nation's scientific and technical base is one of the country's most valuable resources. But without investment, it cannot be maintained." Copies of the Task Force can be requested from Dr. Robert Marlay, DOE, fax (202)586-5342; e-mail: u7635rm@vm1.hqadmin.doe.gov

In a statement accompanying the release of the Task Force report, Energy Secretary Hazel O'Leary stated, "The Task Force has met my expectations in producing one of the most substantive studies of the Department's energy R&D programs that has been written in years.//The report also strongly validates the significant economic benefits that have resulted from the Department's energy R&D programs The Yergin Task Force reminds us that energy is fundamental to the functioning of our economy and that federal support for energy R&D already has been cut by 75% since the 1970's. // Although the nation's energy supplies appear secure at present, the Task Force rightly warns against complacency, emphasizing that energy R&D - both public and private is part of our insurance policy against the severe risks to our economy that would stem from possible future energy supply disruptions."



T. K. Fowler

K. M. Thorpe

FPA AWARDS ANNOUNCED

Fusion Power Associates presented several awards at its Fusion Industry Stakeholders Conference, June 15-16 in Washington, DC.

FPA Leadership Awards were presented to E. Michael Campbell (Lawrence Livermore National Laboratory) and to David O. Overskei (SAIC, formerly with General Atomics), in recognition of their "outstanding leadership qualities." Dean cited Campbell for "contributing greatly to the technical progress and public appreciation of inertial confinement fusion development." He stated that "The current status of the National Ignition Facility project as a national facility and it's response to the process of securing public acceptance owes much to your efforts." Dean cited Overskei for "contributing greatly to the technical progress and public acceptance of magnetic fusion energy development." He stated that "You have provided outstanding leadership not only to the technical program at General Atomics, but also have influenced the direction of the national magnetic fusion program. We also recognize your outstanding contributions to developing outreach educational programs for both Congress and the general public."

T. Kenneth Fowler (University of California at Berkeley) was presented our Distinguished Career Award, "for outstanding accomplishments throughout your distinguished career." In presenting the award, FPA president Steve Dean stated, "Your career, spanning several decades at several institutions, has been one of consistent and imaginative contributions to both the fundamental underpinnings of fusion science and to its future directions."

For only the seventh time in 16 years, Fusion Power Associates Board of Directors decided to give out a Special Award. FPA Special Awards are given to individuals who have made unique contributions to either Fusion Power Associates or to the cause of fusion development in general. The award was presented to Kathryne M. Thorpe. In selecting Ms. Thorpe, the FPA Board stated that it was recognizing "your invaluable service in championing the cause of fusion to members of Congress and to congressional staff. We also recognize the high quality of advice you have provided to Fusion Power Associates since our inception in 1979." In presenting the award, FPA president Steve Dean called Ms. Thorpe "an extraordinarily effective advocate in communicating the benefits of fusion to the United States Congress." She was until recently Director of Washington Operations at General Atomics and has joined SAIC as Vice President for Government Affairs.

FIRE FROM THE SUN, ARIGATO!

The Japan Society of Plasma Science and Nuclear Fusion Research has produced a Japanese version of the video "Fire from the Sun." The original english version was produced by Michael Pack, Manifold Productions, Inc. (See our July 1990 newsletter). FPA president Steve Dean was a scientific consultant to the project. For information on the Japanese version, contact Teruo Tamano, fax 81-298-53-6202; email: tamano@prc.tsukuba.ac.jp For information on the original version, contact Michael Pack, (202)333-1095; fax -2837.

TdeV

Scientists working on the Tokamak de Varennes (TdeV) have been studying the phenomena of detachment of the plasma flow from the surface of divertor plates during plasma exhaust. The phenomena is important because it results in less power being deposited in the plates and more power being radiated (a desirable result). Techniques being studied include biasing the divertor plates electrically and injection of radiofrequency power. Following completion of these experiments this summer, the TdeV will be shut down for a major upgrade that will take about 1 year. The upgrade will include installation of completely new divertors of advanced design and high power-handling capability. Attendees at the Fusion Seminar (September 7-8 in Montreal) will get a chance to tour the TdeV. For additional new on TdeV and other Canadian fusion programs get a free subscription to the Fusion Canada newsletter by contacting Bob Macphee, fax (416)777-9804.

VARIAN SELLS ELECTRON DEVICE DIVISION

Varian Associates, Inc. and Leonard Green & Partners, L.P.(LGP), announced June 12 that they have reached an agreement under which Varian will sell its Electron Devices business to LGP for approximately \$200 million. They anticipated closing the sale within 90 days. The Division, which has been actively involved in developing high power microwave sources for fusion development since 1976, had about \$250 million in sales in 1994.

PPPL EMPLOYEES RECOGNIZED

PPPL employee Jerry Levine has received an award from the Department of Energy for achieving goals set by the National Environmental Policy Act (NEPA). He was cited "for having successfully managed and coordinated the preparation of several technically complex NEPA documents."

PPPL has bestowed the title of Distinguished Research Fellows on Masayuki Ono and Michael Zarnstorff, in recognition of their "excellence in theoretical and experimental plasma physics research."

MEETINGS

Fusion Power Associates and the Canadian Nuclear Society will co-host a Fusion Power Seminar *September 7-8* in Montreal. The seminar will feature a tour of the fusion facilities at the Centre Canadien de Fusion Magnetique, Hydro Quebec, and talks by E.P. Velikhov, chair of the ITER Council, Donald Jackson, Director of the Canadian National Fusion Program, and N. Anne Davies, Director of the U.S. DOE Office of Fusion Energy. For program and registration information, contact Ruth Watkins at Fusion Power Associates. Canadians contact Guy LeClair fax(514)652-8625, e-mail: leclair@ireq-ccfm.hydro.qc.ca

On *September 11-15*, the Lawrence Livermore National Laboratory is sponsoring a conference on "Advanced Approaches to Economical Fusion Power" in Monterey, CA. For information, contact Karen Pangelina, fax (510)422-2956; e-mail: pangelina@llnl.gov



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PRESIDENT'S ADVISORS ENDORSE FUSION BUT BUDGET DISASTER STILL LOOMS

PCAST SUPPORTS FUSION

On July 11, the President's Council of Advisors on Science and Technology (PCAST) unanimously endorsed the report of its Panel on the U.S. Program of Fusion Energy Research and Development (see our July newsletter). The Council, which is chaired jointly by the President's Science Advisor Jack Gibbons and John A. Young, former President and CEO of Hewlett-Packard, had nothing but praise for the accomplishments of the fusion effort to date. PCAST member Murray Gell-Mann, Professor Emeritus of Theoretical Physics from the California Institute of Technology, said that the U.S. government and the scientists working on fusion should be commended for their patience in evolving fusion science successfully over the past forty years and for their promised dedication to continue for another forty if necessary to bring the promise of fusion to reality. PCAST member Diana McArthur, Chair and CEO of Dynamac Corporation, said that she was impressed with the large number of technologies spawned by fusion that were already in commercial use. PCAST member Lilian Shiao-Yen Wu, a research scientist from the IBM Watson Research Center and who had served on the fusion panel, said that she knew almost nothing about fusion when the panel began its work a few months ago but that, during the course of the review, she had become convinced of the importance, progress, and promise of fusion for the country and for the world in the future. By a unanimous show of hands, the Council advised Dr. Gibbons to send the report to President Clinton with their endorsement.

On July 13, Dr. Gibbons released the report to the public and transmitted it to the Congress.

PCAST PANEL BASIS

The findings and recommendations of the PCAST remain as described in their draft executive summary (see last month's newsletter). In its final, more detailed, report the panel enunciated many of the reasons behind its recommendations. These included a description of the energy context within which the fusion effort must be considered.

The panel noted that the fusion objective of providing "this country and the world with an abundant, safe, environmentally attractive, and cost-competitive new energy source . . . would bring large benefits almost irrespective of how the energy future unfolds; and achieving it could be crucial if society finds it necessary, for environmental or political reasons, to reduce sharply the currently dominant role of fossil fuels in world energy supply." Furthermore, the panel found that "fusion R&D yields an immediate and continuous additional benefit by nourishing an important branch of basic science -- plasma physics -- and technologies related to pursuing it. This field of research, for which nearly all of the funding comes from fusion energy R&D budgets, has been prolific in the production of insights and techniques with wide applications in other fields of science and industry." Also, the panel noted, "for a variety of reasons, fusion energy R&D has evolved a higher degree of international scientific and technological cooperation than any other field of scientific or technological research. This cooperation . . . is in itself a valuable model and precedent for internationalization of R&D in other fields. Such cooperation is likely to become increasingly important as the costs of cutting-edge R&D continue to grow in relation to the capacities of individual nations to pay for it."

ENERGY ISSUES

In presenting its justification for fusion, the PCAST panel summarized its view of the world energy situation. The panel noted that "most long-range projections of world energy demand show it reaching 2 to 3 times the 1990 level by the middle of the next century." Even taking into account the possibility of "assigning an unprecedented priority to investments and policies that promote energy efficiency," the panel states that "more than a doubling of energy use between 1990 and 2050 may well be required to sustain global economic development, to foster international stability, and to facilitate investments that improve environmental quality."

The panel noted that "of the total primary energy supplied to civilization in 1990, nearly 30% was used to generate electricity and about 70% was used in nonelectric applications of fuels. Some 80% of the world's nonelectric energy came from fossil fuels in 1990, with most of the rest coming from biomass fuels; of world electricity generation, which in 1990 amounted to about 11 trillion kilowatt-hours, 62% came from fossil fuels, 19% from hydropower, 17% from nuclear fission, and a bit over 1% from the sum of biomass fuels, geothermal energy, wind power, and solar energy. The electric share of total energy use has been increasing: a doubling of energy use between 1990 and 2050 might well be associated with a tripling of electricity generation (to, say, 35 trillion kilowatt-hours)."

The panel stated that "Dawdling in the task of finding supplements and replacements for (fossil fuels) is a prescription not only for increased monetary costs associated with their increasing scarcity in relation to demand, but also for political tensions and perhaps even conflict associated with the circumstance that the largest and most valuable of these resources are concentrated in only a few regions."

The panel concluded, "It should be obvious that there is great merit in the pursuit of diversity in energy options for the next century. // The potential value of developing fusion energy must be understood in this context." Commenting on the cost to develop fusion, which DOE had estimated to require the commitment of \$6.45 billion over the next ten years (for a schedule aimed at a 2025 operating demonstration power plant), the panel said, "The indicated amount also can hardly be said to be beyond the financial means of the United States; \$645 million per year could be raised with a 0.3% tax on current U.S. electricity sales."

WHY FUSION

The PCAST offered the following reasons for pursuing a fusion energy option: "(a) The fuel supply is extractable from ordinary seawater (thus available to all countries) and is sufficient in quantity for millions to billions of years. (b) There are significant advantages over fission energy options with respect to possibilities for minimizing radiological hazards and links to nuclear weaponry, over fossil-fuel options with respect to emissions to the atmosphere, and over many forms of renewable energy with respect to impacts on ecological and geophysical processes. (c) The monetary costs of fusion could be comparable to those of other medium-term and long-term options."

CONTRIBUTIONS TO SCIENCE

The PCAST panel states that "Results from fusion plasma physics have fundamental and pervasive import for many other scientific fields. In astrophysics, plasma science has been employed to understand the behavior of the plasma and magnetic fields in the earth's magnetosphere, in the sun and other stars, and in galaxies. // Fusion plasma physics has been at the forefront in the development of the new sciences of chaos and complexity and has forged new concepts in the area of turbulence, one of the great scientific problems of this century. In the area of large scale computing, fusion researchers have pioneered the use of supercomputers to solve complex problems. In particular, the fusion energy program was the first to employ time-sharing supercomputers serving a large scientific community."

INDUSTRY/TECHNOLOGY CONTRIBUTIONS

The PCAST panel asserts that fusion R&D has "laid the scientific foundation for, and has already contributed to, a number of technologies that have applications in manufacturing, materials, electronics, electric power, computing, and defense industries."

The panel states, "In manufacturing, the unique properties of plasmas have led to important applications in the processing of materials." For example, "Plasma processing is a principal manufacturing technology for creating microelectronic devices on the very small (submicron) scale that is required for the advanced integrated circuits in computers, communications equipment, and consumer electronics products. The technology also reduces toxic wastes from microelectronic-circuit manufacturing."

The panel notes that "Plasma-ion implantation (is used) to harden tools, to produce anti-corrosion coatings, and to reduce wear by creating low-friction surfaces for both industrial and biomedical applications."

The panel says that "Already there are a considerable number of successful spin-off companies, which are transferring important technologies to several commercial sectors."

CONCLUSIONS

The PCAST panel concluded that "Based on the importance of developing energy sources adequate to meet the needs of the next century and the promise of fusion for this purpose, the benefits of fusion R&D in strengthening the national science and technology base, the impressive recent rates of progress in fusion research, the costs of the logical next steps, and the growing investments being made in fusion R&D in the European Union and Japan (which already total more than three times the corresponding investment here), we believe there is a strong case for the funding levels for fusion currently proposed by the U.S. Department of Energy -- increasing from \$366 million in FY 1996 to about \$860 million in FY 2002 and averaging \$645 million between FY 1995 and FY 2005."

However, the panel states, "Although the program just described is reasonable and desirable, it does not appear to be realistic in the current climate of budgetary constraints; we therefore have devoted most of our effort to developing a budget-constrained U.S. fusion R&D strategy that, given level funding at about half of the average projected for the period FY 1996 through FY 2005 under the current DOE plan, would preserve what we believe to be the most indispensable elements of the U.S. fusion effort and associated international collaboration. This strategy would cost about \$320 million per year, \$46 million less than the U.S. fusion R&D budget in FY 1995."

The panel says that such a program "would entail hard choices and considerable pain, including straining the patience of this country's collaborators in the international component of the fusion effort, forcing difficult trade-offs between even a reduced U.S. contribution to international collaboration and maintaining adequate strength in the domestic components of U.S. fusion R&D, shrinking the opportunities for involvement of U.S. industry in fusion technology development, and surrendering any realistic

possibility of operating a demonstration fusion reactor by 2025. But we believe it is the best that can be done within budgets likely to be sustainable in the current climate, and the least that can responsibly be done to maintain a modicum of momentum toward the goal of practical fusion energy."

BUDGET UPDATE

The House of Representatives has passed the DOE FY 1996 appropriations bill. Included in the bill is \$229.1 million for the Office of Fusion Energy (a reduction from the FY 1995 level of \$368.4 M and FY 1996 request level of \$366 M). Also included is \$213.6 M for inertial confinement fusion in the DOE Defense Programs budget (an increase from the FY 1995 level of \$173 M, but a decrease from the FY 1996 request level of \$241 M). The House rejected initiation of construction of the Tokamak Physics Experiment (TPX) in the fusion energy budget. They provide \$33.6 million for the National Ignition Facility (NIF) but limited the use of those funds to continuation of design.

As we go to press, budget markups in the Senate Appropriations Committee are imminent.

The House Science Committee added \$25 M to the \$229.1 M recommended for fusion by its Subcommittee (see our July newsletter). However, this action did not carry over into the appropriation bill. Rep. Zoe Lofgren (D-CA) was responsible for the add-on amendment. Persons wishing to thank her for her efforts can write her at 118 Cannon House Office Bldg., Washington, DC 20515.

FUSION LETTERS

Fusion Power Associates has copies of several letters to Senator Domenici, urging his support for fusion development. The following letters are available on request: (1) June 20 letter from 12 members of the ITER Steering Committee -- U.S. (ISCUS), (2) June 26 letter from Alan Waltar, President of the American Nuclear Society, on behalf of the Society, (3) June 30 letter from John Landis and Steve Dean on behalf of the Fusion Industry Council -- U.S. (FICUS), ITER Industry Council, and TPX Industry Council, (4) July 7 letter from 21 members of the fusion community, (5) July 7 letter from 9 members of the ITER Technical Advisory Committee, (6) July 13 letter from John Landis on behalf of the ITER Industry Council.

WEB NOTES

The report of the DOE Secretary of Energy Advisory Board Task Force on Strategic Energy R&D Priorities (Yergin Panel) is available on the Web via the following address; <http://apollo.osti.gov/html/doe/whatsnew/yergin/yergin.html>

The U.S. ITER Home Team has established a Home Page at the following address: <http://iter.pppl.gov/iterhome>

Stellarator News, edited by Jim Rome of ORNL, is available in Adobe Acrobat (PDF) format via <http://xxx.lanl.gov/plasm-ph> Free Acrobat Readers may be obtained from the Adobe web server at <http://www.adobe.com>

Information on Fusion Power Associates and access to other fusion sites worldwide can be accessed through the DOE Office of Fusion Energy Home Page at <http://wwwofe.er.doe.gov>

DOE CLASSIFICATION REVIEW

The DOE is in the midst of a major review of its classification policies. The review began March 16 under the chairmanship of Dr. Albert Narath, director of Sandia National Laboratories. The review process is estimated to take about 12 months. Persons wishing to provide views to the commission should contact Mr. Jeff Zarkin at DOE at (301)903-0236; fax -6133. At a public meeting July 28 in Oakland, CA, FPA president Steve Dean urged the commission to recommend further declassification of inertial confinement fusion. Dean told the group "Classification of inertial confinement fusion continues to be excessive. Declassifications needed include: (1) all results of calculations of LASNEX computer codes as they relate to the design and performance of inertial confinement fusion capsules, and (2) all results of Halite-Centurion underground tests as they relate to conclusions regarding the feasibility of inertial confinement fusion."

OMEGA UPGRADE LASER OPERATES

The Omega-Upgrade laser facility at the University of Rochester has begun operation. The \$61 million facility, the most powerful ultraviolet laser currently in operation, will be used primarily to study the physics of direct-drive inertial confinement fusion, but will also be used to study indirect-drive physics important to the design and operation of the

proposed National Ignition Facility (NIF). Dr. Robert McCrory, head of the U. of R. Laboratory for Laser Energetics will describe Omega-Upgrade and other aspects of the U.S. inertial confinement fusion program at Fusion Power Associates annual meeting and symposium, September 7-8 in Montreal. For program and registration information, contact Fusion Power Associates.

DOE-JAERI SIGN ACCORD

The DOE and the Japan Atomic Energy Research Institute (JAERI) signed an accord July 17 to continue and expand cooperative activities on nuclear science and technology. The agreement was signed by Under Secretary Charles Curtis and JAERI President Shozo Shimomura. DOE and JAERI have a long history of cooperation in the nuclear field, including fusion energy.

EMILY PELTON LEAVING OMB

Emily Pelton, who has been the fusion program budget examiner at the Office of Management and Budget (OMB) is transferring to the International Affairs Directorate of the Office of Science and Technology Policy (OSTP) in August. In her new position she will be concerned with ITER and other international agreements. We wish her well.

MEETINGS

Sep 6-9 - International Symposium on Heavy Ion Inertial Confinement Fusion. PPPL, Princeton, NJ. Contact Dolores Lawson, fax (609)243-2749; e-mail dlawson@pppl.gov

Sep 7-8 - Fusion Power Associates Annual Meeting and Symposium, "Status and Prospects for Fusion Power Development," Joint Meeting with the Canadian Nuclear Association. Montreal, CA. Contact FPA.

Sep 11-15 - Conference on Advanced Approaches to Economical Fusion Power." Monterey, CA. Contact Karen Pangelina, fax (510)422-2956; e-mail pangelina@llnl.gov

Sep 30 - Oct 5 - 16th Symposium on Fusion Engineering. Champaign, IL. Contact Laurie Wink, fax (217)333-9561; e-mail laurie_wink@ceps.uiuc.edu

QUOTABLE

"Flexibility means immediately abandoning a plan of action that isn't working."

Len Morgan
Flying Magazine, September 1994



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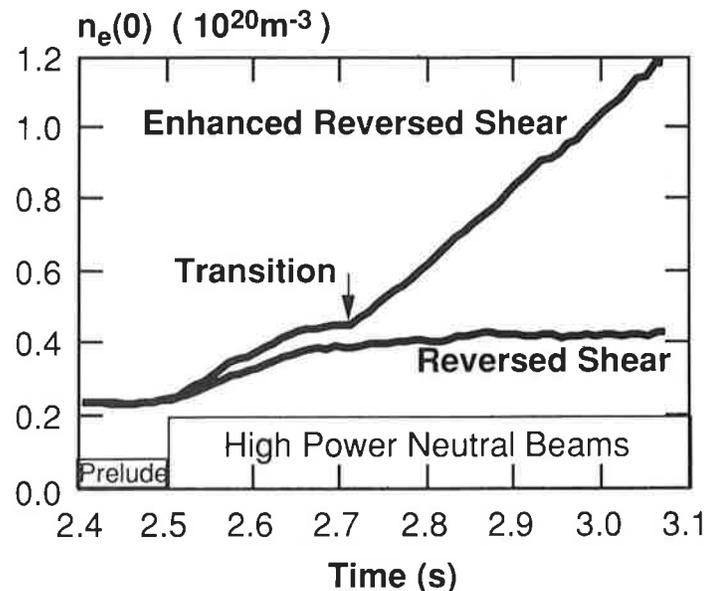
FUSION PHYSICS BREAKTHROUGH EMERGING KOREA INITIATES FUSION EFFORT

BREAKTHROUGH EVIDENCE MOUNTS

Scientists at Princeton and General Atomics (GA) have submitted papers to the journal *Physical Review Letters* documenting evidence of greatly enhanced confinement of the high temperature plasma in the Tokamak Fusion Test Reactor (TFTR) and DIII-D tokamaks, respectively. Commenting on the results in the July 28 issue of *SCIENCE*, Princeton scientist Michael Zarnstorff said, "Your first reaction is 'Holy Smokes! How can this be?'" Charles Kessel, also from Princeton, who developed the theoretical model (*Phys. Rev. Lett.*, 21 February 1994) and estimated the significance of the results, stated that "The improved confinement could slash the size and cost of a fusion power plant by 50%."

By adjusting the radial profile of the current flowing in the donut-shaped tokamak plasma, scientists have succeeded in creating a condition in which there are two distinctly different regions: a central "core" region in which the plasma is extremely stable and well-confined, surrounded by a "mantle" through which the plasma is eventually lost more rapidly. The effect is dramatic. The particle confinement is enhanced and the ion thermal losses are reduced by a factor of about 40, resulting in a rapid rise, by a factor of 3, in the core plasma density, according to the TFTR paper. The result is better than the best thought theoretically possible ("neoclassical" ion confinement) in a perfectly stable plasma, a fact the scientists called "quite astounding."

Experiments in DIII-D, JET, and Tore Supra several years ago provided hints of beneficial effects concurrent with the formation of a core limited to a small region around the tokamak central axis. But evidence for the effect was limited since detailed, local measurements of the internal magnetic field were not available. Recent improvements in



Three-fold core density increase in TFTR due to enhanced core confinement

diagnostics have made high-quality measurements possible. Now the extent of the core has been extended to about one-third of the radius of the plasma.

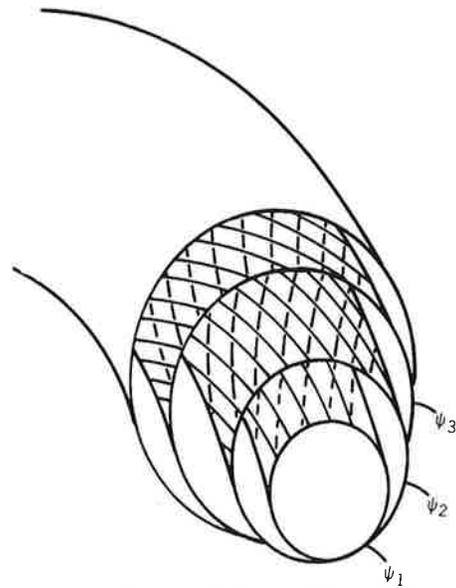
GA scientists report results in the DIII-D tokamak that are similar to those observed in the larger TFTR. Enhanced confinement, higher (peaked) density and high ion temperature are seen in the core region. Tom Simonen, Fusion Group Vice President at GA, says that study of the configuration has been a key element in the DIII-D program for several years.

A bonus, important to future fusion power plant design, is that the configuration lends itself to the creation of the so-called "bootstrap" current, a self-generated plasma current that reduces the need for supplying external input power to drive the necessary plasma current. The papers report that 50-75% of the current was generated by the bootstrap effect.

The tokamak configuration derives its confinement properties by the combination of two magnetic fields, one generated by external magnets, and a smaller field generated by current flowing in the plasma. When these two fields are combined, a twisted (helical) pattern of magnetic field line surfaces, a kind of magnetic mesh or webbing, are created. In the conventional tokamak, the plasma current is peaked at the center (on axis) and results in a configuration such that the severity of the twist decreases with radius from the center. This effect is called a "shearing" of the magnetic surfaces, in effect each successive layer of the magnetic web is twisted slightly less tightly than the previous layer.

The new configuration is achieved by creating a plasma current distribution that is peaked off axis. This "hollow" current profile results in a shearing effect that initially increases, rather than decreases, with radius, i.e., each successive layer of the web is twisted slightly more tightly than the previous layer. The twisting eventually peaks in tightness at the radius where the current density peaks and then decreases again toward the plasma boundary. This reversal in the magnitude of the shearing effect at some intermediate radial position has given rise to the name "reversed shear mode" to describe this tokamak configuration and the term "enhanced reversed shear mode" to describe the recent results. A major difference between the recent results and earlier reversed shear mode experiments is that the magnitude of the shearing effect on axis is lowered in the new configuration. This was predicted to further stabilize the plasma, a prediction that seems now to be born out in practice.

The enhanced confinement of plasma observed in this configuration gives rise to a plasma pressure (hence particle and power density) profile that is peaked at the center, while the current profile is peaked at an intermediate radius. The excitement over the results stems from the fact that it appears to improve tokamak performance in a number of important areas simultaneously: It enhances the fusion power density; it reduces the rate at which particles and energy are lost; and it allows the plasma to self-generate most of the plasma current required to maintain the configuration. In the words of Charles Kessel, Steve Jardin and Bill Tang from Princeton, "These three improvements go a long way towards making projections of a fusion power plant based on the tokamak more competitive with alternative sources of energy production.



Schematic of Sheared Toroidal Magnetic Surfaces

The enhanced reversed shear mode physics results reported were obtained in deuterium plasmas at modest input power. These results also provide exciting possibilities for what new achievements may be possible in the TFTR using deuterium-tritium mixtures. For several years, the best conditions achieved have been at about one-third of breakeven conditions. Scientists now predict that conditions well above breakeven could be achieved in the core region if these conditions can be reproduced at higher power levels. To date, 10 Megawatts of fusion power production are typical of the best TFTR results. Dale Meade, Deputy Director of the Princeton Plasma Physics Laboratory, says that production of between 20 and 40 Megawatts may now be possible, and would result in significant plasma self-heating.

Emphasis in the near term will be on optimizing and further controlling the evolution of the current profile, and attempting to increase the reversal radius, and hence volume, of plasma engaged in the effect. Additional analysis is also required to assess a number of interrelated power plant issues, such as the removal of helium exhaust.

Experiments to date only allow this regime to be accessed transiently, because they do not have the equipment to control the evolution of the current profile. A complete demonstration of this mode in continuous, steady-state conditions is a primary mission of the proposed Tokamak Physics Experiment (TPX) facility. Thus far, however, Congress has failed to authorize TPX construction.

KOREA JOINS FUSION RACE

On July 23, South Korean President Kim Young-sam announced an ambitious plan to join the world effort to develop fusion as an energy source, as part of a greatly expanded effort in Korea to develop energy, space, and other advanced technologies. Kim said Korea would invest \$150 million over the next several years in developing a national capability to participate in the international fusion development effort. Kim announced the plan in San Francisco, during a state visit to the United States, during which he attended the dedication of the Korean War Veterans Memorial in Washington.

Calling fusion a "dream energy source," Kim said Korea would collaborate with the United States and other countries "in the fields of science and industrial technology" because such fields of endeavor are "no less important than in the areas of security and economy." Kim said that Korea would establish a "South Korea-United States Joint Science Center" in a Washington DC suburb, under the sponsorship of the Korea Science and Engineering Foundation. Kim said that Korea would start designing its fusion facilities immediately and start building them in 1998.

FPA HONORS HAROLD FURTH

Fusion Power Associates Board of Directors has presented its Distinguished Career Award to Dr. Harold P. Furth, former director of the Princeton Plasma Physics Laboratory (1981-1990). Dr. Furth was the originator, in the early 1970's, of the Tokamak Fusion Test Reactor project, which has come to be the highest performance tokamak in the U.S. fusion program. He has published over 200 scientific papers and holds some 20 patents. Furth spent his early years at the Lawrence Livermore National Laboratory (1956-1967), where his scientific contributions to the early development of fusion research became legendary. A pioneer of fusion research, he made many contributions to the fundamentals of plasma physics. He has provided both technical and managerial leadership to the world fusion effort almost since its inception. He has received numerous honors and awards, including Fusion Power Associates Leadership Award in 1982. He is a Fellow of the American Physical Society, the American Association for the Advancement of Science, and the American Academy of Arts and Sciences. Fusion Power Associates is pleased to honor Dr. Furth with our Distinguished Career Award.



Harold P. Furth

Farrokh Najmabadi

NAJMABADI RECEIVES EXCELLENCE IN FUSION ENGINEERING AWARD

Fusion Power Associates Board of Directors has presented its 1995 Excellence in Fusion Engineering Award to Dr. Farrokh Najmabadi of the University of California at San Diego. These awards were established in 1987 in memory of Prof. David Rose, Professor of Nuclear Engineering at MIT, a pioneer of the new discipline of fusion engineering. The awards recognize persons relatively early in their careers who have made outstanding technical contributions, combined with evidence of leadership. Dr. Najmabadi received his Ph.D in Nuclear Engineering from the University of California at Berkeley in 1981. Since 1986 he has been the leader of the national Fusion Power Plant Studies Program, first at UCLA, and more recently at UCSD. We are pleased to be able to provide this recognition of his past accomplishments and future potential to provide leadership to the fusion program.

LBL SELECTS INDUSTRY SUPPORT TEAM

The Lawrence Berkeley Laboratory has selected an industrial support contractor for the Inertial Fusion Energy program there. The team is led by the Westinghouse Science and Technology Center (Pittsburgh). Other team members include Northrop Grumman, Maxwell Laboratories, University of Wisconsin, Bechtel Corporation, TRW, SAIC, and Stanford Research Laboratory. The team will support the Elise induction linac project, a 5 MeV, 1 A accelerator with electric focusing. The task areas include developing cost-effective induction cores and pulse modulators, as well as advanced manufacturing technology in fabricating electrostatic quadrupoles.

INERTIAL FUSION ENERGY NOTES

Experiments are underway at the University of California at Berkeley (Prof. Per Peterson) to test the feasibility of developing liquid jets which would line the walls of an inertial fusion power plant, for the purpose of attenuating fusion neutrons before they impinge on structural materials. Designs produced by Ralph Moir (LLNL) indicate that such jets could allow the chamber walls to last the life of the plant, result in low activation waste, resulting in lower cost of electricity. For further information, contact Ralph Moir Fax (510)422-6401; e-mail: moir@quickmail.llnl.gov

ITER CONCEPTUAL DESIGN REVIEW COMPLETED

The Council that oversees the International Thermonuclear Experimental Reactor (ITER) project (ITER Council) met in San Diego July 26-27 to review the Interim Conceptual Design Report (see our June newsletter). The Council accepted a cost estimate (in fixed 1989 dollars) of \$5.85 billion (plus or minus \$800 million) for construction, plus \$1.2 billion for "other related costs during construction." The "Detailed Design Report" is due in December 1996. ITER is designed to be an integrated physics and engineering test reactor, reaching "sustained ignition," producing 1500 Megawatts of thermal power from fusion reactions in 17 minute pulses. The plasma "donut" is 8.1 meters in major radius and 2.8 meters in minor radius. During the pulse the wall of the vessel will receive a "loading" of 1 Megawatt per square meter from fusion neutrons. The maximum field at the superconducting coils is 12.5T and the plasma current is 21 MA.

The ITER Council firmly rejected a suggestion by the U.S. PCAST (see our July and August newsletters) that the technical objectives of ITER be reduced and refocused on the design of an ignition physics test facility at one-third the estimated cost of ITER. The Council stated, "There is a renewed consensus of the ITER Council that this is a necessary step; that the objectives of ITER remain attainable and must not be changed; that the design can meet the objectives; that the quadripartite cooperation has shown to be an efficient frame; and that the right time for such a step is now." The Council concluded, "Accordingly, the Council urges all Parties to fulfill their obligations to this unprecedented international cooperation and to structure their domestic programs to ensure that they provide their full contribution to the ITER Engineering Design Activities."

The four delegations to the ITER Council meeting were headed by Evgenij Velikhov, Chair (Russia), Paolo Fasella (EEC), Naotaka Oki (Japan), and James Decker (US). The next meeting of the Council is scheduled for December 12-13 in Garching, Germany.

BUDGET UPDATE

The Senate passed a magnetic fusion budget of \$225 million for FY 1996, compared to this year's budget of \$368.4 million. In accompanying language, however, the Senate indicated that the costs of the inertial fusion energy program (\$7 million) were being transferred to DOE Defense Programs accounts and some of the fusion program costs (\$8 million) associated with operating the National Energy Research Supercomputing Center should be paid from other DOE accounts. The Senate also indicated that any termination/closeout costs associated with the fusion budget reductions should be paid from other DOE accounts. Also, the full Senate passed an amendment to the appropriations bill authorizing DOE to spend up to \$56 million from other accounts to continue operations of the Tokamak Fusion Test Reactor. DOE had indicated that TFTR and most other major fusion facilities could not operate in FY 1996 under the severe budget reductions that Congress was passing. The Senate action must be reconciled with the House-passed fusion budget of \$229.1 million (see our August newsletter). The House-Senate conference is expected in late September.

The Senate endorsed all aspects of the DOE inertial confinement fusion program (part of DOE's Defense Programs budget), including full construction authorization of the National Ignition Facility (see our August newsletter).

RESTRUCTURING

House and Senate appropriations bills call for a restructuring of the U.S. magnetic fusion program to meet lower projected funding levels. DOE is expected to charge its Fusion Energy Advisory Committee (FEAC) to undertake to make recommendations on this restructuring on an urgent timetable, with a final report due in November. The Executive Branch desires to put forth a revised fusion strategy as part of an overall plan to balance the federal budget over ten years. The Executive Branch plan is not expected until the President submits his budget to Congress in early 1996. The DOE fusion re-planning will fold into this process. FEAC has scheduled a public meeting, its first in a year, October 11-13 in Washington, DC.



FUSION POWER ASSOCIATES

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CONGRESS TAKES AIM AT U.S. TOKAMAK PROGRAM DOE PLANS SMALLER FUSION EFFORT

BUDGET BLOW REALITIES

The Department of Energy, along with the rest of the U.S. government, has gone on "continuing resolution" until November 13. This means that the Congress has failed to pass an appropriation bill to fund the Government for the full fiscal year. For fusion it means that the spending rate must be immediately reduced by 40% relative to FY 1995, (which ended September 30). A press release from the Princeton Plasma Physics Laboratory (PPPL) tells the story—one which is being repeated at many fusion centers around the country. According to the release, dated September 25, PPPL "is issuing layoff notices to 166 regular employees and 80 personnel hired through subcontractors." The laboratory currently employs approximately 820 workers, including 710 Princeton University employees and 110 subcontractor staff.

DOE has indicated that it will order PPPL to stop research on the Tokamak Fusion Test Reactor, the largest operating tokamak experiment in the U.S., unless House-Senate conferees provide more funding than is currently planned for fusion in either the House or Senate bills separately (see our August and September newsletters). In addition, DOE has ordered the shutdown of two medium-sized tokamaks: TEXT at the University of Texas and Phaedrus at the University of Wisconsin. DOE has also indicated that it may have to cease operations for a year or more on the other two major U.S. tokamak devices (at General Atomics and MIT) and scale back its support for the International Thermonuclear Experimental Reactor (ITER) project. Sources in Congress say that they favor continuation of U.S. participation in the engineering design phase of the ITER project, which is scheduled to be completed in 1998.

House-Senate conferees postponed until mid-October their scheduled late September conference to merge their respective bills on DOE funding. DOE deputy secretary Charles Curtis has reportedly asked the conferees to increase the funding for fusion by \$50 million over the House mark of \$229 million. Even this number, however, would leave the fusion energy program with a 24% cut relative to FY 1995.

DOE PLANS FUSION RESTRUCTURING

The DOE has begun the process of "restructuring" the fusion program in anticipation of a lower level of effort that may continue for a number of years. DOE will unveil its "draft strategy" at a public meeting of its Fusion Energy Advisory Committee (FEAC) on October 12-13 at the Renaissance Washington DC Hotel (999 9th Street, NW). Sources indicate that the strategy will emphasize improvements in scientific understanding, the development of associated enabling technologies, and will indefinitely postpone planning for new facilities that could incorporate advances in understanding that have accumulated over the past 20 years since the Tokamak Fusion Test Reactor was designed. As a part of the possible new strategy, the potential of concepts other than the tokamak will also be reassessed.

Following what is hoped to be a rather rapid review of the proposed new strategy by FEAC, DOE is currently planning to seek the blessing of the Secretary of Energy Advisory Board (SEAB) and then incorporate the strategy into the President's FY 1997 budget request to be submitted to Congress early in 1996.

INDUSTRY COMMENTS

At a joint meeting of the Fusion Power Associates Board of Directors, Fusion Industry Council, U.S., ITER Industry Council, and TPX Industrial Council on September 13, it was decided to write a joint letter to Energy Secretary Hazel O'Leary regarding certain aspects of the developing new fusion strategy. The 14 signers of the letter stated, "In adjusting to whatever budget is eventually passed, we ask that you pay special attention to assuring that a balanced effort, which provides for both scientific advances and technology development leading eventually to a commercial energy source, is maintained." The group stated, "Fusion requires continued evolution of three synergistic elements: new science, development of relevant technologies, and a systems approach to program management to optimize the use of limited resources and minimize the time to commercial application." They concluded, "Industry will be the means by which the benefits of fusion energy are brought to society, and industry thus has an interest in keeping the fusion energy option open. We believe the private sector has much to offer in a balanced fusion program at any budget level."

The letter was signed by David E. Baldwin (General Atomics), S. Locke Bogart (Lockheed Martin), James A. Conner (Babcock & Wilcox), Stephen O. Dean (Fusion Power Associates), William R. Ellis (Raytheon Engineers and Constructors), David B. Everson (Everson Electric), Samuel D. Harkness (Westinghouse), John W. Landis (Chairman, FICUS), James D. Lang (McDonnell Douglas Aerospace, East), Chester G. Lob (Communications and Power Industries, Inc., formerly a division of Varian Associates), Michael J. Monsler (W.J. Schafer Associates), William H. Robinette (TRW), Alan Todd (Northrop Grumman), and Stephen J. Toth (CBI Industries). Copies of the letter are available from Fusion Power Associates.

INERTIAL FUSION LOOKING GOOD

In contrast to the dismal outlook for the DOE's civilian fusion energy program, prospects for the nation's inertial confinement fusion program—a key element in the nuclear weapons "Science-based Stockpile Stewardship" program—are looking good. Fusion, initiated in small, high density plasmas by lasers and particle beams, allows scientists to study some of the physics associated with thermonuclear weapons and to calibrate some aspects of computer codes used in their design. Congress has not threatened funding

for military programs to anywhere near the degree they are cutting civilian programs and, in some cases, is increasing them. A key new inertial confinement fusion facility, the National Ignition Facility (NIF), is included for engineering design in the House bill and for construction in the Senate bill. The Senate bill would provide \$27 million more for NIF than would the House version. In either case, however, the total inertial confinement fusion budget would increase relative to FY 1995. The Senate version provides the full \$241 million requested by the President, compared to the FY 1995 level of \$173 million.

DOE, meanwhile, released a draft report August 23 that concludes that (1) "The technical proliferation concerns at the National Ignition Facility (NIF) are manageable and therefore can be made acceptable, and (2) the NIF can contribute positively to U.S. arms control and nonproliferation policy goals." In an August 25 press release, Energy Secretary O'Leary stated, "The NIF is an important part of our Science-based Stockpile Stewardship program that will allow us to ensure the capability of our nuclear stockpile without underground testing. We are committed to operating the NIF in the most open manner possible while supporting our objectives of reducing the global nuclear danger."

In a public hearing last March 9 during preparation of the DOE report, FPA president Steve Dean stated, "The National Ignition Facility (NIF) is a timely and necessary experiment to establish the scientific principles of inertial confinement fusion. The use of high power lasers to create small, high density, high temperature conditions permits not only the study of some of the conditions that occur in nuclear explosions, but also the study of the conditions that occur in stars and the study of the physics basis of fusion energy for civilian applications. As such, NIF will be a unique and powerful scientific tool, allowing scientists to create new, forefront knowledge in several areas. NIF also extends our technological capability in many areas, including precision optics, high speed micro-diagnostics, laser architecture, and computer simulation." Dean stated his opinion that "Nonproliferation policy must continue to be based on the control and inspection of fissionable material and related equipment and not be distorted by misguided efforts to suppress scientific progress, especially in the area of fusion. The route to nuclear weapons by errant non-nuclear states would clearly be through nuclear fission science and technology, not through fusion, which is

incomparably more sophisticated, more difficult, and more expensive." Dean recommended that DOE should include in its report "a chapter that discusses the nature of the nonproliferation issue itself (not just in the context of NIF)" and that this chapter "should discuss the present Nuclear Nonproliferation Treaty principles, describe the control and safeguard policies, and describe the relative likelihood of proliferation through the fission and fusion pathways." He said that "Only by including such a discussion can it become clear how far one has to stretch one's imagination in order to conclude that the NIF would constitute a significant proliferation threat." DOE ignored this recommendation in its most recent draft. Copies of Dean's March 9 testimony are available from Fusion Power Associates. Copies of the DOE draft report, which is open for public comment, can be obtained from Andi Kasarsky, DOE, (202)586-3012 and are also available on the DOE World Wide Web page.

VELIKHOV: MORE ITER PARTNERS?

Academician E.P. Velikhov, chairman of the ITER Council, suggested recently that the solution to the problem of how to pay for construction of the International Thermonuclear Experimental Reactor (ITER) might be to bring in additional parties such as Korea, India, and China. Velikhov made the remarks in a keynote address to a joint meeting of Fusion Power Associates and the Canadian Nuclear Association in Montreal September 7. Velikhov, noting the current financial setbacks in fusion funding in the U.S. and Russia, said that it was "unrealistic to think of Russia as an equal partner in ITER construction." A recent report of the (U.S.) President's Council of Advisors on Science and Technology (PCAST) also suggested that the U.S. might have to be a junior partner in ITER and that other countries might be invited to participate. The primary thrust of the U.S. PCAST report, however, was to recommend "downsizing" the ITER project. This recommendation was rejected by the ITER Council (See our September newsletter). Velikhov stated that it was "logical" for Asian nations to take a more active role in developing fusion "since that is where the future energy crisis will be most acute."

DOE HONORS RICHARD HAWRYLUK

The U.S. Department of Energy has presented Princeton Plasma Physics Laboratory (PPPL) scientist Richard Hawryluk with its Distinguished Associate Award. The award, signed by Energy Secretary Hazel O'Leary, cites



Richard Hawryluk

Hawryluk "for your important contributions to fusion research and for your leading role in preparing for and carrying out the pioneering deuterium-tritium experiments in the Tokamak Fusion Test Reactor." The DOE's Distinguished Associate Award "recognizes outstanding individual efforts or achievements of DOE contractor employees and the relationship of the individual's performance to one or more of the Department's major programs, projects or responsibilities."

PPPL Director Ron Davidson said that Hawryluk's "extraordinary abilities in leading the TFTR team and research program have resulted in several historic advances in our fundamental understanding of the properties of deuterium-tritium plasmas and alpha-particle effects, as well as the achievement of world record fusion power levels on TFTR." He said that "Dr. Hawryluk has brought great distinction to PPPL, and we stand in awe of his technical acumen and outstanding accomplishments as a 'pioneer' in developing fusion as a practical energy source." In accepting the award, Hawryluk said, "This award recognizes the accomplishments of the entire TFTR group. For the past two years, we've had a string of very successful and productive experiments. These experiments are the product of hard work by a highly dedicated scientific, engineering, and technical staff who mastered the art of making D-T plasmas and, in the process, have performed some great experiments."

JAPAN SETS NEGATIVE ION BEAM RECORD

Scientists at the Japan Atomic Energy Research Institute (JAERI) are developing negative-ion neutral beam injectors for heating plasmas and driving plasma currents in tokamak fusion devices, including the JT-60 U and, eventually, for ITER. On August 16 they announced achieving a 6-fold increase in beam current at 500 keV to a record 3.6 amperes. They anticipate raising the current to 22 A in the near future. The goal of the development program for ITER is 22 A at 1 MeV. For further information, contact Dr. Hiroshi Kishimoto, Director, Department of Fusion Plasma Research, JAERI, Fax: 81-292-70-7419.

INERTIAL FUSION BOOK PUBLISHED

The International Atomic Energy Agency has published a book, "Energy from Inertial Fusion." Scientific editor William J. Hogan (LLNL) acknowledges the key role of David L. Banner, Head of the Physics Section at IAEA, "in initiating the project and providing guidance and support throughout the entire project." The 457-page book contains articles with over 80 authors on all aspects of inertial fusion, including fundamentals, target physics, power plant design, safety/environment and economic aspects, among others. The authors come from many countries, including the U.S., France, Japan, Russia, Spain, Germany, Austria, Israel, United Kingdom, and Canada. For information on purchasing this book in the U.S., contact UNIPUB, 4611-F Assembly Drive, Lanham, MD 20706-4391. For information on other countries, contact IAEA Sales and Promotion Unit, P.O. Box 100, A-1400 Vienna, Austria.

SITE ITER IN CANADA?

Enroute to the Fusion Power Associates/Canadian Nuclear Association symposium in Montreal, ITER Council chairman Velikhov toured two possible sites for ITER in Canada. The Canadian Fusion Fuels Technology Project (CFFTP) has been leading a broad initiative to assess the feasibility of siting ITER in Ontario. The two sites are licensed, operating nuclear power stations belonging to Ontario Hydro. They are the Bruce Nuclear Power Station (where eight CANDU fission reactors are located) and the Darlington Nuclear Generating Station (where four nuclear reactors and the Darlington Tritium Removal Facility are located). For additional information, see the July 1995 issue of the CFFTP Journal (contact Janine Loring, 416-855-4710) or contact Dr. Don Dautovich (Fax: 416-207-6325) or Bob Stasko (Fax: 416-823-8020).

JAPANESE SCIENTISTS WRITE U.S. CONGRESS

In unusually blunt fashion, two leaders of the fusion effort in Japan wrote letters to the leaders of the Appropriations Committees of the U.S. Congress saying that "It is distressing to us to watch the fusion energy research program in the United States facing such threats to its well being at this time." Tatsuoki Miyazima (Chairman of the Fusion Council, Japan Atomic Energy Commission) and Atsuo Iiyoshi (Director-General, National Institute for Fusion Science, Japan), in an August 31 letter, stated "without presuming to comment on the budgetary situation of the United States" their opinion that "in the past few years fusion has had a string of extraordinary technical advances which, when added to several decades of very impressive progress, point to an important future for fusion. The U.S. program has been a leading force for decades in developing fusion science at a very high level." Noting that "In Japan there is a program to proceed with construction and operation of Large Helical Device (LHD) and operation of the large tokamak JT-60 U, and to allow growth in university research in fusion," the scientists stated that "Although fusion research in Japan has reached levels of excellence we still look to our international partners for important results and leadership in critical areas." U.S. fusion program managers estimate the fusion effort in Japan is more than 50% larger than the effort in the U.S. due to declining U.S. fusion budgets over the past decade.

Miyazima and Iiyoshi concluded, "The fusion program has made enormous progress over the past two decades, and is now making the greatest progress ever. This is not the time to curtail those experiments that are so productive and to lose those scientists who are making such large advances."

FACTOID

About 40% of the steps involved in the making of the Pentium chip for advanced computer applications involve some form of plasma processing.

Don Rej
Los Alamos National Laboratory

QUOTABLE

"We need a series of large projects. You don't hold together the free people of the planet by small things."

Newt Gingrich, quoted in a
copyrighted article August 13, 1995
by columnist George F. Will



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CLINTON OPPOSES SCIENCE & TECHNOLOGY CUTS CONGRESS CUTS MAGNETIC FUSION BUDGET NATIONAL IGNITION FACILITY ENDORSED

CLINTON OPPOSES R&D CUTS

Speaking at a White House ceremony October 17 honoring recipients of the National Medal of Science and Technology, President Clinton stated that "global competition and rapid change have made technology clearly more central to our future than ever before." He noted that historically both parties had supported science and technology broadly but, he said, "Today that commitment is at risk in the great debate over balancing the federal budget." He said "The plan now being considered by the Congress will cut vital research and development by a third, and any number of other related endeavors by that much or more. We could have a balanced budget to show for it tomorrow, but a decade or a generation from now our nation will be much the poorer for doing that."

Clinton noted that science and technology "may not have the biggest lobby here in Washington." He said "The future, it is often said, has no constituency. But the truth is we must all be the constituency of the future. . . . And we must resist these drastic cuts, for constant churning innovation is the key to economic growth and national strength in the 21st century."

The White House issued a statement indicating that the President would probably veto a bill (H.R. 2405), the "Omnibus Civilian Science Authorization Act of 1995," if it were to reach his desk. In an October 11 statement, Vice President Gore stated, "In the name of rigid ideology that ignores the realities of the marketplace, Congress, through this bill, is taking direct aim at federal investments in high-

risk, long-term research and development." Noting that Japan and Germany already invest 30-35 percent more per capita in civilian technology than the U.S., Gore stated that "This is a foolish choice that, as the President's balanced budget demonstrates, does not have to be made for any budgetary reason."

PCAST SPEAKS OUT ALSO

The President's Council of Advisors on Science and Technology (PCAST) continues to speak out on the threat to science and technology (see our May 1995 newsletter). On September 25 the Committee sent letters to the President and to the leaders of Congress warning of the impacts of reduced R&D funding, saying that "The current budget climate has produced such threats to the long-term economic security, national security or quality of life of Americans." The PCAST suggested a "Statement of Principles" for guiding federal science and technology policy and future budgets. The six principles are: (1) Science and technology have been major determinants of the American quality of life and will be of even greater importance in the years ahead. (2) Public support of science and technology should be considered as an investment for the future. (3) Education and training in science, mathematics, and engineering are crucial to America's future. (4) The Federal government should continue to support strong research institutions . . . as part of the nation's science and technology infrastructure. (5) The Federal investment portfolio in science and technology must support both basic and applied research, including the development of precompetitive technologies with and for the private sector

as well as for national needs. (6) Stability of funding, based on long-range planning, is essential for effective and efficient use of the Federal investment in research and its associated educational function and for enhancing international collaboration.

SAN DIEGO UNION EDITORIAL

In its Sunday October 15 edition, the San Diego Union newspaper ran an editorial entitled "Investment in the Future," in which they state "Fusion is clearly the way of the future. By cutting its funding now, Congress would jeopardize one of the fundamental building blocks that coming generations will need: a new energy source." They editorialize, "Members of Congress often argue that federal spending must be cut or our children and grandchildren will have to pay off the debt we incur today. That's true. But certain federal investments today also will provide huge returns for our children and grandchildren." The Union says "We shouldn't leave our national debt for our children and grandchildren to pay. But we also must not starve important programs that will be crucially important to them."

HOUSE-SENATE CONFEREES CUT MAGNETIC FUSION BUDGET

A key new magnetic fusion project, the Tokamak Physics Experiment (TPX), for which the President had requested construction approval, was not approved by either the House or Senate Appropriations committees, nor in a House-Senate conference on October 25. More disturbing, the conferees voted to slash funding for magnetic fusion research by one-third, to \$244 M, down from \$363 M in FY 1995. As reported in our newsletter last month, the congressional cuts will result in massive layoffs, termination and/or mothballing of experimental facilities, and a forced abandonment of the national plan to operate a fusion demonstration power plant by the year 2025. DOE is preparing a "new strategy" to correspond to the lower budget levels (see our October newsletter). The DOE Fusion Energy Advisory Committee (FEAC) meeting originally scheduled for October 12-13 has been rescheduled to December 7-8. It is still planned to ask the FEAC to review and comment on the DOE fusion strategy by the end of the year (see our October newsletter).

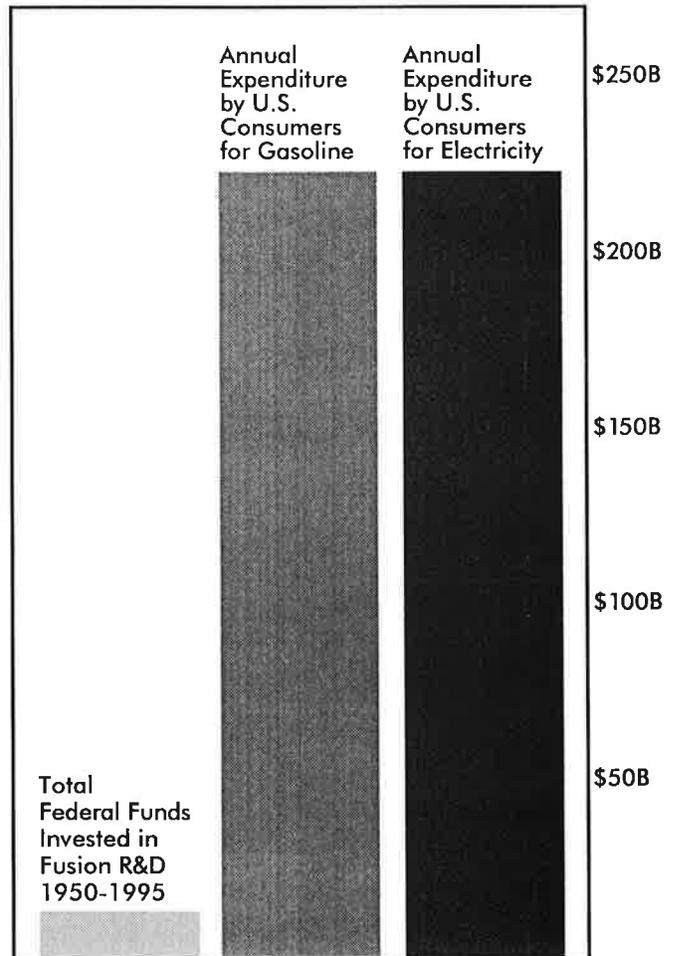
In a committee report accompanying the budget slashing, the conferees stated that their action was due to "severe budget constraints." They said, "With little prospect for increased funding for the fusion program over the next several years,

it will be necessary for the program to restructure its strategy, content, and near- to medium- term objectives. The restructured program should emphasize continued development of fusion science, increased attention to concept improvement and alternative approaches to fusion, and development and testing of the low activation materials so important for fusion's attractiveness as an energy source."

The Committee report states, "The conferees believe that because of the stringent budget realities facing this Nation, the promise of fusion energy can only be realized through international collaboration. The cost of fusion development points to the increasing importance of international cooperation as a means of designing, building, and financing major magnetic fusion facilities in the future."

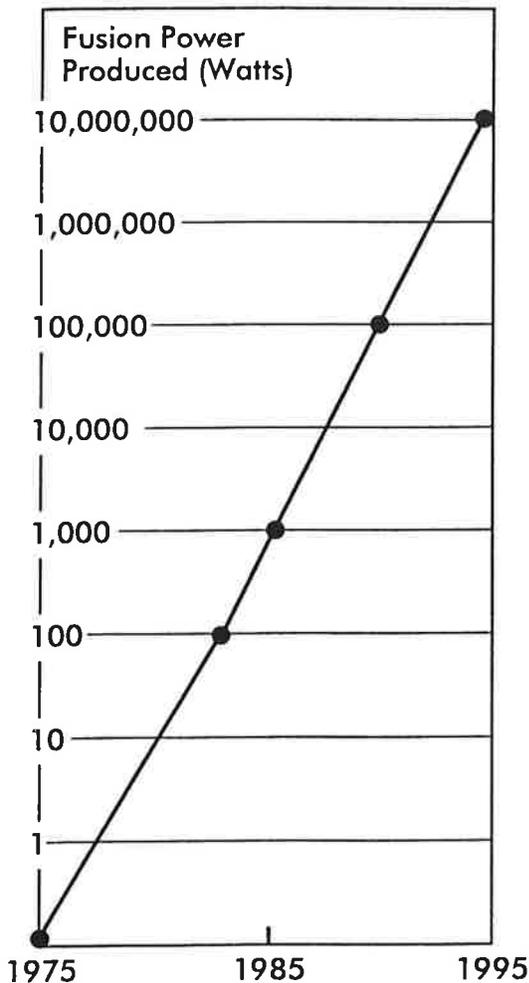
HOW MUCH IS FUSION WORTH?

U. S. consumers spend over \$200 billion per year for electricity and an approximately equal amount on gasoline. By contrast, the total federal investment in fusion research over 40 years is about \$10 billion.



PROGRESS COMPARED

The rate of production of fusion energy in tokamak experimental devices has increased 100 million-fold over the past 20 years, from 0.1 watt (for hundredths of a second) in 1975 to 10 million watts (for a few seconds) in 1994. By way of comparison, the first incandescent filament was demonstrated in 1802 and burned out almost immediately; the first successful electric light bulb experiment, by Thomas Edison in 1879 with a filament made from carbon-coated sewing thread enclosed in a vacuum jar, used a few watts and burned out in 13 minutes.



FUSION BOOK TRANSLATED

Robin Herman's book, "The Search for Endless Energy," (Cambridge University Press, 1990) has been translated and published in Greek (Kostarakis, 1993) and Spanish (McGraw Hill, 1993). A Japanese version is in progress (Asahi-Shin). Author Herman has recently moved from Maryland to Paris, France. She is a regular reader of this Executive Newsletter. Thanks Robin and best wishes.

HOUSE-SENATE CONFEREES ENDORSE NIF

A key new inertial confinement fusion project, the National Ignition Facility (NIF), has been endorsed for construction by conferees of the House and Senate Appropriations Committees. The billion-dollar class laser will be used primarily for studying weapons physics as part of the DOE Defense Programs Science-based Stockpile Stewardship (SBSS) program to maintain weapons skills in their national laboratories. The facility is also essential, however, to develop the scientific and technology base for potential civilian energy applications of inertial confinement fusion (ICF). The total ICF budget approved by the conferees is \$241 M, compared to \$173 M in FY 1995.

INERTIAL FUSION FOR ENERGY

"Construction of the National Ignition Facility as a part of DOE's Stockpile Stewardship program will give a big boost to the prospects that inertial fusion could be a viable option for commercial power generation," according to Dr. Stephen O. Dean, president of Fusion Power Associates. Dean made the comment October 29 at a special session of the annual meeting of the American Nuclear Society in San Francisco. In addition to the large laser facilities now being used to study the physics of inertial fusion, according to Dean, a lesser known, civilian-oriented inertial fusion energy (IFE) technology development program for a "heavy ion accelerator driver" to replace the less efficient laser drivers, is underway at the Lawrence Berkeley National Laboratory (LBNL). Under the direction of Dr. Roger Bangerter, LBNL is struggling with limited funds to build a small proof-of-principle accelerator called ELISE, to validate "new, potentially more economical accelerator strategies." Previous studies at LBNL have verified, on a scaled-down system, that beams of sufficient brightness can be transported, accelerated, and longitudinally compressed. According to Bangerter "The task now before us is to extend these results to an experiment of the same transverse beam size as a (power plant) driver so that the engineering issues can be addressed at the proper scale, and to verify that the remaining beam manipulations of the driver, magnetic transport, beam bending, combining, final focus, chamber transport, and possibly recirculation and beam splitting, can be accomplished while maintaining good beam quality." For further information contact Roger Bangerter, Fax: (510)486-5392. An IFE newsletter is also available free of charge by contacting via e-mail: kemerickson - weber@lbl.gov

GA AWARDED ICF CONTRACT

General Atomics (GA) has been awarded a \$63.6 million multi-year contract by the U.S. Department of Energy to provide "target support" for its inertial confinement fusion (ICF) laboratories. The contract, which is for three years plus two one year options, is a follow-on to a 1991 contract of similar scope. According to the terms of the contract, GA will be responsible for "development and delivery of specified target components, associated support systems, target component measurements and characterization methodologies, and the performance of other ICF target-related technology development tasks in support of five U.S. ICF Laboratories." The five ICF laboratories are LLNL, LANL, SNL, NRL, and University of Rochester. According to GA's Inertial Fusion Technology Division director Ken Schultz, GA is producing millimeter size, multi-layer polymer and glass shells or "capsules" that serve as the "heart of ICF targets," and also the miniature metallic containers called "hohlraums" that are used to hold the capsules during experiments. In addition, GA provides design, development and fabrication of cryogenic target delivery systems.

RALPH PARSONS CHOSEN FOR NIF BLDG.

Ralph M. Parsons Co. (Pasadena, CA) has been selected by the Lawrence Livermore National Laboratory as the architect-engineer for the main Laser & Target Area Building in the proposed National Ignition Facility complex. Mike Campbell, LLNL Associate Director for Lasers, said that "The selection of an architect-engineer is the first formal procurement action which starts our partnering with industry." In addition, Albert G. Martin & Associates (Los Angeles, CA) has been selected as the architect-engineer for the smaller Optical Assembly Building.

FURTH ARTICLE IN SCIENTIFIC AMERICAN

An article entitled simply "Fusion" by fusion pioneer and former Princeton lab director Harold P. Furth appears in the September 1995 issue of Scientific American. Furth summarizes the fusion process and its potential applications and schedule. Says Furth, "By the middle of the next century, our grandchildren may be enjoying the fruits of that vision. // Although far removed from immediate political realities, this schedule matches the critical timescale of 50 to 100 years in which fossil energy resources will need to be replaced."

FUSION PROGRESS IN JAPAN

Scientists experimenting on the JT-60U tokamak in Japan have observed the dramatic particle and thermal confinement improvements previously reported in the U.S. experiments TFTR and D-IIID (see our September 1995 newsletter: "Fusion Physics Breakthrough Emerging"). The extent of the improved core confinement region has been extended "to over half of the plasma minor radius," compared to the one-third reported in the U.S. experiments. Japanese scientists also report that "a neutron diagnostic system on the JT-60U has been successfully remotely-controlled via the INTERNET from Los Alamos National Laboratory under the Japan-US Fusion Research Collaboration agreement." According to the announcement "This remote diagnostic control via the INTERNET has demonstrated long-range, real-time remote control features, as a first step along the way to full-partner JT-60U remote collaborations from abroad." For further information, contact Hiroshi Kishimoto, Director, Department of Fusion Plasma Research, JAERI, Fax 81-292-70-7419.

SPINOFFS FROM LBNL

According to a September 25 communication from Bill Barletta, Director, Accelerator and Fusion Research Division, "Fusion energy R&D at Lawrence Berkeley National Laboratory (LBNL) has resulted in numerous spinoffs to industry and to other government programs." Barletta notes that "The numerous innovations have been recognized with five R&D 100 awards." He states that "One of the prolific sources of transferrable technology was the neutral-beams program for the Magnetic Fusion Energy Group, intended to provide high-power neutral beams for plasma heating and current drive in tokamaks." Barletta cites applications for ion-beam projection lithography for semiconductor manufacturing, ion implantation in semiconductors, proton therapy accelerators, and other applications in science, defense and industry. For more information, contact Bill Barletta, Fax (510)486-6003.

QUOTABLE

"Only when Edison realized that his bulb would have to work outside the lab and be part of a total system did it dawn on him how to create a properly working bulb."

Ira Flatow, in
They All Laughed ... From
LightBulbs to Lasers
Harper Collins Publishers, 1992



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PLASMA TECHNOLOGIES MAKING RAPID INROADS IN WORLD MARKETS WORTH OVER \$200 BILLION ANNUALLY

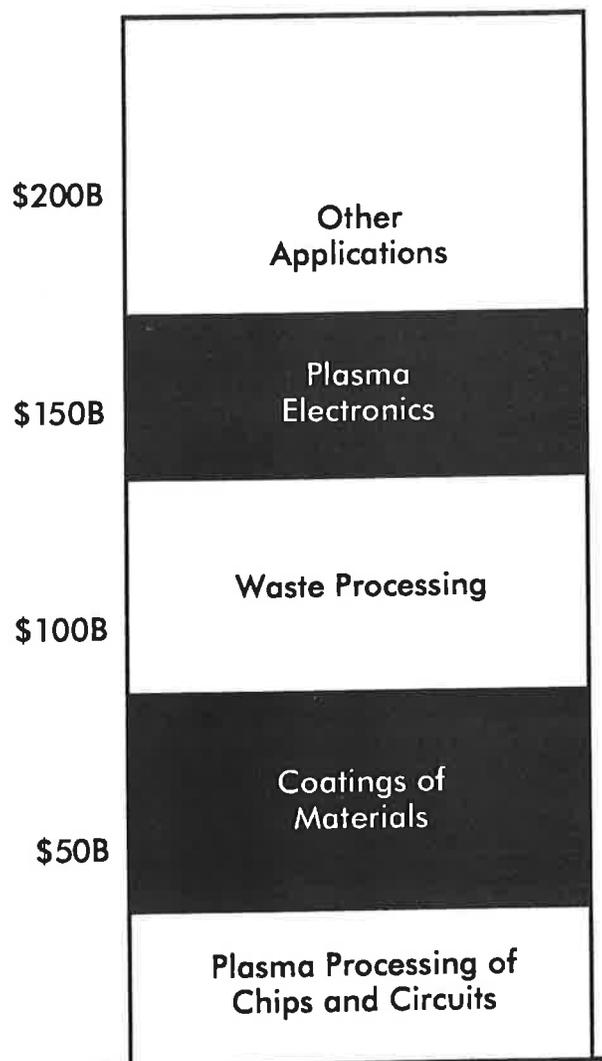
FRANK CHEN WINS MAXWELL PRIZE

COMMERCIAL MARKETS TODAY FOR PLASMA AND FUSION TECHNOLOGIES

Technologies resulting from decades of government support for fusion research have become the technologies of choice to replace older technologies in applications having a market value of over \$200 billion today, according to a new study recently completed by FPA president Steve Dean for Argonne National Laboratory. The compilation, entitled "Applications of Plasma and Fusion Research," describes applications in over 40 areas grouped into 9 categories: Production of Advanced Semiconductor Chips and Integrated Circuits; Coatings and Films; Improvements in Materials, Efficient Cleanup and Detoxification of Waste; Plasma Electronics; Medical Applications; Improved Technologies; New Technologies; and Contributions to Science.

According to Dean, "The technologies include plasma etching, plasma spray coating, ion implantation, microwave sintering of ceramics, vitrification, improved optical elements, light sources, a variety of sensors and instrumentation, and many others."

The report provides listings of fax and e-mail addresses of specialists in the various areas as resources for further information and also provides bibliographies of published reports for more in-depth reading. The report is available for the cost of shipping and handling from Fusion Power Associates in either DOS-PC (Wordperfect 5.1) diskette (\$10) or in hard copy (\$25). Contact FPA at Fax (301)975-9869; e-mail via internet:72570.707@compuserve.com



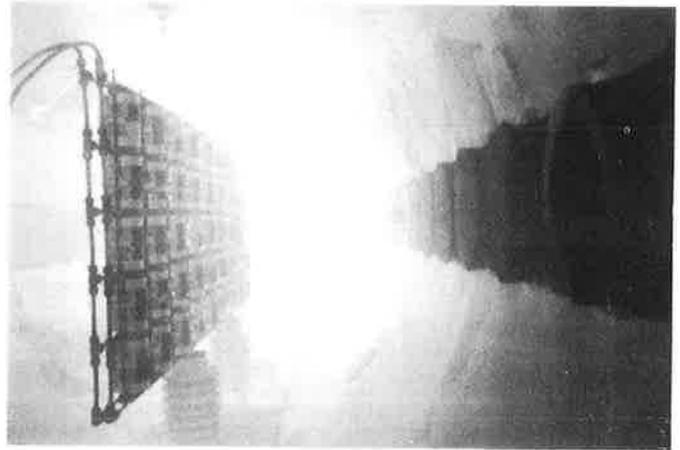
Plasma and fusion technologies are making rapid inroads into world markets valued at over \$200 billion annually

The following published references on these topics are also recommended: (1) Proceedings of Fusion Power Associates symposium "Near-Term Applications of Fusion and Plasma Technologies," published in Journal of Fusion Energy, Vol. 12, No. 3, 1993; (2) "The U.S. Fusion Program as a Source of Technology Transfer," U.S.DOE Office of Fusion Energy, September 1993; (3) Stephen O. Dean and Natalia Poltoratskaya, "Applications of Fusion and Plasma Device Technologies," published in Plasma Devices and Operations, Vol. 4, No. 1, 1995; (4) Francis F. Chen, "Industrial Applications of Low-Temperature Plasma Physics," published in Physics of Plasmas, Vol. 2, No. 6, 1995; (5) Plasma Science: From Fundamental Research to Technological Applications, National Research Council, National Academy Press, 1995; and (6) Plasma Processing and Processing Science, National Research Council, National Academy Press, 1995.

PLASMA ION IMPLANTATION

The Plasma Source Ion Implantation Source (PSSI) developed using a shutdown fusion experiment at Los Alamos National Laboratory (See our July 1993 newsletter) is going commercial. Scientists at Los Alamos and the University of Wisconsin have been engaged in a Cooperative Research and Development Agreement (CRADA) with an 11 company consortium that includes General Motors, Harley Davidson, and A.O. Smith, to develop the technique of implanting ions in the surfaces of materials to make them more wear-resistant. Before perfecting the plasma technique, ion implantation was considered too expensive, slow and complicated for widespread commercial use. Now, according the Fall 1995 issue of USCAR Dateline 2000 (Fax (313)248-4303), "Comprehensive cost analysis, including amortized capital equipment, personnel, and consumables, predict large-scale treatment costs of less than half a penny per square centimeter, typically 100 times less expensive than traditional techniques." The first commercial system is being built by North Star Research Corporation, Albuquerque, NM (505-888-4908; Fax -0072). The system will be placed in commercial service at Empire Hard Chrome, Inc., Chicago, IL (312-762-3156; Fax -4710).

The process works on a variety of materials, including metal, composites, and ceramics. The technique is faster and more environmentally friendly than traditional procedures and it can be applied to parts regardless of shape, due to its unique application technique. The process is expected to be widely used for large-scale automotive and other industrial



Ion Implantation of 100 General Motors' Saturn Pistons (LANL)

applications. For further information contact Don Rej (505)665-1883.

SUPERCONDUCTING ELECTRICITY TRANSMISSION: COMING SOON?

The U.S. Department of Energy has signed a two-year Cooperative Research and Development Agreement (CRADA) with Southwire Company, Carrolton, Georgia, to develop and commercialize superconducting electrical transmission cable by "the turn of the century," according to a DOE news release dated October 31, 1995. Southwire, one of the nation's largest wire companies, will work closely with Oak Ridge National Laboratory (ORNL) to demonstrate the commercial viability of the technology. Superconducting wire research has been sponsored at ORNL by the fusion energy program over several decades. When commercialized, superconducting transmission lines "will permit electric power companies to deliver electricity with greater efficiency, higher power density, and lower costs than now possible," according to the press release.

The technology will utilize a new class of so-called "high temperature" superconductors operating at liquid nitrogen temperatures (approximately 320 degrees below zero Fahrenheit, compared to "absolute zero" which is at 459 degrees below zero). Eventually, the new conductors would be candidates to replace approximately 2500 miles of underground utility cables in the United States and to compete in an expanding international market.

ENERGY FACTOIDS

In 1993, sales of energy-saving devices and equipment topped \$32 billion and are expected to more than double by 1998, according to a study ("Energy-Saving Devices and Equipment: Residential and Commercial," RE-070) published by Business Communications Company, Inc., Norwalk, CT (Contact Betsy DuWaldt, 202-853-0348). Within this area, sensors and software, partially developed in the fusion energy program, are competing in one of the most rapidly growing portions of the market: Monitors and Controls. New lighting technologies, based on plasma processes, are also entering the commercial market (See our December 1994 newsletter).

Two billion people, almost 40% of the world's population, still have no access to electricity according to *The Economist*, (October 7, 1995, p. 26).

According to an October 25 press release from the Energy Information Administration (EIA), annual greenhouse gas emissions in the United States increased by 27 million metric tons to 1,644 million metric tons between 1990 and 1993, an average annual increase of 0.6 percent.

ECONOMIC ADVISORS URGE R&D

The President's Council of Economic Advisors (CEA) has issued a 16-page report, "Supporting Research and Development to Promote Economic Growth," stating that "investments in R&D yield high returns to investors and even higher returns to society," and noting "by 1997, Japan will overtake the United States in government support of non-defense R&D—in total dollars, not just as a share of GDP." The report states that "private firms will not invest enough in R&D from a national perspective," and notes that private sector "underinvestment will be particularly severe for . . . research that yields results only far in the future or is extremely risky." It adds that "the government's role does not end with funding basic research Some types of pre-commercial research may be extremely risky or have an especially large gap between private and social returns." The report concludes, "Government has a vital role in sustaining this infrastructure—from supporting scientists and engineers, to promoting basic research, to assisting in the development of new, high risk technologies with significant spillovers" Copies of the report can be obtained from CEA by calling (202)395-5084.



Professor Francis F. Chen

CHEN WINS APS MAXWELL AWARD

UCLA Professor Francis F. Chen is the recipient of the American Physical Society Division of Plasma Physics 1995 James Clerk Maxwell Prize, given annually since 1975 to recognize outstanding contributions to the field of plasma physics. Chen's citation recognizes him "for his rare combination of physical insight, theoretical ability and skill for performing careful, clear and definitive experiments." The citation also says, "He has made fundamental contributions to plasma physics in such diverse areas as magnetic confinement devices, laser plasma interactions, novel plasma based accelerators and sources for plasma processing. Of particular note are his pioneering works on: electrostatic probes, low frequency fluctuations in magnetized plasma, parametric instabilities in laser plasma interactions, and helicon plasma sources. In addition, his classic text book "Introduction to Plasma Physics and Controlled Fusion" has helped educate a generation of plasma physicists." (To which we might add that he has been an individual affiliate and supporter of Fusion Power Associates since our inception. We congratulate Frank on this well-deserved honor and thank him for his constant encouragement and support of our efforts.)

TEXAS TOKAMAK SHUTTING DOWN

A victim of the Congressional budget cuts and "priority" decisions in the DOE Office of Fusion Energy, the TEXT tokamak at the University of Texas Fusion Research Center is being shut down December 22. According to Dr. Alan Wootton, director of the Center, over 30 people,

representing 75-80% of the staff will leave by December 31. TEXT has been one of the most cost-effective and productive small basic research tokamaks in the world over the past decade. Close proximity to a companion theoretical program at the University's Institute of Fusion Studies has further increased the productivity of the TEXT experimental group. An "Annotated Bibliography of Major Physics Results from TEXT and TEXT-U," (August 1995) is available from Dr. Wootton (Fax: 512-471-8865). The remaining members of the group intend to focus their efforts on the pursuit of innovative improvements in the tokamak concept, possibly leading to a new, small experiment having international collaborations.

LASER SCIENTISTS HONORED

The American Physical Society Division of Plasma Physics (APS-DPP) has honored a group of inertial confinement fusion scientists from Lawrence Livermore National Laboratory and the University of Rochester by presenting the 1995 Excellence in Plasma Physics Research Award to S. Gail Glendinning, Steven Haan, Joseph Kilkenny, James Knauer, David Munro, Bruce Remington, Charles Verdon, Russell Wallace, and Steven Weber. The citation recognizes the groups "outstanding theoretical work, computational design and analysis, and experimental work leading to quantitative and predictive understanding of the Rayleigh-Taylor instability in high energy density plasmas."

The APS-DPP also gave its Simon Ramo Award, recognizing "exceptional young people who have performed original doctoral thesis work of outstanding quality and achievement in the area of plasma physics," to Christopher D. Decker, who received his Ph.D. from UCLA. Decker is currently a post-doctoral research staff member at LLNL, developing x-ray sources and working on x-ray diagnostics for the inertial confinement fusion program.

IN MEMORIAM

Fusion pioneer William B. Thompson, 73, died by drowning while swimming near the Scripps Institution of Oceanography pier, San Diego, on October 17. Thompson worked on fusion since its earliest days when he was a Fellow in the Theoretical Physics Division of the United Kingdom Atomic Energy Authority research laboratory at Harwell. He joined the University of California at San Diego (UCSD) physics department in 1965 and served as its chairman between 1969 and 1972. Former UCSD

Chancellor Richard Atkinson credited Thompson with playing "a major role in building the teaching and research excellence of the department." FPA president Steve Dean said, "We join all of our fusion colleagues in mourning the death of one of the giants of our field."

PEOPLE

Rob Goldston has been named Associate Director for Research at the Princeton Plasma Physics Laboratory, succeeding **Paul Rutherford**, who announced his retirement in October.

Alex Glass has been named executive director of the Bay Area Regional Technical Alliance, Fremont, CA. He is also a consultant and CEO of an Albuquerque-based spectrometer manufacturing company. He can be reached at (510)354-3902; Fax: -3903; e-mail: ajglass@aol.com

Mujid Kazimi, head of the nuclear engineering department at MIT, has been named a Fellow of the American Nuclear Society.

John Landis has suffered a mild stroke and is recovering gradually. John is a member of FPA's Board of Directors and chairman of the Fusion Industry Council, United States. Well-wishers can send correspondence to Mediplex of Newton, 2101 Washington Street, Newton, MA 02162.

Jeff Paisner has been named project manager for the National Ignition Facility (NIF) at LLNL. Jeff has been acting project manager for the past two years.

Jim Rome, longtime fusion researcher and editor of the Stellarator News, is leaving the Fusion Energy Division of Oak Ridge National Laboratory (ORNL) in January to take a position in the Computer Science and Mathematics Division at ORNL. The Stellarator News is available on the Web at <http://www.ornl.gov/fed/stelnews/stelnews.html>

QUOTABLE

"To put some five million transistors on a Pentium™ chip. . . such resolution cannot be achieved without a plasma. All computers and other electronic devices of the future will depend on plasma processing."

Prof. Francis F. Chen, UCLA
Physics of Plasmas, June 1995