



## FUSION POWER ASSOCIATES

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# DOE ABOLISHES INERTIAL FUSION ADVISORY COMMITTEE NATIONAL IGNITION FACILITY FUNDS RELEASED

## ICFAC TERMINATED

A week before their scheduled meeting November 14-15 at General Atomics, members of the DOE's Inertial Confinement Fusion Advisory Committee (ICFAC) received a letter from Energy Secretary Hazel O'Leary advising them that this would be their last meeting. Members of ICFAC said the letter caught them by surprise. O'Leary told the committee in her November 8 letter, "We believe that with the broadening role of inertial confinement fusion within Defense Programs, the limited scope of the committee restricts its usefulness. Accordingly, the committee's last meeting will be this month, and its charter will not be renewed." Curiously, O'Leary said that "This advisory committee was a major factor in focusing the program on national objectives," and she praised the committee saying that the "significant progress" made in the program, and its "exemplary level of inter-laboratory cooperation" was "largely due to the efforts of the committee." Various sources recalled that DOE had only reluctantly established the committee in the first place, in 1992, after having been urged to do so by several review panels of the National Academy of Sciences and by its own Fusion Policy Advisory Committee (see our September 1990 newsletter). The ICFAC was the only advisory committee within the Defense Programs element of the DOE.

According to the minutes of the November 14-15 ICFAC meeting, Dr. Marshall Sluyter, Director of the DOE Defense Programs Office of Research and Inertial Fusion, told the committee that when it was formed in 1992 "there had been neither a Science Based Stockpile Stewardship (SBSS) Program nor a moratorium on the testing of nuclear weapons. Under the circumstances existing at the time, the ICFAC was an appropriate body to offer guidance to DOE

regarding the ICF program. After extensive review, DOE has reached the conclusion that, in view of the greatly expanded role of ICF within the SBSS program, this is no longer the case. The ICFAC's charter is too restrictive to allow it to continue to provide the valuable guidance which DOE has been grateful to receive from it in the past." (The ICFAC charter states that its purpose is to "provide advice and guidance to the Assistant Secretary for Defense Programs on both technical and managerial aspects of the inertial confinement fusion program.")

Sluyter also indicated that DOE was planning to request the National Academy of Sciences to set up a "standing committee" to take over "some of the functions of ICFAC."

## NIF SITE SELECTION SCHEDULED FOR SEPTEMBER

DOE plans to make a formal decision on where to locate the inertial fusion National Ignition Facility (NIF) in September, according to the minutes of the November 14-15 ICFAC meeting. Dr. David Crandall, head of the DOE's NIF Program Office, stated that DOE was considering four sites, including the "preferred site" at Lawrence Livermore National Laboratory, and "alternate sites" at Los Alamos National Laboratory, Sandia (Albuquerque) National Laboratories, and the Nevada Test Site. DOE will begin public hearings in February on a weapons program environmental impact statement (PEIS) which will include a section on the NIF environmental impact statement. The PEIS is expected to be completed in the Summer, prior to final NIF site selection. For further information contact Dr. Crandall by e-mail: david.crandall@mailgw.er.doe.gov

## **O'LEARY RELEASES NIF FUNDING**

In a press release dated December 21, Secretary of Energy Hazel O'Leary declared that "the National Ignition Facility (NIF) supports the nuclear nonproliferation objectives of the United States." The determination cleared the way for the release of FY 1996 funds for NIF that had been sequestered by DOE pending the Secretary's determination. The proclamation was the end point for a year-long process of public hearings (see our March 1995 newsletter). O'Leary stated that "The National Ignition Facility will contribute to the ability of the United States to maintain its nuclear stockpile without underground testing. We are committed to operating the facility in the most open manner possible while supporting our objective of reducing the global nuclear danger." The DOE report on which the Secretary's determination was based concluded that "The technical proliferation concerns at the NIF are manageable and therefore can be made acceptable," and said that "The NIF can contribute positively to U.S. arms control and nonproliferation policy goals." NIF nemesis Jackie Cabasso, executive director of the Western States Legal Foundation, issued a statement saying the report's "conclusions are not supported by its findings." She said the study "does not change the fact that NIF is a very serious threat to nonproliferation policy, both through the development of innovative technologies for nuclear weapons development and by example for a renewed commitment to nuclear weapons as an instrument of national policy." Rep Bill Baker (R-CA), who represents the Livermore district, stated that "NIF will play a vital role not only in keeping America's national defense second to none, but also in developing renewable energy sources in the future."

## **W. J. SCHAFFER ASSOCIATES PROVIDES SUPPORT TO ICF PROGRAM**

W. J. Schaffer Associates, Inc. (WJSA), a long-time member of Fusion Power Associates, has negotiated a new 5-year, \$16 million, subcontract with General Atomics to provide target fabrication services to the DOE inertial confinement fusion (ICF) laboratories. Dr. Keith Shillito is program manager for the effort. WJSA provides research and development support in cryogenic fuel layering experiments at LANL and LLNL, provides precision micro-machining, micro-assembly and target characterization services in support of physics experiments on NOVA, and develops and delivers Rayleigh-Taylor targets to the NIKE laser at the U.S. Naval Research Laboratory. WJSA also participates in

polymer foam and polymer shell development at LLNL, assists GA in providing ion-beam targets for experiments on the Particle Beam Fusion Accelerator at Sandia National Laboratories, and provides scientific and engineering support for the Cryogenic Target Insertion Apparatus being built at GA for the University of Rochester's Omega laser. The target fabrication effort is conducted on site at the ICF laboratories at GA and at WJSA's operation in Livermore, CA, where Dr. Michael Monsler is the General Manager and Dr. Charles Hendricks is the Chief Scientist. Monsler stated that "WJSA is proud to be the principal subcontractor on the General Atomics team, dedicated both toward delivering today's targets and to helping the ICF laboratories develop the extremely challenging targets that will be required for the National Ignition Facility in the next decade."

## **SAIC DROPS OUT**

Science Applications International Corporation (SAIC) vice president Tom Dillon has advised Fusion Power Associates that it will not renew its membership for 1996. SAIC was a charter member of FPA and had been a member since 1979. SAIC was instrumental in the establishment of FPA, under the guidance of then-SAIC vice president Alvin W. Trivelpiece. SAIC is currently responsible for the operation of the ITER Joint Work Site in San Diego and has other fusion research contracts with DOE. FPA regrets the loss of support from SAIC.

## **HIRSCH CRITIQUES RENEWABLES**

In a guest "Commentary" entitled "Renewable Energy in Perspective," in the December 19 *Energy Daily*, former U.S. fusion program director Robert L. Hirsch writes that even though renewable energy technologies such as photovoltaic, wind, and solar thermal "have improved significantly since they were a gleam in the eye in the 1970's . . . the reality is that the popular emerging renewables, as we know them today, will never provide more than perhaps 10 percent of total U.S. electric power needs." Using photovoltaics as an example, Hirsch says that "the true costs of reliable, stand-alone PV electric power can be 10 or more times the quoted price" due to the fact that the oft-quoted prices are based on ideal sunny sky conditions that don't exist in reality or 24 hours a day. Consequently, "those costs cannot be compared to the costs of central station electric generation plants fueled by natural gas, coal, or nuclear power." The declining costs being quoted for renewables also ignores the costs of

required energy storage, for which the technology itself is largely unavailable, according to Hirsch. "Nevertheless," says Hirsch, "these sources will have a variety of applications in niche markets in the United States and much larger markets in developing countries. The further development of renewable energy therefore deserves our continued support."

### **WALKER TO RETIRE**

House Science Committee chairman Robert Walker (R-PA) has announced his intention not to run for re-election next year. The announcement from the 20-year veteran came as a surprise. Since becoming chairman last year, Walker has been very influential in budget matters, including the termination of the Tokamak Physics Experiment (TPX), a new fusion project previously under construction at the Princeton Plasma Physics Laboratory. The dramatic decrease in the magnetic fusion budget (by over 30%) is attributed largely to Walker's viewpoint on fusion energy priorities.

The highest ranking republicans on the Science Committee, after Walker, are (in seniority order) James Sensenbrenner (WI), Sherwood Boehler (NY), Harris Fawell (IL), and Connie Morella (MD).

### **ACADEMY RECOMMENDS R&D**

The National Academy of Sciences/National Academy of Engineering Committee on Criteria for Federal Support of Research and Development issued a 97-page report November 29 giving 13 recommendations to improve the federal process of planning investments in science and technology, selecting priorities among programs, and reallocating funds for better use. Included in the recommendations are the following: The budget for science and technology should be "sufficient to allow the United States to achieve preeminence in a select number of fields and to perform at a world-class level in other major fields." The United States should "pursue international cooperation to share costs, to tap into the world's best science and technology, to meet national goals." Funding "should generally favor academic institutions because of their flexibility and inherent quality control, and because they directly link research to education and training in science and engineering." The federal government "should encourage, but not directly fund, private-sector commercial technology development, with two limited exceptions: development in pursuit of government missions, such as

weapons development and spaceflight; or development of new enabling, or broadly applicable, technologies for which government is the only funder available." Budget decisions "should give preference to funding projects and people rather than institutions." Research and development "should be well managed and accountable but should not be micromanaged or hobbled by rules and regulations that have little social benefit." The report is available on the World Wide Web at <http://www.nas.edu/anp/online/>

### **FEAC FORMS SUBCOMMITTEES**

The DOE Fusion Energy Advisory Committee (FEAC) has formed a standing "Scientific Issues Subcommittee," chaired by Jim Callen (U. of Wisconsin). The group held a first meeting on December 20-21 at the University of California in San Diego. Gerald Navratil (Columbia U.) is vice chair. Other members of the group include P.H. Diamond (UCSD), E. Marmor (MIT), F. Najmabadi (UCSD), G.H. Neilson (ORNL), W.M. Nevins (LLNL), C.K. Philips (PPPL), S.C. Prager (U.WI), M.N. Rosenbluth (UCSD), D.Smith (ANL), E. Solano (U.TX), T.S. Taylor (GA), K. Wilson (SNL), and M.C. Zarnstorff (PPPL).

The FEAC also formed an ad hoc subcommittee to review DOE's draft new strategic plan. That subcommittee, chaired by Michael Knotek of Battelle Pacific Northwest Laboratory held meetings at PPPL and GA during December and will report at the next meeting of the full FEAC on January 18-19 in Washington, DC. The meeting is open to the public.

### **JT-60U PROGRESS**

Scientists at the Japan Atomic Energy Research Institute (JAERI), working on the large JT-60U tokamak, have succeeded in sustaining the enhanced confinement mode (known as the "reversed shear mode") for a record 7.5 seconds. Previously (see our September 1995 newsletter) this mode had been seen only transiently. The result was achieved using lower hybrid current drive to sustain the necessary hollow current profile. Results from the JT-60U and other information on the Japanese program are available on the World Wide Web at <http://www-jt60.naka.jaeri.go.jp> or by contacting Dr. Hiroshi Kishimoto, Director, Dept. of Fusion Plasma Research, JAERI by e-mail: [hiroshik@naka.jaeri.go.jp](mailto:hiroshik@naka.jaeri.go.jp)

## LIQUID WALLS FOR MAGNETIC FUSION?

Scientists working on inertial confinement fusion have long envisaged a flowing liquid on the surface of the containment vessel wall as a means of protecting it from the burst of fusion heat and debris, but the high vacuum required for magnetic fusion concepts seemingly precluded use of liquids facing the plasma. Now, fusion researcher Ralph Moir, at the Lawrence Livermore National Laboratory, has come up with concepts he says would permit the use of liquid wall protection of magnetic fusion devices provided the evaporated material is "efficiently ionized in an edge plasma to prevent penetrating into the burning plasma and diminishing the burn rate." Moir says that with appropriate design "this ionized material would be swept along open field lines into a burial chamber. Moir says the technique is difficult to apply to the tokamak configuration but could be applied to other magnetic fusion geometries, such as the Field Reversed Concept (FRC) or Spheromak. "The use of liquid walls is profound and not trivial," says Moir. Among the advantages cited by Moir are: a potential 35% reduction in the cost of electricity and eliminating the need for a costly materials development program for so-called "low activation" materials, now claimed as "essential" in the latest DOE draft fusion strategy document (see our October 1995 newsletter). For further information contact Ralph Moir, e-mail: moir@llnl.gov

## PLASMA PHYSICS FELLOWS NAMED

The American Physical Society Division of Plasma Physics has announced that the following persons have been named as Fellows: Steven Allen (LLNL), Ian Brown (LBNL), Christopher Clayton (UCLA), Joel Fajans (UCB), Taik Hahm (PPPL), Brian MacGowan (LLNL), Janardhan Manickam (Princeton U.), Michael Mauel (Columbia U.), Bruce Remington (LLNL), Charles Roberson (ONR), Ned Sauthoff (PPPL), Ker-Chung Shaing (ORNL), and Edward Strait (GA). Congratulations one and all.

## EUROPE PLANS NEW STELLARATOR

At a meeting September 28, the Consultative Committee on the Fusion Programme (CCFP) unanimously recommended that the EURATOM Commission award Phase II approval to the Wendelstein 7-X project, including the basic device and "Stage I" heating. This is the final step necessary for the Commission to grant preferential support to the project, which is considered to be a "billion dollar class" facility. As a "preferentially supported project," the W-7-X would receive

45% of its required capital investment from EURATOM and the balance primarily from the German Federal Republic. If all goes according to plan, first plasma will be achieved in mid-2004. For further information contact Josef Junker by e-mail at josef.junker@ipp-garching.mpg.de

For an overview of the engineering design of Wendelstein 7-X, see the May 1995 issue of Stellarator News. For information on the physics of Stellarators reported at the recent 10th International Conference on Stellarators, see the November issue of Stellarator News. Copies of Stellarator News can be requested from Jim Rome by e-mail: jar@ornl.gov or pull it off the World Wide Web at <http://www.ornl.gov/fed/stelnews/stelnews.html>

## MEETINGS

**Jan 18-19** DOE Fusion Energy Advisory Committee public meeting on new fusion strategy. Washington DC. Contact Al Opdenaker (301)903-4927.

**March 12-16** Ninth Transport Task Force Workshop. Philadelphia, PA. Contact Dorothy Tate, Fax: (423)576-7926.

**March 13-14** University of California at Berkeley Industrial Liaison Program 18th Annual Conference. Berkeley, CA. Contact (510)642-661; e-mail: ilpinfo@coe.berkeley.edu

**March 18-20** International Sherwood Fusion Theory Conference. Philadelphia, PA. Contact Gale Stevens (PPPL) Fax: (609)243-2662.

**June 3-7** 24th Conference on Laser Interaction with Matter (ECLIM 96). Madrid, Spain. Contact e-mail: minguez@denim.upm.es or mperlado@denim.upm.es

**June 16-20** 12th ANS Topical Meeting on the Technology of Fusion. Reno, NV. Contact ANS Meetings Department, Fax: (708)352-6464.

**September 16-20** 19th Symposium on Fusion Technology (SOFT). Lisbon, Portugal. Contact Dr. Maria Fernanda, e-mail: mfernanda@cfn.ist.utl.pt



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# COMMITTEE CONCEDES U.S. FUSION LEADERSHIP; URGES SCIENCE AND TECHNOLOGY FOCUS; DOWNSIZING DOE MANAGEMENT OFFICE

## FEAC SPEAKS

The U.S. Department of Energy's Fusion Energy Advisory Committee (FEAC), by a vote of 10-2, has endorsed the findings and recommendations of its Strategic Planning Subcommittee, stating that, at the funding levels they were requested to analyze by DOE (\$200-\$275 million/year), "In this funding range, the United States must concede leadership of the world's fusion energy development effort to Europe and Japan." The report, entitled "A Restructured Fusion Energy Sciences Program," is in response to instructions to DOE from the Congressional Appropriations FY96 Conference Committee to prepare a new strategic plan for a "restructured" fusion program at lower budget levels. Congress cut the DOE Office of Fusion Energy FY96 budget by 33 percent (See our November 1995 newsletter). The Conference Committee said that "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 low-activation materials."

The FEAC report generally responds to the Congressional guidance. However, the FEAC states that "Funding in FY97 is critical, and it is possible only with the \$275M (case) to move forward briskly on restructuring while accomplishing the full programmatic scope directed in the FY96 Appropriations Report from Congress." FEAC states that "Below \$250M, it would be necessary to negotiate yet again with our international partners an affordable share in the ITER-EDA (Engineering Design Activity)." The FEAC states that, in such a circumstance, "The restructuring transition would be prolonged and complicated, and result

in a program that is marginalized in the international context."

## GAVIN DISSENTS

Two members of the FEAC, veterans of the U.S. Space Program, declined to endorse the findings and recommendations of the Subcommittee report: Joe Gavin (retired president/CEO of Grumman Corporation and leader of the NASA Lunar Landing Module Project) and J.R. Thompson (former deputy administrator of NASA and currently executive vice president and general manager, Launch Systems Group, Orbital Sciences Corporation). Gavin stated his view that DOE's decision to put an upper limit of \$275M on the cases to be considered by FEAC "represents fundamentally flawed policy." Gavin noted that the President's Council of Advisors on Science and Technology (PCAST) had only recently recommended that the U.S. fund fusion energy development at a level of \$320M (See our July and August 1995 newsletters). Gavin recommended that the FEAC make "a forthright challenge to the Secretary (of Energy) and to the Administration to undertake a determined effort to convince Congress of the merit of providing annual funding for fusion at the PCAST \$320M." Gavin noted that his recommendations "represent 1/14 of one B-2 stealth bomber, less than 2 fighter aircraft, or 1/10 on one cent on the gasoline tax!" He stated that "The fusion program in the United States has produced too many successes and has too much promise to give up without a fight, without serious review of national priorities. It will require leadership, not poll-following." Thompson did not give his reasons for dissenting in the public meeting.

## **NEW MISSION AND POLICY GOALS**

The FEAC recommended to DOE that they adopt "new mission and supporting policy goals." The proposed Mission statement is as follows: "Advance plasma science, fusion science, and fusion technology—the knowledge base needed for an economically and environmentally attractive fusion energy source."

The proposed Policy Goals are (1) Advance plasma science in pursuit of national science and technology goals; (2) Develop fusion science, technology, and plasma confinement innovations as the central theme of the domestic program; and (3) Pursue fusion energy science and technology as a partner in the international effort. It was emphasized by FEAC that the above listing does not imply a priority ordering of the goals.

## **RENAMING RECOMMENDATION**

The FEAC subcommittee report states that "As a first step (toward restructuring), we recommend the adoption of the mission and goals and renaming the program the Fusion Energy Sciences Program, to reflect accurately the new focus." The report subsequently also refers to the FEAC by the name Fusion Energy Sciences Advisory Committee. The report states that "By incorporating the new mission and goals, the restructured program can fit within a constant annual budget and does not require increased outlays for construction of new facilities."

## **GOVERNANCE**

The FEAC subcommittee report states that "Critical to the success of the restructured program is immediately starting a governance transition, as a mechanism for guiding and implementing the major programmatic changes in a smooth and effective manner." First among their "governance" recommendations is that the FEAC itself, "assisted by (its) Science Subcommittee" (See our January newsletter), should advise the DOE "on policy, goals, priorities, budget, direction, program balance, and governance." To further weaken the authority of the DOE management, the FEAC recommends that "Fusion Energy Sciences Program Management must be reorganized and downsized to match the science-dominated mission, and rely significantly on a peer review process as the primary input for funding allocations." The report recommends a series of additional "specific programmatic reviews" during the remainder of FY96 "to help set the technical priorities of the restructured

program." These include a Major Facilities Review, in association with the establishment of a User Access Working Group; an Alternate Concepts Review; and "planning for review of the ITER-EDA and its results and to establish criteria for a decision on future U.S. participation."

## **FEAC PERSPECTIVE ON PCAST**

The FEAC subcommittee report, endorsed by a 10-2 vote by the full FEAC, states that although "The past U.S. involvement in fusion research and development was recognized by the President's Council of Advisors on Science and Technology Policy as 'a valuable investment in the energy future of this country and the world, as well as sustaining a field of scientific research -- plasma physics -- that is important in its own right and has been highly productive of insights and techniques applicable in other fields of science and industry' . . . the current federal budget realities and the lack of a perceived domestic energy shortage demand program restructuring in accordance with these recommendations so that the U.S. program will focus on the science and technology foundations for a future or internationally led push toward fusion energy."

## **INERTIAL FUSION ENERGY**

The FEAC subcommittee report deals with fusion almost exclusively from the perspective of the magnetic fusion community. Indeed, the chairman of the subcommittee, Mike Knotek of Battelle Pacific Northwest Laboratory, told the FEAC that achieving "community consensus" on his report was "a big thing" and he considered it to be a "boundary condition" on the subcommittee's effort. The subcommittee's report acknowledges that inertial fusion for energy applications (IFE) is a "scientific and programmatic issue" for the DOE Office of Fusion Energy (See our November 1995 newsletter). It further acknowledges that "At an annual budget of \$8M, IFE cannot proceed to its logical next step." The report states that "The Subcommittees did not assess the IFE effort in detail, but acknowledge its potential as a fusion energy source and the major role of DOE Defense Program in addressing key scientific and plasma physics issues." The report recommends that "A programmatic (as opposed to a technical) review should be conducted involving all cognizant DOE program offices and appropriate scientific and technical experts to recommend the priority and management of IFE, in the context of the mission, policy, and scientific goals of the restructured program."

## **OUTREACH**

The FEAC subcommittee report recommends that "The U.S. ITER Home Team should move aggressively to strengthen its outreach to the entire domestic fusion community." The report also recommends that "An outreach effort should be initiated, with the goal of broadly communicating the goals and progress of this important effort to the public, to the broader scientific community, and to the affected stakeholder groups such as the energy and environmental interests."

## **BUDGETS, TFTR, ITER, AND PPPL**

The FEAC did not consider program content in detail in the various budget cases they examined; rather they considered the major elements of the program that would have to be re-examined in various situations. Operations of the Tokamak Fusion Test Reactor (TFTR) at the Princeton Plasma Physics Laboratory (PPPL) appears to be the major "flywheel" in the minds of FEAC. At the highest budget considered (\$275M), the FEAC states that TFTR would operate for two more years which "would allow the highest-priority scientific opportunities on TFTR to be exploited before terminating its operation during FY98." This budget level, the FEAC also believes "would enable us to strengthen our support of the ITER-EDA and restore some of our original commitment." At the \$250M level, FEAC states that "TFTR operations must cease during FY97," and that the "ITER EDA commitment is constant in as-spent dollars at the renegotiated lower level, with scope determined in consultation with our international partners." At either budget level, FEAC imagines that there would be "increases in plasma science and alternates" and "full maximally productive utilization" of DIII-D and C-Mod and the leading smaller facilities."

The FEAC shows concern over the future of the PPPL, saying that it "must maintain a critical mass of core competencies for national leadership and international collaboration for fusion science." They state that PPPL is "a critical national resource for the fusion program," saying that "Its technical infrastructure represents decades of investment and must be effectively utilized." In the "outyears," especially in the event of TFTR shutdown, the report states that there should be a "growing portfolio of new experiments including one or two smaller but scientifically aggressive new facilities, at least one taking advantage of the PPPL infrastructure."

## **ITER-EDA**

An important issue for the FEAC was to provide a perspective on the U.S. role in the ITER-EDA (Engineering Design Activity phase of the International Thermonuclear Experimental Reactor project). Although the internationally agreed upon mission of ITER is to be a fully integrated physics, engineering and technology fusion test reactor, the perspective of FEAC is that "The primary role of the ITER program in the restructured U.S. fusion program is to pursue the science of burning plasmas." The view of the FEAC is that "A burning plasma physics experiment and pursuit of fusion energy as a goal is of such cost and complexity that it can only be achieved through international collaboration," and that "With a constrained budget, the U.S. fusion program cannot pursue a burning plasma physics experiment on its own." The report states that "The restructured U.S. fusion program must make every effort, recognizing budget constraints, to meet our commitment to the completion of the ITER-EDA (in order to) avoid scientific and technological isolation, maintain the opportunity for U.S. participation in ITER construction, (and) remain a credible partner to encourage other international collaborations."

## **PLASMA SCIENCE**

The report states that "The underlying core science of fusion energy is plasma science: the study of the ionized states of matter." It says that "Further progress in the development of fusion energy will require continuing developments in the field of plasma science." The subcommittee recommends that the fusion program "should explicitly assume the responsibility to advocate and act as steward for basic plasma science . . . (and) take the lead by establishing a program to support basic plasma science, while continuing to work with other federal agencies to provide additional support for more basic plasma science research." The report advocates a basic plasma science budget "building up to a support level of about 5% of present fusion funding." The report advocates significantly expanding the number of research universities currently receiving funding for plasma research.

## **ALTERNATIVE CONCEPTS**

The subcommittee report states that "A prime reason for broadening the scope of the (fusion) program to include studies in alternative concepts is that the study of more than one plasma containment system configuration advances

plasma science and fusion technology in ways not possible in one system only." It says that "Indeed, with decades to go to fusion power, it would be premature to narrow to one concept." The report states that "The precise funding level for alternatives cannot be prescribed here. It must be driven by peer-reviewed proposals (from national labs, universities, and industry), as for any scientific research program. One cost effective measure, in the near term, is to fully utilize existing alternative concepts facilities."

## **TECHNOLOGY AND INDUSTRY**

The report recognizes that "At present, ITER is the primary vehicle for plasma technology development in the U.S." and that "U.S. industry has been given a major role in designing and building prototype components of the ITER during the EDA, while having access to all design and development activities of the other parties." The report states that "This role helps to assure that American industry will be able to compete for construction elements, if ITER is built and the United States participates."

## **FUSION MATERIALS AND TECHNOLOGY**

The report acknowledges that "The performance requirements for materials (in fusion power plants) are unprecedented," noting that the materials "must withstand 14 MeV neutron irradiation damage, high operating temperatures, thermal and mechanical loads, and chemical compatibility requirements." The report states that "a 14 MeV neutron source will ultimately be needed to fully qualify materials for fusion reactor applications," and that "Conceptual development of a materials test facility (with a preliminary cost estimate approaching \$1B) is being pursued as part of an international collaboration." The report states that "it is difficult to see how the U.S. share of this facility could be accommodated within the present budget." It recommends that "With a constrained budget, the U.S., jointly with its international partners, must evaluate the priorities of a 14 MeV neutron source proposed for materials evaluation."

The report also states that "Continued advances in enabling technologies is essential for the restructured program which will focus on concept improvement and innovation." and notes that "ITER is now a primary vehicle for enabling technology development in the U.S. program."

## **TRANSMITTAL LETTER**

After thorough discussion of its Subcommittee report, the full FEAC, by majority vote, endorsed its findings and recommendations and transmitted the report to Dr. Martha Krebs, Director, DOE Office of Energy Research. In a transmittal letter, FEAC chairman Dr. Robert Conn, Dean of Engineering at UCSD, highlighted the opinions of FEAC. That letter was not available at press time. The full report and transmittal letter will be available on the DOE Office of Fusion Energy Home Page, <http://wwwofe.er.doe.gov>

## **AWARD NOMINEES SOUGHT BY ANS**

The Fusion Energy Division of the American Nuclear Society is seeking nominations for two awards to be given at the Twelfth Topical Meeting on the Technology of Fusion Energy, June 16-20, 1996, in Reno, Nevada. The first is for "Outstanding Technical Accomplishment." The second is for "Outstanding Achievement." The latter requires demonstrated "leadership of a high caliber," in addition to professional excellence. In addition, a Student Award will be presented. Information on submitting nominations for the awards can be obtained from Prof. Don Steiner (RPI), Chairman, ANS/FED Honors and Awards Committee, (518)276-4016. All nominations must be received by March 22.

### **FPA ANNUAL MEETING SET**

Fusion Power Associates' annual meeting and symposium will be held May 30-31 at the Hilton Hotel, Pleasanton, CA. The theme of the meeting is "The Approach to Fusion Ignition and Beyond." The meeting will highlight plans for the National Ignition Facility and the International Thermonuclear Experimental Reactor, reports of recent progress in both magnetic and inertial confinement fusion, and a discussion of development pathways to commercial fusion power. A tour of the laser facilities at the Lawrence Livermore National Laboratory is also planned. Details of the meeting will be available shortly. Contact Fusion Power Associates.





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### 50 MEMBERS OF CONGRESS URGE INCREASED FUSION SUPPORT

#### BACKLASH

Apparently concluding that the cuts visited on the DOE Office of Fusion Energy last year were more than enough (See our November 1995 newsletter), fifty members of Congress sent a bipartisan letter on February 15 to Secretary of Energy Hazel O'Leary and the President's Science Advisor Jack Gibbons expressing "our support for a strong U.S. program in fusion energy science and technology," and stating "Specifically, we encourage the Administration to submit to Congress a recommendation of at least \$275 million for the Department of Energy's fusion energy program in the Fiscal Year 1997 budget." They noted that a recent study by the DOE's Fusion Energy Advisory Committee (See our February 1996 newsletter) indicated that by "providing a modest increase over the FY 1996 level (of \$244 million), we can maintain our research strengths and thereby ensure our nation's active participation in international fusion energy development." The letter states "Although we are all painfully aware of the severe budgetary constraints facing our nation, we must work to ensure that the U.S. fusion program is not reduced too deeply at a time when the fusion programs of other nations are growing and progress in fusion science and technology is accelerating. The U.S. must maintain a vital and competitive presence in this most fundamental area of science and this most promising energy technology."

Rep. Roscoe Bartlett (R-MD) and Rep. Tim Roemer (D-IN), initiators of the letter, were joined by Fusion Power Associates' local district representative Connie Morella (R-MD) and 47 other members of the House of Representatives. The signatories included 24 Republicans and 26 Democrats, as follows. Republicans: Bill Baker (CA), Roscoe Bartlett (MD), Brian Bilbray (CA), Sherwood

Boehlert (WI), Randy Cunningham (CA), Thomas Davis (VA), Vernon Ehlers (MI), Rodney Frelinghuysen (NJ), Lindsey Graham (SC), Steve Gunderson (WI), Duncan Hunter (CA), Scott Klug (WI), Jerry Lewis (CA), William Martini (NJ), Carlos Moorhead (CA), Connie Morella (MD), Charlie Norwood (GA), Ron Packard (CA), Marge Roukema (NJ), Jim Saxton (NJ), Christopher Smith (NJ), Peter Torkildson (MA), Zach Wamp (TN), and Dick Zimmer (NJ); Democrats: Robert Andrews (NJ), Jim Chapman (TX), Gary Condit (CA), Julian Dixon (CA), Calvin Dooley (CA), Michael Doyle (PA), Vic Fazio (CA), Bob Filner (CA), Bart Gordon (TN), Jane Harman (CA), James Hayes (LA), Steny Hoyer (MD), Joseph Kennedy (MA), Zoe Lofgren (CA), Robert Matsui (CA), Matthew Martinez (CA), Frank Mascara (PA), Jim McDermott (WA), Robert Menendez (NJ), John Moakley (MA), Richard Neal (MA), Frank Pallone (NJ), Donald Payne (NJ), Tim Roemer (IN), John Spratt (SC), and Robert Torricelli (NJ). Copies of the letter were also sent to Alice Rivlin, Director, OMB, and to Leon Panetta, White House Chief of Staff.

We strongly urge all members of the fusion community to write the above members of Congress expressing your appreciation for their support. They can be addressed at U.S. House of Representatives, Washington, DC 20515. If your representative is not one of the signatories, we recommend that you send them a copy of the letter and ask they write Secretary O'Leary, Dr. Gibbons, Ms. Rivlin and Mr. Panetta expressing their support for the letter and the fusion program. Copies of the letter are available from Fusion Power Associates.

## **FEAC LETTER**

The report of the Fusion Energy Advisory Committee's Strategic Planning Subcommittee (See our February newsletter) was formally transmitted by FEAC chairman Robert Conn to DOE Director of Energy Research Martha Krebs on January 27. In the transmittal letter Conn said "The historically strong United States leadership role in the world magnetic fusion energy program came to an end with the decision on FY 1996 funding. However we conclude that the United States can still play an important supporting role in magnetic fusion energy development, but only by recognizing the new dependence of U.S. efforts on the activities and decisions of Europe, Japan, and the Russian Federation. As such, progress will depend on maintaining a balance of domestic and international activities." Details of the recommended program were summarized in our February newsletter. Copies of the FEAC letter are available from Fusion Power Associates.

## **MAJOR FUSION CONFERENCE SCHEDULED**

The 16th IAEA Fusion Energy Conference is scheduled for October 7-11 in Montreal, Canada. Persons wishing to submit papers or attend the conference must be nominated by their respective governments. U.S. participation will be coordinated by Dr. Ronald McKnight. Persons wishing to submit papers must send twenty copies of a synopsis by March 26 to Dr. McKnight at USDOE, 19901 Germantown Road, Germantown, MD 20874. For information on the format for paper submission or application forms for attendance, contact Dr. McKnight at fax (301)903-4716. Because a highly-competitive international paper selection process will be followed, combined experimental/theory papers and multi-laboratory papers on a single topic are encouraged; otherwise the paper selection committees will require combining of papers. The topics of the conference will cover all aspects of magnetic and inertial fusion, including physics, technology, and environmental.

## **KREBS ON FUSION, DOE AND SCIENCE**

Writing in the January issue of "APS News," a publication of the American Physical Society, DOE Director of Energy Research Martha Krebs stated "Another problematic action by Congress is the dramatic reduction of the fusion energy program. Reduced by one-third from \$363 million to \$244 million, the program must be fundamentally restructured away from a time-driven effort. What the character and scope of the new program should be is a tremendous

challenge to the fusion and plasma scientists. Personally I think the Congressional action was unwise, foolish and tragic in the face of what we know will be the energy requirements of the U.S. and the world by the middle of the next century. It is also a tragedy for many individuals who have had a profound commitment to making fusion energy happen. A cut of this size, a shift of direction this sudden, will leave human and scientific wreckage; there is no avoiding it. In spite of this, Congress has made a clear statement and its FY 1996 funding level is based on the expectation that the restructured fusion science program will cost significantly less in the future. This is not the time for denial, delay or recrimination. It is a time for imagination."

Krebs said that "The DOE spent much of 1995 fighting for its existence and caught up in the freshman Republican members zeal for reducing the number of cabinet agencies. In large measure, the energies of Energy Secretary O'Leary and her immediate staff were absorbed in that contest, and it looks like we have survived to fight another year." With respect to DOE programs in the Office of Energy Research, she said "In our case, its been a mixed year. Our FY 1996 request went to Congress at 2.7 billion and came back at \$2.5 billion." However, "There is no way that the science budgets will not be more deeply scrutinized than they already have been by both the Congress and the Administration," she said. "This is a time for defending all of science, not particular fields and institutions. This is a time for articulating the benefits our nation has received from its investments in science and scientists. It is a time for speaking to all of our public representatives, federal and local, and especially when they are not based in Washington, DC. This is a long-term job that will not take place in D.C., nor will it be finished once we know the final determination for the budget for FY 1997."

## **FUSION IN JAPAN**

In Japan, Mr. Hashimoto of the Liberal Democratic Party replaced Mr. Murayama of the Socialist Party as Prime Minister. Several members of the new government have been active in fusion policy matters. The Foreign Minister, Mr. Ikeda, was a member of the Fusion Energy Study Group, one of two fusion policy groups in the Japanese Diet. Mr. Kajiyama, the new Chief Cabinet Secretary, was a member of the another group, "Diet Members Association for Fusion Promotion." Mr. Tsukahara, the new MITI minister, and Mr. Nakagawa, the new STA minister, were also fusion Diet group members.

## **MARILYN LLOYD HONORED**

Fusion Power Associates Board of Directors has voted to present its Special Award for "Outstanding Public Service" to Marilyn Lloyd, former Congresswoman from Tennessee. Ms. Lloyd served for many years as chairperson of the Energy Subcommittee of the House Committee on Science, Space and Technology. In announcing the award, Fusion Power Associates president Steve Dean said, "In selecting you the FPA Board recognizes the outstanding leadership you provided to the evolution of national science policy over many years in the U.S. Congress. That leadership provided the necessary framework within which it has been possible to maintain progress in fusion research during difficult times. Your distinguished political career has been one of consistent and imaginative contributions to the national recognition of the importance of both fundamental and applied research and development, and provided the policy underpinnings within which fusion has continued to make progress toward its ultimate goal of an environmentally and economically attractive energy source."

Rep. Lloyd has also recently been named to the Board of Directors of Lockheed Martin Energy Research Corporation, a new Lockheed Martin subsidiary formed to operate Oak Ridge National Laboratory. Ms. Lloyd served in Congress for 20 years and retired in 1994.

## **EVERSON ELECTRIC COMMENDED**

One of Fusion Power Associates Small Business Affiliates, Everson Electric Company, has been commended by Brookhaven National Laboratory for their work in completing 378 superconducting magnets for the 2.5 mile circumference, \$500 million, Relativistic Heavy Ion Collider (RHIC).

Everson was responsible for the manufacture of approximately 22 percent of the superconducting magnet elements used in the ring. The magnets produced by Everson weigh approximately 500 pounds each and are roughly three feet long. According to RHIC Project Head, Dr. Satoshi Ozaki, "The success of these magnets lies in their design as well as their production. Credit is due to Everson, where production and technology go hand in hand." Our congratulations to Dave Everson, magnet program manager Larry Knecht, and all the Everson staff.



*Marilyn Lloyd*

## **ITER UPDATE**

The international ITER Council (IC), chaired by Academician E.P. Velikhov, held its ninth meeting on 12-13 December, 1995, in Garching, Germany. Its principal agenda item was consideration of the ITER Interim Design Report (See our September 1995 newsletter). Delegations from Europe, Japan, and the U.S. were headed, respectively, by P. Fascella, Director-General for Science, Research, and Development of the European Commission; N. Oki, Deputy Director-General of the Atomic Energy Bureau of the Science and Technology Agency; and J. Decker, Deputy Director of the Office of Energy Research of the U.S. Department of Energy. The Council: (1) approved the ITER Interim Design Report, Cost Review and Safety Analysis produced by the (ITER) Director with the integrated support of the Joint Central Team and the Parties' Home Teams, as the basis on which to continue the technical work of the EDA until their completion in 1998; (2) concluded that the Report of ITER Site Requirements and ITER Design Assumptions is a reasonable basis for continuing with the EDA and for undertaking activities in preparation for possible future decisions on the construction of ITER; and (3) concluded that the Tentative Sequence of Events for such a decision-making process appears to be an appropriate basis for moving toward joint implementation." Furthermore, the Council appointed a "Special Working Group" with the task of "developing proposals on

approaches to Joint implementation." The tasks assigned to this group includes (1) "Elaboration of a set of possible global framework scenarios toward siting, licensing and host support specifying the following: a) benefits and costs; b) siting and hosting including licensing and decommissioning; c) organizational structure and legal arrangements; d) participation and accession; (2) analysis of these scenarios, considering Parties constraints and projects needs, to prepare possible approaches to joint implementation; and (3) from the analysis, identification of those specific issues that should be resolved by the Explorers as a priority to ensure their timely success as they seek convergence to an acceptable approach for possible decisions on the future activities." The IC appointed E. Cannobio and K. Tomabechi as co-chairs of the Special Working Group and asked them to complete task (1) by the time of the next IC meeting, scheduled for 24-26 July, 1996.

## **OTHER ITER NOTES**

An informal meeting was held January 24-26 in San Diego to discuss ways to solicit the views of industries in the four ITER Parties. The meeting was organized and chaired by Bill Ellis, VP and Chief Scientist, Raytheon Engineers and Constructors, and Chairman of Fusion Power Associates Board of Directors. Representatives of the ITER Parties and industrial representatives were present from Europe, Japan, Russia and the U.S. The purposes of the discussions were to "(1) exchange opinions and reach mutual understandings among the industries of the four ITER Parties, (2) learn about roles and responsibilities of industry as presently practiced in the four Parties, (3) discuss ITER construction and EDA issues, 4) explore informally industry's potential roles in ITER, and (5) build relationships for future interactions among the Parties' industries." Following the discussions the industries decided to meet on a regular basis on a rotating site and chairmanship basis. The Japanese have offered to host the next meeting.

The Commission of the European Communities Scientific and Technical Committee (STC) and its subgroup, the Consultative Committee for the Fusion Programme (CCFP) have accepted the ITER Interim Design Report and, in addition, have stated "Discussions in view of identifying a possible European candidate (ITER) site should be started without unnecessary delay notably in view of the fact that Japan and Canada might soon be in a position to make official offers to host ITER," (CCFP) and "the EDA (should) continue as planned into the detailed design phase. At the

same time activities leading to a site selection are of paramount importance and appropriate effort must be devoted to this task within Europe." (STC)

The ITER Scientific Council, United States (ISCUS) has formed a subgroup on US Participation in ITER Construction, Operation and Testing. Tom Simonen of General Atomics was appointed chairman. ISCUS is chaired by Bill Stacey of Georgia Institute of Technology.

## **NEW AFFILIATES**

Fusion Power Associates is pleased to welcome the participation of two new Small Business Affiliates: Calabazas Creek Research (Saratoga, CA) and Quantum Manufacturing Technologies, Inc. (Albuquerque, NM).

Calabazas Creek Research recently won a DOE Small Business Research Innovations grant for the development of a multi-stage depressed collector for Megawatt-class cw gyrotrons. The technique offers promise for increasing the overall device efficiency by 50%. Dr. R. Ives, owner, will represent the company. He can be reached at 20937 Comer Dr., Saratoga, CA 95070-3753; tel (408)741-8680; fax -8832; email: rIves@hooked.net

Quantum Manufacturing Technologies, Inc. was started by scientists from the Sandia National Laboratories pulsed power fusion program. They are applying pulsed power technology to materials surface treatment. The patented process has been shown to increase the lifetime of tools by a factor of three and reduce corrosion by a factor of one hundred. Dr. Regan W. Stinnett, president, will represent the company. He can be reached at 2201 San Pedro Dr., NE, Bldg. #3, Suite 210, Albuquerque, NM 87110; tel (505)881-4121; fax 880-0727; email: rwstinn@rt66.com

## **QUOTABLE**

"I am for fusion energy and for fusion research, but I think the country needs to make up its mind whether it wants to try to commercialize fusion or to run a basic research program. // Am I enthusiastic about fusion? I am enthusiastic but skeptical, and I think we ought to get our best scientists and engineers to try to make a careful judgment on the chances of producing commercially affordable fusion energy."

Sen. J. Bennett Johnston  
Interview with Irwin Goodwin  
Physics Today, January 1996



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### CLINTON REQUESTS FUSION FUNDING INCREASE NATIONAL IGNITION FACILITY MOVES AHEAD

#### FUSION BUDGETS

President Clinton's FY97 budget, submitted to Congress March 19, requests an increase of \$125.8 million for inertial confinement fusion (ICF) and an increase of \$28.2 million for magnetic fusion. The inertial confinement fusion increase is for the second year of construction of the National Ignition Facility (NIF), a megajoule-class laser that will be used to ignite a small capsule containing fusion fuel shortly after the turn of the century.

The total FY97 funding requested is \$366.5 million for ICF, of which \$191.1 million is for NIF; and \$255.6 million for the newly-renamed Office of Fusion Energy Sciences, which devotes 97% of its resources to magnetic fusion concepts.

In the ICF program, which DOE supports within its Defense Programs office as part of the "Science-Based Stockpile Stewardship" program, in addition to the NIF, DOE will support a base program (\$175.4 M) at the Lawrence Livermore National Laboratory (\$86.4 M), Sandia National Laboratories (\$26.4 M), Los Alamos National Laboratory (\$21.3 M), University of Rochester (\$20.3 M), General Atomics (\$10.9 M), and U.S. Naval Research Laboratory (\$8.1 M), with \$2.0 M in other expenses.

Within the Office of Fusion Energy Sciences, the tokamak concept continues to receive the bulk of the funding, receiving \$205.6 M of the \$255.6 M, or 80% of the total. The budget indicates that new initiatives will be started in alternate concepts (\$18 M, up from \$7.5 M in FY96) and in fundamental plasma science (\$4 M up from \$0.2 M in FY96). The budget targets the fusion systems studies program for a 20% cut. The biggest dollar and percentage increase goes to General Atomics for the DIII-D tokamak program (up \$7.7 M to \$46.0 M). Funding requested for

TFTR (\$54 M) at Princeton Plasma Physics Laboratory (PPPL) would permit the facility to run throughout the fiscal year. A new \$20 M facility, the National Spherical Tokamak Experiment (NSTX), would also be built at PPPL, assuming positive outcome from a planned review. The Alcator C-Mod tokamak program at MIT would receive a \$3.1 M increase to \$13 M (It had been cut from \$16.1 M to \$9.9 M from FY95 to FY96.). Most other categories remain essentially at their FY96 levels.

#### NIF MOVES FORWARD

The prospects for igniting a capsule of fusion fuel shortly after the turn of the century received a boost by the DOE's decision to request, and the President's decision to endorse, continued construction of the National Ignition Facility. The project received \$61 M in FY96 towards its total estimated cost of approximately \$1 billion. Lawrence Livermore National Laboratory director Bruce Tarter, testifying before the House Committee on National Security March 12 stated, "The National Ignition Facility (NIF) was identified by the Assistant Secretary of Energy for Defense Programs Victor Reis as being 'the most important new facility' in the Defense Programs budget request last year. It is the only facility that will permit well-diagnosed experiments pertinent to fusion and high-energy density physics processes that occur after the high explosive is detonated. The NIF is also the critical next step in the development of Inertial Confinement Fusion (ICF) as an environmentally attractive energy source, and it will serve as a user facility for a wide range of fundamental scientific research. Initial operational capability is planned for late 2002. To keep this effort on schedule and on budget, DOE Defense Programs has requested \$191 million for the NIF project in FY 1997." NIF will be a featured topic at FPA's annual meeting and symposium, May 30-31, in Pleasanton, CA.

## **FUSION ENERGY SCIENCES HEARING**

The House Science Committee Subcommittee on Energy and Environment, chaired by Rep Dana Rohrabacher (CA), held a hearing on programs of the DOE Office of Fusion Energy Sciences March 7. Rohrabacher noted approvingly that the Congress had cut the fusion program budget significantly last year [See our November 1995 newsletter.] because, in his view, the program had "ignored budget realities and set no priorities in future spending projections." At various times during the hearing Rohrabacher commented, "Sometimes making cuts actually spurs productivity," and "We keep shoveling money out the back of the truck." DOE Fusion Energy Advisory Committee chair Robert Conn, Dean of Engineering at the University of California at San Diego, described the revised fusion energy strategy [See our February 1996 newsletter.] and noted that "The U.S. program is only about 20% of the world fusion energy effort, making us close to marginal as a player on the world scene." Conn compared the \$275 million fusion effort his committee was recommending to Japan, which he said was spending approximately \$450 million per year on fusion and to the European Community, which he said was spending \$600 million.

Other witnesses included Bill Drummond (U.Texas), George Miley (U. Illinois), Clifford Surko (UCSD), Joe Gavin (retired former CEO of Grumman Corp.) and John Perkins (LLNL). Perkins told the committee that, in his view, "The present fusion program includes no unifying element focused on the gathering, generation and objective examination of advanced ideas." He said his recommendation is that "a broad, expert team be built to perform physics analysis, configuration design and prospective power plant implementation studies for (advanced) ideas." Gavin criticized the government for its lack of vision and perspective and called for a higher level of fusion spending. "A \$100 million increase in fusion spending would amount to only one-fourteenth of the cost of a single B-2 bomber," Gavin said.

Another witness was Dr. Martha Krebs, director of DOE's Office of Energy Research. Krebs said that the Department was changing its fusion program "from a goal-oriented energy technology program to a fusion energy sciences program," in accordance with the recommendations of its Fusion Energy Advisory Committee [See our February 1996 newsletter.] and in accordance with the "unambiguous message" that DOE believes it received from Congress last

year that "the long-term focus of the program must change to research instead of technology demonstration." Krebs said that "Significant features of the new program will include: a plasma science initiative . . . (to) broaden the academic base in the field through outreach to institutions not now involved in plasma science . . . (and) increased emphasis on alternative concepts . . . to identify one or two small alternative concept experiments for construction." Krebs stated that one alternative concept "that has already been favorably reviewed is the National Spherical Tokamak Experiment (NSTX) proposed by Oak Ridge National Laboratory, Princeton Plasma Physics Laboratory, and the University of Wisconsin, to be built at the Princeton Plasma Physics Laboratory." Although NSTX is a tokamak, DOE has chosen to label it as an alternate concept.

Krebs said that DOE would shut down its largest operating facility, the Tokamak Fusion Test Reactor at PPPL, "in either 1997 or 1998." She said the Department had "no longer any plans for large construction projects." She said that the U.S. would "remain an active participant in the International Thermonuclear Experimental Reactor (ITER) Engineering Design Activities . . . through its completion in July 1998." She said that "given the financial limitations (of the U.S. program) the Department will not seek to be the host of the ITER facility (if and when it goes into construction)." She also indicated that "The FEAC will be re-named the Fusion Energy Sciences Advisory Committee (FESAC) and its membership changed to reflect the scientific nature of the program."

FEAC is expected to hold its next meeting next summer and has yet to receive any new charges from DOE. However, its Science Subcommittee, chaired by Jim Callen (U. Wisc.) has been meeting, even in the absence of a charge, and expects to give DOE independent advice on priorities among major tokamak facilities and its opinions on NSTX in early April.

## **SEABORG, DEAN CRITICIZE DOE CLASSIFICATION STUDY**

About a year ago, the DOE began a "Fundamental Classification Policy Review," under the direction of then-director of the Sandia National Laboratories, Al Narath. FPA president Steve Dean and others made presentations the Narath Commission on July 28, 1995. [See our August 1995 newsletter.] The Commission issued a "Draft Report for Public Comment" on February 1, with comments due by

February 29. Chairman Narath briefed Secretary of Energy Hazel O'Leary March 7, saying that comments received had been "largely favorable." The report is being reviewed by other government agencies, after which DOE is expected to adopt its findings.

The report, in the view of FPA president Steve Dean, is largely a collection of platitudes and their adoption is unlikely to result in any concrete changes in DOE classification policy.

Former Atomic Energy Commission chairman and Nobel Prize winner Glenn T. Seaborg wrote the Commission on February 22 stating, "I was disappointed that the draft report, while acknowledging that classification should not be used to conceal embarrassment, does not seem to deal aggressively in its review process with wrongful deletions of material that might have been politically or personally embarrassing to individuals or groups but whose publication would not in any way threaten U.S. national security." Seaborg says, "In a broader vein, cannot this much needed classification and declassification reform be accomplished by a revised method that is simpler and capable of much more rapid action than the complicated system described in your draft report? Why, for instance, would it be unreasonable to swiftly institute a sweeping declassification of everything (except weapons and military reactors information) that was written more than 25 years ago?"

Dean wrote the Commission February 27 stating, "As someone interested in fundamental change in classification policy as it pertains to openness in scientific investigations and the development of inertial confinement fusion, I regret to say that the draft report is a major disappointment. The entire report emphasizes maintenance of the existing attitudes regarding classification, underestimates the importance of scientific openness, and completely disregards the special problems that have plagued inertial confinement fusion since its inception." Dean said, "The report does not recognize the special role that inertial confinement fusion plays in defining the boundary between classified weapon science and a vibrant field of unclassified international scientific investigation." Dean noted, "Despite the statement on page 5 of your draft that in December 1993 Secretary O'Leary 'disclosed for the first time . . . key information about fusion energy . . .,' not a single previously classified document on inertial confinement fusion has been declassified and released to the public by the Department.

Furthermore, claims by the Department that a series of underground tests proved the scientific feasibility of inertial confinement fusion remain unsubstantiated and classified." Dean concluded, "In sum, my reading of the draft report leads me to the conclusion that the views expressed largely reflect the opinions of those who wish to maintain the status quo."

Dean received a reply from Dr. Glen R. Otey, deputy chair of the Commission, dated March 18. Dr. Otey states, in full, "Thank you for your letter of February 27 and the comments therein on the Fundamental Classification Policy Review. The results of our work were presented to Secretary O'Leary on March 7. Her decision on our recommendations should be announced in April following coordination within the government. Not included in the draft report is a recommendation developed late in the Review on declassifying certain Centurion/Halite data [underground tests conducted for ICF]. However, on the whole, we concluded that the 1991 recommendations on ICF are still valid. We sincerely appreciate your comments and participation."

Copies of the report may be requested from Mr. Jeffrey Zarkin at DOE, ph. (301)903-0236; fax: - 7444.

## **BANNER YEAR AT ROCHESTER**

"This has been a banner year for the Laboratory (for Laser Energetics, University of Rochester) with the successful completion of the OMEGA (laser) system on time, on budget, and exceeding all acceptance test criteria (45 kJ of UV light)," says UR-LLE director Robert McCrory in issuing the lab's 1995 annual report. Says McCrory, "OMEGA is the newest of (DOE) Defense Program's facilities. We take pride in having established a new neutron yield record of 100 trillion (fusion) neutrons." Copies of the report may be requested from Dr. McCrory at fax (716)275-5286; email: rmcc@lle.rochester.edu

The facility is a world-class, 60-beam, frequency-tripled, Nd:glass laser. In initial tests the laser produced over 60 Terawatts of UV light with up to 45 kilojoules of energy, with better than 8% rms energy balance. The design goals were for 10% rms energy balance at greater than 30 kJ. The system demonstrated its design goal of a 1 hour shot rate by firing 15 times at full power in 14 hours and 52 minutes.

## **RUSSIANS SIGN NEW COLLABORATION**

Russia, China, India, and Iran have signed an agreement to collaborate on fusion energy development. A working group will arrange exchanges between research institutions in the various countries. Details will be discussed at the forthcoming 16th IAEA Fusion Energy Conference, October 7-11 in Montreal (See our March newsletter).

## **HENNING'S BACK**

Fusion veteran Carl Henning has returned to LLNL to take on duties with the National Ignition Facility project. For the past year Carl has headed the University of California Laboratory Administration Office. For NIF, Carl will be responsible for establishing the management and reporting structure within the laboratory to complete the NIF, "using modern cost-effective business practices." He had previously served on assignment at DOE as deputy director of the Office of the National Ignition Facility and, prior to that, had a distinguished career as a project and program engineer in the magnetic fusion program, specializing in superconducting magnets. He can be reached at (510)422-0235, email: henning1@llnl.gov. Welcome back, Carl.

## **VAN FLEET & ASSOCIATES**

Julie Van Fleet has resigned from General Atomics to launch her own consulting business, Van Fleet & Associates. The company will specialize in "developing bi-partisan political support, creating innovative business promotions, and implementing state-of-the-art media communications for high-technology and research organizations." She will be providing support for the 1996 Fusion Forum, to be held Thursday, May 16, 5-8 PM, in the Cannon House Office Building. Julie says that all fusion supporters are welcome and they are especially urged to invite their local Congresspersons and their staffs to the Forum. For further information on the Forum, contact Marion Stav at General Atomics, fax: (619)455-2496; email: stav@gav.gat.com. Julie can be reached at ph. (619)455-4523; fax: -2494.

## **PHYSICISTS FACTOIDS**

A recent American Institute of Physics (AIP) study finds there are approximately 20,000 physicists in the U.S., employed about as follows: 10,000 in academe, 4500 in national laboratories, 3,200 in industry, and 2,300 in government and other areas. Early retirement programs resulted in a retirement rate of 4.3% in 1993 and 1994, projected to decrease to 3.7% in 1995 and 1996. For a free

copy of the 4-page report contact Jean Curtin, email: jcurtin@aip.acp.org

## **ERRATA**

Our March issue newsletter listed Rep. Sherwood Boehlert as (R-WI). He is actually (R-NY). Our apologies.

## **MEETINGS**

**May 12-16** - Annual Topical Conference on High Temperature Plasma Diagnostics. Monterey, CA. Contact Judy Knecht. Fax: (510)422-7390; email: knecht2@llnl.gov

**May 16** - Fusion Forum. House of Representatives Cannon Office Bldg., Washington, DC. Contact Marion Stav. Fax (619)455-2496; email: stav@gav.gat.com

**May 30-31** - Fusion Power Associates Annual Meeting and Symposium, "The Approach to Fusion Ignition and Beyond," Pleasanton, CA. Contact Ruth Watkins, Fax (301)975-9869.

**June 3-7** - 24th Conference on Laser Interaction with Matter (ECLIM 96). Madrid, Spain. Contact email: minguez@denim.upm.es or mperlado@denim.upm.es

**June 16-20** - 12th ANS Topical Meeting on the Technology of Fusion. Reno, NV. Contact ANS Meetings Department. Fax (708)352-6464.

**September 16-20** - 19th Symposium on Fusion Technology (SOFT). Lisbon, Portugal. Contact Dr. Maria Fernanda, email: mfernanda@cfm.ist.utl.pt

**October 7-11** - 16th Biennial IAEA Fusion Energy Conference. Montreal, Canada. Contact Ron McKnight. Fax (301)903-4716; email: ronald.mcknight@mailgw.er.doe.gov

**November 11-15** - APS Division of Plasma Physics. Denver, CO. Contact Richard Hazeltine. Fax (512)471-6715, email: rdh@hagar.ph.utexas.edu

## **QUOTABLE**

"The best way to predict your future is to create it."

Peter Drucker  
Managing the Future: The 1990's  
and Beyond  
Truman Talley Books, 1992





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### HARKNESS HEADS FUSION INDUSTRY COUNCIL CRANDALL TO HEAD DOE INERTIAL FUSION FEAC GETS INERTIAL FUSION ENERGY CHARGE

#### HARKNESS HEADS FICUS

Dr. Samuel D. Harkness, Director of R&D Operations, Westinghouse Science and Technology Center, has been elected chairman of the Fusion Industry Council, U.S. (FICUS). FICUS was established in 1994 by the Fusion Power Associates Board of Directors "to identify and disseminate the consensual views of U.S. industry on matters pertaining to domestic and international fusion power programs."

Harkness joined Westinghouse in 1979 and has held a variety of senior management positions at the Westinghouse Science and Technology Center since 1990. From 1976-1979, he was Associate Director for the fusion energy program at the Argonne National Laboratory. He is a Fellow of both the American Nuclear Society and the American Society of Metals.



*Samuel Harkness*



*David Crandall*

#### CRANDALL TO HEAD DOE ICF PROGRAM

Dr. David H. Crandall will assume directorship of the newly created "Office of Inertial Fusion and NIF" at the U.S. Department of Energy on July 1. Crandall has headed the NIF (National Ignition Facility) Office since January 1995. The current head of the Inertial Fusion Office, Dr. Marshall Sluyter, will retire July 1 and the two offices will be combined under Crandall.

Crandall joined the DOE Office of Fusion Energy in 1983 and was Director of the Applied Plasma Physics Division from 1987 to January 1995. From 1974-1983 he performed atomic physics research at Oak Ridge National Laboratory.

#### FEAC GETS INERTIAL FUSION CHARGE

In a letter dated April 8 to Fusion Energy Advisory Committee (FEAC) chairman Bob Conn, DOE Office of Energy Research Director Martha Krebs asks the Committee "to provide us with an assessment of the content of an inertial fusion energy program that advances the scientific elements of the program and is consistent with the Fusion Energy Sciences Program, and the budget projections over the next several years." In the charge, Krebs says "The potential for inertial fusion energy has been judged to be real, but the fusion program no longer has as a goal the operation of a demonstration power plant by 2025. Given that the basic mission of the fusion program has changed from energy development to fusion energy science, and that the funding for the entire fusion program

will be constrained for some number of years, I would like FEAC to again consider inertial fusion energy and recommend what the new Fusion Energy Sciences program should be doing in support of this future fusion application and at what level?" Krebs asks for a report by July. Members of the inertial fusion review subcommittee had not been appointed as of press time. The full FEAC is scheduled to meet July 16-18 in the Washington, DC area.

## **EUROPE SETS UP FUSION REVIEW**

In preparation for the 1999-2003 European Fusion Program Decision, and before firm decisions are taken on the construction of ITER, a new fusion "Evaluation Board" is being set up by the European Commission. The European fusion program, which receives funding guidance on a five year basis, is currently operating under an approved policy that states "For the period 1994-1998, the priority objective is to establish the engineering design of the Next Step within the framework of the quadripartite cooperation between Euratom, Japan, Russia, and the USA on the engineering design activities for the International Thermonuclear Experimental Reactor (ITER-EDA)."

The "Terms of Reference" for the review include (1) "to conduct an independent assessment into the management of and progress with Community activities carried out within the Fusion Programme during the last 5 years; (2) to assess the prospect of fusion in the light of available evidence of real progress achieved towards the programme's ultimate goal, before firm decisions are taken on whether, when, where and in what frame a Next Step should be constructed; (3) to cover within the assessment all aspects of fusion, including scientific, technical, environmental, socio-economic and financial aspects, including a comparison with other types of energy generation; (4) to analyze strategic options for the Community Fusion Programme, with particular emphasis on (a) the Next Step, its objectives and time schedule, (b) the scope of international collaboration, with particular emphasis on ITER, (c) the balance between Next Step support, concept improvements and long-term technology, (d) the role of JET and of medium-size devices, (e) the role of industry, (f) the activities on other approaches to fusion, and in particular inertial confinement, (g) the role of education and training in the programme; . . . ." The report is expected to be completed late in 1996.

## **EUROPEAN GROUP URGES LARGER INERTIAL FUSION EFFORT**

The European Commission has a variety of "consultative committees" to advise it on various matters. One such group, among many, is the European Science and Technology Assembly, a 100 member group appointed in their personal capacities from the scientific and industrial communities in Europe. The idea is to provide the Commission with a direct, ongoing link with these communities. Recently, the Assembly set up a "working party" to prepare a report on the topic "Inertial Confinement Options to Controlled Nuclear Fusion." Although the report has not yet been made public, the April 25 issue of Nature magazine summarized its findings. According to the Nature article, the report chastises the European Commission for "putting all its eggs in one basket by spending almost all its annual funding . . . on magnetic confinement fusion." The report calls the current European program "unbalanced and no longer justified," according to Nature. The article states, "To redress the balance, the report calls on the EU to establish immediately a modest programme in inertial confinement research, with initial financial support running at around 10 percent of the total fusion budget."

## **CONGRESS PERSONS PRESSURE COLLEAGUES ON FUSION**

Nearly 70 members of the House of Representatives signed an April 15 letter to the chairs of the House Science Committee and the House Appropriations Committee urging them not to cut the fusion budget. The members urged a fusion budget of \$275 million, higher than the President's request level of \$256 M. Sixty-eight members signed the letter to Science Committee chairman Robert Walker and 65 signed the letter to Appropriations Committee chairman Robert Livingston. Copies of the letters are available from Fusion Power Associates.

Meanwhile, an attempt by Mr. Walker to "mark up" a DOE authorization bill in which he allocated only \$200 million to fusion failed in committee and was abandoned. Many republicans broke ranks with Walker on the fusion funding issue and a number of other DOE programs that Walker wanted to cut. It is not clear whether the Science Committee will be able to agree on a DOE authorization bill. Appropriations is expected to mark in mid- to late-May. Senate action will come later.

## **FPA PROCEEDINGS PUBLISHED**

The proceedings of two 1995 Fusion Power Associates symposia have been published in the Journal of Fusion Energy, Vol. 14, No. 2 (1995). The first symposium, entitled "Fusion Industry Stakeholders Conference," was held June 15-16 in Washington, DC; the second, entitled "Status and Prospects for Fusion Power Development," was held jointly with the Canadian Nuclear Association September 7-8 in Montreal, Quebec, Canada. The issue also contains the July 1995 fusion review report of the Presidents Council of Advisors on Science and Technology (PCAST) and a recent report on fusion applications by FPA president Steve Dean (see our December 1995 newsletter).

## **BROCHURES AVAILABLE**

A color brochure, entitled "Investment in an Energy Source for Tomorrow -- FUSION -- Yields Important Benefits Today," is available in single copies from Fusion Power Associates. It is also available in lots of 50 (\$30 per lot) from the Government Printing Office (Stock Number 061-000-00859-4) by calling (202)512-1800. The brochure was prepared for the DOE Office of Fusion Energy by Fusion Power Associates through Argonne National Laboratory.

Another color brochure, entitled "Fusion Science -- Harnessing the Energy of the Stars," is available in single or multiple copies from Fusion Power Associates. The brochure was produced by General Atomics, with assistance from various fusion institutions.

## **FRENCH TOKAMAK SETS RECORD**

According to a letter received from D. Escande, Head of the Department of Controlled Fusion Research at Cadarache, the French superconducting tokamak Tore Supra set a world record by sustaining a tokamak discharge for two minutes. Ninety percent of the 0.8 MA tokamak current was driven by 1.9 MW of radio-frequency waves at the lower hybrid frequency. In another experiment, lasting 75 seconds, a feedback loop was successful in maintaining a constant plasma current and improved confinement was observed. Further advances are limited by the steady-state power exhaust capability of the device. Improvements are in progress that should permit a significant increase of the RF power. For further information, contact D. Escande, email:drfc@cea.fr

## **NEGATIVE IONS INJECTED INTO JT-60U**

For the first time, negative ion injection has been demonstrated as a heating and current drive technology in the JT-60U at the Japan Atomic Energy Institute. Negative ions are more efficient than the conventional positive ion neutral beam systems operating on other tokamaks. Acceleration voltage reached 200 kV, 3.2 A, 0.47 seconds. The full capability of the system is 500 kV, 20 A, 10 seconds. For further information, contact Hiroshi Kishimoto, email:hiroshik@naka.jaeri.go.jp

## **HIGH TEMPERATURE SUPERCONDUCTORS ADVANCE**

Researchers at Oak Ridge National Laboratory and Los Alamos National Laboratory have announced breakthroughs in the development of cost-effective, practical high temperature superconductors. Oak Ridge scientists reported they have produced a roll-textured, buffered metal superconducting tape with a critical current density of 300,000 amperes per square centimeter. Standard household wires typically carry fewer than 1000 amperes per square centimeter. Midwest Superconductivity, Inc. of Lawrence, Kansas announced that it had received a non-exclusive patent license from Oak Ridge to develop the process with Westinghouse Science and Technology Center and Southwire Company for commercial high temperature wire and tape applications. Los Alamos announced that it had entered into cooperative r&d agreements with American Superconductor Corp. and the Electric Power Research Institute to develop a high temperature superconducting tape. For further information, contact James Daley, manager of DOE's Superconductivity Systems Program at (202)586-1165.

## **ICFAC ISSUES FINAL REPORT**

The DOE's Inertial Confinement Fusion Advisory Committee (ICFAC) has issued its final report, based on its meeting of November 14-15, 1995. DOE has abolished the committee (see our January 1996 newsletter) saying that "the limited scope of the committee restricts its usefulness." DOE is in the process of setting up a new advisory committee through the National Research Council. In its report, the ICFAC says "The overall impression of the committee on the target physics is that there has been remarkable progress in the last six months. During the three years of ICFAC reviews of ICF, the ICF target physics program for ignition has identified and resolved many

potential target physics issues" The Committee states that "In all critical areas -- cryogenic layer production, hohlraum laser plasmas, and implosions -- there is now a substantial data base supporting a good margin of confidence of attaining ignition." They say, "The committee recommends that, as far as ignition is concerned, there is sufficient confidence that the program is ready to proceed to the next step in the NIF project, that is to go to the final design phase in FY 1997."

## TFTR

The Tokamak Fusion Test Reactor at the Princeton Plasma Physics Laboratory will be the first major U.S. operating tokamak to cease operations, according to the priorities expressed by DOE's Fusion Energy Advisory Committee (see our February 1996 newsletter). The exact timing of the shutdown (FY 1997 or 1998 or earlier if there is another budget disaster this year) is critically dependent on the fusion budget request for FY 1997 currently pending in Congress. In an interview for the April 1996 issue of Nuclear News, associate editor Allen Zeyher asked Princeton deputy director Dale Meade what would be the focus of TFTR research if it continues into 1998. Here are excerpts from Meade's reply.

"The first thing we're going to look at is exploiting and understanding a regime that was discovered last year on TFTR (see our September 1995 newsletter), a new operating regime where the plasma particle containment is very good. We call it the enhanced reversed shear mode. We want to extend that regime, understand it, because if we can then export this to machines of the future like ITER, potentially we can develop much better operating modes and perhaps even learn how to make a tokamak fusion reactor smaller than people currently think of it."

"One of the things that we will do in the coming two years is that at the present time we see about a 20 percent increase in the temperature of the electrons in the plasma, and we've been attributing that to the alpha particles. We'd like to make that a clearer demonstration of the heating of the plasma, and so we would begin to work toward higher power levels. TFTR is currently at 10 MW, and we would work our way up, aiming toward 15 and beyond toward 20."

". . . one of our experimental program elements for the coming year in 1997, and I would expect if TFTR is extended in 1998, also in 1998 . . . is to use radio frequency waves to

set up barriers at certain points in the plasma to keep the plasma from leaking out and thereby to improve its fusion power output."

## ENERGY FACTOIDS

Asia's energy consumption is growing at 4.3 percent compounded annually. China accounts for 40% of the total increase in Asia's energy demand.

World oil production grew by 1.5%, while U.S. production fell by 1.9% in 1995.

Source: Global Energy Outlook, February 1996. Fax: (817)457-8224.

## PEOPLE

*Milt Johnson* has joined the Office of Fusion Energy as Deputy Associate Director to Associate Director N. Anne Davies. Milt was previously head of the DOE's Princeton Area Office.

*Ann Snell McNeil* has left her position in the Washington office of Princeton University to join the firm of Lewis-Burke Associates, a federal relations firm in Washington, DC. She can be reached at (202)466-4111.

*Geraldine Shannon* has joined the Princeton University Washington office where she will be handling matters relating to fusion. She was director of Corporate Relations for the Southeastern Universities Research Association, which manages the Continuous Electron Beam Accelerator Facility (CEBAF), and more recently consulted for the University of California. She can be reached at (202)639-8420.

## QUOTABLE

"These days a hunch will not get you funding for your research project; you need to submit reams of paper documenting your thesis, explaining why and how your experiment will work. Intuition won't do it. Call me simpleminded, but it strikes me that if a scientist knows enough to do all this documentation ahead of time, it may not be necessary to do the experiment."

Walter Pierpaoli, M.D., Ph.D.  
Institute of Medical Research  
Davos, Switzerland



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### FPA AWARDS ANNOUNCED SANDIA SETS X-RAY PULSED POWER OUTPUT RECORD MAGNETIC PINCH CONCEPTS STAGING COMEBACK



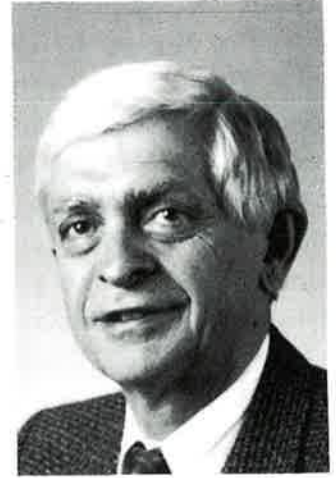
*Mohamed Abdou*



*Robert L. McCrory*



*Joseph G. Gavin*



*John H. Nuckolls*

#### FPA AWARDS

**LEADERSHIP:** ABDOU, MCCRORY  
**DISTINGUISHED CAREER:** GAVIN, NUCKOLLS  
**ENGINEERING:** DENISOV, GIERSZEWSKI

Fusion Power Associates announced its 1996 Awards at its Annual Meeting and Symposium, May 30-31 in Pleasanton, CA.

Leadership Awards were presented to **Mohamed Abdou** (UCLA) and to **Robert L. McCrory, Jr.** (University of Rochester), in recognition of their "outstanding leadership qualities." Abdou was cited for "the outstanding job you have done over many years to provide vision, leadership, and direction to the U.S. and world fusion nuclear technology programs." The FPA Board also recognized

Abdou's "prolific technical contributions and your leadership of several multi-institutional technical and planning studies." McCrory was cited for "the outstanding job you have done over the past two decades to ensure high quality contributions to fusion research from the Laboratory for Laser Energetics generally and, most recently, the successful completion and operation of the Omega Upgrade laser facility." In addition, the FPA Board noted "the key role you play in the management councils of the national and international inertial confinement fusion communities and the important role you play in bringing an academic perspective to the national ICF program."

Distinguished Career Awards were presented to **Joseph G. Gavin, Jr.** (retired CEO of Grumman Corporation and **John H. Nuckolls** (former director of LLNL). Gavin was cited not only for his "outstanding career as an industrial

leader of the U.S. space program, but especially for your support of the U.S. fusion program as an executive of the Grumman Corporation." The FPA Board noted Gavin's "role as a fusion advisor, including chairing the NRC study 'Cooperation and Competition on the Path to Fusion Energy' and the 1986 ERAB Technical Panel on Magnetic Fusion, your service on the DOE Fusion Energy Advisory Committee, and your visionary papers, speeches, and congressional testimony relating to fusion energy development." Nuckolls was cited for "your pioneering work in inertial confinement fusion, your support of the fusion program during your tenure as Director of LLNL, your visionary papers and speeches relating to fusion development, and your incisive technical challenges to the fusion development program."

Excellence in Fusion Engineering Awards are being presented to **Gregory G. Denisov** (Institute of Applied Physics, Russia) and to **Paul J. Gierszewski** (Canadian Fusion Fuels Project). Denisov is recognized for his work on the development of high power millimeter wave sources and transmission systems, and their application to electron cyclotron heating and current drive in large fusion experiments. Gierszewski is recognized for "your outstanding technical contributions to numerous fusion projects, including FINESSE, NET, ARIES, TIBER, TITAN, TPSS, PILOT, and ITER." The FPA Board also recognized his "leadership skills, as evidenced by your current responsibilities to oversee CFFTP fusion fueling technologies and Canadian contributions to ITER."

### **SANDIA SETS X-RAY RECORD**

Scientists at the Sandia National Laboratories (SNL) in Albuquerque, NM, produced 85 terawatts and 500 kJ of x-ray power and energy in a 4 nanosecond pulse on the 750 kJ Saturn accelerator (originally built as the Particle Beam Fusion Accelerator - I). The results were achieved by driving a 7 MA current through a cylindrical array of fine tungsten wires, creating an imploding cylindrical pinch. Beginning last September, the researchers began reducing the diameter of the wires and increasing the number of wires in the array, with the result that the x-ray power systematically increased from 20 terawatts using 24 wires, to 40 terawatts using 70 wires, to 85 terawatts using 120 wires. According to Don Cook, Director of Sandia's Pulsed Power Center, up to 194 wires have been used, each having a diameter of only a few microns, but about 120 wires is

optimum. By using the more powerful 3 Megajoule Particle Beam Fusion Accelerator - II (PBFA-II) later this year, Cook hopes the x-ray yield may be increased to as high as 150 terawatts. The Lab has future plans for a new facility, called the X-1 Advanced Radiation Source, that could achieve up to 400 terawatts, with 8 Megajoules of x-ray output, early in the next century.

The x-rays are useful in simulating the effects of nuclear weapons and for verifying the predictions of three-dimensional computer codes that predict what happens inside a thermonuclear weapon when it detonates. Such capability is an important part of the so-called "Science-Based Stockpile Stewardship" program, aimed at ensuring the safety and reliability of the nation's nuclear weapons stockpile. Large bursts of pulsed x-rays are also important for driving symmetric implosions of small capsules of fusion fuel as part of the DOE's inertial confinement fusion program. For further information, contact Dr. Jeff Quintenz, email: [jpquint@sandia.gov](mailto:jpquint@sandia.gov)

### **HARTMAN PROPOSES "SIMPLE" MAGNETIC PINCH FUSION REACTOR**

Physicist Charles Hartman (LLNL) has proposed a new version of an old fusion concept: the Z-Pinch. Called the "Continuous Flow Pinch," the concept has no superconducting magnets and a damage-resistant liquid first wall. The Z-Pinch was one of the first, and simplest, fusion concepts to be examined in the 1950's. It was quickly found to be unstable, however. According to Hartman, experimental evidence for a transiently stable regime was first seen by Marshall and Newton in 1967 and more recently (1990) in Russia by Morozov, with theoretical stability predicted by Kadomtsev for all but internal kink modes and sheared flow velocity stabilization of the kink predicted by Shumlak and Hartman. Hartman says, "Because the development time is short and the cost small, a continuous flow pinch neutron line source with low energy gain can be considered for near-term application to fusion waste processing, plutonium disposal, and tritium production. In the longer-term, the prospects for high gain at high pulsed power appear promising for electricity production." An article has been submitted for publication in the journal *Comments on Plasma Physics and Controlled Fusion*. For further information, contact Dr. Charles Hartman, fax:(510)423-2395; email: [hartman2@llnl.gov](mailto:hartman2@llnl.gov)

## **O'LEARY SPEAKS AT FUSION FORUM**

Energy Secretary Hazel O'Leary gave a luncheon address at the Third Annual Fusion Forum, May 16, in the Rayburn House Office Building in Washington, DC. In her prepared remarks, O'Leary said that "One job of the Department of Energy is to support science and technology that can lessen economic impacts of short term energy supply problems and will ensure development of long term energy options to power our economy well into the next century." Describing DOE's "Portfolio of Energy Options," O'Leary said "We support development of Sustainable Technologies, including renewable energy and energy efficiency." She said, "Fusion is a long term option that must be developed, since world energy demand will grow rapidly -- mostly in the developing nations -- over the next 20 years -- because we know that total energy available from conventional sources will not meet the expected growth in energy demand."

O'Leary indicated her discomfort that the DOE program leaders had abandoned a timetable for a fusion power plant. She indicated that she had gone along with that rhetoric reluctantly, while acknowledging that "Taking away milestone dates for energy technology development relieves budgetary pressures somewhat." She remarked, "I believe you have to drive everything by the calendar. Ten years from now, someone will ask me why we removed the milestones." She said the Administration's budget request for fusion was "bare bones." She said that "Below \$250 million it would not be possible to implement the goals of the restructured program, including honoring our international commitments to the engineering design activity on the International Thermonuclear Experimental Reactor." Copies of Secretary O'Leary's prepared text are available from Fusion Power Associates.

## **ITER DEBATE**

The June issue of Physics Today carries an exchange of views on the topic "Build the International Thermonuclear Experimental Reactor?" between Andrew Sessler (LBNL) and Tom Stix (PPPL) on the one hand, and Marshall Rosenbluth (UCSD and ITER JCT) on the other. Sessler/Stix argue "No," while Rosenbluth argues "Yes."

Sessler/Stix state, "In a few words, the step is too large and the overall concept, for all its attractiveness, is both premature and overambitious with respect to current knowledge."

Rosenbluth says, "It seems to me that fusion research requires a test bed such as ITER that we could use to design a desirable reactor by interpolation rather than continual extrapolation from undersized experiments. It will always be possible to argue for indefinite delays in building such a test bed while awaiting more perfect knowledge." Also, Rosenbluth notes, "With the US program now perhaps 15% of the world program, probably slipping to the 10% level in the near future, we can no longer dictate the nature of the international fusion program." He says, "After 46 years of effort and progress, the US fusion community should think very carefully before turning its back -- for whatever reasons -- on an internationally agreed upon experiment designed as the first exploration of the burning plasma environment."

Stix and Sessler reply, saying "We are fully aware of the special interests of each partner in ITER and in no way do we wish to dictate international strategy. But we would be less than honest if we failed to reiterate our opinion, that the ITER step is too large and that the time to 'first plasma' is too long: 12-14 years from now, not including a decision-making delay of uncertain length after mid-1998." They conclude, "Accordingly we advocate a collaborative multinational fusion strategy that we believe will answer the most important magnetic fusion reactor questions more reliably, quickly, flexibly and cost-effectively than the currently proposed single ITER machine."

## **FUSION BUDGET HISTORY**

In the 45 years since fusion research began (FY 1951-1996), the federal government has spent \$8.1 billion on magnetic fusion (including a small amount for energy applications of inertial fusion). The government began funding inertial confinement fusion within Defense Programs in FY 1963 and through FY 1996 will have spent \$3.8 billion. The dollars referenced above are "as spent dollars," i.e., no adjustments made for inflation. A year by year table of the expenditures is available from Fusion Power Associates.

## **QUOTABLE**

"The difference between a goal and a wish is that a goal has a definite time frame attached to it, within which we intend to do certain things to help accomplish that goal."

Thomas W. McKnight, Author  
1988

# FUSION POWER ASSOCIATES AWARDS PROGRAMS

## *LEADERSHIP*

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

1980	S. J. Buchsbaum R. L. Hirsch M. McCormack P. Tsongas
1981	E. E. Kintner
1982	H. P. Furth J. H. Nuckolls
1983	J. L. Emmett T. K. Fowler
1984	T. Ohkawa G. Yonas
1985	E. P. Velikhov C. Yamanaka
1986	R. C. Davidson
1987	M. N. Rosenbluth
1988	J. F. Clarke
1989	P-H. Rebut
1990	B. B. Kadomtsev
1991	B. Coppi E. Storm
1992	R. W. Conn G. L. Kulcinski
1993	D. L. Cook J. Sheffield
1994	C. C. Baker S. E. Koonin
1995	E. M. Campbell D. O. Overskei
1996	M. Abdou R. L. McCrory

## *DISTINGUISHED CAREER*

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

1987	M. B. Gottlieb D. Kerst R. F. Post L. Spitzer, Jr.	1992	R. Bickerton A. Bishop V. Glukhikh S. Mori
1988	K. Husimi D. Palumbo R. S. Pease	1993	R. A. Gross M. W. Rosenthal
1989	F. H. Coensgen D. J. Grove F. L. Ribe	1994	C. A. Flanagan W. G. Kunkel
1990	N. G. Basov T. Sekiguchi	1995	T. K. Fowler H. P. Furth
1991	H. K. Forsen J. W. Landis R. L. Sproull H. G. Stever	1996	J. G. Gavin J. H. Nuckolls

## *EXCELLENCE IN ENGINEERING*

1987	Steven J. Piet
1988	Michael A. Ulrichson
1989	David Ehst Y-K. Martin Peng
1990	Wayne Reiersen
1991	John Santarius
1992	Oleg Filatov Steven Zinkle
1993	John D. Galambos Scott W. Haney
1994	C. E. Kessel K. A. McCarthy
1995	F. Najmabadi
1996	G. G. Denisov P. J. Gierszewski





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### U.S - KOREA SIGN FUSION COLLABORATION

#### KOREA ON THE MOVE

On June 14, Korean Minister of Science and Technology Dr. KunMo Chung and Energy Secretary Hazel R. O'Leary signed an agreement to collaborate on fusion energy research. Secretary O'Leary stated that the agreement "underscores the importance of worldwide participation in developing peaceful uses for atomic energy and pursuing fusion energy as a future resource." The agreement sets up formal links of collaboration between DOE and Korean Laboratories. Dr. Chung, who went on to attend the American Nuclear Society Annual Meeting and imbedded Topical Meeting on the Technology of Fusion Energy in Reno, NV, announced that Korea would construct an advanced superconducting tokamak, similar in design and purpose to the Tokamak Physics Experiment (TPX). The TPX facility, which was to be built in the U.S. at the Princeton Plasma Physics Laboratory, was scuttled by Congress last year in its budget cutting frenzy (See our August and November 1995 newsletters). O'Leary and Chung announced that, under the agreement, Korea would provide funds to the Princeton laboratory to assist them in the design of the facility.

Chung also announced that the Korean government had plans to levy a tax on all nuclear-generated electricity to provide a stable source of long-term funding for fusion and other forms of nuclear energy. The proposed funding mechanism is similar to one first proposed by FPA president Steve Dean in a luncheon address to the American Nuclear Society in 1985 (Text available from FPA; see also our March 1990 newsletter).

Chung's announcements follow up on the remarks of Korean President Kim Young-sam last July (See our September 1995 newsletter), in which he stated that Korea

would mount 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. He called fusion a "dream energy source."

#### KREBS GIVES HER VIEWS ON FUSION

In a "Dear Colleagues" letter, dated June 12, to "Members of the Fusion Energy Science Community," DOE Director of Energy Research Martha Krebs gives "My Views on the Fusion Energy Sciences Program." She said that her "Vision for 2001," included "a new medium scale alternative concept device" at General Atomics, that "ITER will be under construction, primarily funded by Japan and Europe. The United States will contribute in science-based niche areas," and a "DOE plasma science program . . . at about \$10 million." She said that she expected there will be "a set of small to medium alternative concept experiments at universities and laboratories exploring plasma behavior," and that "Princeton will continue to be a center of excellence for fusion science but at smaller scale." She announced that DOE had already authorized "increasing support for alternative concepts . . . including small devices at the University of Wisconsin and the University of Washington." She indicated that "We are changing the way we manage the program . . . by including the fusion science community more in the governing process." (A "permanent" Science Subcommittee of the Fusion Energy Advisory Committee, under the chairmanship of Jim Callen of the University of Wisconsin, has been appointed, as reported in our January 1996 newsletter.)

Notably absent from Krebs' statement was any recognition of the inertial fusion energy option (for which her Office is responsible) or of the significance to fusion of the

construction currently underway in the U.S. of the laser-based National Ignition Facility (See our April 1996 newsletter). The Fusion Energy Advisory Committee meets at the Gaithersburg (MD) Hilton July 16-18 to consider reports from subpanels it established to review alternate concepts and inertial fusion. Krebs letter is available from FPA.

## **THERMACORE DEVELOPS POROUS METAL HEAT EXCHANGERS**

Thermacore, Inc. of Lancaster, PA (one of Fusion Power Associates Small Business Affiliates) has won a \$744,000 Phase II award from the Department of Energy to develop and test a prototype helium-cooled Porous Metal Heat Exchanger for potential use in the International Thermonuclear Experimental Reactor (ITER). In its Phase I work, Thermacore developed and built articles for extensive testing in the Plasma-Facing Materials Test Facility at Sandia National Laboratories. The articles easily met the heat-flux/temperature requirements for the Faraday Shield applications for ITER, setting a world record of 4000 watts/cm<sup>2</sup> for a helium-cooled heat exchanger. Porous metal heat exchangers also have tremendous potential for cooling electronics. Thermacore is presently producing more than 50,000 heat pipes per month which are used to cool the Pentium processors in notebook computers. They are also working with McDonnell Douglas on the design of porous metal cooled avionics for fighter aircraft. For further information, contact John Rosenfeld at (717)569-6551; fax -4797.

## **NEW INERTIAL FUSION COMMITTEE FORMED**

At the request of, and with funding from, the Department of Energy, the National Research Council of the National Academy of Sciences has set up an Inertial Fusion Advisory Committee (See our December 1995 newsletter for related article). Professor Steve Koonin, California Institute of Technology, will chair the committee. Koonin is the recipient of Fusion Power Associates 1994 Leadership Award. A primary purpose of the Committee is to advise DOE on the program content of its Inertial Confinement Fusion Program and its relevance to weapons stockpile stewardship. The committee will hold its first meeting August 1-2. Very likely much (but hopefully not all) of the meeting will be closed to the public.

## **JET WILL OPERATE THROUGH 1999**

The Council of the European Union, after "extensive consultation with the European Parliament," approved a 3-year extension of operations of the Joint European Torus (JET), to the end of 1999. JET is one of three flagship fusion tokamak facilities in the world (alongside the TFTR in the U.S. and the JT-60U in Japan). JET has previously produced somewhat more energy but somewhat less power than its American rival TFTR. After a 9-month shutdown for major improvements, JET began operations in April aimed at increasing the fusion power in the experiment by a factor of 5 and performing a range of experiments relevant to the design of the International Thermonuclear Experimental Reactor (ITER).

## **PEOPLE**

*Robert Aymar* is the recipient of the Department of Energy's Award for Exceptional Public Service, for his "personal dedication and outstanding leadership in directing the International Thermonuclear Experimental Reactor Project."

*Cor Bobeldijk* retired from his position as scientific editor of the International Atomic Energy Agency journal Nuclear Fusion July 1. He is succeeded by PPPL scientist *David W. Ignat*.

*John Davis* (McDonnell Douglas) is the new chairman of the American Nuclear Society Fusion Energy Division.

*Robert Iotti* is the recipient of the DOE Distinguished Associate Award, for his "outstanding leadership of and personal commitment to the International Thermonuclear Experimental Reactor Project."

*Edward Hoffman* (Georgia Tech) is the recipient of the American Nuclear Society Fusion Energy Division Student Award for his thesis on the topic "Radioactive Waste Disposal Characteristic of Candidate Tokamak Demonstration Reactors."

*Bill Hogan* (LLNL) is the recipient of the American Nuclear Society Fusion Energy Division Outstanding Achievement Award, which is the "most prestigious" award presented by the Division, for his "leadership role in defining inertial fusion energy development issues and needs." Hogan has also been elected vice chair/chair elect of the Fusion Energy Division.



**Victory Lap: Livermore's Mike Campbell (l) escorts DOE's Marshall Sluyter on his last tour of the NOVA laser as head of the DOE Inertial Confinement Fusion Program. Sluyter retired July 1.**

*Weston Stacey* (Georgia Tech) is the recipient of the American Nuclear Society Fusion Energy Division Outstanding Technical Accomplishment Award for his contributions to fusion reactor design.

#### **SLUYTER RECEIVES FPA SPECIAL AWARD**

Dr. Marshall M. Sluyter, head of the DOE Inertial Confinement Fusion program, received a Special Award for Outstanding Public Service at Fusion Power Associates Annual Meeting and Symposium, May 30-31 in Pleasanton, CA. In presenting the Award, FPA president Steve Dean said that the FPA Board of Directors "notes your leadership of the U.S. inertial confinement fusion program for over a decade, and the key role you have played in the evolution of the National Ignition Facility as a joint venture among the Nation's weapon's laboratories and others for both science, energy and stockpile stewardship." While accepting his award, Marshall was interrupted by a message that his daughter had given birth to his second grandchild. His other daughter delivered his first grandchild only one day earlier.

#### **QUOTABLE**

"So we cut research and development, we cut education, we cut infrastructure, and pretty soon -- over a 20- or 30-year period -- we have a budget that is all pensions and health care and nothing is left for the investment items that every society needs. Take what everybody says is the most exciting economic phenomenon at the moment -- the Internet. Where did the Internet come from? It was paid for by the Department of Defense and the National Science Foundation 30 years before it became economically viable. Government basically kept that technology going until it could attract private investment. The same thing happened in biotechnology. If we don't make similar investments today, we won't have new industries coming along later that can provide jobs, income and productivity."

Lester Thurow  
MIT Technology Review  
May/June 1996

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### INERTIAL FUSION: ON TRACK MAGNETIC FUSION: BACK TO BASICS FRANCE, GERMANY DECLINE TO HOST ITER

#### INERTIAL FUSION GOING STRONG

The House and Senate have both appropriated the full amount requested by President Clinton for the DOE's Inertial Confinement Fusion (ICF) Program, \$366.5 million, including \$191 million to begin construction of the laser-based National Ignition Facility (NIF). This year's budget is \$240.7 million. Energy Secretary O'Leary has said that the "most likely site" for the NIF is the Lawrence Livermore National Laboratory, but a formal selection will not be made until September.

Construction of the \$1.1 billion facility, aimed towards producing about 10 times more fusion energy than will be used to ignite the small capsule of fusion fuel, is scheduled to be completed in 2002. A similar facility is planned for construction in France. The NIF will be used for a wide variety of scientific studies, including nuclear weapons physics, astrophysics, high density matter physics, and fusion energy.

Other major ICF facilities are in operation at Sandia National Laboratories (see our June newsletter), at the University of Rochester (see our April newsletter), and at the U.S. Naval Research Laboratory, as well as in Japan, England, and Russia. Strong support activities are also in progress at General Atomics and at Los Alamos National Laboratory. Energy applications of inertial fusion are centered at the Lawrence Berkeley National Laboratory in the U.S., with strong programs internationally in Japan and Germany. With the construction of the NIF almost assured (Congress has been known to change its mind), scientists working on inertial fusion still believe that a commercial demonstration power plant, based on inertial fusion, could

be operational around 2025. Good starting points for web information on inertial fusion are [http:// www.dp.doe.gov/](http://www.dp.doe.gov/) or [www.llnl-lasers.gov/](http://www.llnl-lasers.gov/) or [www.sandia.gov](http://www.sandia.gov/) (then look for "pulsed power") or [www.lanl.gov/](http://www.lanl.gov/)

#### MAGNETIC FUSION SET BACK (AGAIN)

Neither the House nor the Senate provided the funds requested by the President for programs managed by the DOE Office of Fusion Energy (97% of which are for magnetic fusion research and 3% of which support energy applications of ICF). Indeed the House slashed the President's request by 17% (this on top of last year's cut of 33%). The result would be a budget of \$225 million, compared to this year's \$244 million. The Senate did somewhat better, allocating \$240 million, compared to the President's request of \$272 million.

DOE officials are saying that they have "restructured" the (magnetic) fusion energy program to be a "science program" (see our February and July newsletters) and have abandoned any timetable for completing the research phase of the program. Previously, both the magnetic and inertial fusion programs were aimed at operation of a commercial demonstration power plant in 2025. DOE cites "Congressional guidance" for the change in mission. DOE has restructured and renamed its Office of Fusion Energy to the Office of Fusion Energy Sciences (OFES). Dr. N. Anne Davies will continue to head the Office, which is subdivided into two Divisions (Science and Technology). Dr. Milton Johnson will head the Technology Division as well as serving as deputy to Dr. Davies. Dr. John Willis will head the Science Division, which is larger than the Technology Division by the ratio of \$144 million to \$84 M

this year. In keeping with its "science" focus in the President's FY97 request, DOE asked for increases of \$27 million for its Science Division and \$1 million for its Technology Division.

A good place to start web browsing (and for downloading DOE and DOE Advisory Committee policy statements, PDF format), is the OFES Home Page: <http://www.foe.er.gov/> or the Princeton Plasma Physics page: <http://www.pppl.gov> There are good hyperlinks from here to many other fusion sites around the world.

### **FRANCE, GERMANY DECLINE ITER SITE**

The science ministers of France and Germany (Francois d'Aubert and Juergen Ruettggers) caught U.S. officials by surprise by issuing a joint communique July 17, stating ". . . France and Germany do not want to apply to be the location of the International Thermonuclear Experimental Reactor." Their decision, they said, was based on the expectation that the host country would be asked to pay for up to 70% of the estimated \$10 billion cost. The complete text of their statement is as follows:

"According to the European Commission's first report (Framework Assumptions) on the implementation of ITER, the host might have to pay up to 70% of the cost of construction. Under these conditions, France and Germany do not wish to and are not able to propose candidate sites for ITER. However, the two countries are both of the opinion that the EDA (Engineering Design Activities) should be pursued until its completion in 1998, so as to gain further information concerning the implementation of ITER. In Europe, controlled thermonuclear fusion is pursued as a potential energy source for the next century. The European Union has made much progress in fundamental physics and improvements in technology. Several research installations exist already. In Cadarache, France, the CEA has been working very successfully on fusion for years. Germany will continue to concentrate its efforts in this field in Greifswald (W7X), working in cooperation with the Max Planck Institute of Plasma Physics. With existing and planned projects, France and Germany support the declared goal of further progress at world level in controlled thermonuclear fusion. For the moment, four partners are participating in the ITER-EDA. France and Germany want to wait for the final report from the EDA, and on that basis will define their commitment, in the European Union framework."

### **FESAC REPORTS**

The newly-named Fusion Energy Sciences Advisory Committee (FESAC), chaired by Bob Conn (UCSD) met in Gaithersburg, MD, July 16-17. The committee discussed the current budget situation and heard reports from three special review panels: on the priorities among the major tokamak facilities, on alternative concepts, and on inertial fusion energy. The major facilities panel had completed its work in May and Conn had already sent recommendations to DOE. Letter reports to DOE were adopted by FESAC and sent to DOE on the other two topics. FESAC will get a new chairman and many new members effective August 18 (See related story this issue).

### **MAJOR TOKAMAK FACILITIES PRIORITIES**

The FESAC Scientific Issues Subcommittee (SciCom), chaired by Jim Callen (U. Wisconsin), formed a "Major Facilities Review Panel," chaired by Hutch Neilson (ORNL) to review the "major U.S. fusion facilities" and produce "an optimum plan for obtaining the most scientific benefit from them." Three facilities were under review: TFTR at PPPL, DIII-D at GA, and Alcator C-Mod at MIT. The report of the panel and a covering letter from SciCom was transmitted to DOE Director of Energy Research Martha Krebs May 21 by FESAC chairman Bob Conn. The panel report contains two recommendations: (1) The DIII-D facility at General Atomics should have its operating time in FY1997 increased by about 50% (within their reference budget level) by reducing downtime for and/or delaying the divertor upgrade installation. (In his covering letter, SciCom chairman Jim Callen said that SciCom did not agree with this recommendation of its Panel by a vote of 9-6); (2) Additional resources of about \$1 million should be applied to the Alcator C-Mod program at MIT. This money was to be obtained 50-50 from TFTR and DIII-D. (Callen indicated that SciCom agreed with this recommendation by a vote of 13-1-1).

### **ALTERNATIVE CONCEPTS**

The FESAC SciCom established an "Alternative Concepts Review Panel," chaired by Farrokh Najmabadi (UCSD) to "review the status of alternative concept development in light of the international fusion program and produce an overall plan for a U.S. alternative concepts development program, including experiments, theory, modeling/computation and systems studies, which is well integrated into the international alternative concepts program." The Panel

report, endorsed by SciCom and FESAC, developed criteria for evaluating alternative concepts, a classification scheme related to their level of maturity, and recommended establishment of a "Concept Development Panel" to "provide consensus scientific input and recommendation on the directions and priorities of alternative concepts research." For FY1997, they recommended ("not in priority order") (1) an "expansion of the Concept Exploration Activities," (2) "initiation of a proof-of-principle program in the spherical tokamak (ST) area and construction of new ST experimental facilities," (3) "strengthening and broadening of the existing reversed field pinch (RFP) program," (4) "an expanded stellarator program, including theoretical studies, concept development, and collaborations on international experiments," and (5) "establishment of a vigorous theory activity in alternative concepts."

DOE had earmarked \$10.6 million of the \$28.2 million increase it was seeking in the FY 1997 budget request for alternative concepts. Since it is likely that there will be little, if any, increase (and probably a decrease) in FY 1997 relative to FY 1996, DOE will have a major task deciding how to implement these recommendations. DOE did not indicate its priorities at the FESAC meeting.

## **INERTIAL FUSION ENERGY**

FESAC established an "Inertial Fusion Energy Panel," under the chairmanship of John Sheffield (ORNL) "to consider inertial fusion energy and recommend what the new Fusion Energy Sciences program should be doing in support of this future fusion application, and at what level," in light of the fact that the DOE now proclaims that "the fusion program no longer has as a goal the operation of a demonstration power plant by 2025." The Panel found that progress in the inertial fusion energy (IFE) program (which consists almost entirely of heavy ion accelerator driver development) has been good since 1993 despite it having been funded at only about half the level recommended by FEAC Panel 7; that "a strong IFE program is a proper and important component of the restructured OFES/DOE program;" that there is "an essential symbiotic relationship" between the IFE program supported in OFES and the larger ICF program supported in DOE Defense Programs, such that "the United States is positioned to lead the world in IFE science and technology;" that "the time frame is set by a succession of anticipated events in the DP (Defense Programs) and the OFES programs," for example the planned shutdown of TFTR in 1997 or 1998, the planned completion of the ITER EDA in

1998, and the planned operation of the National Ignition Facility in 2002, such that DOE should encourage the preparation of some new initiatives, "including one in IFE," to be "ready for consideration by OFES" (in this time frame). The Panel believed that "there is a need for an Integrated Research Experiment (IRE)" and encouraged DOE to develop a conceptual design for such a facility by 1999.

The Panel and FESAC recommended that "the budget for the IFE program should be increased to about \$10 million per year (it is now \$7.8 million) for the next few years," with about \$2-3 million devoted to "non-driver science and technology, with highest priority (beyond heavy ion driver development) being wall protection and cavity clearance schemes and confirmatory simulations of heavy ion driver target performance." FESAC qualified its endorsement by adding "a final judgement on the proper budget level and program balance (should) await final resolution of the FY 1997 budget for OFES programs."

## **SHEFFIELD TO HEAD FESAC**

John Sheffield (ORNL) will become chairman of the Fusion Energy Sciences Advisory Committee effective August 18. He replaces Bob Conn, who chaired FEAC/FESAC since its inception in 1991. Conn, who is Dean of Engineering at the University of California at San Diego, will remain as a member of FESAC. FESAC will have many new members. The new membership includes: Ira Bernstein (Yale), Richard Briggs (SAIC), Jim Callen (U. Wisconsin), Patrick Colestock (Fermilab), Melissa Cray (LANL), Fred Dylla (Thos. Jefferson Accelerator Laboratory), Katherine Gebbie (NIST), Richard Hazeltine (U. Texas), Joseph Johnson (Florida A&M U.), Charles Kennel (UCLA), Mike Knotek (Battelle), John Lindl (LLNL), Earl Marmor (MIT), Bruce Montgomery (MIT), Marshall Rosenbluth (UCSD), Tony Taylor (GA), Nermin Uckan (ORNL), and Stewart Zweben (PPPL). In addition, the chairs of the plasma and fusion divisions of the American Physical Society, American Nuclear Society, and Institute of Electrical and Electronic Engineers will be ex-officio members. This year those individuals are Stewart Prager (U. Wisconsin), John Davis (McDonnell Douglas), and Ned Sauthoff (PPPL), respectively. There will probably be one or two others named. No date has yet been set for a meeting of the reconstituted FESAC.

## **FICUS WRITES DAVIES**

Following a meeting May 15, Fusion Industry Council, United States (FICUS) chairman Sam Harkness (Westinghouse) wrote a letter dated July 2 to DOE Office of Fusion Energy Sciences head N. Anne Davies, providing her "FICUS thoughts on those issues directly related to fusion matters." Harkness said that on the issue of "ITER versus base program support," FICUS views were split, "although more members were in favor of not letting increased ITER support erode the base program." He said that "a number of FICUS members recommended that an attempt be made to organizationally separate the ITER and the base program budgets in order to protect one from the other." On the issue of the "benefits for ITER construction in Canada," he said that "FICUS generally feels that the US should include the Canadian site as a possibility in any discussions where our input is requested," based on "overarching issues such as cost, risk and schedule rather than suggesting any parochial views such as convenience to US fusion researchers." He said that "US fusion industry strongly encourages the US fusion program to develop new confinement schemes that lead to a simpler, more maintainable reactor than does a tokamak. Further, FICUS feels that there (should) be considerable industrial involvement in reactor design efforts based on these alternative approaches and, in fact, should assume project leadership as soon as practicable." He said, "Finally, FICUS notes that fusion industry presently is not involved in the process of identifying and selecting alternative fusion concepts possessing the potential for practical fusion power. Consequently, we recommend that DOE form a panel of potential reactor vendors and users to help select those alternate confinement approaches with the most potential for upgrade to a reactor." Copies of the FICUS letter are available from Fusion Power Associates.

## **THE PLASMA TOUCH**

Reprints are available from Fusion Power Associates of an article entitled "The Plasma Touch" by FPA president Steve Dean, in the June 1996 issue of *The World and I*, a monthly National Geographic-style magazine published by The Washington Times and sold in major bookstores throughout the world. The article describes a wide range of commercial technologies that depend on plasma processing techniques developed in part by scientists working on fusion.

## **MEETINGS**

**August 12-13** - NAS Inertial Confinement Fusion Advisory Committee. LLNL. Contact Dave Crandall at DOE (202) 586-2349.

**August 27** - ITER Industry Council. St. Louis. Contact Bill Ellis, (212)839-3398.

**Sept 9-13** - 11th Kiev International Conference on Plasma Theory and 11th International Congress on Waves and Instabilities in Plasmas. Nagoya, Japan. Contact icpp96@nifs.ac.jp

**Sept 16-20** - 19th Symposium on Fusion Technology (SOFT). Lisbon, Portugal. Contact SOFT Secretariat, Fax: 351-1-841-78-19.

**Sept 17-18** - FESAC SciCom. PPPL. Contact Jim Callen (608)262-1370.

**October 7-11** - 16th IAEA Fusion Energy Conference. Montreal, Quebec, Canada. (Must be nominated by your government.) US persons contact Ron Blanken, (301)903-3306.

**October 22-25** - Solid State Lasers for Application to Inertial Confinement Fusion. Paris, France. Contact (US): Deana Eshpeter (510)424-3685; eshpeter@llnl.gov  
Contact (Europe): Evelyne Biessy (France) 33/16926-5298; biessy@bruyeres.cea.fr

## **QUOTABLES**

"Fusion still is, in fact, an energy program focusing on an eventual product rather than a research program solely to advance plasma and fusion science. In this connection we (FICUS) feel that an emphasis on plasma and fusion science to the exclusion of energy will lead to a continuing downward spiral of congressional support."

Dr. Samuel D. Harkness, Director  
R&D Operations, Westinghouse, and  
Chairman, FICUS  
July 2, 1996 letter to Dr. N. Anne Davies





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### MIT JOINS FUSION POWER ASSOCIATES

#### NEW AFFILIATE

The MIT Plasma Fusion Center (PFC) has joined Fusion Power Associates as an Institutional Affiliate. Dr. Miklos Porkolab, Director, will represent the Center. He can be reached at (617)253-8448; fax: -0238; email: porkolab@pfc.mit.edu. The PFC address is 167 Albany Street, NW16-288. Cambridge, MA 02139. We welcome their participation in Fusion Power Associates.

#### ALCATOR C-MOD AT MIT

With an operating budget that has ranged around \$10-15 million a year, the Alcator C-Mod tokamak at the MIT Plasma Fusion Center is the smallest of U.S. "major tokamak facilities," and some say the most cost-effective. The Alcator C-Mod is the latest in a series of high magnetic field, compact tokamaks at MIT pioneered by Bruno Coppi and Ron Parker. A recent view by a subpanel of the DOE's Fusion Energy Advisory Committee (See our August newsletter), recommended that additional resources of about \$1 million "should be applied to the Alcator C-Mod program to increase its near-term scientific output and to build up scientific capabilities needed for the long-term." The panel said, "The development of Alcator C-Mod capabilities has been hampered by tight budgets for its entire operating life."

The panel said, "The emphasis of the Alcator C-Mod program over the next two years will be to develop heat and particle control schemes for advanced tokamak scenarios, and to develop the heating and current drive and diagnostic capabilities for the future." They said, "The panel notes the potential for Alcator C-Mod to make significant contributions in this area in the long term; in particular, the tokamak has the capability to operate pulse lengths that are



*Dr. Miklos Porkolab*

several times the current-penetration time, 7 sec at 5 T toroidal fields."

Alcator C-Mod recently completed a scheduled five-month maintenance and upgrade period and has begun a short operating campaign. Experiments in progress will concentrate on issues of dissipative divertor operation and H-mode confinement and threshold conditions. New capabilities installed during the upgrade include a prototype divertor cryopump and divertor Thompson scattering (PPPL collaboration). The C-Mod group, under the direction of Ian Hutchinson, puts out a "Weekly Highlights" report by email. Persons wishing to be on the distribution for these reports can send their request to wolfe@cmod2.pfc.mit.edu

#### PROGRESS ON JET

The Joint European Torus (JET), the largest tokamak facility in Europe, completed a 9 month scheduled shutdown

on March 31 and has begun operations. The main purpose of the shutdown has been to carry out major modifications to the divertor. Modifications were also carried out on the Ion Cyclotron Resonance Heating antennae and the Lower Hybrid Current Drive launcher. The current operations campaign is aimed at the production of some 10 MW of fusion power for several seconds. According to JET officials, "This would be a major achievement, improving the power by a factor of 5 on JET's previous results." Progress on JET can be tracked on their web page, <http://www.jet.uk/>

## **PROGRESS ON JT-60**

JT-60, the largest tokamak facility in Japan, recently achieved record injection power of negative ion neutral beams into the device (See our May newsletter) of 200 kV, 3.2 A, 10 seconds. Emphasis has been on "core physics research," studying a reversed shear configuration (See our September 1995 newsletter) with plasma currents of up to 2.5 MA at 4 T. Fusion performance was found to be "significantly improved," with equivalent D-T Q-values of 0.6, comparable to the best achieved in TFTR and JET. Energy confinement times of up to 0.87 seconds were achieved. Progress on JT-60 can be tracked on their web page, <http://www-jt60.naka.jaeri.go.jp/>

## **PLASMA APPLICATIONS**

Plasma applications will be a featured topic at the 49th Annual Gaseous Electronics Conference, 20-24 October. The conference will be held in the conference facilities of the Advanced Photon Source at Argonne National Laboratory near Chicago, IL. The conference hotel is the Hyatt Regency Oakbrook, (630)573-1234. Among the topics of interest: plasma and surface chemistry in semiconductors, ion-surface interactions, deposition of diamond and diamond-like films, dielectric etch techniques and mechanisms, laser discharges and ablation, magnetron sputtering and physical vapor deposition, plasma sprays and plasma torches, plasma processing of polymers and other materials, discharges in air and other materials, plasmas in displays. Registration prior to September 30 is \$210; after that \$240. For further registration information, contact Conference Services, Argonne National Laboratory, fax: (630)252-5274.

## **DOE SETS "DECISION PROCESS" REVIEW**

In a press release dated August 1, DOE said it would conduct "a series of four departmental and laboratory

reviews of the process of making management decisions shaping the agency's research laboratory complex." Deputy Energy Secretary Charles Curtis said that the first review, to be completed by November 1, would address "how DOE's research and development (R&D) program managers choose their R&D performers (DOE laboratories, universities, or industry) to carry out their missions." Curtis and John P. McTague (Vice President of Ford Motor Company), as chair and vice-chair, respectively, of the DOE Laboratory Operating Board, said they "will also examine whether work would be more effectively done if concentrated at a smaller number of R&D performers, and whether departmental programs could make better use of capabilities in universities and industry."

During the next year, DOE, through its Laboratory Operating Board, will conduct three addition reviews in series. The first "will examine the Department's small, mission-specific laboratories to 'validate' their roles and determine if they are candidates for privatization or alternative contracting mechanisms." The second "will examine the institutional and strategic plans for its nine, large multiprogram laboratories to determine how these may better contribute to the Department's needs." The third "will document and review the mechanisms used throughout the Department for evaluating the scientific and technical merit of the work at the laboratories."

The Laboratory Operating Board has issued a two volume report entitled "Strategic Laboratory Missions Plan - Phase I," available by calling (202)586-5575. The text of Volume I is also available on DOE's Home Page, <http://www.doe.gov/> in the "What's New" section.

## **WE THREW A PARTY**

Fusion institutions in the San Diego area set up and hosted a "Fusion Visitor Center" during the four days of the Republican National Convention, August 12-16. The center was located near the airport in space provide by Lockheed Martin Corporation to the host companies: General Atomics, ITER Joint Central Team, ITER U.S. Home Team, LLNL, Lockheed Martin, SAIC and UCSD. The exhibit area was manned from 8 AM to 3 PM each day. Copies of the invitation flyer were widely distributed at the convention, at convention media headquarters, and to delegates' hotels by Julie Van Fleet ([jfleet@sprynet.com](mailto:jfleet@sprynet.com)) of Van Fleet & Associates. According to Julie, "Although I had a few nibbles, there were no bites." She said, "The schedule of

activities is brutal and the competition stiff. C'est la vie."

## **HERRMANNSFELDT WRITES CURTIS**

In an August 6 letter to DOE Deputy Secretary of Energy Charles Curtis, Bill Herrmannsfeldt of the Stanford Linear Accelerator Center, Stanford University, said "I very much support the new science-based (fusion) program. My support is however conditional on the Office of Fusion Energy Sciences (OFES) following the recommendations of their committees. In particular, the recommendations for stressing innovative approaches have earned the program credibility in the Congress." He continued, "One area in particular, Inertial Fusion Energy (IFE), was reviewed again recently in response to a request by Dr. Krebs. The report of the FESAC/IFE Review Panel, which was chaired by Dr. John Sheffield, calls for a program at the \$10M level to lever off the DP/ICF program." He said, "I believe that your efforts to gain support in Congress for the President's budget for fusion will be especially aided if you can show that the OFES will follow a program in IFE that takes advantage of the advances provided by the National Ignition Facility." Copies of Herrmannsfeldt's letter are available from Fusion Power Associates.

## **OFES RESTRUCTURING**

The DOE Office of Fusion Energy Sciences (OFES) has coalesced into two divisions, a Science Division (headed by John Willis) and a Technology Division (Headed by Milt Johnson), as reported in last month's newsletter. Programs will not be managed by the divisions, however. Rather, management teams will be established, drawing staff as appropriate from the two divisions, to oversee programs in 8 topical areas. The areas are: Tokamak Physics, Alternate Concepts, Basic Plasma Science, ITER, Theory, Advanced Technology, Diagnostics, and International Programs (non-ITER). Team leaders for the various areas have not yet been announced. The OFES expects its staffing to be reduced from the current level of 39 to 29 as part of a general downsizing of the DOE.

## **ITER TOPICS**

Although the U.S. budget for ITER was reduced this year compared to the planned level, the U.S. has essentially met its obligations to ITER to date. DOE ITER program manager Warren Marton reports that through May 1, 1996, the U.S. has provided 102 person-years to the ITER effort, compared to 103 for Europe, 98 for Japan and 52 for

Russia. Based on current budget projections, by the end of the ITER Engineering Design Activities phase in mid 1998, Marton estimates that the U.S. will have contributed 188 person-years, the Europeans 210, the Japanese 210 and the Russians 105.

The ITER Technical Advisory Committee (TAC), chaired by Paul Rutherford of the U.S., met July 8-10 in Vienna and submitted a report to the ITER Council at its meeting July 24-25 in St. Petersburg. The TAC reviewed a number of detailed design features of ITER. The most contentious issue is a suggestion that the central solenoid be changed from its current monolithic structure to one that is segmented. The TAC showed a strong preference for the segmented option, citing advantages such as better plasma shape control, more flexibility for operating steady-state, reduced manufacturing risk, reduced requirements on other components, and possible reduced overall cost. However, due to the advanced stage of the design effort, the TAC concluded that it would be difficult to complete a redesign within the remaining time span of the EDA. They therefore recommended that the current design be retained as the primary option, with the segmented option as a backup to be revisited during the construction phase. Copies of all TAC and other ITER reports are available from the U.S. ITER Home Team, fax: (619)534-5440.

The ITER Joint Central Team expects to issue a "Detailed Design Report" by the end of this year. This report will be reviewed by specialists in the four parties, including a U.S. national review in early 1997. A "Final Design Report" will be issued by the end of 1997. The EDA officially ends in July 1998.

For more information on ITER, check out the ITER U.S. Home Team web page at <http://iter.ucsd.edu/> and the ITER JCT page at <http://www.iterus.org/>

## **MEETINGS**

Fusion Power Associates will sponsor a symposium on the topic "Materials for Fusion" December 16-18 in Oak Ridge, TN. The symposium is aimed at identifying critical issues and discussing policy on all aspects of materials R&D for fusion systems. Oak Ridge National Laboratory director Alvin W. Trivelpiece will keynote the symposium. The detailed agenda is still being developed and will be mailed separately to all recipients of this newsletter.

The newly re-constituted DOE Fusion Energy Sciences Advisory Committee (FESAC) described in last month's newsletter has tentatively scheduled its first meeting September 24-25 in the Washington, DC area. The meeting is open to the public. However, the meeting anticipates action from a House-Senate Conference on the FY1997 budget by mid-September; consequently contact Albert Opdenaker at DOE to confirm time and place, (301)903-4927; email: albert.opdenaker@mailgw.er.doe.gov

### **PLASMA CHEMISTRY AT PPPL**

Scientists at the Princeton Plasma Physics Laboratory (PPPL) are engaged in a joint project with Drexel University (Philadelphia, PA) and Plasma Technology, Inc. (Santa Fe, NM) to develop a novel technique for the conversion of toxic wastes and other materials to useful chemical products. Princeton is providing expertise in spectroscopic analysis to the project. Experimental work, carried out at Drexel, utilizes a commercial plasma torch manufactured by Tekna, a Canadian company, to provide a high temperature plasma in which complex molecules can be broken down into their constituent parts. The current phase of the work is looking at the synthesis of ozone and the conversion of polymeric materials such as polystyrene, which are difficult to eliminate from the environment. It is believed that the polystyrene can be converted to methane which can be used as a fuel. PPPL scientists are performing spectroscopic diagnosis with the goals of identifying the species and concentrations of the chemicals present. They are also developing a capability for chemical kinetics modeling to support research on plasma applications on a broad front. David Mikkelsen and Brent Stratton are co-principal investigators at PPPL. For further information, contact PPPL Information Services at (609)243-2750.

### **OPENNESS AT DOE**

In an August 9 "Dear Department of Energy Stakeholder" letter, DOE says that a National Academy of Sciences panel chaired by Dr. Wolfgang K. H. Panofsky, has issued a report that "affirms that the DOE is on track with its Openness Initiative." DOE says that the report states that the DOE "has demonstrated a clear commitment to openness." However, DOE acknowledges, that the report also states that while "admirable progress has been made toward openness by the DOE, as noted, there is a long road from changes in policy to reversal of the classification culture that dates back to the Manhattan Project." DOE says that it is

working toward implementing a recommendation of a 1995 National Research Council report to establish a "Classification Regulation." DOE says "The classification regulation will replace the past practice of issuing DOE orders on classification matters with a process of formal public rulemaking, in which the intended regulations are published in the Federal Register, with enactment following an opportunity for public comment." They are also moving forward with a "Fundamental Classification Policy Review" which, they say, "is the Department's first ever comprehensive review to determine what should really be classified with quick declassification of the remainder." However, on several recent occasions (See our April newsletter) FPA president Steve Dean and former AEC Chairman Glenn Seaborg have criticized the Fundamental Classification Review group for not facing up to specific issues. Seaborg criticized the DOE for dragging their feet on the declassification of his memoirs. Dean pointed out that the DOE has yet to declassify a single previously-classified document on inertial confinement fusion and continues to avoid the issue of declassifying aspects of the Halite-Centurion underground tests that DOE claims prove the "feasibility" of inertial confinement fusion.

### **QUOTABLE**

"Fusion power is the ideal solution to the energy problem, and its development should be given the highest priority. In May 1983 we were invited to visit the Lawrence Livermore Laboratories to see the great installations in magnetic and inertial fusion research. It was an enormously impressive experience, and, with the thought of what safe fusion power could contribute to the world's energy supply, I became more confident in the future. During my visit with President Reagan, I suggested that he take ten billion dollars from his defense program and apply it to a crash program for magnetic fusion development. Reagan raised an eyebrow to my temerity, but I believe it is obvious that once fusion is achieved, the energy shortage will be past and we will be independent of foreign fuels. In 1902 the automobile was in its infancy and the airplane an insubstantial dream. From the two cylinder gas engine to magnetic fusion is a giant stride, but, incredibly it can be accomplished within one lifetime."

Ansel Adams

"Ansel Adams: An Autobiography"

Ansel Adams, with Mary Street Alinder  
Boston: Little Brown, 1985



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### GERMANY LAUNCHES \$BILLION FUSION PROJECT FESAC URGES BROAD BASE FOR U.S. FUSION EFFORT

#### A BILLION DOLLAR STELLARATOR

Construction of the Wendelstein 7-X Stellarator will officially commence at the end of calendar 1996, with "calls for tender" to industry for the project. The facility will be built at a new branch of the Institute of Plasma Physics (IPP) in Greifswald (Mecklenburg-Vorpommern), which is in the territory that was previously known as East Germany. Germany will provide 55% of the cost, while 45% of the cost will be borne by the European Commission. Construction is expected to be completed in 2004; a staff of some 300 will be employed in operations. Seventy specially-shaped superconducting magnetic coils will provide the magnetic field configuration. The stellarator configuration, initially pioneered at the Princeton Plasma Physics Laboratory, is inherently steady-state, thus avoiding some of the transient features of the more popular tokamak configuration. There is mounting evidence that the plasma confinement properties are similar for both tokamaks and stellarators, though stellarators appear to lead to somewhat larger sized power plants. An announcement from the IPP states that "Wendelstein 7-X constitutes a key experiment for fusion research: it is intended to demonstrate that fusion devices of the stellarator type can achieve conceptual improvement avoiding the fundamental difficulties hitherto encountered." For further information, contact Isabella Milich by email at [ism@ipp-garching.mpg.de](mailto:ism@ipp-garching.mpg.de)

#### CONGRESS CUTS FUSION ENERGY AGAIN

For the second year in a row Congress has cut back funding for civilian fusion energy research. A House-Senate conference committee agreed to provide FY97 funding of \$232.5 million for programs conducted by the DOE's Office

of Fusion Energy Sciences (OFES). The bill has been passed by both houses of Congress. A "general reduction" is expected to lower the actual amount available to about \$230.1 million, however. President Clinton had asked for \$272 million. This year's level is \$244 million, while last year's level was \$365 million. The conference committee report made the following statement: "The conferees support the House and Senate inclusion of program direction and computational support within the amount provided for the fusion program. The conferees encourage the Department to reduce the amount identified for program direction, but do not stipulate amounts for program direction or computational support. To further provide maximum flexibility, the conferees have not included the prescriptive language included in the House report. The conferees have provided funds to continue and complete operations and provide for safe shutdown of the TFTR in fiscal year 1997. This is the final year of funding for fusion operations of TFTR. The conference agreement includes funding to continue the U.S. participation in the engineering design activities phase of the International Thermonuclear Experimental Reactor (ITER) project, to which the United States is committed through fiscal year 1998."

#### FUSION FOR DEFENSE ENDORSED

Congress provided the full amount requested by the President for Inertial Confinement Fusion (ICF), which is funded by DOE's Defense Programs office, including funds requested to begin construction of the National Ignition Facility (NIF). An amount of \$366.5 million was provided, of which \$191.1 million is for NIF. The ICF program, which is funded primarily as part of the "Science-Based Stockpile

Stewardship" program, also shows promise as a potential civilian energy source, provided DOE's civilian program develops an efficient, multi-pulse "driver" for igniting small capsules of fusion fuel. Ignition of single capsules is expected to be demonstrated in the NIF experiments around 2005.

## **FUSION ADVISORY COMMITTEE CONSIDERS BUDGET ALLOCATIONS**

The DOE's Fusion Energy Sciences Advisory Committee (FESAC) met September 24-25 in Gaithersburg, MD. A primary topic was to review the DOE/OFES "strawman" proposed distribution of the FY 97 budget approved recently by Congress. DOE/OFES proposed to "zero out" all fusion technology programs except those funded for the International Thermonuclear Experimental Reactor (ITER) project and to cut in half funding for Inertial Fusion Energy (IFE) for the development of an efficient, multi-pulse "driver" to provide an energy development path to complement the ICF/NIF program funded by DOE's Defense Program. OFES also proposed to cut by more than half, its Systems Studies program aimed at identifying the critical issues associated with deriving commercial benefits from fusion R&D. OFES believed that these cuts were necessary to accommodate the Congressional cut, while giving priority to the Tokamak physics program and plasma science programs in universities.

Votes were taken on various programmatic and budgetary issues on the second day of the FESAC meeting. Seventeen members voted; not everyone voted on every issue. Chairman John Sheffield did not vote. The FESAC unanimously re-affirmed "the importance of proceeding expeditiously" to implement the so-called "Restructured Fusion Energy Sciences Program" (see our February 1996 newsletter). However, FESAC split 11-6 on the question of whether "broadly speaking, the DOE (strawman) budget strategy is responsive to the FEAC restructured program proposals." The FESAC was unanimous in stating that the budget needs to be presented in a way to make it "clearer" that the restructuring is underway and that there is extensive national and international collaboration underway in all elements of the program. They were also unanimous in their opinion that the Princeton Plasma Physics Laboratory needed "to emphasize more clearly the transition to its future program." The FESAC was fearful that, unless this was done in a visible way, the fusion program risked losing the

money labeled as "TFTR" after TFTR was shut down during the next year.

Votes were taken on the budgets proposed for various elements in the strawman budget. With respect to the tokamak experimental physics budget (proposed to go from \$115.0M to \$111.1M next year), 11 members said the amount was "slightly too high," 3 said it was "roughly correct," and 2 said it was "slightly too low." With respect to the Alternate Concepts budget (proposed to go from \$7.4M to \$13.1M), 3 said it was "slightly too high," 7 said it was "roughly correct," and 7 said it was "slightly too low."

With respect to Inertial Fusion Energy (IFE), the FESAC voted 15-2 to recommend that its status be elevated that of being a principal alternative concept to the tokamak. Previously the OFES had described the program as an "enabling technology" and budgeted it as a subcategory of the Technology program. The FESAC also voted 15-1 to restore some or all of the IFE funding cut proposed in the strawman budget, which had proposed a cut from \$7.8M to \$4.9M.

On Fusion Theory, 11 persons thought the budget (proposed to go from \$18.6M to \$16.8M) was "slightly too low," and 5 thought it was "roughly correct." In the area of Basic Plasma Science (proposed to go from \$0.2M to \$3.0M), 12 persons thought this be to "correct," and 5 thought this was "high." The strawman budget had proposed to "zero out" the plasma technology and fusion technology programs, which this year have budgets of \$5.6M and \$3.3M, respectively. The FESAC voted 11-4 to restore some or all of the plasma technology money and 9-5 to restore some of the fusion technology money.

The strawman budget proposed to reduce ITER and its direct supporting technology programs from \$54.4M plus \$5M, respectively, this year to \$54.5M total next year. Three persons thought that the amount allocated in the strawman budget was "slightly too high," 5 thought it was "roughly correct," and 5 thought it was "slightly too low." The FESAC also voted 12-4 to restore some or all of the proposed cuts in the Materials category, which had been targeted for a reduction from \$7.9M to \$4.9M. They also voted 9-5 to restore some or all of the money to the Systems Studies category, which had been earmarked for a reduction from \$2.3M to \$1.0M.

When asked to indicate the priority in which the recommended increases should be funded, 13 members indicated Inertial Fusion Energy, 9 indicated Base (Plasma and Fusion) Technology, 9 indicated Materials, 7 indicated Theory, and 5 indicated Systems Studies. A variety of opinions were expressed on the question of where money for the proposed increases should come from. In the end, FESAC voted to leave that problem to the DOE, taking into account the written opinions that had been expressed.

FESAC member Charles Kennel (UCLA) attended only the first day of the meeting and hence did not take part in the voting. Members Bob Conn (UCSD), Katherine Gebbie (NIST), and Mike Knotek (PNL) did not attend. As mentioned, chair John Sheffield did not vote. The 17 voting members present were: Ira Bernstein (Yale), Richard Briggs (SAIC), Jim Callen (Wisconsin), Melissa Cray (LANL), Sam Harkness (Westinghouse), Richard Hazeltine (Texas), Joseph Johnson (Florida A&M), John Lindl (LLNL), Earl Marmor (MIT), Bruce Montgomery (MIT), Marshall Rosenbluth (UCSD), Tony Taylor (GA), Nermin Uckan (ORNL), Stewart Zweben (PPPL), Stewart Prager (Wisconsin and APS), John Davis (McDonnell Douglas and ANS), and Ned Sauthoff (PPPL and IEEE).

Over 20 members of the fusion community signed up to make statements during the Public Comment portion of the meeting, the most ever for a fusion advisory committee meeting. Chairman John Sheffield revised the meeting agenda to accommodate all of them. Public comment was heard from shortly before noon on the first day until 7 PM that night. Numerous written statements had also been received and were distributed at the meeting.

## **EUROPEAN FUSION REVIEW NEARS COMPLETION**

Earlier this year, the European Commission (EC) established the membership and terms of reference for the "1996 Fusion Evaluation Board," under the chairmanship of Sergio Barabaschi of the Ansaldo Company, Italy. Barabaschi is a former Under Secretary of State (Italy) for Research and Development. These reviews are conducted approximately every 5 years, with the last one being the so-called "Columbo Committee" in 1990. The panel has a broad charter, including comparing fusion's prospects with other energy sources; taking into account scientific, technical, environmental, socio-economic, and financial

aspects of the fusion program. It will also address the balance of support between next generation facilities, such as ITER, other types of fusion concepts, and long term fusion technologies. The Board has spent much of the summer visiting fusion sites in Europe and holding discussions. Their report is due at the end of this month and will be submitted for consideration as part of the European Union's "5th Framework Programme of R&D," which is for a 5-year funding plan beginning in 1998.

## **JT-60 SETS NEW RECORD**

Scientists working on the JT-60 tokamak at the Japan Atomic Energy Institute have set a new world record for the fusion "triple product" of plasma density confinement time, temperature, and a new record temperature of 45 keV (about 500 million degrees). The triple product reported is  $1.5 \times 10^{21} \text{ m}^{-3} \text{ s keV}$ . The record surpasses the previous record, also set in JT-60, by about 20%. The improvement was obtained by optimization of operation at high plasma current with fast current ramp and current profile peaking, resulting in improved stability and confinement. For further information, contact H. Kishimoto by email at [hiroshik@naka.jaeri.go.jp](mailto:hiroshik@naka.jaeri.go.jp) and ask for JT-60 report No. 36, or check out the JT-60 web site at <http://www-jt60.naka.jaeri.go.jp>

## **CFFTP INCREASES ITER WORK**

The Canadian Fusion Fuels Technology Program (CFFTP), in Mississauga, Ontario, has taken on more work and wider responsibilities for the ITER remote handling program, at the request of Europe's ITER Home Team. They will be assisted by Spar Aerospace, Weston, Ontario. CFFTP is now working on divertor cassette replacement and maintenance, replacement of breeder blanket modules, and cryogenic vacuum pump replacement methodology. Europe's Home Team has also expressed an interest in a Canadian laser camera, which has metrology capabilities, for possible use in positioning divertor subassemblies during the refurbishing of the divertor cassettes in hot cell facilities. This camera will be tested at the JET fusion site this year. For more information, contact Janine Loring at email: [janine.loring@oht.hydro.on.ca](mailto:janine.loring@oht.hydro.on.ca)

## **CCFM SPINOFFS STUDY AVAILABLE**

The Centre Canadien de Fusion Magnetique (CCFM), in Varennes, Quebec, has had its fusion activities reviewed from the point of view of the social and economic benefits

that have arisen from its fusion program. The study, performed by Michel Trepanier of Quebec's Institut National de la Recherche Scientifique (INRS), found that one third of the companies associated with the CCFM program saw their exports increase significantly in the wake of their contracts with CCFM. Almost all companies definitely increased their technological capabilities as a result of their CCFM contracts. Examples of custom goods and services supplied to CCFM by local companies included complex microwave antennas, plasma spray equipment, computer controls and data acquisition systems, and high voltage power supplies. A 20-page summary report is available in english from Dr. Richard Bolton, email: [bolton@ccfm.ireq.ca](mailto:bolton@ccfm.ireq.ca)

As we go to press, scientists from around the world are converging on Montreal for the 16th IAEA Fusion Energy Conference. During the conference, attendees will have an opportunity to visit CCFM and see the TdeV-96 tokamak facility there.

### **DOE FUSION STRATEGIC PLAN AVAILABLE**

The DOE Office of Fusion Energy Sciences has issued a report (DOE/ER-0684, August 1996) entitled "Strategic Plan for the Restructured U.S. Fusion Energy Sciences Program." Hard copy can be requested from Al Opdenaker at email: [albert.opdenaker@mailgw.er.doe.gov](mailto:albert.opdenaker@mailgw.er.doe.gov) The report can also be downloaded from the DOE/OFES web page: <http://wwwofe.er.doe.gov>

### **FPA BOARD MEMBERS ELECTED; SYMPOSIUM CANCELLED**

The members of Fusion Power Associates have elected Sam Harkness, Westinghouse, to a three year term to the FPA Board of Directors, commencing November 1, and re-elected Dave Baldwin (GA) and S. Locke Bogart (Lockheed Martin) to additional three year terms.

The FPA Symposium on Materials for Fusion, scheduled for December in Oak Ridge, TN, has been cancelled.

### **ITER MAGNET WORK PROGRESSES**

Winding of the superconducting coils for the prototype central solenoid for the International Thermonuclear Experimental Reactor (ITER) is underway at a Lockheed Martin facility in San Diego. ITER is a joint design effort of the U.S., Europe, Japan and Russia. Preparations for the

prototype coil is a cooperative effort among the parties. Superconducting and copper strands were fabricated by all the parties; the jacket material was fabricated in the U.S.; the materials were sent to the European Home Team who handled the cable jacketing operation; the model coil will be tested in Japan. Dr. Robert Aymar, director of the ITER project, said "The fabrication of the model coil marks a new and exciting stage in the ITER project." A seven minute animation of the assembly plan for ITER is available to the media on request. For further information contact Julie Van Fleet at email: [jfleet@sprynet.com](mailto:jfleet@sprynet.com)

### **FUSION DEFENDED**

Web Crawlers might want to check out a defense of fusion, in question and answer format, on the Scientific American web site (then click on physics):

(<http://www.sciam.com/askexpert/index.html#acs46>).

The defense is provided by Charlie Baker (U.S. ITER Home Team Leader) and Barrie Ripin (APS).

### **OFES REORGANIZATION**

The DOE Office of Fusion Energy Sciences (OFES) has reorganized into teams (see our September newsletter). The teams, and their respective leaders, are as follows:

**ITER:** Warren Marton (Leader), Sam Berk, Chris Bolton, Sam Cohen, Rostom Dagazian, T.V. George, Robert Kratzke, Darlene Markovich, Gene Nardella, Steve Rossi, Walter Sadowski, Stan Staten, and Bill Wiffen.

**Tokamak:** Erol Oktay (Leader), Sam Cohen, Bill Dove, Steve Eckstrand, Chuck Finfgeld, T.V. George, Jeff Hoy, Darlene Markovich, Gene Nardella, Steve Rossi, and Walter Sadowski.

**Technology:** Sam Berk (Leader), Sam Cohen, Bill Dove, T.V. George, Warren Marton, Gene Nardella, Steve Rossi, Stan Staten, Bill Wiffen, and Mark Wilson.

**Alternate Concepts:** Ron McKnight (Leader), Ron Blanken, Sam Cohen, Michael Crisp, Bill Dove, T.V. George, Jeff Hoy, and Darlene Markevich.

**Plasma Science:** Ron McKnight (Leader), Ron Blanken, Walter Sadowski, Michael Crisp.

**Theory:** Walter Sadowski (Acting Leader), Chris Bolton, Michael Crisp, Rostom Dagazian, and Steve Eckstrand.





## FUSION POWER ASSOCIATES

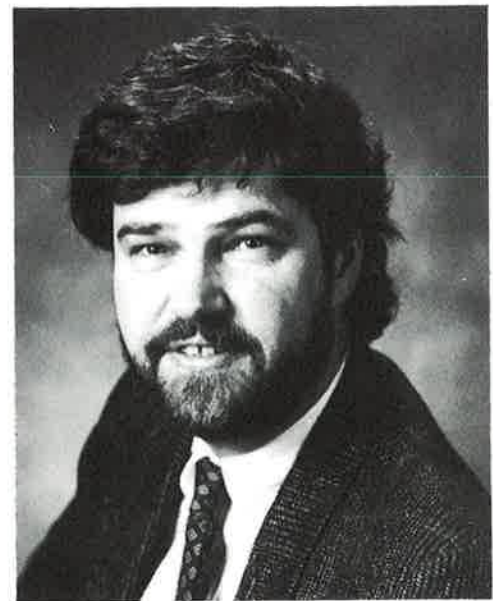
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### LLNL AND UCLA JOIN FUSION POWER ASSOCIATES UTILITY GROUP ENDORSES FUSION CONCEPTS

#### NEW MEMBER AND AFFILIATES

The Lawrence Livermore National Laboratory, Laser Programs, has joined Fusion Power Associates as a full voting Member. LLNL Associate Director for Laser Programs, Dr. E. Michael Campbell, will represent the Laboratory. He can be reached at LLNL, 7000 East Avenue, L-466, Livermore, CA 94550, (510)422-5391; fax: -5411. Fusion Power Associates appreciates the encouragement and support it has received from the Inertial Confinement Fusion community over the past two decades and is proud to welcome the LLNL ICF program as a Member of Fusion Power Associates.



*Dr. E. Michael Campbell*

The Lawrence Livermore National Laboratory, Magnetic Fusion Energy Program, has joined Fusion Power Associates as an Institutional Affiliate. Dr. Keith I. Thomassen, Program Leader - Magnetic Fusion Energy, will represent the Program. He can be reached at LLNL, P.O. Box 808, Livermore, CA 94550, (510)422-9815; fax: 424-6401. Fusion Power Associates also appreciates the encouragement and support it has received over the years from the LLNL Magnetic Fusion Program and welcomes their participation in Fusion Power Associates.

The University of California, Los Angeles (UCLA) Institute of Plasma and Fusion Research, has joined Fusion Power Associates as an Institutional Affiliate. Professor Mohamed Abdou, Co-Director, will represent the Institute. He can be reached at UCLA Institute of Plasma and Fusion Research, 44-133 Engineering IV, Los Angeles, CA 90095-1597, (310)206-0501; fax: 825-2599. We have worked closely with Prof. Abdou on a number of issues and projects over the years and look forward to working with the Institute.

#### UTILITY GROUP LIKES INERTIAL FUSION

The Fusion Working Group of the Electric Power Research Institute (EPRI) met at the Lawrence Livermore National Laboratory on September 16 to hear presentations on Inertial Fusion Energy (IFE) Power Plant concepts. Steve Rosen, Houston Lighting and Power, chairs the Group, whose other members are Jack Kaslow (EPRI), John McCann (Consolidated Edison Company), Dennis McCloud (TVA), Bill Muston (Texas Utilities Electric), Tom Schneider (EPRI), and Peter Skrgic (Allegheny Power System). In a statement issued after the meeting, chairman Rosen said "We came into this meeting with limited prior exposure to IFE and skepticism about its prospects, but we came away with a more positive feeling about IFE's potential. A lot more thinking and work has gone into IFE power plant designs that we had realized. IFE power plants

have some unique features that may help them meet some of the Criteria for Practical Fusion Power Plants that were developed by our working group." Among the "key attractive features" of IFE power plant designs, the Group noted that the use of thick fluid walls "increases the wall lifetime, minimizes first wall activation and maintenance, and minimizes the need for materials development." They also noted that "The demonstrated high reliability of accelerators for high energy physics helps make the case that heavy ion drivers will be highly reliable, which is crucial for power plant economics." They said that "The IFE group went a long way in convincing us that the target can be injected and that the driver can hit it on the fly." They said that "We are pleased that some experimental demonstrations are underway at LBNL." Copies of their 2-page report are available from Fusion Power Associates.

### **UTILITIES LIKE LATEST TOKAMAK DESIGN**

The EPRI Fusion Working Group also met at UCSD in San Diego September 17-18 to review the design of the Starlite Tokamak Demonstration Power Plant. In a letter to DOE Director of Energy Research Martha Krebs following the meeting, Chairman Steve Rosen said "We were often critical of what we saw (in the past) in that the existing preliminary designs and draft standards then available were not fully responsive to our new criteria." However the latest (ARIES-RS) power plant design and the accompanying safety requirements document pleased the Group. "The safety standards have been revised to directly address our criteria and the ARIES-RS conceptual design appears to have carefully considered our inputs in order to provide a useful starting point for further design evolution within the envelope of the newly-approved safety standards." He said that "while we would like to see a further reduction in the projected cost of energy, the ARIES-RS conceptual tokamak power plant design has many of the features we, as end-users, find attractive in a future power system."

Copies of Rosen's letter, and also copies of the EPRI report "Criteria for Practical Fusion Power Systems (1994)", are available from Fusion Power Associates.

### **NIF PLANS INDUSTRY CONTRACTS**

The Lawrence Livermore National Laboratory plans to let approximately \$121 million in contracts to industry in FY 1997 for support of construction of the National Ignition Facility (NIF). The activities will include continuing design

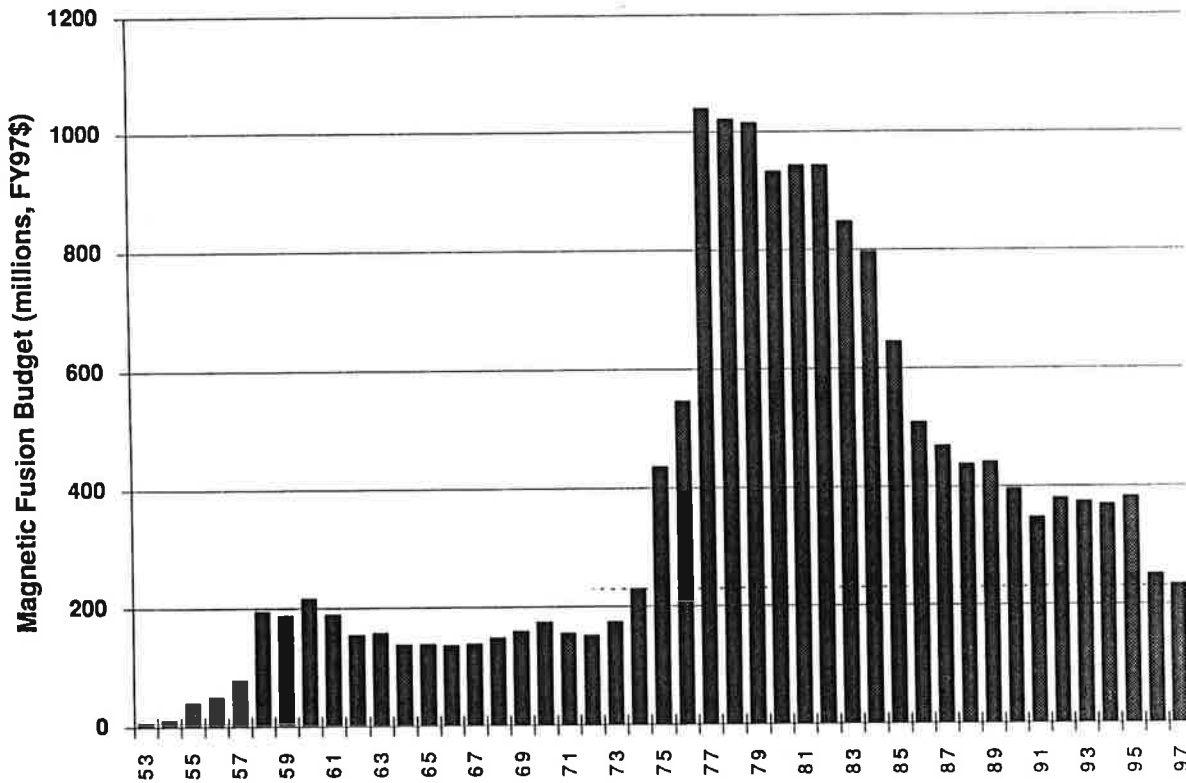
and component development; installing prototype optics manufacturing equipment and producing prototype optical components; completing site preparation; placing construction contracts for the Laser and Target Area Building and the Optics Assembly Building; and initiating long lead-time procurements for the target chamber materials and certain optical materials. This represents a marked increase in expenditure, compared to FY 1996, when more than \$18 million was contracted to over 35 companies for design and management support, manufacturing process development, component development, and precision part fabrication for prototyping facilities. For more information, contact Bill Hogan at (510)422-1344; fax: 423-6506; or by email: hogan5@llnl.gov

### **STELLARATORS MAKING COMEBACK**

In addition to the new W7-X stellarator planned in Germany (see our October newsletter), another billion-dollar class stellarator-like facility, the Large Helical Device (LHD), has been under construction in Japan. In July, the DOE's Fusion Energy Sciences Advisory Committee accepted the report of its Alternative Concepts Review Panel, which contained favorable findings on the stellarator concept, saying it "is in the transition phase between proof-of-principle and proof-of-performance." The Panel said that "The U.S. can play a valuable role in stellarator concept development. An appropriate U.S. focus area is in the effort to reduce the size of stellarator power plants." The Panel urged the U.S. to "seek to gain a support role on LHD and W7-X and seek to provide substantial theory support to LHD and W7-X." The U.S. is constructing a small stellarator, the Helical Symmetric Experiment (HSX) at the University of Wisconsin and, in mid October, a U.S./Japan Joint Institute of Fusion Theory workshop emphasizing stellarators was held at Columbia University. Persons wishing to follow stellarator progress should subscribe (free) to Stellarator News by contacting Jim Rome, (423)574-1306; fax: -0680; email:jar@ornl.gov

### **JAPAN PLANS LARGE FUNDING BOOST**

According to the October issue of "Physics Today," the Japanese government plans to boost funding on science and technology by \$155 billion over the next five years, a 50% increase over the 1991-1996 period. The plan is said to have broad support among various government agencies, including Parliament and the Ministry of Finance. The funding increases should make it easier for Japan to pursue their



*Fusion Energy Budget History, Adjusted to FY 1997 \$. Source: Dale Meade, PPPL*

goal of becoming the site for the International Thermonuclear Experimental Reactor (ITER). Budget requests for FY 1997 vs. FY 1996 already show the trend. Overall funding is slated to increase by 33%, with the Ministry of Education, Science, Sports and Culture getting a 20% increase; the Science and Technology Agency getting a 38% increase; the Ministry of International Trade and Industry getting a 237% increase; and other ministries getting a 128% increase for their R&D programs. In an address before the National Academy of Sciences in Washington on August 8, Japan's minister of state for science and technology, Hidenao Nakagawa said "Our vision is to create a country based on creative science and technology."

### END OF AN ERA?

The Congressional budget cuts of the last two years have reduced the U.S. fusion energy program's buying power to its 1974 levels, i.e., the level we were at just before the modern era of fusion science and technology R&D began.

During the intervening two decades, major facilities were constructed capable of heating and confining high temperature plasmas at conditions close to those required in a fusion power plant. Theoretical analysis and computer

simulations of these plasmas, in the words of Westinghouse director of R&D Operations Dr. Sam Harkness, "has developed a knowledge base that makes it credible to construct a burning plasma experiment/fusion engineering test reactor."

### MIT PRESIDENT ASKS FOR BOLD NATIONAL COMMITMENTS

In his annual report for the academic year 1995-96, MIT president Charles Vest asks for "a renewed national commitment to a bold and open society." He said that "Today - in 1996 - we live in an age that seems to reject bold thought and bold action." He asks, "Why is this? Does boldness come with a price tag we can no longer afford? Does it imply excess or waste or impracticality? Are we too cynical to embrace visionary new ideas? Have we turned from boldness because such vision and action usually call for shared commitment . . . and we only care for what affects us personally and immediately? Is this a natural outcome of our maturation as a nation and as a society?" He says, "We have slipped into complacency and self-interest, but we need not, and cannot, remain there. As a society we must once again believe that we can envision and generate greatness in our time, and build the foundation for future generations of

greatness." Vest says, "Take, for example, our nation's magnetic fusion program. As the trauma of the 1970's oil embargo and other 'wakeup calls' regarding worldwide energy needs have receded in our memories, we have ceased to think much about the future of energy supplies and utilization. The most conservative analyses indicate that we will need at least to double worldwide energy production by 2050 if nations around the world are going to have the opportunity to become industrialized and improve their standards of living. At the same time, doing this in a way that does not degrade the earth's atmosphere to an intolerable extent represents a major challenge. Just consider one country, China, with a population of 1.2 billion people, which is developing its industrial base and meeting its heating needs primarily by burning coal.

"Meeting the demand for energy throughout the world will require new technologies for large-scale generation of heat and electricity that are relatively environmentally benign and that utilize readily available fuels. It is difficult, if not impossible, to construct a scenario that does not involve substantial use of thermonuclear fusion reactors for this purpose. They offer the potential of using essentially inexhaustible fuel, producing very little radioactivity, and releasing no carbon dioxide into the atmosphere.

"The problem is that fusion science and technology are very complex and the state of the art must be advanced considerably over the next few decades. A great deal has been learned, but much remains to be done. In 1995, the U.S. fusion program was funded at a level of \$375 million and scheduled to increase substantially in the years ahead, in large part to meet our obligations to the International Thermonuclear Reactor (ITER) project. ITER is a large joint undertaking of the United States, Europe, Russia, and Japan. In 1996, however, funding for the U.S. magnetic fusion program has been cut to \$244 million - and is headed toward a still lower level in 1997. In order to maintain a viable program in the most essential basic fusion science and technology, the U.S. will likely have to drop its commitment to ITER. Reducing our overall fusion program to such levels decreases the probability that our companies will be major players in the provision of power generation plants in the expanding world markets as we approach the middle of the next century. Furthermore, we greatly increase the risk that no acceptable means of meeting world energy needs will be available."

Vest concludes, "Boldness flows from a spirit of adventure and a 'can do' attitude long associated with America. These characteristics must again be dominant. To be effective, however, we must remember that boldness must be accompanied by staying power." Copies of Vest's address can be requested from the MIT News Office, (617)253-2700; email: [newsoffice@mit.edu](mailto:newsoffice@mit.edu)

## PEOPLE

**Dr. Ron Davidson**, Director of the Princeton Plasma Physics Laboratory has announced his intention to step down as director effective January 1 to return to teaching and research.

**Dr. Bob Iotti**, Raytheon Engineers and Constructors, has resigned his post as Administrative Officer of the ITER project in San Diego.

**Dr. Chris Keane** has joined the Office of Inertial Fusion and the NIF Project at DOE. He received his Ph.D. from Princeton University and has worked in the inertial fusion program at LLNL for the past ten years. He can be reached at (301)903-3345.

**Dr. Ned Sauthoff**, PPPL, is the recipient of the IEEE 1996 United States Activities Board Divisional Leadership Award.

Errata: In our October newsletter we mistakenly said that Sam Cohen was a member of several new "teams" at the DOE Office of Fusion Energy. We meant Marvin Cohen. Sam Cohen is at PPPL. Also, we inadvertently left out Erol Oktay's name from the list of people on the ITER team. Sorry guys!

## ALTERNATIVE PATHS TO FUSION

A 12-page color brochure, "Alternative Paths to Fusion," has been prepared by the Lawrence Livermore National Laboratory. The brochure describes 18 nontokamak concepts, including inertial confinement fusion, field-reversed configurations, spheromaks, reversed-field pinch and non-maxwellian systems. Single copies may be obtained from Fusion Power Associates. Requests for larger amounts for distribution to your friends and the public, contact Keith Thomassen by fax at (510)424-6401 or email: [thomassen@llnl.gov](mailto:thomassen@llnl.gov)



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### JOHN LANDIS RECEIVES ANS NUCLEAR STATESMAN AWARD JOHN NUCKOLLS RECEIVES DOD PUBLIC SERVICE AWARD ENERGY SECRETARY HAZEL O'LEARY RESIGNS

#### LANDIS, NUCKOLLS HONORED

John W. Landis, retired senior vice president of Stone and Webster Engineering Corporation and a former chairman of Fusion Power Associates Board of Directors, was recently honored by the American Nuclear Society with its Nuclear Statesman Award. The award, established in memory of Henry D. Smyth, one of the original commissioners of the U.S. Atomic Energy Commission, recognizes individuals for outstanding service in developing and guiding the peaceful uses of atomic energy. Landis is also the recipient of Fusion Power Associates 1991 Distinguished Career Award.



John W. Landis



John H. Nuckolls

John H. Nuckolls, former director of the Lawrence Livermore National Laboratory and a former member of Fusion Power Associates Board of Directors, was recently honored by the U.S. Department of Defense as a recipient of the Secretary of Defense Outstanding Public Service Award. The award was presented for his assistance "in conducting the first-ever assessment of the health of the nation's nuclear stockpile." Nuckolls is also the recipient of Fusion Power Associates 1996 Distinguished Career Award.

#### ENERGY SECRETARY O'LEARY RESIGNS

As widely anticipated, Secretary of Energy Hazel O'Leary has announced her intention to leave her post effective January 20, 1997. In a press release dated November 13, the Department said that "despite bitter partisan attack to the worth and vitality of the agency, her colleagues have worked tirelessly and loyally to deliver on important commitments related to the department's national security, energy, environmental, science and technology, and economic missions. Among the "critical national issues" on

which the press release said there had been "clear progress for the American people," no mention was made of the historic production of 10 Megawatts of fusion power at the Princeton Plasma Physics Laboratory in November 1994.

#### PLASMA APPLICATIONS CONTINUE

Near-term commercial applications of plasma and fusion science and technology (see our December 1995) newsletter continue at an accelerating pace. Here are two examples

According to the Fall 1996 issue of the journal "Technology Transfer Business," technologies developed at government labs are underpinning a revolution in the \$220 billion U.S. textile industry, citing as an example, "A laser sensor developed (at the Princeton Plasma Physics Laboratory) to analyze particle behavior during fusion reactions is providing real-time information on polymer structure as newly made fibers fly by." The fusion program's contribution is one of many innovations in the textile industry being fostered by a

industry-government consortium called the "AMTEX Partnership," which was initiated by Energy Secretary O'Leary in 1993. The U.S. textile industry, under heavy competitive pressure from other nations with lower wage laborers, is fighting back by implementing new technologies to speed assembly lines while improving fault detection.

According to the August 1996 issue of "Dateline: Los Alamos," scientists there recently demonstrated a novel environmental technology that efficiently destroys a number of organic contaminants. The system destroys volatile organic compounds with a non-thermal plasma that creates large concentrations of free radicals (atoms or molecules that have unpaired electrons). High Mesa Technologies, Santa Fe, NM, is partnered with the Los Alamos National Laboratory on the project. The portable 20 kilowatt plasma system treated 10 cubic feet of contaminated gas per minute at McClellan and Tinker Air Force bases. According to the announcement, "the degree of destruction reached 99.9 percent for the trichloroethylene and nearly 98 percent for the perchloroethylene." Ninety-five percent removal is a standard target for today's environmental technologies.

In a 28-page paper, "Applications of Plasma and Fusion Research," in the June 1995 issue of the Journal of Fusion Energy, Fusion Power Associates president Steve Dean describes over 40 near-term applications of plasma technologies, with references for further information. Fusion Power Associates also has available on request an article, "The Plasma Touch," published by Dean in the June 1996 magazine, "The World and I," and a color brochure entitled "Investment in an Energy Source for Tomorrow -- Fusion -- Yields Important Benefits Today." The American Physical Society Division of Plasma Physics has also recently issued a color brochure entitled "The Pervasive Plasma State," authored by science writer James Glanz, that describes numerous applications of plasmas. Copies may be requested by contacting Saralyn Stewart at the University of Texas, (512)471-4378; [stewart@hagar.ph.utexas.edu](mailto:stewart@hagar.ph.utexas.edu)

## **FUSION COMMUNITY RETREAT REPORT**

Sixty representatives of the U.S. fusion community, hand-picked by DOE Office of Fusion Energy head N. Anne Davies, met October 22-24 in a retreat setting in Leesburg, Virginia. Six members were selected to summarize the results of the three days of discussion in the form of a letter to DOE Director of Energy Research Martha Krebs. The letter, signed by M. Abdou (UCLA), D. Baldwin (GA),

R. Briggs (SAIC), G. Neilson (PPPL/ORNL), S. Prager (U. WI), and T. Simonen (GA), was sent to Krebs November 3. A longer summary is still under preparation. In the November 3 letter (copies of which are available from Fusion Power Associates) the group said that the purpose of the workshop was "to chart the short and medium term future of the nation's fusion energy science program," and "to consolidate plans for restructuring the program, based on last winter's Fusion Energy Advisory Committee (FEAC) recommendations."

The letter suggests that there be a three-fold "vision" for the U.S. fusion program that "will serve to focus the U.S. program toward innovation and scientific discovery, to strengthen our ties to other fields of science, to position the U.S. to continue playing a significant role in the world fusion effort, and to form the basis for an expanded fusion energy effort when national needs require it." The three-fold vision is (1) "Understanding the physics of plasmas, the fourth state of matter;" (2) "Identifying and exploring innovative and cost-effective development paths to fusion energy;" and (3) "Exploring the science and technology of burning plasmas, the next frontier in fusion research, as a partner in an international effort."

The letter says that the group "addressed two tough, major issues in the restructuring process: the US role in the large international burning-plasma experiment (ITER); and the role in the restructured program of our dedicated national laboratory, the Princeton Plasma Physics Laboratory." Regarding ITER, the letters states, "We reaffirmed that the ITER program represents a unique opportunity for the United States to participate in advancing the fusion science frontier," and adds, "If ITER were not to continue beyond the Engineering Design Activity, the U.S. should continue to seek to participate at a similar financial level in an international burning-plasma experiment." Regarding the Princeton laboratory, the letter states, "As PPPL defines its lead-lab role in this restructured program, it will direct its on-site facilities to focus on exploration of innovative fusion concepts carried out as collaborative national activities. In parallel, PPPL will complete analysis and publication of the TFTR results; collaborate on DIII-D and Alcator C-Mod, enabling their increased scientific productivity; collaborate internationally in areas like DT-tokamak physics . . . and nurture core competencies and new activities in fusion science nationally." The letter proposes a set of six, generally-worded, "5-year objectives," and suggests

## FESAC TO MEET JAN 22-24

The DOE Fusion Energy Sciences Advisory Committee (FESAC) plans to meet in San Diego January 22-24. The committee will receive briefings on the ITER Detail Design Report (DDR) and take public comment on ITER. The FESAC has a charge from the DOE to review the DDR and has set up a set of technical subpanels on various aspects of the design and an integration subpanel. The subpanels are expected to officially receive the DDR in late December and hence will be in an early stage of their review at the time of the FESAC meeting.

Note to the fusion community and the public: If you have any opinion on ITER, the January meeting of the FESAC is the time to express it. If you cannot attend the meeting in person, send written comments to John Sheffield (sheffield@ornl.gov or fax: (423)576-6118). If you wish to attend the meeting or sign up for public comment, contact Al Opdenaker at DOE (opdenaker@mailgw.er.doe.gov or fax:(301)903-8584).

## NIF REPORTS

Two reports of interest to the National Ignition Facility (NIF) have recently been completed and are available from DOE on request. The first, dated September 1996 and issued by DOE's Oakland Operations Office, is entitled "Technology Basis and Site Comparison Evaluation for the National Ignition Facility." In addition to comparing five possible NIF sites, the report contains a good discussion of the role of NIF in the nation's Stockpile Stewardship Program. The report may be requested from Dave Crandall at DOE (david.crandall@dp.doe.gov or fax: (202)586-8005).

The second report is entitled "Programmatic Environmental Impact Statement (PEIS) for the Stockpile Stewardship and Management Program." It includes a discussion of the need for three new facilities, including the National Ignition Facility. Copies of the PEIS or its Executive Summary can be requested from DOE at 1(800)776-2765 or by writing to Reconfiguration Group, Office of Technical and Environmental Support, USDOE (DP-45), Washington, DC 20585.

## PEOPLE

**Mike Roberts** will take over as Director, Technology Division, DOE Office of Fusion Energy Sciences (OFES). He will replace **Milt Johnson**, who has been wearing two hats as Director of the Technology Division and Deputy Director of the OFES. Milt remains Deputy Director. Mike will continue to be responsible for ITER.

**Tom O'Neil**, UCSD, is the recipient of the APS DPP James Clerk Maxwell Prize for outstanding contributions to plasma physics.

**Christopher Clayton** and **Chan Joshi**, UCLA, are the recipients of the APS DPP Excellence in Plasma Physics Research Award.

**Michael Beer**, Princeton University, is the recipient of the APS DPP Simon Ramo Award for young scientists who have performed outstanding doctoral thesis research.

## FUTURE MEETINGS

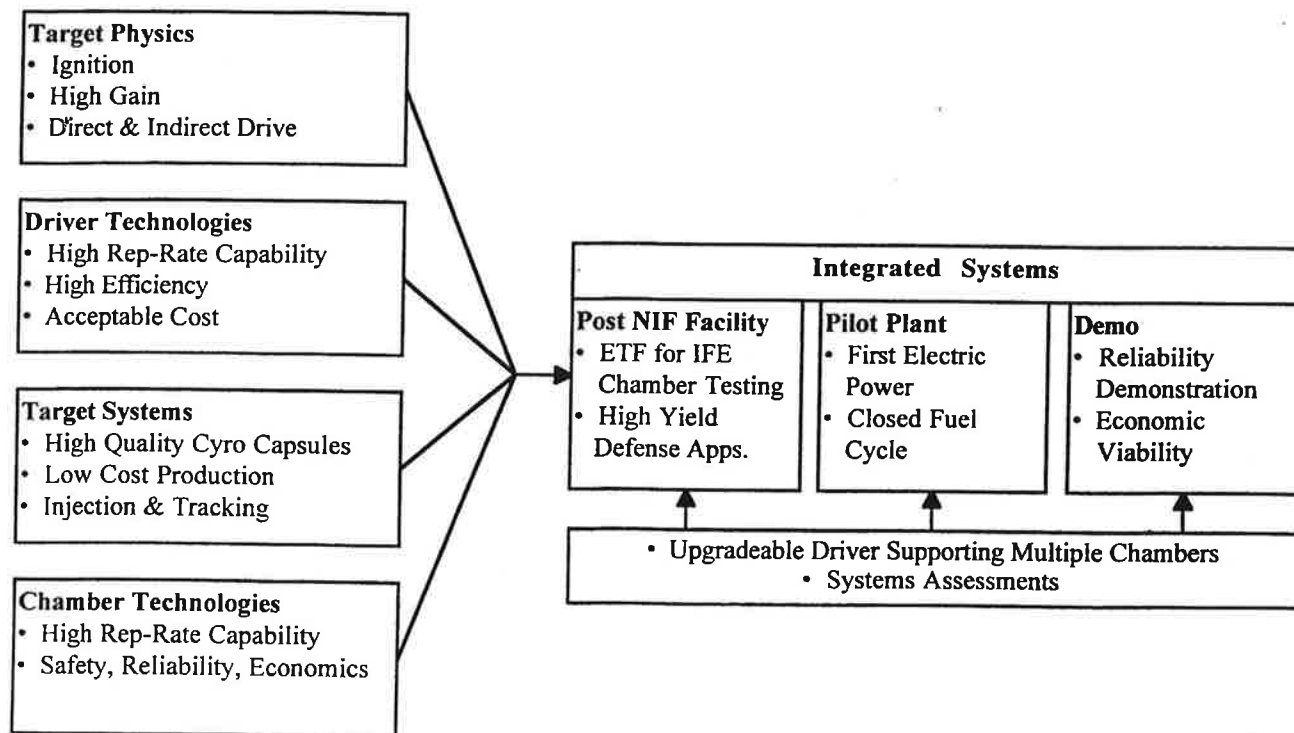
**Jan. 22-24** FESAC Meeting. San Diego. Contact Al Opdenaker, opdenaker@mailgw.er.doe.gov or fax (301)903-8584.

**March 10-14** IAEA Technical Committee Meeting on Drivers and Ignition Facilities for Inertial Fusion. Osaka University, Japan. Contact Prof. M. Nakatsuka, naka@ile.osaka-u.ac.jp or fax: 81-6-877-4799 or check web page: <http://www.ile.osaka-u.ac.jp/iaecatcm97/index.html/>

**March 10-14** 2nd Symposium on Current Trends in International Fusion Research. Washington, DC. Contact Dr. Julio Herrera, herrera@roxanne.nuclecu.unam.mx or fax:52-5-616-2233 (Mexico).

**April 6-11** Fourth International Symposium on Fusion Nuclear Technology. Tokyo, Japan. Contact Prof. Satoru Tanaka, isfnt4@hooker.gen.u-tokyo.ac.jp or fax: 81-3-3818-3455.

**April 13-18** Thirteenth International Conference on Laser Interactions and Related Phenomena. Monterey, CA. Contact Prof. George Miley, lirpp97@uiuc.edu or fax: (217)333-2906.



**Integrated Systems Development Path for Inertial Fusion Energy**

mechanisms for achieving them. The letter also says, "Throughout the workshop we discussed the need (emphasized by staff from OMB, OSTP, and Congress) for the fusion and plasma science community to improve communications with other scientific disciplines and to improve our outreach to the public and to the environmental and educational communities."

### **ITER DETAIL DESIGN REPORT FINISHED**

The ITER Joint Central Team has just put the finishing touches on the ITER Detail Design Report (DDR). The report, approximately 1000 pages in length, has been given to the ITER Technical Advisory Committee (TAC) for review at its scheduled meeting December 3-7 in Naka, Japan. The DDR, with an accompanying comment from the TAC, will be considered formally by the ITER Council (IC), the governing body for ITER, at its meeting December 17-18 in Tokyo. Presuming that the IC accepts the report, it will be released to the "Parties" (European Community, Japan, Russia, and United States) for national reviews. Based in part on the results of the national reviews, the respective governments will decide whether to begin formal "negotiations" this summer on whether to proceed to the construction phase of ITER. This would give the Parties approximately 1 year to complete negotiations, since the current agreement for the Engineering Design Activities

phase expires in July 1998. The results of the DDR review will also result in recommendations for some design improvements that will be incorporated in the Final Design Report, scheduled to be completed by December 1997.

### **SYSTEMS APPROACH FOR INERTIAL FUSION ENERGY**

In a paper entitled "Developing Inertial Fusion Energy -- Where Do We Go From Here?" LLNL researchers Wayne Meier and Grant Logan show how inertial fusion for energy (IFE) can leverage off the DOE Defense Programs research on inertial confinement fusion (ICF), including the planned demonstration of ignition and positive energy gain in the National Ignition Facility (NIF). The paper was presented at the June, 1996 ANS Topical Meeting on the Technology of Fusion Energy. The development path consists of coordinated R&D on all aspects of inertial fusion required for eventual commercial electricity application, including target physics, driver technologies, target systems and chamber technologies. Research in the near-term, including NIF, would lead to a "Post-NIF Facility/ Pilot Plant/Demo" in which an upgradable driver would power multiple chambers (see figure). Copies of the report may be requested from Wayne Meier (wmeier@llnl.gov) or Grant Logan (grant.logan@quickmail.llnl.gov) or fax: (510)422-7390.