FUSION POWER ASSOCIATES
EXECUTIVE NEWSLETTER

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http://fusionpower.org

JAN/FEB 2000
Vol. 22, No. 1

ENTERING OUR THIRD DECADE AND THE NEW MILLENNIUM

NEW AFFILIATES

Advanced Power Technologies, Inc. (APTI) has joined Fusion Power Associates as a Small Business Affiliate. Dr. Robert L. Hirsch, Executive Advisor to the President, will represent the company. He can be reached at APTI, 1250 24th Street, Suite 850, Washington, DC 20037; (202)223-8808; fax (202)223-1377; (rlhirsch@apti.com). Dr. Ramy Shanny is president of APTI. APTI is a high technology research, development, and commercial product company, with activities in such areas as high-altitude ionospheric research, underground imaging, hyperspectral imaging, analytical instrument development and sales, microwave and RF technologies, electrothermal combustion technologies, plasma physics, and facility design, construction and operations (http://www.apti.com).

Eastlund Scientific Enterprises Corporation (ESEC) has joined Fusion Power Associates as a Small Business Affiliate. Dr. Bernard J. Eastlund, President, will represent the company. He can be reached at ESEC, 13413 Tiverton Road, San Diego, CA 92130; (858)720-9833; (esec@aol.com); (http://www/eastlundscience.com). ESEC provides scientific, engineering and technical services. Current projects include potential applications of fusion technology, such as a fusion torch for separating uncharacterized weapons waste and high-frequency oscillators to prevent tornado formation.

We welcome the participation of APTI and ESEC in the activities of Fusion Power Associates.

ENTERING OUR THIRD DECADE

Fusion Power Associates was incorporated as a not-for-profit scientific research and educational foundation on August 16, 1979, with support from 10 charter industrial members. On December 31, 1999, we had 32 supporting institutions, consisting of a mix of industries, laboratories and universities. We thank all the institutions that have supported us over the past two decades.

In the beginning, based on the passage of the Magnetic Fusion Energy Engineering Act of 1980, signed into law by President Jimmy Carter on October 7, 1980, we had high hopes that the ensuing 20 years would be a period of ambitious development of the science and technology required for practical fusion power systems. Such was not to be the case, however. For the past 20 years, government commitment to the science of fusion has remained strong, but commitment to developing a new energy source for society has been lacking. As we enter the 21st century, the U.S. government has no timetable for the development of fusion.

The past two decades have seen the accomplishment of a myriad of scientific milestones, as originally promised. Europe and Japan have emerged as world leaders of fusion research and development, with budgets and facilities superior to those in the United States. We applaud the efforts of our colleagues in other countries, as well as those of our own scientists and engineers. The world effort, taken as a whole, is stronger today than it was 20 years ago, due in part to the strong international collaborative spirit of the research effort.

New decades, let alone new millennia, are appropriate times for new commitments and renewal of old commitments. The world energy crisis of the 1970's has abated. But the eventual need for new, nonpolluting sources of energy remains.

FY 2001 BUDGET REQUEST

President Clinton sent his Fiscal Year 2001 Budget to Congress on February 7. Contained therein is a request for $247.27 million for the DOE Office of Fusion Energy Sciences (OFES). This compares to a level of $244.686 million for FY 2000 (Congress actually appropriated $250 million, but this was subsequently reduced by across-the-board spending cuts).

The OFES allocates these monies in three subcategories: Science, Facilities Operations, and Enabling R&D. The Science category is proposed to decrease from $138.489 million in FY 2000 to $136.202 in FY 2001; the Facilities Operations is proposed to increase from $71.545 million to $77.440 million; the Enabling R&D is proposed to decrease from $34.652 million to $33.628 million. The increase in Facilities Operations is due to a planned increase in the cost of decommissioning the TFTR

at thePrinceton PPPL and a DOE decision that fusion must pay about $3 million for "waste management" at PPPL that previously was paid for by the DOE Office of Environmental Management. Funds allocated for actual operations of the major research facilities (DIII-D, Alcator C-Mod, and NSTX) all decrease. There is a significant increase proposed for the Theory program: from $24.536 million to $27.536 million, aimed at a new initiative in computational modeling, and an increase for General Plasma Science, from $7.964 million to $8.45 million. All other subprograms show varying degrees of decrement.

The budget document is available at the DOE/OFES web site: http://wwwofe.er.doe.gov/ then click on "Program News," then click on FY 2001 budget (pdf format).

President Clinton also has asked Congress to provide $265.5 million for Inertial Confinement Fusion within DOE's Office of Defense Programs. This compares to this year's budget of $226.3 million. However, DOE explicitly states, "Funding is not requested for High Average Power Lasers in 2001." For the past 2 years, Congress has added approximately $10 million each year for high average power laser research. The development of high average power is important for the eventual civilian applications of inertial confinement fusion. In addition to the above request, the President's budget requests $74.1 million for continued construction of the National Ignition Facility (NIF). This is the amount needed according to the original NIF funding profile. However, due to unforeseen technical problems discovered during construction, NIF is facing cost increases that have not yet been fully assessed. A "rebaselining" of the NIF cost and schedule is underway, with a report to Congress due in June.

The budget document states that the funding increases for the operating program are needed "to support the design and development of the NIF Cryogenic System, the development of the initial set of core target diagnostics and laser characterization diagnostics for NIF, ignition target design and development and experiments to verify conditions necessary for ignition, weapons physics experiments which also support other Stewardship campaigns, and additional grants and national ignition program coordination and technical activities."

The DOE Defense Programs budget document can be accessed on the web (http://www.dp.doe.gov/dp_web/public_f.htm). The complete DOE budget can be accessed at http://www.cfo.doe.gov/budget/01budget/index.htm/

INTEGRATED PLANNING ACTIVITY LAUNCHED

The DOE Office of Fusion Energy Sciences (OFES) has initiated an "Integrated Program Planning Activity (IPPA)" in response to a Secretary of Energy Advisory Board's (SEAB) report (Sep/Oct 1999 Newsletter). The SEAB stated, "Given the complex nature of the fusion effort, an integrated program planning process is an absolute necessity." The report says, "Proper management of the fusion program requires a comprehensive planning system that: provides the means to manage by performance; encourages fundamental, innovative scientific research; drives resource planning; provides linkage of accomplishments to goals; establishes accountability; encourages the development of trained personnel; describes activity interrelationships, and aids in integration among the base programs in OFES and DP (DOE Defense Programs) and the fusion energy goal of practical fusion energy."

In a January 28 letter to Dr. Charles C. Baker (University of California at San Diego), asking him to "chair a group to begin preparing such a plan," OFES head, Dr. N. Anne Davies, said, "Your group should start with the FESAC (DOE Fusion Energy Sciences Advisory Committee) reports, work closely with the fusion research community and this office, and have a draft plan ready for review by FESAC no later than July 14, 2000."

A charter for the group, which accompanied the letter, states "The draft plan should include the following elements: (1) a description of the program goals that acknowledges both the science and energy goals of the program; (2) a description of program activities needed to achieve the goals; (3) a set of intermediate milestones for each program activity; (4) a description of the interrelationships among the activities; and (5) a linkage between program accomplishments and program goals."

The letter states, "The draft plan when implemented should provide: (1) a flexible program framework to account for the inevitability of scientific and programmatic surprises; (2) the basis for performance-based management of the program; (3) the basis for resources planning; (4) the basis for establishing accountability; (5) encouragement of fundamental, innovative scientific research; and (6) encouragement of the development of trained personnel."

Other members of Baker's "Working Group," include: Steve Dean (Fusion Power Associates), Bill Ellis (Raytheon Engineers and Constructors), Richard Hazeltine (University of Texas), Grant Logan (LLNL), Mike Mauel (Columbia University), Ned Sauthoff (PPPL), and Tony Taylor (General Atomics).

The study will also have a "Steering Committee" consisting of John Lindl (LLNL), Chair, Stewart Prager (U. Wisconsin), Vice Chair, Ben Carreras (ORNL), Steve Cowley (UCLA), Rich Hawryluk (PPPL), Tom Jarboe (U. Washington), Earl Marmar (MIT), Kathy McCarthy (INEEL), Dick Siemon (LANL), and Ron Stambaugh (General Atomics).

ITER SITE IN CANADA PROPOSED

At a meeting of the ITER Parties (European Union, Japan and Russia), January 19-20 in Tokyo, the Parties "took note also of the interest expressed by Canada through the EU in offering to host ITER in Canada." ITER, the International Thermonuclear Experimental Reactor, would be the world's first power-producing fusion experimental reactor and has an estimated construction cost of $5 billion. The U.S. was forced by Congress to withdraw from the project in 1998, but the ITER Parties are hopeful that the U. S. will rejoin the project at a later date. The Parties are scheduled to decide whether and where to construct ITER in 2001.

The Canadian proposal was officially presented to the ITER Parties through the representatives of the European Union (EU) following receipt of a January 11 letter from Ralph Goodale, Ministre of Natural Resources Canada to Phillip Busquin Commissioner for Research, EU, in which Goodale states, "I am writing to confirm that ITER Canada will soon be forwarding to your Services an expression of interest to host the International Thermonuclear Experimental Reactor (ITER) project." ITER Canada subsequently provided a 38-page document entitled "ITER Canada Expression of Interest to Host ITER." The document is available at the ITER Canada web site (http://itercanada.com/host/index.cfm/).

The ITER Canada expression of interest document states that "Canada has two excellent sites for the ITER facility. The Bruce site is located 250 kilometres northwest of Toronto on the shores of Lake Huron. The Darlington site is located on Lake Ontario 60 kilometres east of Toronto. The sites are both owned by Ontario Power Generation (a successor company to Ontario Hydro), one of the world's largest electricity generation companies."

The document states, "ITER Canada anticipates that the Government of Canada would be a signatory to an international agreement that would be established by the Parties to govern the project." It says, "We will provide all the necessary support and facilitation to ensure smooth implementation of the project, including application to responsible authorities for regulatory approvals, technical infrastructure and a skilled labour force, as well as pre-negotiated union agreements and contracts for critical ITER inputs including labour, tritium, power and site services." The document says, "In addition to the site and its preparation described above, ITER Canada expects to contribute further up to 25 % of anticipated construction costs and an amount to be determined in the range of 10–20 percent of the reference operating costs for ITER. Financial contributions will be provided by a combination of the private sector and the Government of Ontario." The document cautions, "This statement is not to be considered a formal offer of commitment. A formal offer will be submitted in 2001." For further information, view the ITER Canada web site or contact Don Dautovich (dautovich@itercanada.com).

NSTX ACHIEVES MEGAMP MILESTONE

On Tuesday, December 14, the National Spherical Torus Experiment (NSTX) at the U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) produced a 1 million ampere plasma current—a new world record for a spherical torus device. The result was accomplished nine months ahead of schedule.

Secretary of Energy Bill Richardson said, "I'm delighted that the NSTX experiment has met this technical milestone 9 months ahead of schedule. We can now begin the scientific investigations that the machine is designed to do."

One million amperes is the highest plasma current ever produced in a spherical torus device. The previous record is 310,000 amperes achieved in a smaller spherical torus device called START, the Small Tight Aspect Ratio Tokamak, at the Culham Laboratory in England.

NSTX, which began operating in February 1999, is designed to test the physics principles of spherical torus plasmas. It produces a plasma that is shaped like a sphere with a hole through its center. This configuration may have several advantages, a major one being the ability to confine a higher plasma pressure for a given magnetic field strength. This could lead to a less expensive development path for fusion energy.

The production of a 1-million-ampere plasma current on NSTX required the appropriate plasma shaping, such as the width and height of the cross section of the plasma torus. Proper plasma shaping helps eliminate plasma instabilities. By October of 1999, the NSTX team had produced all of the desirable plasma shapes that they plan to use on NSTX, also a key aspect of preparation for research.

NSTX is one of a new class of relatively inexpensive devices called "Proof-of-Principle" experiments, currently being used to establish the scientific underpinnings for the development of fusion energy.

NSTX Program Director Martin Peng said, "The goals of the next few years of research on NSTX are to produce high-quality scientific results and excellent plasma performance. If successful, NSTX will have an impact on the design of future devices. These future machines would extend the temperatures, densities, and other plasma parameters to the levels necessary for fusion energy production."

For further information, contact Martin Peng (mpeng@pppl.gov).

WORLD'S LARGEST CRYSTAL GROWN

The world's largest fast-growth crystal, weighing in at 701 pounds, has been grown by inertial confinement fusion researchers at the Lawrence Livermore National Laboratory (LLNL). The pyramid-shaped KDP (potassium dihydrogen phosphate) crystal measures approximately 26 inches by 21 inches by 23 inches high. It was grown in a record 52 days using a special rapid-growth technique that delivers twice the yield originally projected. The previous crystal record-holder weighed 650 pounds. It was also produced at Livermore, using an earlier variant of the rapid-growth technique.

The enormous crystal will be sliced into plates for use in the National Ignition Facility (NIF). The crystal plates (1/2-inch thick and 16-1/2-inches square) will be used to convert the laser's infrared light beams to ultraviolet light just before the beams strike the laser target. The National Ignition Facility, whose primary purpose will be to help maintain the safety and reliability of the nation's nuclear weapons stockpile, will require as many as 600 crystal plates.

Based upon a Russian technique pioneered by Natalia Zaitseva, now at Livermore, the Lab's improved rapid-growth process begins with a synthetic, thumbnail-sized seed crystal placed inside a 6-foot-high tank filled with nearly a metric ton of supersaturated KDP solution at 150 degrees Fahrenheit. The temperature is gradually decreased to maintain supersaturation as the growing crystal extracts salt from the solution. The record size of the latest crystal was achieved by giving the solution a transfusion of additional salt though a device called a continuous filtration system, which helps maintain crystal quality.

"This technique offers the possibility of producing even larger and higher quality crystals in the future," said Ruth Hawley-Fedder, group leader for the Livermore crystal growing team. "Our newest recordholder could have grown even larger, but we simply ran out of room in our growth tank." The improved technique has been shared with commercial crystal suppliers who are producing crystals for NIF. About half the required crystals have been produced. "Ruth and her team brought large-scale rapid-growth technology to the reliability needed to realize savings of millions of dollars for both construction and later operation of NIF," said Alan Burnham, deputy system manager for NIF final optics.

IAEA FUSION ENERGY CONFERENCE

The 18th International Atomic Energy Agency (IAEA) Fusion Energy Conference will be held October 4–10 in Sorrento, Italy. This biennial meeting is the major forum for assessing fusion progress worldwide. Participants must be approved by their respective governments or by the IAEA. Information on the conference and forms for requesting participation are posted on the conference web site (http://www.iaea2000.enea.it). U. S. persons wishing to submit papers or attend the meeting must submit Forms A and B (available on the web site) no later than March 3 to the DOE Office of Fusion Energy Sciences, Attention Erol Oktay (erol.oktay@science.doe.gov).

QUOTABLE

"A ship without rudder may wander aimlessly among perilous isles yet sink not to the bottom."

Kahlil Gibran
"The Prophet"

PEOPLE

E. Michael Campbell, former Associate Director for Lasers, LLNL, has joined General Atomics as Vice President, Laser and Inertial Confinement Fusion Programs.

Jim Luxon has resigned his position as Director, DIII-D Operations, at General Atomics and will take a position as Senior Technical Advisor.

Larry Papay has left his position as Senior Vice President, Bechtel Corporation, to become a Sector Vice President, Science Applications International Corporation.

David Overskei has left his position as a Senior Vice President, Science Applications International Corporation, to become a Senior Vice President, General Atomics.

Tom Simonen has stepped down as DIII-D Program Director, General Atomics and has announced his intention to retire in the late Spring. **Ron Stambaugh** has succeeded Tom Simonen as DIII-D Program Director, General Atomics.

Steve Obenschain has been named Branch Head of the Laser Branch, U. S. Naval Research Laboratory, succeeding **Steve Bodner,** who has retired.

Mike Zarnstorff has been named Head of Physics, National Compact Stellarator Experiment Project, Princeton Plasma Physics Laboratory.

Mark Crawford, freelance science reporter *par excellence,* has joined the U. S. Department of Commerce.

Ron Cohen and **Andris Dimits,** LLNL, have been awarded the Gordon Bell award for their state-of-the art contributions to advanced supercomputing.

Keith Matzen has been named Inertial Confinement Fusion Program Manager at Sandia National Laboratories, reporting to **Jeff Quintenz,** Director, Pulsed Power Sciences.

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MAR/APR 2000
Vol. 22, No. 2

FPA ANNUAL MEETING AND SYMPOSIUM SET FOR JULY 17 IN SAN DIEGO

FPA SYMPOSIUM JULY 17

Fusion Power Associates will hold its annual meeting and symposium July 17 in San Diego. The theme of the symposium is "Science and Technology for Fusion Power." We will survey and discuss the outstanding science and technology issues that are critical to the development of practical fusion power. This one-day symposium will lead directly into a scheduled two-day public meeting, July 18-19, of the DOE's Fusion Energy Sciences Advisory Committee (FESAC), also scheduled to be held in San Diego.

Details on the agenda and registration for the symposium will be forthcoming in a separate mailing and posted on Fusion Power Associates web site. For information on the FESAC meeting, contact Albert Opdenaker (Albert.Opdenaker@science.doe.gov).

NRL ELECTRA LASER MAKES PROGRESS

Electra is an R & D program at the U. S. Naval Research Laboratory (NRL) to develop a rep-rate, reliable, and efficient high energy, high average power Krypton Fluoride (KrF) laser. A primary motive for this program is to develop a driver for inertial fusion energy (IFE). For IFE, the ultimate goals are: overall efficiency: 6-7%; cost: $10.00/ e beam joule; durability: 2 x 10exp8 shots.

The program will use advanced scientific research to develop the necessary technologies. These technologies will then be integrated into a single 5 Hz, 700 J rep-rate laser. This size is small enough to be manageable but large enough to demonstrate that the technology would scale to higher energy (30-100 kJ) systems. The laser technologies that need development are: a durable, efficient pulsed power system; a durable electron beam emitter; a long life pressure foil structure ("hibachi"); a recirculator to quiet the laser gas between shots; and long life optical windows. In the course of developing these technologies advanced research will be performed in the fields of: large area electron beam propagation, advanced gas kinetics, 3-D radiation and laser transport, hydrodynamics, solid state electronics, pulsed power, materials, and advanced optics.

Electra will be pumped by two 500 kV, 110 kA, 100 nsec, electron beams. The durable and efficient pulsed power system that will eventually be needed will require several years of advanced R & D. To provide a test bed to start addressing the other laser issues right away, a First Generation Pulsed Power System that is based on existing technology is being built. This system uses existing spark gap technology, and has been designed and built by Pulse Sciences, Inc (PSI). It has two identical and independent sides. One side was sent to NRL for installation, the other kept at PSI for testing.

The tests at PSI showed the pulsed power system can run at 5 Hz, at full voltage, for 90,000 shots. This 5-hour run exceeds the original lifetime specification by a factor of 9 and is unprecedented for a spark gap based system. (After 180,000 shots the output electrodes need to be replaced. This is a 2-hour job.) The run time is more than enough for the initial laser research. Both sides are expected to be installed, working, and ready for electron beam studies by June 2000.

For further information, contact: John Sethian (sethian@this.nrl.navy.mil); (202) 767-2705.

NUCLEAR POWER ALIVE IF NOT WELL

A total of 436 nuclear (fission) power plants produced 25 percent of the electricity generated in the world in 1999, according to the International Atomic Energy Agency (//www.iaea.or.at/worldatom). During 1999, 4 new nuclear power plants representing 2700 MWe were connected to the grid, 1 in France, 1 in India, 1 in the Republic of Korea and 1 in the Slovak Republic. No new nuclear power plants have been ordered in the United States since the mid-seventies, though the United States has more nuclear power plants in operation (104) than any other country. The countries with the highest percentage reliance on nuclear power for electricity production in 1999 were: France (75%), Lithuania (73%), Belgium (58%)

and Bulgaria, Slovak Republic and Sweden, all at 47 percent. Twenty percent of electricity in the United States is supplied by nuclear power.

WHEN FUSION?

Reporter Kitta Macpherson, Newhouse News Service, published an article March 6 speculating that the recent rise in fossil fuel prices may rekindle an interest in fusion power. The story ran in a number of newspapers around the country, including the Newark (NJ) Star Ledger and the San Diego Union. She quotes PPPL director Rob Goldston as saying "There's a window of opportunity for us to make an investment now, and Congress has seen it. The question for the country is this: Do you want to fix the roof while the sun is shining, or do you want to wait?" Regarding "the dream of creating a commercially viable fusion reactor," she quotes Goldston as saying, "I want proof that we can get three times more energy that costs three times less."

The article has also been published on the MSNBC web site, including an on-line survey of public attitudes toward fusion energy. As of March 27, almost eight thousand individuals had expressed opinions, with 65% believing that fusion "will make a difference in my lifetime," 25% believing that fusion "will become an important power source but not in my lifetime," and only 6% expressing the opinion that fusion "will not make a difference" due to either "economic or scientific factors." To see the full article and to participate in the survey and see the results: http://www.msnbc.com/news/381628.asp

RESEARCH POSITION OPEN AT COLUMBIA

The Department of Applied Physics and Applied Mathematics at Columbia University has a position open for a post-doctoral research scientist or associate research scientist to work on the Levitated Dipole Experiment (LDX) project, <http://www.pfc.mit.edu/ldx/>, a joint effort between Columbia University and Massachusetts Institute of Technology (MIT). The successful candidate is expected to conduct both supporting and independent research in the execution of the LDX experimental program. This position is full time and on location at the MIT Plasma Science and Fusion Center, Cambridge, MA. Level of the appointment will be commensurate with experience. Screening of applications will begin on June 5, 2000, and will continue until the position is filled. Columbia University is an Equal Opportunity/Affirmative Action employer. Women and minorities are encouraged to apply. Send resume to Columbia University, Dept. of Applied Physics and Applied Mathematics, 500 W. 120th St., MC 4701, New York, NY 10027 or contact: Prof. Michael E. Mauel, (212)854-4455; fax (212)854-8257; email: mauel@columbia.edu

APEX INTERIM REPORT ISSUED

APEX (Advanced Power EXtraction) is a study to identify and explore novel, possibly revolutionary, concepts for fusion chamber technology that may substantially improve the attractiveness of fusion energy systems. The study is being carried out by a multi-institutional team led by Mohamed Abdou of UCLA. An Interim Report has recently been issued, "On the Exploration of Innovative Concepts for Fusion Chamber Technology (UCLA-ENG-99-206, November 1999).

In the first phase of the study, a set of goals for chamber technology were adopted to calibrate new ideas and to measure progress. These goals include: (1) high power density capability with neutron wall loads greater than 10 Megawatts per square meter and surface heat flux greater than 2 Megawatts per square meter, (2) high power conversion efficiency (greater than 40%), (3) high availability (i.e., low failure rate and fast maintenance), and (4) simple technological and material constraints.

A number of promising ideas have emerged from the study, which will need extensive further research and development. They fall into two categories. The first category seeks to totally eliminate the solid "bare" first wall of the fusion chamber. The most promising ideas in this category are flowing liquid first wall variations. The liquid wall idea evolved during the APEX study into a number of concepts that have some common features but also have widely different issues and merits. These concepts differ according to (1) the type of working fluid, (2) the thickness of the liquid flow, and (3) the type of restraining force used to control the liquid flow. The second category of ideas focuses on extending the capabilities, particularly the power density and temperature limits, of solid first walls. A promising example is the use of high temperature refractory alloys (e.g., tungsten) in the first wall, together with an innovative heat transfer and heat transport scheme based on the vaporization of lithium.

The APEX team has already initiated Phase 2 of the study, which will focus on more detailed exploration of liquid walls and cooling of solid walls by lithium vaporization. For further information, contact Mohamed Abdou (abdou@fusion.ucla.edu).

ITER EXPERT GROUPS FUNCTIONING

In addition to the focused effort on design, the ITER Parties (European Union, Japan and Russia) have formed seven Physics Expert Groups to identify and work on critical physics issues. These research activities are undertaken on a voluntary basis by research groups in the various countries, outside the formal ITER framework. Though U.S. scientists are anxious to contribute to these studies, and the issues themselves are largely generic fusion scientific issues, the U. S. has been forbidden by Congress to formally participate in the Expert Groups. The ITER Physics Group coordinates the activities of the Expert Groups. Based on the work of the Expert Groups, the Physics Group has compiled a list of "Urgent Physics Research Areas."

Noting that U.S. physicists "no longer participate in the ITER physics activities," ITER Director Robert Aymar nevertheless commented, "It is expected that mutually beneficial interactions with the U.S. fusion physics community will continue outside the ITER framework on the underlying general issues of tokamak physics that relate to the ITER-specific work of the Expert Groups." He said, "Given the continued commitment, support and recognition of their value, the ITER Physics Expert Groups will, it is hoped, continue to make the profound impact on the world-wide progress of tokamak physics, to the benefit both of ITER and of fusion science in general." Aymar said, "Physics work in the base experimental and theoretical research programmes of the ITER Parties is a crucial part of the validating research and development required for ITER. The projections of ITER performances require extrapolations from present experience and these must rest on established theory and experimental results from the leading laboratories, facilities and universities that together pursue the Parties' fusion science programmes."

The seven Physics Expert Groups are (1) Diagnostics, (2) Edge and Pedestal Physics, (3) MHD, Disruptions, and Control, (4) Energetic Particles, Heating, and Steady-state Operations, (5) Scrape-off layer and Divertor Physics, (6) Transport and Internal Barrier Physics, and (7) Confinement Database and Modeling.

For further information, contact ITER Director Robert Aymar (lyrauda@merlin.itereu.de).

DIII-D ACHIEVES NEW HIGH DENSITY RESULTS

Researchers at General Atomics in San Diego, using the DIII-D tokamak facility, have produced plasmas with densities above the commonly accepted limit, using a novel method of pumping hydrogen gas from the boundary of the plasma. According to GA scientist Tom Simonen, "The importance of this discovery is that, at constant plasma temperature, the fusion power increases four-fold with a doubling of the plasma density. Thus a future fusion power plant could generate more electricity, or could be made smaller."

An exceptional feature of this new DIII-D result is that the plasma energy confinement did not deteriorate at high density as in previous worldwide experiments. Another important feature of the new high-density results is the manner in which heat escapes from the plasma. In previous lower-density experiments, the heat escaped in brief high power pulses, which could erode the plasma vessel walls. In the recent experiments, the heat escape pulses were five times lower in power and escaped in a more continuous fashion. The researchers are continuing these experiments using new improvements to the plasma vessel, in which a dual pump was installed to increase control of the hydrogen gas.

For further information, contact Tom Simonen (tom.simonen@gat.com) and visit the GA web site (http://fusion.gat.com)

PETAWATT POWER

In 1993, scientists at the Lawrence Livermore National Laboratory began in earnest to develop a high energy, Petawatt (quadrillion-watt) laser with the aim of proving that it could be used as a "fast ignitor" for capsules of fusion fuel. The fast ignition concept is to separate the usual target implosion into two stages: the familiar compression stage to assemble the fuel at high density, followed by a very rapid ignition stage using a separate "fast ignitor" Petawatt laser. The technique theoretically reduces the total energy needed for ignition by a large factor.

After demonstrating the technology of the Petawatt laser at smaller scale, LLNL converted one of the NOVA laser's ten beams into a 680 Joule Petawatt. The facility operated until May 27, 1999 when NOVA was shut down to make way for the National Ignition Facility prototype.

George Miller, LLNL Associate Director for National Security and recently named Associate Director for NIF Programs, commented that the Petawatt "was considered to be such a high-risk undertaking that, although initially proposed in 1987, work on it did not begin until 1993, when funding was provided by Livermore's Laboratory Directed Research and Development program." "Seven years later," he said, "it is clear that the science and technology that emerged through developing the Petawatt laser will benefit the scientific community, U.S. industry, and the Laboratory for years to come." Miller said that "to produce petawatt pulses, the development team had to produce diffraction gratings much larger and more advanced than what was the state of the art." "The development of facilities and know-how to manufacture these gratings has made Livermore into one of the world's centers for the development and manufacture of diffractive optics," he said, noting "Since completion of the Petawatt gratings, we have developed diffractive optics for laboratories throughout the world, numerous companies, and several government agencies, as well as for Livermore's next superlaser, the National Ignition Facility." Miller said that the Petawatt research led to discoveries about short pulse laser-damage mechanisms to materials that "are now being applied in the Lifetime Extension Program for stockpiled weapons, and we are refining the technology for use in large-scale commercial and defense applications." Among the many scientific discoveries, he noted observations on "laser-initiated nuclear reactions, high energy electron production, and the formation of positron-electron pairs and proton beams far brighter than those produced by any accelerator." Although Livermore's Petatwatt laser is no more, Miller said LLNL would be collaborating on new Petawatt

facilities under construction in Germany, France, England and Japan.

Livermore's Mike Perry has led the Petawatt effort as Associate Program Leader for Short Pulse Lasers. He noted that "a primary spinoff from the Petawatt laser program has been the development of ultrashort-pulse lasers for high-precision laser cutting and machining." He said, "Brent Stuart and others first observed the laser's cutting capabilities during early research on the laser damage threshold for a variety of optical materials." He said, "This discovery was put into practical use in developing the first femtosecond laser cutter for use as a precision cutting tool in dismantling weapons at DOE's Y-12 Plant (in Oak Ridge, TN)." Other uses of the technology will include the production of thin films and medical surgery, he said.

General Atomics recently announced that Perry will join the firm as Director of Lasers and Optics Science and Technology. They said, "He will play a central role in developing and implementing GA's strategic objectives in the fields of optics and lasers and their applications to government missions and the commercial arena." Perry thus joins former LLNL Associate Director for Lasers Mike Campbell, who was recently appointed Vice President, Laser and Inertial Fusion Programs at GA.

IEA FUSION COMMITTEE ELECTS NEW OFFICERS

At its annual meeting on January 26, 2000, the International Energy Agency's (IEA) Fusion Power Coordinating Committee (FPCC) elected new officers for a three-year term. Michael Roberts, Director of International Activities, U.S. Department of Energy Office of Fusion Energy Sciences (OFES), was elected Chair along with two equal Vice-Chairs, Gunnar Leman, National Science Research Council of Sweden, and Masayuki Nagami of JAERI. Mike Roberts is also Director of the Facilities and Enabling Technologies Division in OFES.

Mike Roberts had just completed serving 7 years as Vice-Chair with Gunter Grieger, IPP, Germany, as Chair. At the end of his service at the January meeting, Grieger was thanked for his many contributions to the international fusion program and recognized at his retirement as the last serving member of the original FPCC dating to the mid-1970s. The FPCC is the body responsible for fusion activities in the IEA Technology, Research and Development effort.

Presently there are eight active IEA international fusion collaborative agreements covering a wide range of topics, both fusion science and technology. Each of these agreements to do joint work has typically three or more parties, usually the U.S. DOE, EURATOM, and JAERI or another Japanese entity. The Russian Federation now is participating in four of these agreements, China one (Materials) and Ukraine has recently agreed to join one (Stellarator) as well.

The FPCC is one of two such international bodies, with the other being the International Fusion Research Council (IFRC) which is the consultative body for fusion activities in the International Atomic Energy Agency (IAEA). Ernesto Canobbio of EURATOM is the Chair of the IFRC. Shigeru Mori and Donato Palumbo were the previous Chairs of the FPCC.

QUOTABLE

"The real world is not always what you calculate."

Robert W. Conn
University of California at San Diego
March 16, 2000

PEOPLE

Charles Neumeyer (PPPL) has been named "Engineer of the Year" by the Professional Engineering Society of Mercer County, New Jersey.

CALENDAR

April 23–28 International Symposium on High Power Laser Ablation 2000. Santa Fe, New Mexico.
http://www.spie.org/info/sf/ email:sf@spie.org

April 26–28 8th Workshop on the Physics of Dusty Plasmas. Santa Fe, New Mexico. Dan Winske (winske@lanl.gov; 505-667-2868).

April 26–29 13th U. S. Transport Task Force Workshop. Burlington, Vermont.
http://www.psfc.mit.edu/ttf/2000/meeting.html/

May 22–24 17th International Conference on Numerical Simulation of Plasmas. Banff, Alberta, Canada.
http://www.phys.ualberta.ca/icnsp/

May 22–26 14th Int. Conf. on Plasma Surface Interaction in Controlled Fusion Devices. Rosenheim, Germany. N. Noda (Tel: 0572-58-2152; Fax: 0572-58-2618).

May 29–Jun 2 Workshop on Waves in Dusty, Solar and Space Plasmas. Leuven, Belgium. email: Frank.Verheest@rug.ac.be
http://allserv.rug.ac.be/~verheest/fsaw.html/

June 4–7 International Conference on Plasma Science (ICOPS). New Orleans, Louisiana. email Michael Mazzola: mazzola@ece.msstate.edu
http://www.ece.msstate.edu/icops2000/

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EXECUTIVE NEWSLETTER

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MAY/JUN 2000
Vol. 22, No. 3

JAPAN SCIENCE MINISTER URGES ITER
DRESSELHAUS NOMINATED FOR DOE SCIENCE POST

ITER GETS BOOST

Japan's Minister of State for Science and Technology, Hirofumi Nakasone, met with US DOE Energy Secretary Bill Richardson to discuss future cooperative activities between the two countries.

A joint statement issued May 3 states in part, "The Minister and the Secretary took note of the history of successful U.S.-Japanese collaboration in fusion energy science and technology research. The Secretary welcomed STA's decision to host a conference in Tokyo to commemorate and review 20 years of U.S.-Japanese fusion research collaboration. The Minister and the Secretary recognized the potential value of the International Thermonuclear Experimental Reactor (ITER) project in developing the scientific basis to promote fusion as a viable energy source. The Minister said he would welcome the U.S. rejoining the ITER project."

The joint statement also describes U.S.-Japan cooperations in the areas of nuclear nonproliferation, nuclear energy research and development, nuclear safety and emergency preparedness, and basic scientific research.

The release is accessible from the DOE home page: //www.doe.gov/

CANADA PICKS ITER CANDIDATE SITE

On May 26, ITER Canada confirmed it has taken the next step in its quest to bring the international ITER Fusion Energy Research and Development Centre to Canada by selecting Clarington, Ontario (previously commonly referred to as Darlington) as the site for its Bid. The Centre would be located in the Municipality of Clarington on the north shore of Lake Ontario at the well-developed site of the Darlington nuclear power station.

"As a potential host country, Canada has two excellent sites at Bruce and Clarington and both of these communities have been longtime supporters of bringing this important project to Canada," said Peter Barnard, President and CEO of ITER Canada. "After a long and thorough selection process, Clarington has been chosen by our Board as Canada's proposed site. We greatly appreciate the co-operation and commitment shown by both communities and we are very excited about (the prospects for) bringing this prestigious international scientific research centre to Canada."

In January of this year, ITER Canada submitted its EXPRESSION OF INTEREST TO HOST to the International ITER Parties (see Jan/Feb 2000 newsletter). The document was well received, prompting ITER Canada to move forward with submitting a formal Bid, to be finalized November 30, 2000. ITER Canada proceeded with Canada's lead site selection to meet this aggressive timetable and maximize Canada's chances to host the project. The bid is scheduled to be submitted early next year to be followed by international negotiations in 2002. Construction is not expected to begin before 2003.

A formal process was developed to guide the selection. The overall criteria under consideration included technical issues, socio-economic issues, regulatory and environmental assessment issues, cost issues, community support and the views of the ITER Parties who will decide what country hosts the project.

ITER Canada is a not-for-profit corporation established in 1997 with members from universities, labour, industry and government. It is committed to locating the world's ITER Fusion Energy Research and Development Centre in Canada. For more information contact: Laura Ferguson, (416) 964-6444 Ext. 444 or visit the ITER Canada Web site at www.itercanada.com

DRESSELHAUS NOMINATED FOR DOE SCIENCE DIRECTOR

On April 13, President Clinton nominated Mildred Dresselhaus as the next Director of the U.S. Department of Energy Office of Science. The DOE Office of Fusion Energy Sciences is a part of the Office of Science. Dresselhaus is Institute Professor of Electrical Engineering and Physics at (MIT).

Professor Dresselhaus has an A.B. from Hunter College and a Ph.D. from the University of Chicago. Following her doctoral studies, she spent two years at Cornell University as an NSF postdoctoral fellow and then seven years as a staff member of

the MIT Lincoln Laboratory in the Solid State Physics Division. She joined the MIT faculty in the Department of Electrical Engineering and Computer Science in 1967 and the Department of Physics in 1983. She was named an Institute Professor in 1985.

Professor Dresselhaus previously held the Abby Rockefeller Mauze chair at MIT in the Department of Electrical Engineering and Computer Science. She is also affiliated with the Center for Materials Science and Engineering, MIT, which she formerly directed, and the Francis Bitter Magnet Laboratory, where some of the experimental work of her group is carried out.

Professor Dresselhaus has been active in the study of a wide range of problems in the physics of solids. Her recent interests have been directed toward the modification of the properties of electronic materials by intercalation and implantation and the investigations of the structure and properties of carbon fibers, of fullerenes and carbon nanotubes, and of high Tc superconductors. She is widely published in these areas and is the co-author of three books on carbon science.

Professor Dresselhaus has a long history of service to the scientific community. She has served as President of the American Physical Society, treasurer of the National Academy of Sciences, President of the American Association for the Advancement of Science, and on numerous advisory committees and councils. In 1988 she served as chairman of the National Academy of Sciences Planning Committee to assess possible initiatives for improving the representation of women in scientific and engineering careers.

Professor Dresselhaus has received numerous awards, including the National Medal of Science and 16 honorary doctorates. In March of this year at the American Physical Society meeting, she was honored with the 1999 Nicholson Medal for Humanitarian Service "For being a compassionate mentor and lifelong friend to young scientists; for setting high standards as researchers, teachers and citizens; and for promoting international ties in science." She is a member of the National Academy of Sciences, National Academy of Engineering, the American Philosophical Society. She is a Fellow of the American Academy of Arts and Sciences, the American Physical Society, the American Association for the Advancement of Science, IEEE, the Materials Research Society, and the Society of Women Engineers.

DRAFT US FUSION PLAN POSTED

The first draft report of the recently initiated (see Jan/Feb 2000 newsletter) US Integrated Program Planning Activity (IPPA) has been posted for review and comment (http://vlt.ucsd.edu). All interested parties are encouraged to read the draft and to provide specific suggestions for changes and improvements to Dr. Charles Baker (cbaker@vlt.ucsd.edu) who is chairing the Working Group that prepared the draft. Comments received will be considered for incorporation into future revised drafts. It is planned to provide the report, still in draft, to the DOE Fusion Energy Sciences Advisory Committee at its meeting at General Atomics in San Diego July 18-19, which immediately follows Fusion Power Associates annual meeting and symposium, July 17 at the University of California at San Diego. FESAC will then conduct a review of the document before submitting it in final to DOE in November. Persons wishing to attend the July 18-19 FESAC meeting should contact Marion Stav (stav@gav.gat.com). Persons wishing to attend the FPA symposium July 17 should view our web site (//fusionpower.org/) or contact us directly (fpa@compuserve.com).

The draft report seeks to respond to a charge from DOE that asks the group to prepare a draft plan that includes the following elements: "(1) a description of the program goals that acknowledges both the science and energy goals of the program; (2) a description of program activities needed to achieve the goals; (3) a set of intermediate milestones for each program activity; (4) a description of the interrelationships among the activities; and (5) a linkage between program accomplishments and program goals."

The charge to the group states, "The draft plan when implemented should provide: (1) a flexible program framework to account for the inevitability of scientific and programmatic surprises; (2) the basis for performance-based management of the program; (3) the basis for resources planning; (4) the basis for establishing accountability; (5) encouragement of fundamental, innovative scientific research; and (6) encouragement of the development of trained personnel."

Preparation of the plan was stimulated by a report of the Secretary of Energy Advisory Board (SEAB) (see Sep/Oct 1999 newsletter). The SEAB stated, "Given the complex nature of the fusion effort, an integrated program planning process is an absolute necessity." The SEAB report says, "Proper management of the fusion program requires a comprehensive planning system that: provides the means to manage by performance; encourages fundamental, innovative scientific research; drives resource planning; provides linkage of accomplishments to goals; establishes accountability; encourages the development of trained personnel; describes activity interrelationships, and aids in integration among the base programs in OFES and DP (DOE Defense Programs) and the fusion energy goal of practical fusion energy."

In a January 28 letter to Dr. Charles C. Baker (University of California at San Diego), asking him to "chair a group to begin preparing such a plan," OFES head, Dr. N. Anne Davies, said, "Your group should start with the FESAC (DOE Fusion Energy Sciences Advisory Committee) reports, work closely with the fusion research community and this office, and have a draft plan ready for review by FESAC no later than July 14, 2000."

Other members of Baker's "Working Group," include: Steve Dean (Fusion Power Associates), Bill Ellis (Raytheon Engineers and Constructors), Richard Hazeltine (University of Texas),

Grant Logan (LLNL), Mike Mauel (Columbia University), Ned Sauthoff (PPPL), and Tony Taylor (General Atomics).

The study also has a Steering Committee consisting of John Lindl (LLNL), Chair, Stewart Prager (U. Wisconsin), Vice Chair, Steve Cowley (UCLA), Rich Hawryluk (PPPL), Tom Jarboe (U. Washington), Earl Marmar (MIT), Kathy McCarthy (INEEL), Dick Siemon (LANL), and Ron Stambaugh (General Atomics).

HEAVY ION VIRTUAL LAB FORMED

Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory and Princeton Plasma Physics Laboratory have signed a Memorandum of Agreement to "collaborate as a Heavy Ion Fusion Virtual National Laboratory (VNL)."

The collaboration will include "the conduct of heavy ion driver development and related topics in the common pursuit of Inertial Fusion Energy (IFE), and to promote more rapid progress in the development of heavy ion drivers through technical management integration of the Laboratories' scientific staff, equipment, and experimental facilities."

The agreement does not cover research on IFE target design, power plant chamber development, materials and target fabrication/injection R&D, which will "be carried out in a separate Inertial Fusion technology program for both laser and ion approaches to IFE."

The agreement states that "this framework may be extended later to other participating organizations in the HIF-VNL through their petition to do so and by mutual agreement of the Parties."

Roger Bangerter (LBNL) is Director of the HIF-VNL. Ronald Davidson (PPPL) and Grant Logan (LLNL) are the Deputy Directors. Victor Karpenko is System Engineer. Other responsible managers include John Barnard (LLNL), Physics Design of the Integrated Research Experiment; Peter Seidl (LBNL) for the High Current Experiment; Joe Kwan (LBNL) for Ion Sources and Injectors; and Alex Freidman (LLNL) for Accelerator Modeling.

The VNL will have an Oversight Board appointed by the respective Laboratory Directors and a Program Advisory Committee, reporting to the Oversight Board.

For further information, contact Roger Bangerter (bangerter@lbl.gov).

ITER MAGNET TEST SUCCESSFUL

Hiroshi Tsuji, Head of Superconducting Magnet Laboratory at the Naka Fusion Research Establishment in Japan, has reported successful testing of the ITER superconducting Central Solenoid Model Coil. The experimental team consisted of about 50 persons from France, Germany, Italy, Japan and the United States.

On April 19, the team reached its goal of 13 T, 46 kA and 640 MJ. Tsuji said that the coil was charged up to 100% current without any quench, all 38 conductor joints worked as designed and the coil was then "dumped" from 46 kA to zero amps in 17.7 seconds. Tsuji said that the team will be conducting additional tests, including a 10,000 cyclic fatigue test.

Miklos Porkalab, Director of the MIT Plasma Science and Fusion Center, which had a key role in the coil's design and construction, hailed the success, saying, " I think it is a wonderful news, not only for those directly involved in designing and fabricating the CS coil, but also a credit to the whole US Fusion Engineering effort. This success is particularly noteworthy when we consider the great financial and political difficulties in the final year of this project."

Porkolab said that the "success justifies the effort spent on making sure that this project would be completed" and wished the researchers "continued success in the future continued testing of the CS coil." He said, "I am convinced that the day will come when the data obtained from the present tests will be a key element in deciding the shape and form of the next major experimental fusion device."

The US-built CS coil was fabricated by Lockheed Martin Corporation in San Diego. The Lockheed division that built the magnet has since been purchased by General Atomics.

For further information, contact Hiroshi Tsuji (tsuji@naka.jaeri.go.jp).

JAERI URGES NEW TOKAMAK

According to an article appearing in the Japanese newspaper Nikkan Kougyou Shinbun on March 30, the Japan Atomic Energy Research Institute (JAERI) presented a plan March 29 to the Nuclear Fusion Committee to "upgrade" the present large tokamak facility JT-60U, the world's largest tokamak, to a new superconducting "JT-60 Super-Upgrade." Construction of the new tokamak would start in 2001 and be completed in 2004, according to the plan. The article states that the purpose of the upgrade is "to enhance the device capability for studying various objectives associated to the long duration required for the fusion reactor, including such as the ITER high performance plasma control." The article states that the "plan includes the updated performances with 100 sec operation from 15 sec of the present device." The Nuclear Fusion Committee is now discussing this plan.

NEW COST ESTIMATE FOR NIF

On June 1, the U.S. Department of Energy sent to Congress an "interim certification for the revised cost and schedule baseline" for the National Ignition Facility (NIF), including "a preliminary estimate of the total project cost and funding profile." The plan is based on having "the full National Ignition

Facility capability consisting of 192 beams" completed in fiscal year 2008, with some beams operational in 2004.

In its report, the DOE acknowledges that "the most expedicious schedule to complete the National Ignition Facility has shown that it could be completed as early as the end of fiscal year 2006," and that the slower schedule mandated by DOE would result in a higher total cost. The Livermore laboratory had completed a detailed cost estimate for the faster schedule of $1.95 billion, compared to the original estimate of $1.2 billion. DOE's construction cost estimate for the slower schedule is $2.25 billion. DOE chose the slower, higher cost plan in order to cap the annual costs over the next several years. Energy Secretary Richardson reportedly wanted to limit expenditures to increments of no more than $100 million per year, but reluctantly agreed to provide $150 million per year when told that the project could not be properly managed at the lower figure. DOE indicated they planned to provide an additonal $95 million in FY 2001; "no more than $150 million in FY 2002 and 2003; $140 million in FY 2004; $130 million in FY 2005; and a declining profile thereafter." DOE's insistence on a cost-profile-based schedule resulted in the need for another new rebaselining of the project. DOE promises to provide a firm estimate by mid September.

DOE also estimated that "Other related (non-construction) costs" associated with NIF would rise from $0.8 billion to $1.4 billion.

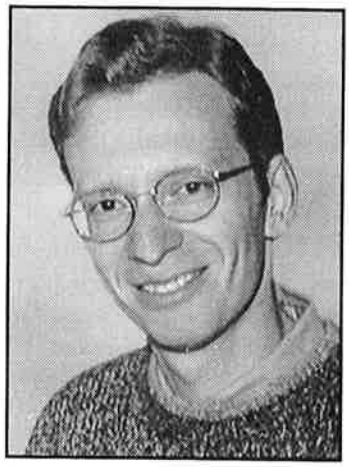
Despite the cost increases, Secretary Richardson asserted that a detailed review by several groups, including the Directors of the three DOE weapons laboratories, has concluded that "The National Igniton Facility remains a cornerstone of the Stockpile Stewardship Program." He said that "the project is technically sound and based on good engineering design."

The report can be viewed at //www.dp.doe.gov/dp_web/news_f.htm

SHVETS RECEIVES PRESIDENTIAL, DOE AWARDS

Gennady Shvets, a fusion physicist at the Princeton Plasma Physics Laboratory (PPPL), has been named by President Clinton as one of 60 young researchers to receive the Presidential Early Career Awards for Scientists and Engineers. He also was one of four scientists designated by Energy Secretary Bill Richardson as a recipient of the DOE Office of Science Early Career Awards.

Clinton stated, "We honor these outstanding young scientists and engineers for their research contributions, for their promise, and for their commitment to broader societal goals. They will do much to shape our society and advance our national interests in the twenty-first century." Richardson cited Shvets for "theoretical and computational investigations of the interaction of ultra-strong laser pulses with plasmas, with applications to inertial confinement fusion, to plasma-based particle accelerators, (and) to new radiation sources based on beams and plasmas."



Gennady Shvets

Shvets was born in Kiev (Ukraine) and attended the Moscow Institute of Physics and Technology from 1986-1989, majoring in physics and chemistry. In December 1989, he and his family emigrated to the United States and settled in Baltimore. He received a Ph.D. in plasma physics from MIT in 1995 and came to PPPL the same year.

QUOTABLES

"To this day, the (fusion) field is dominated by plasma physicists as opposed to engineers. The problems facing fusion are as much, if not more, in engineering than in plasma physics. Still, the major responsibility for improving the attractiveness of fusion has been left to the physicists through advanced modes of operation and innovative alternate concepts. Plasma engineering and fusion technology, public pronouncements notwithstanding, still primarily serve in a support role. The irony is that it is the area of plasma science that is relatively mature. Engineering should be transformed from a support to a research endeavor in view of the fact that engineering innovation will likely be just as important as plasma science innovation in increasing the attractiveness of fusion as a source of energy."

Jeffrey P. Freidberg, Chairman
MIT Nuclear Engineering Department
FPA Symposium, June 3, 1998

"When you're hungry you ask for the bread, not the butter."

Mohamed Abdou, Professor
UCLA Mechanical & Aerospace
Engineering Department
DOE Budget Meeting, April 4, 2000

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JUL/AUG 2000
Vol. 22, No. 4

FPA ANNUAL AWARDS PRESENTED

NEW AFFILIATE

Innovation Services, Inc., Knoxville, TN has joined Fusion Power Associates as a Small Business Affiliate. Jeffrey Hubrig, VP, Operations, will represent the company. The company is engaged in the applied research and development of thermoset resin systems, especially epoxy resin formulations. They have 45 years' experience in the manufacture, repair, maintenance and life extension of high performance composite structures and electrical and electronic devices. The company has provided support to fusion projects, including TFTR, in the past.

They can be reached at 342 Mapletree Drive, Knoxville, TN 37922-0831; (865)671-2279; fax (865)675-0179; jghubrig@mindspring.com

YEAR 2000 FPA AWARDS PRESENTED

Fusion Power Associates Year 2000 Awards were presented at FPA's annual meeting and symposium July 17 at the University of California at San Diego. FPA Awards are given annually for Distinguished Career, for Leadership, and for Excellence in Fusion Engineering. This year a Special Award was also given for Education and Outreach. For a list of previous award recipients, go to the FPA homepage (//fusionpower.org) and click on Awards.

DISTINGUISHED CAREER awards have been presented annually since 1987 to those individuals, at or beyond retirement age, who have made distinguished lifelong career contributions that have benefitted fusion development. This year's recipients are: Alan Gibson, Thomas Simonen, Ken Tomabechi and Alvin Trivelpiece.

Alan Gibson was a longtime scientific and managerial leader at the Culham and JET laboratories in the United Kingdom. In selecting him the Board recognizes his seminal research contributions to fusion and his technical and managerial contributions to the success of the JET project.

Tom Simonen has been a leader of experimental fusion research programs at both LLNL and General Atomics. The Board recognizes his many solid scientific contributions and leadership of major fusion research facilities over many decades.

Ken Tomabechi has been a leading fusion researcher and director of the Japan Atomic Energy Research Institute. The Board recognizes his many years of leadership of the fusion program in Japan and his essential contributions to the ITER project and to fusion international collaboration.

Alvin W. Trivelpiece recently retired from his post as Director of Oak Ridge National Laboratory. He was a pioneering fusion researcher, university professor, and top-level manager in both the private and public sectors, including co-founder of Fusion Power Associates and member of its first Board of Directors. The Board recognizes his seminal research and educational contributions to fusion research, his government service to fusion and energy research, his role in founding Fusion Power Associates and his many other distinguished career accomplishments, including head of the AAAS and director of ORNL.

LEADERSHIP awards have been presented annually since 1980 to individuals who have shown outstanding leadership qualities in accelerating the development of fusion. This year's recipients are: Robert Aymar and John Lindl.

Robert Aymar is a leading European fusion researcher and has been director of the ITER project since 1994. The Board recognizes his dedication to the pursuit of an ambitious approach to the development of practical fusion power, as represented both by his early career accomplishments and his more recent outstanding leadership of the ITER international collaboration.

John Lindl is a leading inertial confinement fusion researcher at the Lawrence Livermore National Laboratory, is a member of the DOE Fusion Energy Sciences Advisory Committee and currently is chair of the Steering Committee for the US fusion Integrated Program Planning Activity. The Board recognizes the guidance and leadership he has provided over the years to the inertial confinement fusion program, in general, and especially theperspective he has provided the fusion community as a whole on the energy applications of inertial fusion.

EXCELLENCE IN FUSION ENGINEERING awards, in memory of MIT Professor David J. Rose, have been given annually since 1987 to individuals relatively early in their careers who have shown both outstanding technical accomplishment and potential to become exceptionally influential leaders in the fusion field. This year's recipients are Gianfranco Federici and Michael Mauel.

Gianfranco Federici, an engineer with the ITER project, based in Garching, Germany, is recognized for both his broad perspective and his many contributions to the ITER design, including his comprehensive model for predicting the behaviour of tritium in solid breeder ceramics and for calculating the tritium release rate and inventory.

Michael Mauel, Professor of Applied Physics at Columbia University, is recognized for his technical leadership of the Levitated Dipole fusion concept, his programmatic leadership of the 1999 Fusion Summer Study, and his dedication to the education of graduate students in applied plasma physics.

A Special Award for **EDUCATION AND OUTREACH** was given this year to recognize several individuals who have been energetically and creatively working for many years to educate the public on the benefits of fusion, with a special focus on teachers and students. The recipients are **Diane Carroll** (Princeton Plasma Physics Laboratory), **Donald Correll** (Lawrence Livermore National Laboratory) and **Carol Danielson** (General Atomics). The Board is pleased to recognize them for their dedication and efforts to explain the fusion message to students, teachers and the general public, thereby providing a great service to the fusion community as a whole.

FUSION 2001 BUDGET DELAYED

Congress adjourned until September without passing the Fiscal Year 2001 Appropriations Act for the Department of Energy, which includes funding for the Office of Fusion Energy Sciences and the Defense Programs' Inertial Confinement Fusion program. Prior to the recess, the House of Representatives had passed its version of the Appropriations Bill, containing slightly more funds for fusion than this year, and the Senate Appropriations Committee had voted to send a bill to the full Senate recommending considerably less.

On June 29, the U.S. House of Representatives voted approval of Energy and Water appropriations bill that included Fiscal Year 2001 funding for the U.S. Fusion Energy Sciences Program. The funding action is accompanied by the following language from the House Committee on Appropriations:

"The Committee recommendation for fusion energy sciences is $255,000,000, an increase of $7,730,000 over the budget request. Additional funding of $25,000,000 has been provided in the inertial confinement fusion program in the Weapons Activities appropriation account to support work on the development of high average power lasers Funds for this program should be allocated in accordance with the Fusion Energy Science Advisory Committee's (FESAC) report on Balance and Priorities. The Committee is pleased that the FESAC review process seems to be positioning the U.S. program to take advantage of the much larger international fusion research effort with the resources available and also positions the program to accelerate the development of fusion energy. The Committee recommendation includes the budget request of $19,600,000 for decontamination and decommissioning of the Tokomak Fusion Test Reactor (TFTR)."

"Inertial Confinement Fusion — The Committee recommends $364,600,000 for the inertial confinement fusion program, an increase of $169,700,000 over the budget request of $194,900,000. The recommendation includes $144,700,000 which has been transferred to inertial confinement fusion from the readiness in technical base and facilities program, and $25,000,000 to further the development of high average power lasers. Last year the Committee requested the Secretary of Energy to complete and certify a new cost and schedule baseline for the National Ignition Facility (NIF). This certification was to be submitted by June 1, 2000. If the Department was unable to provide such a certification, the Department was to prepare an estimate of the costs necessary to terminate the project. The Department has not been able to certify a new cost and schedule baseline, but has submitted an interim report calculating the total project cost at approximately $3.26 billion. The Committee does not believe that the information provided to date is an adequate basis for additional appropriations in fiscal year 2001. The Committee will reserve judgment on this project until the final report is submitted in September. Although completion of the NIF project in a timely and cost effective manner is a high priority for the stockpile stewardship program, it is important that the Department continue to support and maintain the work at other inertial fusion facilities, and efforts in diagnostics, target fabrication, and cryogenic target development. These elements of the inertial confinement fusion program not only enable the goals of NIF, but have important roles in meeting the overall goals of stockpile stewardship. With significant delays in NIF, increased use of existing facilities and the continued development of the supporting activities are essential to the long term success of the program. The Committee recommendation includes the budget request of $9,750,000 for the Naval Research Laboratory and $32,150,000 for the University of Rochester."

On July 18, the Senate Committee on Energy and Water Development Appropriations completed its action on the FY01 Energy and Water Development Appropriations bill. The Committee funded the fusion energy sciences program at only $227.27 million. This is substantially below the Administration's requested level of $243.9 million and the House level of $255 million. In addition, there are no additional dollars for high average power lasers or related research and development under

the defense programs account (recall that the House bill contains $25 million for this work). Hence, considering the fusion energy sciences and defense high average power laser work as one, the Senate bill is approximately $52 million lower than the House funding level for FY01. In addition, the draft bill funds NIF at the Administration's requested level of $74.1 million. The language accompanying the Senate Committee's report reads as follows:

"The Committee recommendation for fusion energy sciences is $227,270,000, a reduction of $22,730,000 from the current year appropriation. While in the past, the Committee has supported increases above the level of the request for this program, severe budget constraints and shortfalls elsewhere in the Department's request, necessitate the reduction at this time."

NASA PURSUES PLASMA ROCKET

An agreement to collaborate on development of an advanced rocket technology that could cut in half the time required to reach Mars, opening the solar system to human exploration in the next decade, has been signed by NASA's Johnson Space Center, Houston, TX, and MSE Technology Applications Inc., Butte, MT. The technology could reduce astronauts' total exposure to space radiation and lessen time spent in weightlessness, perhaps minimizing bone and muscle mass loss and circulatory changes.

Called the Variable Specific Impulse Magnetoplasma Rocket (VASIMR), the technology has been under development at Johnson's Advanced Space Propulsion Laboratory. The laboratory director is Franklin Chang-Diaz, a NASA astronaut who holds a doctorate in applied plasma physics and fusion technology from the Massachusetts Institute of Technology, Cambridge. Chang-Diaz, who began working on the plasma rocket in 1979, said, "A precursor to fusion rockets, the VASIMR provides a power-rich, fast-propulsion architecture."

On a mission to Mars, such a rocket would continuously accelerate through the first half of its voyage, then reverse its attitude and slow down during the second half. The flight could take slightly over three months. A conventional chemical mission would take seven to eight months and involve long periods of unpowered drift en route. There are also potential applications for the technology in the commercial sector. A variable-exhaust plasma rocket would provide an important operational flexibility in the positioning of satellites in Earth orbit.

Several new technologies are being developed for the concept, Chang-Diaz said. They include magnets that are super-conducting at space temperatures, compact power generation equipment, and compact and robust radio-frequency systems for plasma generation and heating.

Coordinated by Jchnson's Office of Technology Transfer and Commercialization, the Space Act Agreement calls for a joint collaborative effort to develop advanced propulsion technologies, with no money exchanged between the two parties. Such agreements are part of NASA's continuing effort to transfer benefits of public research and development to the private sector. Images associated with this release are available on the Internet at: http://spaceflight.nasa.gov/mars/technology/propulsion/aspl/ For further information contact Franklin Chang-Diaz (fchang@ems.jsc.nasa.gov).

FRANCE TO OFFER ITER SITE

France has joined Canada (See May/Jun Newsletter) in indicating that it intends to offer a candidate site for the construction of ITER. At a July 11 meeting of the Consultative European Committee on Fusion in Brussels, the French delegate announced the Candidature of France for the site of ITER. He said that France intends to offer Cadarache as the site the European Union (EU) might wish to have. Furthermore, it was reported by sources close to the event, it seems to have become evident that Mr. Schwarzenberg, the new French minister responsible for nuclear energy, is now laying the emphasis of the development of French nuclear energy on fusion.

Officials at ITER Canada, which had previously indicated their intent to propose a site for ITER in Canada, welcomed the news. They stated, "Overall we can take this as good news for the ITER project, strengthening the probability that it will be constructed. Secondly, it establishes the basis for Canada as the compromise site between Europe and Japan that has been recognized by each of the ITER Parties from the outset. Once ITER Canada has submitted its bid to the federal government and has received the government's endorsement (planned for early next year), then our natural advantages will come into full consideration."

A French source commented, "This change is surprising and predictable at the same time. It would have been surprising if France held itself out of the debates on a grand piece of scientific equipment like ITER. Given the absence of a European candidate, the isolation of Japan, and the fragility of governmental support for the Canadian site, the French — always opportunists — and without any doubt judged that the moment was propitious to throw themselves in the arena. This will certainly change all the facts on the table, because the French will present a candidacy that is very attractive and solid, which will pose a big challenge to ITER-Canada."

IDAHO LAB LANDS FUSION PROJECT

The Fusion Safety Program at the Department of Energy's Idaho National Engineering and Environmental Laboratory (INEEL) has received a significant boost. DOE's Office of Fusion Energy Science has selected the INEEL as the site of the Safety and Tritium Applications Research (STAR) Facility. INEEL officials stated, "The selection will expand the INEEL's scope of fusion research and development, elevate the INEEL standing in the

fusion community, help attract top scientists to do research at the INEEL and promote the INEEL mission of using science to support operations at the Laboratory."

Dave Petti, Ph.D., INEEL engineering fellow and leader of the Fusion Safety Program, says, "Our getting the project rested on a good technical reputation in fusion safety. We are known as team players and understand our role as a team player. We are good collaborators. Also, the caliber of our work and our people was important. DOE looked at our responsiveness and our ability to meet milestones. These were all influencing factors."

He says that support from John Gill, an expert in tritium work at DOE's Mound Facility that is operated by BWXT, made a big difference in preparing the winning proposal. "He contributed to the stature of our proposal and helped with understanding the needs of handling tritium and the applicable DOE orders," said Petti. "He provided us with real-world cost estimates and technical detail."

Kathryn McCarthy, Ph.D., INEEL Nuclear Engineering Design and Research manager, says the new program will help diversify the INEEL's fusion program from strictly safety oriented into research into tritium/chemistry areas. "It's a feather in our cap. Our technical proposal was very high quality. It says a lot for our technical capabilities and our scientists."

Petti says the key elements of the STAR Facility are the Tritium Plasma Experiment and experiments to study chemistry and tritium behavior in molten salts. The Tritium Plasma Experiment is now housed at Los Alamos National Laboratory. It's a large plasma column research device used to study the interaction of tritium with materials. Petti says the INTEL's Fusion Safety Program has worked with small amounts of tritium in the past, but the Tritium Plasma Experiment will increase the volume of tritium experimented with and help make the INTEL a world center for this kind of research. "Our experience in handling tritium and the design of the expansion to the INTEL's Tritium Research Laboratory will ensure the safety of operations," he added.

McCarthy explained, "Tritium is a fusion fuel. When you produce tritium, you need to know how much of it permeates the solid materials and how much tritium is retained in the material. The TPX will help us understand this process."

The molten salt work will be done in conjunction with Japanese fusion scientists. It will involve investigating using molten salts to breed tritium. A primary salt to be studied is lithium fluoride/beryllium fluoride, known as Flub. McCarthy said the lithium in the Flub, when bombarded with neutrons, breeds tritium. "But when you breed tritium, you create free fluorine which is very corrosive. So we must learn how to control this condition. Also, Flub, when exposed to air or steam, may release other materials and we need to study those releases."

Glen Longhurst, Ph.D., a consulting engineer in the Fusion Safety Program, noted, too, that other research performed in the STAR Facility could benefit the INTEL's Advanced Test Reactor program. Inside the AT core are beryllium reflectors that reflect neutrons back towards the experiments when the reactor is running. Over years, the neutron bombardment causes tritium to build up in the reflectors, and they must be replaced periodically. The tritium buildup makes the reflectors difficult to dispose of. The research in the fusion program may help scientists understand how the tritium can be recovered from the reflectors, making them eligible for shallow land disposal. "One of the charters of the INTEL contract," says Longhurst, "is to merge science with operations issues. We have scientists who can help solve an operational problem."

Located at the Test Reactor Area, the INTEL's existing Tritium Research Laboratory, under the direction of consulting scientist Bob Anders, Ph.D., will be expanded to house the new research equipment and experiments. Experiments in the expanded area could begin by April 2001. The first experiments will be a joint U.S./Japanese collaboration involving Flub research. A full range of fusion experiments could be running by 2005.

McCarthy said, "The STAR Facility will provide an opportunity for us to interact with a new group of scientists, broaden our contacts within the fusion community and give us the opportunity for new work. There will be offshoots with the TPX that will provide the opportunity for research with outside programs including the Inland Northwest Research Alliance. (INCA is a consortium of seven universities that is part of the INTEL contractor team.) We hope to have many experiments with different applications, not all of them in the fusion area."

McCarthy stated, "We want to make the STAR Facility an official User Facility, which makes it easier to bring in researchers and projects." Patti adds that letters of support for the project from DOE-Idaho Manager Bev Cook and INTEL Laboratory Director Bill Ship made a big difference. Patti concludes, "This is exciting because it's new R&D. It's rewarding to work on a successful proposal that wasn't even envisioned a year ago. It's going to provide some new internal opportunities for employees and attract new researchers with new ideas, which helps a research program remain dynamic."

The INTEL's Fusion Safety Program has existed since 1978 and has been involved in both national and international fusion programs. The program's overall goals have been to demonstrate the safety and environmental potential of fusion.

The program's focus has been to understand the behavior of radioactive and hazardous materials in deuterium-tritium-powered fusion machines, to develop the analytical tools to describe and understand how a fusion machine would act in an off-normal event and to determine the safety and potential environmental risks of fusion as an energy source.

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SEP/OCT 2000
Vol. 22, No. 5

HAZELTINE NAMED FESAC CHAIRMAN GRUNDER NAMED ARGONNE DIRECTOR

FESAC GETS NEW CHAIRMAN, NEW MEMBERS

The U.S. DOE Fusion Energy Sciences Advisory Committee (FESAC) will meet November 14–15 in Bethesda, Maryland, under the guidance of its new chairman, Prof. Richard D. Hazeltine. Hazeltine, who is Director of the Institute for Fusion Studies (IFS) at the University of Texas, Austin, succeeds John Sheffield of Oak Ridge National Laboratory. Sheffield will remain a member of the Committee.

Hazeltine received his AB from Harvard University (1964) and his Ph.D. in Physics from the University of Michigan (1968). He has been at the University of Texas since 1971 and has been a full professor there since 1986. He has served as Director of the IFS since 1991. He is a Fellow of the American Physical Society, has served as chair of its Division of Plasma Physics and is a member of the Board on Physics and Astronomy, National Research Council.

The FESAC will have several new members: Vincent S. Chan (General Atomics), Kathryn McCarthy (Idaho National Engineering and Environmental Laboratory), William McCurdy (Lawrence Berkeley National Laboratory), and George Morales (UCLA). In addition, James F. Drake (University of Maryland) will join the FESAC as an ex-officio member in his capacity as Chair of the American Physical Society Division of Plasma Physics. Continuing members of FESAC are: Charles Baker (UCSD), Jill P. Dahlburg (U.S. Naval Research Laboratory), Gerald Navratil (Columbia University), Jeffrey Freidberg (MIT), Joseph Johnson III (Florida A&M University), John Lindl (Lawrence Livermore National Laboratory), Cynthia Phillips (Princeton Plasma Physics Laboratory), Marshall Rosenbluth (General Atomics), John Sheffield (Oak Ridge National Laboratory) and Ned Sauthoff (ex-officio, representing the IEEE). Kathryn McCarthy will also serve as representative of the American Nuclear Society Fusion Energy Division.

The November 14–15 FESAC meeting will be held at the Bethesda Ramada Hotel, 8400 Wisconsin Avenue, Bethesda, Maryland, and is open to the public. The FESAC is expected to complete work on its current charge to review the Integrated Program Planning Activity (May/June 2000 Newsletter) and to receive several new charges. Details are posted at the DOE Office of Fusion Energy Sciences web site (//www.ofe.er.doe.gov/). The FESAC is chartered under the Federal Advisory Committee Act (Public Law 92-463) to provide independent advice to the Director of the DOE Office of Science on scientific and technological issues that arise in the planning, implementation, and management of the Fusion Energy Sciences program.

Dr. Richard D. Hazeltine

For further information contact Al Opdenaker (Albert.Opdenaker@science.doe.gov).

HERMANN GRUNDER NAMED ARGONNE DIRECTOR

Hermann Grunder, Director of the Thomas Jefferson National Accelerator Laboratory, has been named Director of Argonne National Laboratory, effective November 1.

In making the announcement, Argonne officials said, "Dr. Grunder is an internationally recognized nuclear and accelerator physicist, and former Deputy Director of Lawrence Berkeley Laboratory. He has published extensively on nuclear physics, high-energy and heavy-ion accelerators, on application of accelerators in medical research, and on accelerator technology. Dr. Grunder brings to the directorship great experience and understanding of our national laboratory system. His knowledge of science and technology, combined with his energy and wisdom, will provide outstanding leadership for Argonne."

In accepting the appointment, Dr. Grunder said, "I have made it my career to serve where I am most needed in the national lab system. I am honored that the University of Chicago and the Department of Energy found my knowledge, experience and management style equal to the complex needs of a multi-program lab such as Argonne National Laboratory. While it will be difficult to leave Jefferson Lab and the community that has been so supportive, I look forward to the challenges ahead."

Dr. Grunder was an early fusion research scientist at the Berkeley Laboratory. More recently, in 1997, while Director of the Jefferson Laboratory, he chaired a panel of the DOE Fusion Energy Sciences Advisory Committee charged with reviewing the role of the U.S. in the international ITER fusion project (November 1997 Newsletter). Among the recommendations of that group was that "in concert with our international partners, a burning plasma facility should be built at the earliest possible time." The "Grunder Panel" also recommended that the U.S. "undertake design efforts on lower cost fusion-energy-producing plasma concepts."

Hermann Grunder was a recipient of Fusion Power Associates 1998 Leadership Award. He can be reached at grunder@cebaf.gov

FPA BOARD APPROVES ITER STATEMENT

In a show of support to the international parties attempting to move the ITER fusion engineering facility into construction (July/August 2000 Newsletter), the Fusion Power Associates Board of Directors has approved the following statement. Efforts to agree on construction of the facility have been hampered in part by the Congressionally-forced U.S. withdrawal from ITER collaboration in 1998 (August 1998 Newsletter).

"The Board of Directors of Fusion Power Associates (FPA) notes the significant progress on the design and potential construction of the ITER project, as presented at FPA's annual meeting July 17 by ITER Director Robert Aymar and by ITER Canada Chairman Peter Barnard. The Board is especially pleased about the development of a reduced cost design and the development of a schedule for making site decisions among the three ITER parties: Europe, Japan and Russia. The Board congratulates ITER Canada, a member organization of Fusion Power Associates, for proposing a very attractive candidate site for ITER in Canada. The Board expresses the hope that the U.S. would consider rejoining the ITER project if it moves forward into a construction phase."

This statement is endorsed by the following members of Fusion Power Associates 18 member Board of Directors:

Charles C. Baker (University of California at San Diego), Chairman
Roger Bangerter (Lawrence Berkeley National Laboratory), Vice Chairman
Stephen O. Dean (Fusion Power Associates)
David E. Baldwin (General Atomics)
E. Michael Campbell (General Atomics)
John F. Clarke (Battelle Pacific Northwest Laboratories)
Donald P. Dautovich (ITER Canada)
John Davis (The Boeing Company)
William R. Ellis (Raytheon Engineers and Constructors)
John Gilleland (Archimedes Technology Group)
Robert J. Goldston (Princeton Plasma Physics Laboratory)
Richard Hazeltine (University of Texas)
Robert L. McCrory (University of Rochester)
Gerald Navratil (Columbia University)
Miklos Porkolab (MIT Plasma Science and Fusion Center)
John Sheffield (Oak Ridge National Laboratory)

DOE PRESSING FORWARD ON NIF

On September 15, the U.S. Department of Energy (DOE) sent to Congress a "final baseline report for the National Ignition Facility (NIF)." DOE said the report "confirms a construction cost of $2.2 billion and completion of the project by September 2008." These figures are consistent with an interim report sent to Congress in June (May/June 2000 Newsletter). DOE said that, in addition to actual construction costs, there are other related R&D costs. "Total project-related costs are $3.5 billion," they said. Originally, NIF was expected to cost $1.2 billion for construction, with a total project cost of $2.0 billion.

Lawrence Livermore National Laboratory (LLNL) officials stated that NIF cost could be reduced by about $300 million from the $2.2 billion figure if DOE had chosen a faster (2006) schedule for completion. Secretary Richardson reportedly chose a schedule that would limit total annual future expenditures to no more than $150 million per year. NIF originally was to be fully operational in 2004.

Secretary Richardson, in transmitting the report to Congress, reaffirmed the importance of NIF. "NIF is essential for our stockpile stewardship program to maintain the long-term reliability and safety of the nation's nuclear stockpile without nuclear testing," he said. "This report details the extensive work performed in getting NIF back on track. The final baseline takes into account the in-depth technical and cost reviews that I ordered so that we can move ahead with confidence." The rebaseline report and a DOE-led cost review are posted at www.dp.doe.gov

Richardson said that an independent technical review of the project, known as the Carlson-Lehman Review, "validated the project's revised cost and schedule baseline." He said the review team "consisted of forty experts with extensive experience in the management of major government and industrial projects, lasers, accelerators and procurement." He said, "The review concluded that the NIF project can be completed successfully using current technology within the total cost and schedule defined in the revised baseline."

John Gordon, Administrator of the newly-formed National Nuclear Security Administration, echoed Richardson's view. He said, "I am confident that NIF will deliver, beginning in 2005, key scientific data that will allow our scientists to continue to certify the safety, security and reliability of the stockpile." The NIF final baseline report includes a strategy to deploy the NIF laser beamlines in stages beginning in 2005, three years before completion of all 192 beamlines.

Not everyone agrees with DOE on the importance of NIF in stockpile stewardship. An article in the September 14 issue of the British science magazine *Nature* by former Naval Research Laboratory laser branch chief Stephen Bodner and Christopher Paine of the National Resources Defense Council claims "this facility cannot produce the same extreme physical conditions generated in a nuclear weapon explosion. Some scaling is required. It would be risky and unwise to rely on such extrapolations to evaluate future modifications to, or aging of, nuclear weapons." The pair also questions a number of technical assumptions on which the NIF is based, including the ability to develop adequate damage-resistant optics and the probability of reaching ignition. "We do not believe there is (any real target design with the potential to achieve ignition), and the NIF project is far too expensive to gamble that viable targets will simply materialize when needed," they say.

The General Accounting Office also issued a report August 17 critical of NIF. The report was requested by members of the House Committee on Science. The GAO warned that "unresolved technical problems may further drive up the cost of NIF." GAO also cautioned DOE not to reallocated funds to NIF from other nuclear weapons programs until "DOE (1) evaluates the impact of its cost and schedule plan, as well as other options for NIF, on the overall nuclear weapons program and (2) certifies that the selected NIF cost and schedule plan will not negatively impact the balance of the Stockpile Stewardship Program."

Funding is a critical issue for the NIF project. Congress has thus far refused to appropriate the additional funds to complete the project, waiting ostensibly for the new baseline report which it has now received. Sen. Tom Harkin (D-Iowa) succeeded in offering an amendment to the Senate's version of the DOE appropriations bill that would limit spending for NIF to $74 and require a National Academy of Sciences study on whether the facility is necessary to maintain the safety and reliability of the nuclear weapons stockpile. The House previously passed an appropriations bill that included $74 million for NIF but did not require any additional studies. DOE states that $206 million is required in FY2001 for NIF to maintain the new cost and schedule.

In offering his amendment, Senator Harkin stated, "I fully support efforts to maintain our nuclear weapons without a return to testing. If I thought NIF was necessary for that effort, I would support it at almost any price. But there are better ways to maintain our weapons. NIF appears to be mostly a jobs program for nuclear weapons scientists." Senator Kyl (R-AZ) disputed Harkins view saying, "The National Ignition Facility is a key component of the Stockpile Stewardship Program because it will actually allow an event to occur that simulates a nuclear explosion. Without it, eventually the Stockpile Stewardship Program provides you nothing in terms of data." He added, "I am hopeful and I presume (this amendment) will not be part of the final legislation that goes to the President for his signature."

Following the DOE transmittal of the new cost and schedule plan to Congress, LLNL Director Bruce Tartar issued the following statement. "We are pleased that the Department of Energy has validated the go-forward plan for the NIF and reaffirmed the importance of the facility for the nations' Stockpile Stewardship Program. The Department has submitted the new baseline to Congress with supporting documentation - including the very positive results of the Carlson-Lehman Review. This review, recommended by the GAO and the Secretary of Energy's Advisory Board, was an independent, high-quality, intensive and rigorous process using experts from industry, academia and other DOE laboratories. Their report concluded that the project plan was credible, that we have an outstanding technical and management team, and that the cost and schedule proposal is valid.

The entire NIF team and the Laboratory is eager to move forward to finish this strategic national asset."

LLNL LETS NIF CONTRACT TO JACOBS ENGINEERING

The Department of Energy announced August 31 that the Lawrence Livermore National Laboratory had selected Jacobs Engineering Group, Inc. to build and install the laser system infrastructure for the National Ignition Facility. The need to put this work out to industry was a primary cause of the NIF cost increase and schedule slippage that has caused so much review and controversy over the past year, since it was determined that the assembly and integration processes required for NIF were too complex to be performed by in-house engineers at LLNL but instead needed to be contracted out to industry.

The $230 million cost-plus-award-fee contract provides for project integration, design integration management and facility

commissioning for the 192 lasers that will comprise the completed NIF project. Jacobs Engineering was also the construction manager for NIF's conventional facilities, which have now largely been completed.

John Gordon, National Nuclear Security Administration Administrator, said "This is a very important element of the NIF project. Jacobs Engineering has a big job ahead of them, performing clean assembly and installation of this complex beampath hardware."

In the release, DOE said "NIF is a vital research facility that, in conjunction with other experimental facilities, will allow researchers to maintain the safety, security and reliability of the nation's nuclear weapons stockpile without the need for underground nuclear testing. When complete it will house the world's most powerful laser and will produce conditions similar to those that occur inside detonating nuclear weapons. It will mark the first time that such conditions have been replicated in a laboratory setting."

LLNL Director Bruce Tartar issued a statement saying, "This is a major milestone for the National Ignition Facility. We look forward to working with Jacobs on this next important phase for NIF."

DEAN RECEIVES DOE AWARD

The U.S. Department of Energy has recognized Fusion Power Associates President Steve Dean by presenting him with one of their highest awards, the Distinguished Associates Award. The award, signed by Energy Secretary Bill Richardson and dated July 2000, states "United States Department of Energy Distinguished Associate Award presented to Dr. Stephen O. Dean, for your many contributions to the fusion program over the past 20 years in your role as the co-founder and President of Fusion Power Associates. Your tireless work in bringing diverse components of the fusion community together for topical meetings, and your efforts to increase public awareness and understanding of the potential benefits of fusion, have helped to make fusion an important element of the Nation's energy sciences portfolio."

Fusion Power Associates Board Chairman Charles Baker also presented Dean with a Special Award from the FPA Board of Directors for his 20 years of service at FPA's President. The award was presented at FPA's annual meeting July 17 in San Diego.

SUPERCOMPUTING AT OAK RIDGE

Using new, highly advanced supercomputers at Oak Ridge National Laboratory (ORNL), Fred Jaeger and Lee Berry of ORNL's Fusion Energy Division have developed a better understanding of radio waves in the plasma that would be at the heart of a fusion power plant, according to an ORNL press release.

"Our research is allowing us to study the high-power radio waves we use in fusion research experiments," the release quotes Jaeger as saying. "This newly gained knowledge should help us get a clearer picture of the physics of the heating system and control for a fusion machine."

"It's essential to have a good theoretical understanding of the wave behavior and to be able to calculate it accurately," Jaeger said. "But computing these waves is difficult because the particles are so hot they move at almost the speed of light. This motion makes it difficult to calculate how the plasma particles will respond to the wave and how much electric current they will produce."

Until now, researchers wanting to calculate the effects of radio waves in plasma have been forced to either ignore the variation of the plasma in all but one direction or consider just waves having long wavelengths and low frequencies.

"The first choice, treating the plasma as one-dimensional, is akin to adopting tunnel vision," the release quotes Berry as saying. "The wave is computed along a single line through the plasma, but we don't get a picture of what is occurring in the whole plasma cross-section." The second choice, Berry said, eliminates from consideration many of the wave processes that are of most importance in today's fusion experiments that require high frequencies and can have very short wavelengths.

Working with Ed D'Azevedo of ORNL's Computer Science and Mathematics Division, Jaeger and Berry have developed a computer program to solve the equations that take advantage of the massively parallel structure of modern supercomputers. They obtained the first high-definition picture in two dimensions of a tokamak for a process called "mode conversion." In this process, researchers inject radio waves from outside the device. At a certain location, the waves suddenly change character to a different type of wave having very fine scale structure and are absorbed by the plasma.

The solutions were obtained running on ORNL's 1-trillion-operation-per-second (teraflop) IBM RS/6000 SP supercomputer, which with Berry and Jaeger's program achieved speeds of 650 billion operations per second.

"These calculations are considered to be a breakthrough for wave studies in fusion machines," Don Batchelor, section head of the theory group in the Fusion Energy Division, is quoted in the release as saying.

The new computer program provides high-resolution pictures that clearly detail the formation of the short wavelength structures and how the various waves propagate, reflect and are absorbed in the plasma. Researchers expect the new technique to be useful to much more complex plasma shapes than the tokamak type used in this experiment.

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NOV/DEC 2000
Vol. 22, No. 6

FUSION PIONEER MEL GOTTLIEB DIES AT 83
LASER SCIENTIST HOWARD POWELL DIES SUDDENLY IN DC

MEL GOTTLIEB

Melvin B. Gottlieb, a pioneer physicist of the U.S. fusion program and an international leader in the field of research on fusion energy, died on December 1 in Haverford, Pa. He was 83.

Dr. Gottlieb, educated at the University of Chicago, was head of the experimental fusion research program in the mid-to-late 1950's at Princeton University where he was Professor of Astrophysical Sciences. From 1961-1980, he was Director of the Princeton Plasma Physics Laboratory. The Laboratory is the largest facility in the United States devoted to studying the physics of the high temperature plasmas and magnetic fusion.

Dr. Gottlieb led the Laboratory at a very exciting time. In the mid 1960's, initial experimental results from the Soviet Union pointed to a new path to the very high temperature plasmas needed for making fusion energy. Under Dr. Gottlieb's leadership the Laboratory quickly extended these results, passing through three generations of highly successful "tokamak" experiments. The Tokamak Fusion Test Reactor, whose construction started under Dr. Gottlieb, created plasmas at nearly a billion degrees Fahrenheit, and made more than 10 million Watts of fusion power.

Dr. Gottlieb is remembered as much for his warm personal style as for his insightful scientific leadership. His thoughtfulness and calm — often expressed by putting his re-assuring arm around the shoulder of an over-stressed researcher — is a cherished memory at the Princeton Plasma Physics Laboratory.

Dr. Gottlieb devoted considerable time during his career to working toward better understanding and cooperation with other nations in the development of fusion power. Laboratory personnel including Dr. Gottlieb made frequent trips to meet with scientists abroad and encouraged extended visits to the U.S. by foreign scientists.

During his tenure as Director at the Princeton Plasma Physics Laboratory, Dr. Gottlieb was also involved in high-level discussions with government officials responsible for energy policy in many countries, including France, England, Germany, Italy, Norway, Japan, China, South Korea, Spain, Brazil, Canada, U.S.S.R., and the European Economic Community. He was a member of the U.S. Fusion Power Coordinating Committee; the U.S.-U.S.S.R. Joint Committee on Atomic Energy; the U.S.-People's Republic of China Committee on Fusion Cooperation; the U.S.-Japan Fusion Cooperation Committee. In 1971, he was a recipient of the North Atlantic Treaty Organization (NATO) Senior Foreign Fellowships in Science.

At the national level Dr. Gottlieb was active in many organizations whose purposes included finding alternative safe sources of energy and was for a time a member of Fusion Power Associates Board of Directors. He was a recipient of Fusion Power Associates first Distinguished Career Award in 1987. He had a long association with the American Physical Society and was founder and first chairman of its Plasma Physics Division. In 1980, he was Vice Chairman of its panel on Public Affairs (POPA). He was also a member of the American Nuclear Society and of Scientists and Engineers For Safe Energy.

After his retirement from the Laboratory, Dr. Gottlieb continued consulting in his field and, from 1980–1992, served as Chairman of the Nuclear Oversight Committee of the Public Service Electric and Gas Company of New Jersey.

Dr. Gottlieb is survived by his wife, Golda, of Haverford, Pa. whom he married in 1948; his daughter, Paula Bastian, of Cedar Run, N.J.; two grandchildren, Will Bastian and Mary Kate Bastian, and two nephews, David and Edward Mehlman, of Chicago. He was pre-deceased by his daughter, Martha, who died in an automobile accident in 1986.

Condolences may be sent to his wife, Mrs. Golda Gottlieb, 3300 Darby Road, Haverford, PA 19041-1066

HOWARD POWELL

It is with a great sense of sadness that we report the sudden death of Livermore laser scientist Howard Powell. Howard died of a massive heart attack while returning from lunch on November 15 in Washington, DC. He was pronounced dead at 2:27 PM at George Washington Hospital. He had attended the U.S. DOE Fusion Energy Sciences Advisory Committee meeting in Bethesda, Maryland, November 14–15 and was en route to another meeting in downtown Washington, DC, when the attack occurred. He appeared to be in good health at the meeting but was reported to suffer from high blood pressure.

Howard was a leader and champion of diode-pumped solid state lasers for fusion and had presented a paper on this topic at Fusion Power Associates annual meeting last July and on other occasions. He was well-known and well-liked for both his expertise and sincerity and his calm, friendly personality.

Howard made major contributions to the laser research program at LLNL, including fundamental contributions to the physics and engineering of flashlamps and to the design and operating characteristics of glass amplifiers. He was a major contributor to fixing the platinum impurity problem in the laser glass that initially hampered operation of the Nova laser. Former LLNL scientist Mike Perry said that Howard's contributions were such as "to change Nova from an expensive blow torch to a quantitative high precision laser that performed the experiments on Nova that served as the basis for NIF." He said, "Technologies that Howard developed have been adopted by every major laser facility worldwide."

Former LLNL Associate Director for Lasers Mike Campbell said, "Perhaps most notably, Howard and co-workers developed and demonstrated the world's highest power laser, the petawatt. The laser has revolutionized laser matter interactions, and again in testimony to the lab's influence in this field, is now being copied at six laboratories across the globe." Campbell said, "Howard also committed himself in pursuing his true passion — inertial fusion energy. If his beloved diode-pumped, solid-state lasers ever power a man-made sun in the heart of a fusion energy station, the glow from the target chamber will not come from hot plasma, but from Howard's smile."

His sudden death brings a deep sense of personal loss to all of us who knew him.

Person's wishing to send condolences to Howard's wife, Mary, may do so via Howard's secretary at LLNL, Kimberly Baynes, LLNL (L-482), PO Box 808, Livermore, CA 94551 (baynes1@llnl.gov).

CONGRESS PASSES FUSION BUDGET

The U.S. House and Senate have agreed on funding for the Department of Energy, including funds for the U.S. fusion programs for the Fiscal Year 2001, which began October 1.

The Office of Fusion Energy Sciences (OFES) was provided $255 million. Administration request was $247 million. The House-Senate conference committee report contains the following language:

"The Committee recommendation for fusion energy sciences is $255,000,000, an increase of $7,730,000 over the budget request. Additional funding of $25,000,000 has been provided in the inertial confinement fusion program in the Weapons Activities appropriation account to support work on the development of high average power lasers.

"Funds for this program should be allocated in accordance with the Fusion Energy Sciences Advisory Committee's (FESAC) report on Balance and Priorities. The Committee is pleased that the FESAC review process seems to be positioning the U.S. program to take advantage of the much larger international fusion research effort with the resources available and also positions the program to accelerate the development of fusion energy.

"The Committee recommendation includes the budget request of $19,600,000 for decontamination and decommissioning of the Tokamak Fusion Test Reactor (TFTR)."

In Defense Programs, the Inertial Confinement Fusion program received $449.6 million, of which $199.1 million is for NIF. As indicated above, the conferees provided $25 million for high average power lasers (money placed in Defense Programs account). The Senate bill contained no funding for this nor was it included in the Administration request.

The report language on Inertial Confinement Fusion is as follows:

"The conference agreement includes $449,600,000 for the inertial fusion program in the budget structure proposed by the House.

"Additional funding of $25,000,000 as proposed by the House has been provided to further development of high average power lasers. The conference agreement includes the budget request of $9,750,000 for the Naval Research Laboratory and the budget request of $32,150,000 for the University of

Rochester. The conference agreement reflects the transfer of $40,000,000 from National Ignition Facility (NIF) operations funding to the NIF construction project.

"The conference agreement provides $2,500,000 from within available funds to transfer the Petawatt Laser from Lawrence Livermore National Laboratory to the University of Nevada-Reno, as proposed by the Senate.

The National Ignition Facility (NIF) construction funding provided is $199.1M, compared to $209M requested by the Administration in its latest rebaselining report. Prior to the rebaselining, only $74M was requested in the President's budget request. The language on the NIF construction is as follows:

"The conference agreement provides $199,100,000 for continued construction of the National Ignition Facility (NIF). The conferees have included a directed reduction of $25,000,000 in the Weapons Activities account which is to be applied to programs under the direction of the Lawrence Livermore National Laboratory.

"The conferees have included statutory language providing that only $130,000,000 shall be made available for NIF at the beginning of fiscal year 2001 and the remaining $69,100,000 shall be available only upon delivery of a certification by March 31, 2001, by the Administrator of the National Nuclear Security Administration that several requirements have been met. These requirements include:

"A. A recommendation on an appropriate path forward for the project based on a detailed review of alternative construction options that would (1) focus on first achieving operation of a 48 or 96 beam laser; (2) allow for the full demonstration of such a system in support of the stockpile stewardship program before proceeding with construction and operation of a larger laser complex; and (3) include a program and funding plan for the possible future upgrade to a full NIF configuration. The recommendation should include identification of available "off-ramps" and decision points where the project could be scaled to a smaller system.

"B. Certification that project and scientific milestones as established in the revised construction project data sheet for the fourth quarter of fiscal year 2000 and the first two quarters of fiscal year 2001 have been met on schedule and on cost.

"C. Certification that the first and second quarter project reviews determined the project to be on schedule and cost and have provided further validation to the proposed path forward.

"D. Completion of a study that includes conclusions as to whether the full-scale NIF is required in order to maintain the safety and reliability of the current nuclear weapons stockpile, and whether alternatives to the NIF could achieve the objective of maintaining the safety and reliability of the current nuclear weapons stockpile.

"E. Certification that the NIF project has implemented an integrated cost-schedule earned-value project control system by March 1, 2000.

"F. A budget for NIF that fully describes how the NNSA intends to pay for NIF over the out years and what the potential for other impacts on the stockpile stewardship program will be.

"The conferees remain concerned about the Department's proposed budget increase and schedule delay for the NIF at the Lawrence Livermore National Laboratory (LLNL). The conferees believe that previously the Department of Energy, and most recently the National Nuclear Security Administration (NNSA), may have failed to examine adequately options for NIF that have fewer than the full 192 beams. For example, a preferred course for NIF may be to complete 48 or 96 beams as soon as possible (although block procurement of infrastructure and glass may be considered), bring the reduced NIF into operation, perform the necessary scientific and technical tests to evaluate whether a full NIF will work and its impact on stockpile stewardship, and then develop a path forward for NIF that balances its scientific importance within the overall needs of the stockpile stewardship program. To move on this path in fiscal year 2001, the conferees recommend that $199,100,000 be appropriated for NIF as follows: $74,100, 000 as originally proposed for Project 96-D-111, $40,000,000 from NIF operations funding within the budget request for LLNL, $25,000,000 to be identified within the budget request at LLNL, plus an additional $60,000,000 in new appropriations.

"Furthermore, the conferees direct the Administration to prepare a budget request for fiscal year 2002 that fully reflects a balanced set of programs and investments within the stockpile stewardship program, and that the overall budget profile over the next eight years will accommodate a $3.4 billion NIF along with the other critical aspects of the program."

There is a "general reduction" included in the bill which is likely to cost the fusion energy sciences program approximately $3 million. The whole conference report on the Energy and Water bill can be viewed at //www.house.gov/rules/welcome2.htm (Click on the line that says "Conference Report for H.R. 4733" at the top).

FESAC GETS TWO NEW CHARGES

U.S. DOE Office of Science Director Mildred Dresselhaus, in an October 6 letter to Fusion Energy Sciences Advisory Committee (FESAC) chair Richard Hazeltine, asks the committee "to address the scientific issues of burning plasma physics" and to provide a report by July 21, 2001.

Dresselhaus notes, "For many years, the U.S. magnetic fusion community has recognized that burning plasma physics is the next frontier of fusion research," and that "in the last two decades, the program has made several attempts, both international and domestic, to move forward on the design and construction of a tokamak experimental device in which the science of burning plasmas could be explored." She notes, "For various reasons, all these attempts failed."

Dresselhaus says, "the community needs to come to consensus on two aspects of burning plasma physics as follows:

"1. What scientific issues should be addressed by a burning plasma physics experiment and its major supporting elements? What are the different levels of self-heating that are needed to contribute to our understanding of these issues?

"2. Which scientific issues are generic to toroidal magnetic confinement and which ones are concept-specific? What are the relative advantages of using various magnetic confinement concepts in studying burning plasma physics??

She says, "As a part of your considerations, please address how the Next Step Options program should be used to assist the community in its preparations for an assessment in 2004, as recommended in the Priorities and Balance report."

The complete text of the charge letter can be viewed at the DOE Office of Fusion Energy Sciences web site: http://wwwofe.er.doe.gov/

In addition, Dresselhaus, in a November 9 charge letter, has asked her Fusion Energy Sciences Advisory Committee (FESAC) to review the Office of Fusion Energy Sciences (OFES) theory and computation program. She asks for the review to be completed by May 1, 2001. John Sheffield (ORNL) will chair the panel. Dresselhaus noted that "The theory and computation program is the only major element (of the OFES program) remaining to be evaluated." She said, "Because the National Academy of Sciences committee has already provided a detailed review of the scientific quality of the fusion program, FESAC should focus its effort on reviewing the theory and computation program's overall content, plans, structure and governance."

Dresselhaus asked the FESAC to review "at least the following questions:"

1. What is the appropriate role of theory and computation in the OFES program? Is the current balance between theory/computing and the rest of the fusion program reasonable?

2. Is the current structure and balance between the elements of the theory/computing program appropriate? What changes, if any, are needed in program content?

3. Several groups and numerous individual investigators at many institutions carry out theory/computing research. Is the distribution of research among these research performers appropriate? Are there structural changes that would make the program stronger?

4. In many areas of physics, "modeling/simulation" studies are now viewed as a third discipline, distinct from both experimental and theoretical studies. How effectively are the modeling/simulation and theory communities working together to support the needs of the rest of the fusion program?

5. How should the modeling/simulation efforts be conducted to increase their contribution to the overall program, considering issues such as code proliferation, legacy codes that are expensive to maintain and difficult to upgrade, introduction of modern computational techniques, and formation and functioning of multi-institutional modeling/simulation teams?

Dresselhaus says, "In reviewing program governance, FESAC should consider the following topics: planning and goal setting processes, merit review procedures, and coordination of international collaboration." She asks the review to include the following questions:

1. Are the current management practices of the program, such as program planning and merit review, sound?

2. Is the role of various organizations in managing certain elements of the program reasonable (e.g., IFS coordination of the Joint Institute for Fusion Theory [with Japan] or PPPL coordination of the Plasma Science Advanced Computing Initiative)?

3. What management would strengthen the program?

QUOTABLE

"Attempt the end, and never stand in doubt. Nothing's so hard but that search will find it out."

Robert Herod
in *Seek and Find*