



FUSION POWER ASSOCIATES

EXECUTIVE NEWSLETTER

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<http://fusionpower.org>

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NIF LASER LIGHTS UP MARBURGER SPEAKS ON FUSION POLICY

NIF Laser Lights Up

The National Ignition Facility (NIF) laser, under construction at the Lawrence Livermore National Laboratory in California, reached a major milestone, activating the first four of its 192 laser beams. The NIF laser, largest in the world, is aimed at being the first to ignite a controlled fusion reaction in the laboratory. Subsequent facilities, igniting fusion-fueled pellets repetitively, could provide a new, safe, limitless source of electricity for mankind.

Starting the week of Dec 9, scientists and engineers powered up the laser beams in a series of test runs. At the end of this series of shots, these four laser beams generated a total of over 43,000 Joules of infrared light in a pulse lasting five-billionths of a second. This corresponds to a power level of over 8 thousand billion watts (8 terawatts), which is about 10 times more power than the entire US electrical generating capacity, for 5-billionths of a second.

The next major milestone, scheduled for this spring, is to transport the four laser beams into the 10-meter diameter, one-million pound target chamber. The infrared light will be converted into ultraviolet light and focused on the first targets. This milestone will mark the beginning of commissioning of scientific diagnostic instruments for NIF experiments in support of the Stockpile Stewardship Program, basic science, and inertial fusion energy research.

The NIF is being constructed at Livermore under the auspices of the National Nuclear Security Administration (NNSA), a separately organized agency of the U.S. Department of Energy.

For further information contact: Dr. Craig R. Wuest
(wuest@llnl.gov)

Marburger Speaks on Fusion

Jack Marburger, Director of the Office of Science and Technology Policy, Executive Office of the President, spoke to the National Academy Burning Plasma Assessment Committee November 18 "regarding the Administration's view of issues associated with the peaceful exploitation of nuclear fusion." He said, "Let me say at the outset that this Administration is supportive of the concept of electrical power generation from nuclear fusion." He commented, "The closer we are to a transition from a fusion science program to a fusion device engineering program, the easier it will be to create favorable economic conditions to accelerate the practical implementation of fusion power." He said, "The promise of fusion is too great to ignore -- but we also understand that this has been a true statement for fifty years."

Marburger said, "I believe the fusion community has made a compelling case that a burning plasma experiment is the essential next scientific step for fusion research. I am convinced there is no foreseeable path to practical fusion without a burning plasma experiment."

Marburger said that in addition to a burning plasma experiment, an "equally important part is the search for a commercially optimal containment technology." "Other issues, like the development of materials that can withstand 14 MeV neutrons or the design of blanket technologies are only important once the first problem -- the creation of a burning plasma -- has been solved."

Marburger said, "Based on these beliefs, this Administration has several decisions to make:

- (1) Do we enter the ITER negotiations?
- (2) What terms are acceptable for US participation?
- (3) What changes should be made in the Fusion Energy Science Program if we do decide to move in the direction of a burning plasma experiment?"

The complete text of Dr. Marburger's remarks is posted at <http://fire.pppl.gov>

US Committee Finds ITER Cost Estimate "Credible"

A committee formed by the U.S. Department of Energy (DOE) to review and assess the cost estimates for the construction of the International Thermonuclear Experimental Reactor (ITER) has "concluded that the ITER Team has prepared a complete cost estimate that is based on sound management and engineering principles, and is credible as a basis for establishing relative contributions by the Parties to the construction of ITER." The review committee was appointed by DOE Office of Science director Dr. Raymond Orbach as part of the ongoing U.S. government's process for deciding whether to rejoin the project from which the U.S. withdrew by Congressional mandate in 1998.

The committee said the ITER cost estimate, which they estimated at \$5 billion (constant 2002 dollars), "is supported by the design and R&D results that are unusually mature for a science project facing the decision to fund construction." They recommended that "in the event the U.S. decides to join the current negotiations (to construct), it should prepare, as soon as possible, its own cost estimate for a set of procurement packages for components the U.S. would be interested in providing."

The committee said the proposed 10-year construction schedule "seems generally reasonable." However, they cautioned, "there is an inevitable uncertainty in estimating the duration of the government approval process that is a prerequisite to starting the construction of the project."

The committee also was briefed on the proposed management structure currently being discussed by the negotiators. The committee commented "Since management will be the key to the ultimate success of the project, the Committee believes that for a complex international project such as ITER, a strong line-management approach will be in the best interest of the Parties."

U.S. government officials, speaking at Fusion Power Associates annual meeting Dec 3 in Washington, said that the U.S. is expected to make a decision on whether to join the project before the end of the year, though possibly the decision might not be formally announced until "early next year." They said the Administration is currently favorably inclined toward ITER and that the main issue is "budget." The U.S. fusion budget has been essentially flat for several years and fusion community spokespersons have told the DOE that substantial

increases in funding would be required to participate in ITER. The full committee report is posted at <http://fire.pppl.gov>

US Academy Endorses ITER

In a letter interim report dated December 20, a committee of the National Academies has recommended to DOE Office of Science director Raymond Orbach "that the United States enter ITER negotiations while the strategy for an expanded U.S. fusion program is further defined and evaluated." The letter, signed by co-chairs John Ahearne and Raymond Fonck, says "A strategically balanced fusion program, including meaningful U.S. participation in ITER and a strong domestic program, must be maintained, recognizing that this will eventually require a substantial augmentation in fusion program funding in addition to the direct financial commitment to ITER construction." The full report is posted at <http://fire.pppl.gov>

In Memoriam: Burt Fried and Derek Robinson

UCLA Emeritus Professor **Burton D. Fried**, a pioneer of the U.S. fusion and plasma research community, passed away on Saturday, October 12. He died at age 76 of complications following a surgical procedure in Palm Desert, California, where he moved shortly after retiring nearly ten years ago. A memorial service will be planned at UCLA .

Burt Fried was an internationally renowned theoretical physicist and pioneering computer researcher in the aerospace industry before becoming a professor at UCLA. He retired in 1991.

Noted fusion research scientist Dr. **Derek Charles Robinson**, Director of the UK Fusion energy research programme and of UKAEA Culham Science Centre, died on Monday 2 December 2002, in Sobell House, Oxford.

His career in fusion research spanned forty years, encompassing work in the UK first at Harwell and then at Culham, and abroad as far afield as Russia, China and Japan. He was the driving force behind the very successful spherical tokamak approach to fusion, pioneered at Culham with first the START and now the MAST experiment. Expressions of regret may be sent to martin.obrien@ukaea.org.uk



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U. S., CHINA JOIN ITER NEGOTIATIONS CONGRESS PASSES FY 2003 FUSION BUDGET

U.S. and China Join ITER Project

On January 10 Minister Guanhus XU of the Ministry of Science and Technology, People's Republic of China sent a letter to the ITER Participants stating "On behalf of the Government of the People's Republic of China and with its due authorization, I have the honor to formally apply for China to join the International Thermonuclear Experimental Reactor (ITER) negotiation." XU said "China's participation in ITER is solely committed to peaceful uses of fusion energy and non-proliferation." He said, "China intends to provide a substantial contribution, in kind or in finance, to the Project comparable to what is currently envisaged by some of the participants in the present Negotiations."

On January 30 U.S. President George W. Bush issued a statement saying, "I am pleased to announce that the United States will join ITER, an ambitious international research project to harness the promise of fusion energy. The results of ITER will advance the effort to produce clean, safe, renewable, and commercially-available fusion energy by the middle of this century. Commercialization of fusion has the potential to dramatically improve America's energy security while significantly reducing air pollution and emissions of greenhouse gases." A U.S. Department of Energy press release stated ".The U.S. share of the (estimated \$5 billion) construction cost is expected to be about 10 percent of the total."

The U.S. and China joined the other ITER Participants, Canada, European Union, Japan and Russia, at a mid February meeting of the Negotiators in St. Petersburg Russia. A February 19 press release from the meeting stated in part, "The Negotiators approved the Report of the Ad Hoc Group on the Joint Assessment of Specific Sites (JASS). It was completed within the framework of the Negotiations following detailed reviews and visits to all four potential locations: Clarington in Canada; Cadarache in France; Vandellós in Spain; and, Rokkasho-mura in Japan. The Report confirms that all four sites

meet the criteria established for the location of the ITER project, although there are different strengths and weaknesses for each site. The Delegations agreed to release this report. The Report will be posted on the ITER Website (www.iter.org/jass) in the coming weeks."

In a letter to Department of Energy Secretary Spencer Abraham, five members of the U.S. House of Representatives Committee on Science called ITER "one of the most important endeavors being undertaken by the international energy science community" and urged U.S. participation to "ensure that our domestic fusion program is strong and that a new generation of scientists is inspired to work in this area." The Members were Chairman Sherwood Boehlert, Ranking Minority Member Ralph Hall, and Reps. Zoe Lofgren (D-CA), George Nethercutt (R-WA), and Vernon Ehlers (R-MI).

Energy Secretary Spencer Abraham announced the U.S. decision in a speech January 30 at Princeton Plasma Physics Laboratory. Abraham also said, "But let me be clear, our decision to join ITER in no way means a lesser role for the fusion programs we undertake here at home. It is imperative that we maintain and enhance our strong domestic research program -- at Princeton, at the universities and at our other labs. Critical science needs to be done in the U.S., in parallel with ITER, to strengthen our competitive position in fusion technology."

Related documents are posted at <http://fire.pppl.gov>

Congress Passes FY 2003 Budget

The U.S. Congress has finally passed a federal budget for the fiscal year that began October 1, 2002. Most of the U.S. government, including the Department of Energy (DOE), had been operating on a "continuing resolution" since that time.

For the DOE Office of Fusion Energy Sciences (OFES), \$250 million was appropriated, compared to the

President's request for \$257 million and a FY 2002 level of \$248 million. Details of the OFES program are expected to be discussed at a forthcoming public meeting of the DOE Fusion Energy Sciences Advisory Committee, scheduled for March 5-6 in Gaithersburg, MD.

The inertial confinement fusion program, funded under the DOE National Nuclear Security Administration, received \$504 million (which includes \$214 million for continued construction of the National Ignition Facility), compared to the President's request for \$453 million and a FY 2002 level of \$507 million. The appropriated amount includes \$22 million for the congressionally mandated High Average Power Laser (HAPL) program, for which, as always, DOE asked for no money. The HAPL program was appropriated \$24 million in FY 2002.

The appropriations bill also mandates an "across the board" cut of between 0.6% and 0.7% for all programs to offset additional domestic spending in other areas of the federal budget.

With respect to the Office of Fusion Energy Sciences appropriations the Congress said, "Fusion energy sciences.--The conference agreement includes \$250,000,000 for fusion energy sciences, an increase of \$1,505,000 over fiscal year 2002. The conferees note that the fiscal year 2002 funding level included \$19,604,000 for the completion of decontamination and decommissioning of the Tokamak Fusion Test Reactor (TFTR), leaving \$228,891,000 available for fusion research and facility operations in fiscal year 2002. By comparison, the conference agreement for fiscal year 2003 makes this \$19,604,000, plus an additional \$1,505,000, available for fusion research and facility operations, an increase of 9.2 percent over the comparable amount available in fiscal year 2002.

"Within the funding available for fusion energy sciences, the Department should make additional funding of \$1,500,000 available to the Princeton Plasma Physics Laboratory to support the National Spherical Torus Experiment (NSTX) research, NSTX operations, and preliminary design for the National Compact Stellarator Experiment (NCSX). Within available funding, the Department should report back to the Appropriations Committees no later than August 1, 2003, with an evaluation of the "fast ignition" concept and with any recommendations regarding the schedule and milestones of the High Energy Density Physics Program. "

President Submits FY2004 Budget Request

President Bush sent his Fiscal Year 2004 budget requests to Congress on February 3. At the time, the Congress, however, had not yet acted on the FY 2003 budget, keeping the U.S. government operating on a "continuing resolution." The President, therefore, assumes FY2003 levels at his original request levels.

For the Department of Energy as a whole, the President requests an increase of \$1.4 billion over his FY 2003 request, of which approximately \$1 billion would go to the National Nuclear Security Administration (NNSA) which funds the U.S. nuclear weapons related programs. The NNSA also funds the major portions of the effort on inertial confinement fusion, including the construction of the laser-based National Ignition Facility (NIF). For inertial confinement fusion DOE/NNSA requests \$467 million (including \$150 million for NIF construction, an increase of \$14 million from the FY 2003 request. As in the past, DOE requested no funds for the congressionally-mandated High Average Power Laser program, which has been running at approximately \$25 million per year for the past several years.

The DOE Office of Science, of which the civilian fusion energy sciences program is a part, would remain essentially at the FY 2003 level of \$3.3 billion. The Office of Fusion Energy Sciences budget would also remain at the FY 2003 requested level of \$257 million. The budget narrative, however, indicates that within the \$257 million, \$12 million would be redirected to support ITER.

The budget detail for the Office of Fusion Energy Sciences proposes (figures are rounded):

- > Increase funding for NSTX at PPPL by \$2.3 M
- > Increase funding for General Plasma Science by \$1 M
- > Increase funding for Theory by \$1 M
- > Increase funding for DIII-D at General Atomics by > \$1 M
- > Increase funding for Alcator C-Mod at MIT by \$0.5 M
- > Increase funding for fabrication of NCSX at PPPL by \$4.9 M
- > Increase funding for Plasma Technologies by \$1.9 M
- > Decrease funding for Heavy Ion Fusion at LBNL by \$0.5 M
- > Decrease Fusion Technology and Advanced Design by \$12.1 M from \$16.4 M to \$3.3



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U.S. Prepares Plan for Fusion Demo Power Plant Pulsed Power Fusion Advances

Pulsed Power Fusion Advances

Scientists from the Sandia National Laboratories (Albuquerque) have reported successfully compressing a small pellet containing fusion fuel using X-rays from the Z pulsed power facility. The results were reported at the spring meeting of the American Physical Society, April 5-8 in Philadelphia. Although such experiments have been successfully performed previously using lasers, this is the first time such experiments have shown fusion reactions using the method of X-rays produced from a Z-pinch pulsed power device. Z-pinches have the attractive feature of being relatively low in cost. Calculations predicting scaling to high fusion yield were reported previously.

Concepts have been developed to permit these currently single shot experiments to become repetitively pulsed. Fusion power plants based on the Z-pinch would pulse about once every ten seconds and would have recyclable transmission lines that would be automatically replaced between pulses. For more information on Z-pinch fusion power plants contact Craig Olson (clolson@sandia.gov). Copies of the vugraphs from the Sandia presentation have been posted at http://fire.pppl.gov/aps_zpinch_leeper.pdf

FESAC Endorses 35-year Fusion Power Plan

The U.S. Department of Energy (DOE) Fusion Energy Sciences Advisory Committee (FESAC) has endorsed a "Plan for the Development of Fusion Energy" and transmitted the report to DOE Office of Science Director Raymond Orbach. The plan, prepared by a FESAC panel chaired by Princeton Plasma Physics Laboratory Director Rob Goldston, calls for the operation of a demonstration electric power plant (Demo) in about 35 years that enables the commercialization of fusion.

The plan envisages a broadly-based "portfolio" of both magnetic and inertial fusion energy approaches and associated technologies over the next fifteen years at a total cost of approximately \$10 billion, at which time the technology for the first generation of fusion power plants would be selected for focused development over the next approximately 20 years.

The plan anticipates "major accomplishments" from the inertial fusion National Ignition Facility (NIF) and the International Thermonuclear Experimental Reactor (ITER) during the period 2009 - 2019. Data from NIF and ITER, combined with data from ongoing core experimental and theory/computation programs, would lead to the selection of the Demo path around 2019.

The report calls for initiating the plan in FY 2004 at a level of \$332 million, although the President's FY 2004 budget request is for only \$257 million. The plan calls for the fusion budget to continue to grow, to approximately \$570 million in 2008 and to peak at approximately \$900 million around 2013.

The plan states, "To achieve the goals of this plan, the program must be directed by strong management. Given constrained budgets, the wide variety of options and the linkages of one issue with another, increasingly sophisticated management of the program will be required."

The plan is aimed at having fusion ready for commercialization in a timeframe as defined recently by President Bush. Bush called for having "clean, safe, renewable, and commercially-available fusion energy by the middle of this century."

The full report is posted at <http://fire.pppl.gov>

U.S. Organizes for ITER Negotiations

Dr. N. Anne Davies, Associate Director for Fusion Energy Sciences, USDOE, has announced "a working mechanism to help us get started (on participation in ITER negotiations) immediately." Ned Sauthoff (Princeton Plasma Physics Laboratory) will serve as U.S. ITER Planning Officer, with Charles Baker (UCSD) as his deputy. They will "form a multi-institutional working team of people from around our program to assist us in meeting these many needs." Mike Roberts at DOE will oversee the effort, assisted by Warren Marton.

Davies has asked Sauthoff "to assemble a Burning Plasma Program Advisory Committee to strengthen community involvement in the working team's activities." Stewart Prager (University of Wisconsin) has been named to chair that committee.

For further information contact Ned Sauthoff (sauthoff@pppl.gov)

FESAC Letter on FY2004 Budget

At its meeting March 5-6 in Gaithersburg, Maryland, the U.S. Department of Energy Fusion Energy Sciences Advisory Committee (FESAC) expressed dismay with the Department's FY2004 fusion budget submission to Congress and especially with the distribution of funds within subelements of the fusion program. In a letter dated March 5, FESAC chairman Richard Hazeltine (University of Texas) said that "devastating cuts to certain program elements are alarming; this note expresses our most serious concerns." The full text of the letter is posted (<http://fire.pppl.gov>). Excerpts are as follows:

"The fusion energy sciences budget for FY2004, as described in the President's request, stunned FESAC members. Both its total amount and its devastating cuts to certain program elements are alarming; this note expresses our most serious concerns."

"FESAC is puzzled by the elimination in FY2004 budget of funding for fusion technology. This loss will seriously compromise US participation in ITER as well as other burning plasma research activities."

"The study of future energy systems is a central component of fusion research. Its evolving conceptualization of an eventual fusion power plant has helped us visualize our target, while allowing us to identify key scientific challenges. As the energy goal becomes closer and more central to fusion research, such

systems studies provide even more important insights. Yet the FY2004 budget significantly reduces funding for this type of research."

"FESAC recommendations regarding the burning plasma initiative have emphasized the importance of maintaining scientific and technological breadth in the program. The Secretary of Energy renewed this emphasis in his recent announcement concerning US participation in ITER. Yet funding for FIRE, a domestic burning plasma experiment that could provide an alternative to ITER, has been eliminated. Similarly inertial fusion energy (IFE) is an important element of a balanced US fusion program: it provides the principal alternative to magnetic fusion and takes advantages of NNSA investments in the National Ignition Facility. The FY2004 budget, however, eliminates chamber technology for both MFE (magnetic fusion energy) and IFE."

"In summary, FESAC finds the Presidential request for fusion research funding in FY2004 to be not only meager but also harmfully distorted. It terminates components of the program that are truly essential. Fusion research has accepted new challenges and identified new priorities, consistent with the President's stated agenda; fusion scientists want to get on with the job. What is needed is a funding allocation that respects the magnitude and nature of the task at hand."

University Group Urges Increased Fusion Funding

The University Fusion Association (UFA) has sent a letter to members of the Subcommittee on Energy and Water Development of the House Committee on Appropriations of the U.S. Congress urging them to add \$25 million to President Bush's Fiscal Year 2004 budget request for the DOE Office of Fusion Energy Sciences. The President has requested \$257 million. The February 25 letter, signed by the UFA 12-member Officers and Executive Committee, says "Without additional resources, carrying out the necessary preparations for ITER in FY04 with the present budget request of \$257 million (unchanged from the FY03 request) will result in destroying critical elements of the base science and technology part of the fusion program." The letter notes, "In FY04 and in subsequent years, as we move forward with the ITER project, the necessary additional funding must be provided to ensure that there is a strong U.S. fusion program to participate in and make use of the advances we achieve in ITER."

The letter is posted (<http://fire.pppl.gov>).



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NIF PROGRESS CONTINUES ITER ENTERS NEW PHASE

NIF PROGRESS CONTINUES

Impressive progress continues to be made with initial operations of the National Ignition Facility (NIF) four-beam system. Tests have been conducted into a Precision Diagnostic System for both the fundamental 1.06 micron frequency and at the frequency-tripled frequency.

At the fundamental frequency, energy levels exceeding 20 kilojoules per beam were achieved, surpassing the design requirement. The total of 83 kilojoules achieved sets a new record for this configuration. Tests at the tripled frequency yielded 10.4 kilojoules from a 13.65 kilojoule fundamental frequency beam (76% conversion efficiency). At 3.9 terawatts, this was the highest power fundamental frequency beam ever fired on the NIF. The overall result scales to 2 MJ for the full 192-beam NIF, compared to the design level of 1.8 MJ. These are the highest energy levels ever achieved in a single beam line at these frequencies.

In a test of operational efficiency, NIF fired three shots per day for three days in a row, giving researchers confidence that the ultimate design target of 700 shots per year will be achieved when NIF becomes fully operational.

For further information, contact NIF project manager Ed Moses (moses1@llnl.gov).

ITER ENTERS NEW PHASE

The Republic of Korea has joined the negotiations to construct the International Thermonuclear Experimental Reactor (ITER), becoming the seventh Party. The others are European Union, Japan, Russia, Canada, United States and China.

Since November 2001, eight ITER Negotiations meetings have been held, paving the way to the first high level ITER Preparatory Meeting June 19 at the International Atomic Energy Agency (IAEA) in Vienna, Austria. High

level government officials from the European Union, Japan, Russia, Canada, United States, China and Republic of Korea participated.

The meeting discussed the following topics: (1) the site for ITER, (2) key personnel to head the ITER management structure, (3) procurement allocations, i.e., which Party provides which components, and (4) cost sharing formulas for the construction, operation and decommissioning phases of the ITER project. At the June 19 meeting, a schedule and work plan was agreed upon with the goal to reach agreement on these matters in Autumn 2003. The next meeting is scheduled for early October in Vienna.

Further information on ITER and the negotiations is posted at <http://www.iter.org>

EU SUMMARIZES ITER STATUS

A formal communication dated 30 April 2003 from the European Commission to its parent body, the European Council, "summarizes the state of negotiations conducted by the Commission on behalf of the European Union concerning the ITER nuclear fusion energy research project."

The report notes "the total cost of the construction phase is estimated at 4.57 billion Euros, at 2000 values." It says "ITER implementation will include a construction phase lasting about ten years, an operation phase lasting about 20 years and a decommissioning phase." It estimates the total cost of all three phases at 10.3 billion Euros.

The report says that in negotiations so far "Agreement has been reached on the legal status of the entity which would be responsible for ITER implementation. However, fundamental points have still to be discussed, such as choice of site, sharing between the parties of the costs of and responsibilities for supplying components for the project and their management. This contribution 'in kind'

will form the main part of the overall contribution of each party during the construction phase."

The legal entity responsible for ITER implementation "would have a duration of thirty-five years with the possibility of an extension of a maximum of ten years," according to the report. "It would have legal existence and would be granted privileges and immunities by the parties and the host country which are similar to those normally granted to international organisations." The report says "A Director-General and a project team will be responsible for the proper day-to-day running of the Organisation." It says, "Given the scale and complexity of the project, it has also been accepted that each party should have only one clearly identified interface with the Organisation, managing its contribution both in cash and in kind."

The report notes that presently four sites have been preferred: Canada, Japan, France and Spain. However, the report says, "it is appropriate now to converge towards the identification of (one) EU site candidate through a consensual and well regulated process."

The report notes that, prior to the entry of China and the U.S., a working assumption within the EU on cost sharing was the host country would pick up about 20% of ITER costs for local construction elements (called "non-common area" costs), with the remaining, primarily machine, costs (called "common area" costs) shared by Russia (14%), EU (33%) and Japan (33%). The report notes that several factors have led to a rethinking of this formula, namely the expectation that Russia would pay a smaller fraction, that the U.S. and China and perhaps others would pick up a substantial fraction, and a proposal from Japan stating that, as a smaller economic party compared to Europe, they wished to pay a smaller fraction than the EU. The EU paper notes that the Canadian site proposal is being restructured within Canada, since it originally did not envisage any Canadian contribution to the common area costs. The paper proposes a new working distribution of the 80% common area costs as China + Russia + USA (more than 30%) and EU + Japan (less than 50%).

OSTP DAMPENS FUSION HOPES

During the summer 2002, the President's Science Advisor and Director of the Office of Science and Technology Policy (OSTP), Jack Marburger, asked fusion community leaders if it would be possible to prepare a U.S. plan to put fusion-generated electricity on the grid within about 35 years. He had been told of such a plan within the European Community by his counterparts there. Subsequently, such a plan was formally requested in a September 10, 2002 letter from U. S. Department of Energy (DOE) Office of Science Director Ray Orbach to

his Fusion Energy Sciences Advisory Committee (FESAC). The plan was completed and transmitted to Orbach on March 5, 2003.

However, in a May 5, 2003 presentation to the National Academies Burning Plasma Assessment Committee entitled "Administration Perspective on ITER and Fusion Energy", Marburger aide Patrick Looney, OSTP Assistant Director for Physical Science and Engineering, told the committee "There is no agreed upon fusion energy development timeline." Though acknowledging that President Bush stated "The results of ITER will advance the effort to produce clean, safe, reliable and commercially-available fusion energy by the middle of this century," Looney said there were "large error bars" on the President's estimate and did not constitute a timeline commitment. Furthermore, Looney said "This is energy science not (underline not) an energy technology." He said the U.S. decision to join ITER negotiations is not part of a "broader fusion initiative." "The ITER decision will not imply endorsement of other fusion-related initiatives," Looney said. He said, "As (ITER) construction does not begin until FY06, the (ITER) decision will be overall budget neutral until FY06." He also said "If the U.S. joins ITER it would not be as a lead player," and "the U.S. is absolutely neutral on the issue of site." "The U.S. has no interest in hosting ITER," he said.

On the positive side, Looney said that the decision to join ITER negotiations was in part based on a recognition that "a burning plasma experiment is the crucial element missing from the world fusion energy science program." "ITER provides U.S. scientists access to the world's most sophisticated burning plasma experiment," he said.

Looney's vugraph presentation is posted at <http://fire.pppl.gov>

ALCATOR C-MOD POSTS PROGRESS

The U. S. Department of Energy (DOE) held a review of the MIT Alcator C-Mod program renewal proposal for the next five year period (November 2003 - October 2008) in mid May. The review panel included: Jim Luxon (GA, Chair), Don Batchelor (ORNL), George Cava (DOE Princeton Area Office), Dave Hill (LLNL), Bob Kaita (PPPL), Sergei Krasheninnikov (UCSD), Fritz Leuterer (IPP Garching), Takahisa Ozeki (JAERI), and Doug Post (LANL). Attending from the DOE Office of Fusion Energy Sciences (OFES) were John Willis and Rostom Dagazian.

Viewgraphs from the presentations summarizing progress and plans can be found at:

http://www.psfc.mit.edu/cmmod/sciprogram/5_Yr_Review_03/00_agenda.html



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NEW INERTIAL FUSION TECHNIQUE STUDIED DOE LAUNCHES INERTIAL FUSION REVIEW

New Inertial Fusion Implosion Technique Studied

Recently scientists at Sandia National Laboratory have had stunning success in generating x-rays to implode fusion pellets by driving high current through an array of wires surrounding the capsules. Now a new technique using a "laser-driven analog" of this technique has been created using the OMEGA laser at the University of Rochester.

Forty beams of the OMEGA laser are incident on a 20-micron thin-walled capsule filled with 1.5 atm of Xenon gas. A shock is driven in the Xenon, which radiates so strongly that it collapses to a thin dense layer. This dense layer is opaque to radiation and so functions as a hohlraum wall. The technique may lead to being able to replace the rigid hohlraums that are currently envisaged for indirect drive laser fusion.

Scientists say that this technique has potential applications as an x-ray source for radiography and probing, and as a driver for opacity and implosion experiments.

For further information, visit <http://www.llnl.gov/nif/icf/icf.html> and go to the March-April 2003 Bimonthly Update.

FESAC to Review Inertial Fusion Energy Prospects

The U.S. Department of Energy's Fusion Energy Sciences Advisory Committee (FESAC) has been asked to "provide an assessment of the present status" of inertial fusion for energy applications (IFE). In a letter to FESAC chair Richard Hazeltine, DOE Office of Science director Ray Orbach said he was requesting the review "in response to the considerable scientific and technical progress in the Inertial Fusion Energy (IFE) program during the past few years."

Orbach said "the specific topics to be addressed in this review are:

"1. The current status of the scientific basis and related technology of each of the approaches to IFE, including an assessment of the quality of work being carried out in the programs.

"2. Critical scientific issues identified in each of the approaches to IFE that would contribute to understanding the long-range potential of IFE.

"3. The impact that fast ignition as a concept improvement program may have on IFE.

"4. The potential contribution of the various IFE program elements to the emerging field of High Energy Density Physics."

Orbach said "the IFE approaches to be considered in this review are those involving heavy ion beam drivers, laser drivers and the "Z" approach." He asked to receive a final report by early 2004.

The letter is posted at http://www.ofes.fusion.doe.gov/More_HTML/FESAC_Charges_Reports.html

Non-electric Fusion Applications Reviewed

A panel of the DOE's Fusion Energy Sciences Advisory Committee (FESAC) has reviewed "the possibility of non-electric applications of fusion." The panel was chaired by Dr. Kathy McCarthy (Idaho Engineering and Environmental Laboratory). The panel specifically was asked by DOE Office of Science Director Ray Orbach to consider "whether the Fusion Energy Sciences program should broaden its scope and activities to include non-electric applications of intermediate-term fusion devices."

The FESAC was asked to consider the following questions: (1) What are the most promising opportunities for using intermediate-term fusion devices to contribute to the Department of Energy missions beyond the production of electricity? (2) What steps should the program take to incorporate these opportunities into plans for fusion research? (3) Are there any possible negative impacts to pursuing these opportunities and are there ways to mitigate these possible impacts?

The panel concluded that "the most promising opportunities for non-electric applications of fusion fall into four categories: (1) Near-term Applications, (2) Transmutation, (3) Hydrogen Production and (4) Space Propulsion.

The panel cautioned "It is important to note that these opportunities should not be pursued at the expense of existing programs, particularly since the fusion program has seen many significant budget cuts, particularly in the area of technology."

In the area of near-term applications, the panel cited the production of isotopes for the diagnosis of cancers and other abnormalities and the production of DD neutrons in small portable fusion devices for the detection of clandestine materials. The panel recommended that a "small, but steady, source of funding" be provided to look at these potential applications.

In the area of transmutation, the panel cited the potential use of fusion neutrons for the destruction of long-lived radioisotopes in spent nuclear fuel, disposal of surplus weapons grade plutonium, and breeding of fissile fuel for fission reactors. The panel recommend establishing a "watching brief" to monitor studies currently underway within the nuclear fission community. They also recommended an expansion of the "small ongoing systems/conceptual design investigation of the application of fusion to the transmutation mission" as a necessary first step for evaluating the possibility of incorporating a transmutation mission into the U. S. fusion program.

In the area of hydrogen production, the panel said "From the design and evaluation studies done over the past 30 years, fusion could provide a long term source of hydrogen by low temperature electrolysis, high temperature electrolysis or thermochemical water-splitting." They said that hydrogen production by low temperature electrolysis would have no impact on the fusion power plant "and, in fact, could be done remotely for distributed production of hydrogen where it is needed." The panel recommended immediately including

hydrogen production a goal of the fusion program and "as an element in the fusion research planning." They recommended that fusion personnel become active participants in the U. S. Interagency Hydrogen Research and Development Task Force. They also recommended that, within the fusion program, a "small task should be established to review hydrogen production techniques and recommend technical areas, such as tritium control, that may need additional study.

In the area of space propulsion, the panel said that fusion and anti-matter appear to be "the only conceivable bases for propulsion systems for manned or heavy payload deep-space missions." They said "the technical challenges of fusion propulsion for space are not know in detail," and recommended that the DOE should be "responsive to any NASA request for support in evaluating (and subsequently developing) space fusion propulsion systems. As a first step, they recommended that DOE contact NASA about establishing a joint task force (led by NASA) to evaluate at the conceptual level the feasibility of fusion for space propulsion.

Abraham on Fusion and Climate Change

Energy Secretary Spencer Abraham, along with Commerce Secretary Don Evans, and the President's Science Advisor Jack Marburger unveiled the Administration's "Strategic Plan for the Climate Change Science Program," at a July 24 briefing. Abraham said that DOE's research program, including those in hydrogen, clean coal, carbon sequestration and fusion, could ultimately reduce greenhouse gases.

The 360-page plan, a 34 page synopsis and a 4-page Executive Summary are posted at <http://www.climate-science.gov>

At a July 29 Hearing of the Senate Energy and Natural Resources Committee, chaired by Sen. Lamar Alexander (R-TN), Secretary Abraham made the following comment:

"... perhaps in 20 to 30 years my successor can come before this Committee and explain how the investments we made today have ultimately paid off. What might that Secretary of Energy say? I would hope he or she could say that after successful completion of the ITER experiment, we are now ready to consider construction of a demonstration fusion power plant to deliver electric power to the grid..."



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Fusion Pioneer Marshall Rosenbluth Passes Away Academies Panel Endorses Burning Plasma Effort

Marshall Rosenbluth Dies at Age 76

Marshall Rosenbluth, whose legendary scientific contributions to the world effort in fusion and plasma physics, began in the early 1950s, died September 28 in San Diego of pancreatic cancer. As a research scientist he authored and co-authored countless papers that provided much of the scientific basis of this evolving field. As a professor, he was mentor to a whole generation of plasma scientists. As a human being, few could match his honesty and wit, his genuine interest in people and his inquiring mind.

He received his doctorate in physics from the University of Chicago in 1949 at the age of only 22. In 1950, he was recruited by Edward Teller to join the staff of physicists at Los Alamos, seeking to understand the physics that would make possible the hydrogen bomb. In 1956, he joined some of the most brilliant plasma physicists of the era at General Atomics in San Diego, seeking to tame fusion for the production of electricity. He was a professor of physics at the University of California 1960-1967 and again from 1987 - 1993, when he became Emeritus. He was also a professor at the Princeton Institute for Advanced Study from 1967 - 1980 and at the University of Texas 1980 - 1987.

He was the recipient of many awards, including the National Medal of Science, the Nation's highest scientific honor. Fusion Power Associates honored him with its Leadership Award in 1987 and its Distinguished Career Award in 1997.

Although he had been suffering from cancer for several years, he continued to attend scientific meetings and was actively providing advice to the fusion community until near the very end of his life. One cannot overstate the sense of loss that his death brings to fusion scientists around the world.

Academies Panel Endorses Burning Plasma Effort

The Burning Plasma Assessment Committee (BPAC) of the U. S. National Academies issued its report in the form of an "Unedited Prepublication Copy" entitled "Burning Plasma: Bringing a Star to Earth."

The report is available at
http://www7.nationalacademies.org/bpa/BPAC_Draft_Pr_epub.pdf

The 170-page report concludes that "a burning plasma experiment is critically needed to advance fusion science," that "undertaking a burning plasma experiment cannot be done on a flat budget," and that "if negotiations proceed successfully, the fusion science program will move ahead with the ITER endeavor."

The panel, which was co-chaired by John Ahearn (Sigma-Xi) and Ray Fonck (U. Wisconsin) recommends that "the United States should participate in ITER," and that "if the ITER negotiations fail, the United States should continue, as soon as possible, to pursue the goal of conducting a burning plasma experiment with international partners."

The panel states "A strategically balanced U. S. fusion program should be developed that includes U. S. participation in ITER, a strong domestic fusion science and technology portfolio, an integrated theory and simulation program, and support for plasma science. As the ITER project develops, a substantial augmentation in fusion science program funding will be required in addition to the direct financial commitment to ITER construction."

The panel claims that "the addition of so major a new element as ITER" requires a new "prioritization process" to be "initiated by the Office of Fusion Energy Sciences

to decide on the appropriate programmatic balance given the science opportunities identified and the budgetary situation of the time."

The report concludes "The elements required for the long-term health and vitality of this part of the U.S. research enterprise are not entirely clear, but this report strives to provide guidance for balancing the fusion program through elucidation of the key scientific, technical, and programmatic issues that need to be addressed in the coming years as it enters the burning plasma era. What is clear is that whichever strategy is adopted, it should be flexible, innovative, and inclusive in achieving the required balance for success."

FESAC to Review Fusion Priorities

The recent National Academies Burning Plasma Assessment Committee recommended a "prioritized balancing of the (fusion) program" in view of the likelihood of the construction of ITER. In a letter October 23, 2003 to DOE Fusion Energy Sciences Advisory Committee (FESAC) chair Richard Hazeltine, DOE Office of Science Director Ray Orbach asks FESAC's help in responding to this recommendation, with a report due July 2004. Hazeltine has asked Dr. Charles Baker, University of California at San Diego, to chair a FESAC panel to address this task.

Orbach asks FESAC "to identify the major science and technology issues that need to be addressed, recommend how to organize campaigns to address those issues, and recommend the priority order for these campaigns." He asks FESAC to "look at the program through 2014.

Orbach says three funding scenarios should be considered: (1) the current level of \$257M, increasing for inflation; (2) the levels authorized in the FY2003 Energy Bill, of \$335M in FY2004, increasing to \$393 in FY2008; and (3) a level "between today's funding and that in the Energy Bill. He says "It should be assumed that funding for ITER construction is provided in addition to these funds." Although the amount of U.S. contribution to ITER construction has yet to be negotiated, it is widely reported likely to be in the neighborhood of \$500M over ten years.

In selecting these cases, Orbach appears to have rejected the funding levels projected in the recently completed FESAC study deemed necessary to put fusion power on the grid in approximately 35 years. That plan required increasing the fusion budget to \$393M in FY2005, to \$569M by FY2008, and to \$897M by FY2013. The complete text of the letter is posted at <http://fire.pppl.gov>

FPA Announces 2003 Awards

Fusion Power Associates Board of Directors announces the recipients of its 2003 Awards.

LEADERSHIP AWARD

The FPA 2003 Leadership Award will be presented to Stewart Prager (University of Wisconsin) in recognition of his many outstanding contributions to fusion development. In selecting him, the FPA Board notes that, in addition to being one of the outstanding scientists in the fusion field, he also has on many occasions served on and chaired advisory committees that have helped to chart the course of fusion development.

DISTINGUISHED CAREER AWARDS

FPA Distinguished Career Awards will be presented to Robert Aymar (ITER Director Emeritus) and John Sheffield (Oak Ridge National Laboratory and University of Tennessee).

In selecting Dr. Aymar for this award, the FPA Board recognizes his many years of outstanding scientific and managerial contributions to fusion development, both as a leader of the European fusion program and as Director of the international ITER project.

In selecting Dr. Sheffield for this award, the FPA Board recognizes his many years of outstanding scientific contributions to the field, as well as his managerial leadership and contributions to many fusion advisory committees.

EXCELLENCE IN FUSION ENGINEERING AWARD

The FPA Excellence in Fusion Engineering Award, established in memory of MIT Professor of Nuclear Engineering David J. Rose, will be presented to Abbas Nikroo (General Atomics). In selecting Dr. Nikroo, the FPA Board recognizes his outstanding technical contributions to the technology of inertial fusion energy and his potential to become an exceptional leader in the fusion field.

SPECIAL AWARD

The FPA Board of Directors presented a Special Award to John DeLooper (Princeton Plasma Physics Laboratory) in recognition of his many contributions in support of the fusion program, both locally and nationally. The Board especially noted his educational outreach efforts and logistical support for the fusion Snowmass meetings.