



# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

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## CONGRESS RESTRICTS ACADEMY REVIEW PROCESS FAREWELL TO TFTR

### THANKS TFTR

As the new year begins, it is fitting to note that 1997 was the final year of operation of one of the world's most productive fusion research facilities: the Tokamak Fusion Test Reactor (TFTR) at Princeton Plasma Physics Laboratory. Construction began in the mid-1970's, with initial operation in the early 1980's. The aim of the program was to study, for the first time, the magnetic confinement properties of a plasma at fusion densities and temperatures and in which a substantial amount of fusion power was being produced. TFTR was more than successful on all counts.

Among the many accomplishments of the TFTR team, under the able leadership of (now PPPL deputy director) Rich Hawryluk, TFTR pioneered achieving the "high temperature regime" of over 500 million degrees Centigrade; achieved record values of the Lawson triple product of density-temperature-confinement time; achieved record values of fusion energy and power (over 6 million Joules and almost 11 million Watts); demonstrated the "bootstrap current" which promises high efficiency and steady state tokamak power plants in the future; made the first measurements of the products of fusion reactions (alpha particles) and demonstrated their removal process; and achieved routine and safe operation with tritium fuel. All of the above were achieved in the declining budget atmosphere of the past 17 years and in the face of a general lack of interest in energy programs in both the Congress and the Executive Branch.

TFTR is now being decommissioned. Some TFTR data is still being analyzed at PPPL, and many of the skilled TFTR scientists are collaborating on experiments on other large tokamaks around the world, including DIII-D, Alcator C-Mod, JET and JT-60.

Our thanks to the TFTR team!



*Dr. Richard Hawryluk*

### CONGRESS RESTRICTS ACADEMY REVIEWS

Despite heavy pressure from the National Academy of Sciences and a number of universities and government agencies, Congress refused to exempt the National Academy of Sciences from the provisions of the Federal Advisory Committee Act (See our December 1997 newsletter). Instead the Congress passed, and the President signed (Public Law 105-153), the "Federal Advisory Committee Act Amendments of 1997," to "clarify public disclosure requirements that are applicable to the National Academy of Sciences and the National Academy of Public Administration." The amendments require more public access to Academy review processes than has been characteristic of Academy reviews in the past.

Specifically, the law now requires the Academy to "provide public notice of the names and brief biographies of individuals that the Academy appoints or intends to appoint to serve on the (review) committee," and to "provide a reasonable opportunity for the public to comment on such appointments before they are made or, if the Academy determines that prior comment is not practicable, in the period immediately following the appointments."

The law further specifies that the "Academy shall make its best efforts to ensure that (a) no individual appointed to serve on the committee has a conflict of interest that is relevant to the functions to be performed, unless such conflict is promptly and publicly disclosed and the Academy determines that the conflict is unavoidable, (b) the committee membership is fairly balanced as determined by the Academy to be appropriate for the functions to be performed, and (c) the final report of the Academy will be the result of the Academy's independent judgment."

The law now requires the Academy to "provide public notice of committee meetings that will be open to the public," and to "ensure that meetings of the committee to gather data from individuals who are not officials, agents or employees of the Academy are open to the public." The law further requires that the Academy make available to the public "written materials presented to the (review) committee" by such individuals.

With respect to "any committee meeting that is not a data gathering meeting," and is closed to the public, the law now requires the Academy to make a brief summary "available to the public as soon as practicable." The summary "shall identify the committee members present, the topics discussed, materials made available to the committee, and such other matters that the Academy determines should be included."

Finally, the law specifies that "After publication of the final report, the Academy shall make publicly available the names of the principal reviewers who reviewed the report in draft form and who are not officials, agents, or employees of the Academy." Unless Academy reviews are conducted in the future under the provisions of the Federal Advisory Committee Act, as amended, the law states that a sponsoring federal agency "may not use any advice or recommendation provided."

Following passage of the above restrictions, Academy of Sciences president Bruce Alberts issued a statement calling the law the "Bill to Exempt the National Academy of Sciences from the Federal Advisory Committee Act." Alberts said, "We are gratified that the President today signed legislation that exempts the National Academy of Sciences from procedures of the Federal Advisory Committee Act of 1972 which would have placed our work under government control and made it subject to political and special-interest pressures." He said, "We recognize the importance of keeping the nation informed about our studies and satisfying the openness and public disclosure requirements of the Act." The National Resources Defense Council, which had been instrumental in bringing about the court challenge leading up to the passage of the Act, stated that the Act "represents a compromise between the Academy's desire

to conduct scientific reviews in secret and those who believe an open process represents the best protection against abuses such as those reflected in the Academy's review of NIF (See our December 1997 newsletter)."

## **FESAC TO MEET**

DOE's Fusion Energy Advisory Committee (FESAC) will meet January 22-23 in the DOE auditorium, Germantown, MD. The focus of the meeting will be to (1) complete the charge dealing with the nature and level of U. S. participation in ITER Transition Phase Activities (see our November 1997 newsletter), (2) make comments and recommendations on the Strategic Plan for International Collaborations on Fusion Science and Technology Research, and (3) begin the FESAC review of the Fusion Materials research program. Persons wishing to make "public comments" should contact Al Opdenaker (albert.opdenaker@mailgw.er.doe.gov).

## **ALCATOR C-MOD ON LINE**

The Alcator C-Mod tokamak is back in operation at MIT after a lengthy modifications period. Research currently in progress is focused on JET dimensionless similarity experiments, evaluation of boronization effects, E-radial measurements during RF, and the collection of probe and pedestal data during various H-mode regimes. Persons wishing to receive Alcator C-Mod Weekly Highlights by email should send their request to [irby@psfc.mit.edu](mailto:irby@psfc.mit.edu)

## **NIF WORKERS FIND MAMMOTH FOSSIL**

On December 15, workers constructing the National Ignition Facility (NIF) at the Lawrence Livermore National Laboratory unearthed the lower jawbone and portion of skull of "what may be a mammoth." Berkeley paleontologists estimated the bones to be 10,000 to 75,000 years old. Construction workers were compacting soil in a trench for electrical utilities some 30 feet below the surface, causing some soil above to fall away revealing the bone. A 4 by 12 foot area has been secured around the find. DOE inertial fusion head Dave Crandall called the find "the first scientific discovery at the NIF site." NIF project director Jeff Paisner said, "This is very exciting. I see it as a good omen." In 1974, the foreleg of a mastodon, estimated to be one million years old, was discovered on the Livermore site. That bone, four feet long and weighing 25 pounds, is on display at the LLNL Visitors Center. Paleontologists say the find is not unusual for the region. The discovery is disrupting construction work on only a small portion of the NIF site and is not expected to appreciably affect the overall construction schedule.

## LLNL SHUTS DOWN 2-BEAM LASER FACILITY

After more than 10 years of productive research, LLNL has shut down its 2-Beam laser facility, so-called because it used 2 of the Nova laser's 10 beams. Among the facilities list of accomplishments: demonstration of the shortest wavelength and most powerful X-ray laser; first use of multi-pulse laser techniques, leading to the development of a wide range of new X-ray laser materials; first demonstration of X-ray laser holography; first demonstration of extreme ultraviolet interferometry of large dense plasmas; first opacity measurement of iron, used to model Cepheid star variables, which serve as distance standards in astronomy; first demonstration of a 125-terawatt laser and the subsequent results that helped in the design and operation of the present petawatt laser on Nova.

The facility is being redirected into an Optics Processing Development Laboratory, in support of the National Ignition Facility. The laboratory, which should be operational in late 1998, will serve as a clean area for developing techniques for polishing, assembling and assuring quality of optical components for NIF and other inertial fusion experiments.

## PRESIDENT AWARDS SCIENCE MEDALS

In late December, President Clinton presented the National Medals of Science and Technology. The recipients, including fusion researcher Marshall Rosenbluth, had been announced earlier (see our June 1997 newsletter). In presenting the medals, Clinton said, "These (R&D) investments have surely paid off -- in higher paying jobs, better health care, stronger national security, and improved quality of life for all Americans." Clinton said, "Half our economic growth in the last half-century has come from technological innovation and the science that supports it." Clinton remarked, "By giving these awards, we honor the American passion for discovery that has driven our nation forward from field to factory to the far reaches of cyberspace." The December 17 San Diego Tribune quotes Rosenbluth as saying, "I think the country is heading into a terrible energy and environmental problem. It may well be the dominant crisis of the 21st century and we're doing very little about it."

## NUMERICAL SIMULATION CONFERENCE SET

The 16th International Conference on Numerical Simulation of Plasmas, combined with the joint US-Japanese workshop on Nonlinear Plasma Simulation & Visualization, and organized in cooperation with the International Atomic Energy Agency (IAEA), will be held February 10-12, 1998 in Goleta (a suburb of Santa Barbara), CA. Held about every 3 years, its purpose is to share advances in numerical methods and practice in computational plasma physics. All areas of plasma simulation



**MIT engineer Alexander Rabinovich holds the Plasmatron device he developed with Leslie Bromberg (left), Daniel Cohn (right) and colleagues (see our November 1997 newsletter). The "soup can-size" device is designed to add a small amount of hydrogen-rich gas to the fossil fuel powering a car, making possible a significant decrease in emissions of pollutants like nitrogen oxides.**

are covered, including fusion, space, device simulation, accelerators, beams, and astrophysics. Since the last meeting in 1994, the area of plasma modeling has broadened in scope, ambition and realism, driven by advances in parallel processing, algorithm development and programming techniques. For information on paper submission, registration and hotel, contact Tom Thompson ([icnsp@physics.ucla.edu](mailto:icnsp@physics.ucla.edu)).

## BEAMS '98 CONFERENCE

The 12th International Conference on High-Power Particle Beams (BEAMS '98) will take place in Haifa, Israel, June 7-12, 1998 (not January 7-12 as stated in our December newsletter). Information on the conference can be found on the conference web page ([physics.technion.ac.il/~peter/beams98.html](http://physics.technion.ac.il/~peter/beams98.html)) or by email ([beams98@kenes.com](mailto:beams98@kenes.com)).

## NEXT IAEA FUSION CONFERENCE SET

The 17th Fusion Energy Conference of the International Atomic Energy Agency (IAEA) will take place October 19-24 in Yokohama, Japan. This is the major biennial gathering of fusion researcher from around the world. The last conference was held in Montreal in 1996. Persons wishing to participate must apply through their appropriate governments. Extended synopses of proposed papers, not to exceed 800 words, will be reviewed by both national and international selection committees. Appropriate topics include magnetic confinement experiments, theory and modeling; plasma heating and current drive; ITER Engineering Design Activities; inertial fusion energy; innovative concepts, fusion technology and reactor concepts; and safety, environmental and economic aspects of

fusion. Papers selected will be published by the IAEA in unedited form.

Persons wishing more information should contact the Scientific Secretary of the Conference, Tom Dolan, by email ([t.dolan@iaea.org](mailto:t.dolan@iaea.org)).

## FUSION PIONEER JOHN MARSHALL DIES

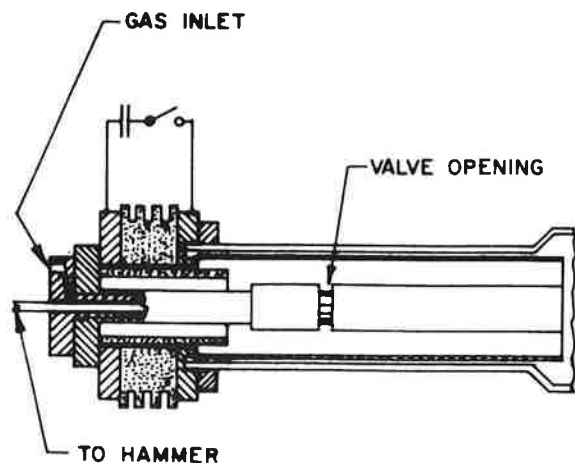
Fusion pioneer John Marshall died October 21, 1997. He was a pioneer of the U. S. fusion program. Although his contributions to fusion research were legion, he was perhaps best known for his invention of a "plasma gun" which bears his name (J. Marshall, *Phys. Fluids*, 3:135, 1960). The "Marshall gun" is a co-axial-accelerating plasma source which emits a high energy plasma out one of its ends. A small quantity of gas is admitted into the region between two conductors. A voltage difference between the two conductors results in an electrical breakdown, causing an arc to form. The current flow in the arc creates a magnetic field behind the arc which exerts an accelerating force on the arc, propelling it down the coaxial tube toward the open end of the gun. Energetic plasmas thus created can be subsequently trapped in a variety of magnetic traps for study. The basic design is still in widespread use today. A memorial service was held in Los Alamos December 4. His many friends mourn his passing.

## PPPL "GRADS" GO COMMERCIAL

Trinitech, an Irish firm headquartered in Dublin and specializing in so-called "Smart Cards" for making pre-paid or credit commercial transactions, has opened a 10-person office in Princeton, NJ, staffed almost entirely by former employees of the Princeton Plasma Physics Laboratory. One of the former PPPL employees is Kevin McGuire, whose brother, John McGuire, is the firm's founder and CEO. The firm's magnetic cards and card readers are already widely used in Europe for small purchases like newspapers, vending machine items, phone calls, and bus fares. The cards are now used in the United States largely for purchases within a closed environment, such as a college or resort.

The Princeton office of the firm will specialize in developing new software for use with the cards and readers. In addition, the firm will be developing software for use in downloading Internet materials for which there may be a small charge. For the latter purpose, a diskette version of the card is being developed. Trinitech's Princeton office is already working with Visa Latin America and Visa Central in San Francisco and has a pilot project in operation in Manhattan.

The former PPPL employees, now at Trinitech, include Kevin McGuire, Dave Chang, Steve Scott, Marilee Thompson, Jane Murphy, Michael Diesso and Richard Wieland.



*Schematic of Marshall gun*

## WEB SITES OF NOTE

Web browsers may wish to check out the following sites: ITER Joint Central Team ([//www.iter.org/](http://www.iter.org/)); U. S. ITER Home Team ([//iter.ucsd.edu/](http://iter.ucsd.edu/)); NIF construction progress ([//lasers.llnl.gov/lasers/pubs/monthly/](http://lasers.llnl.gov/lasers/pubs/monthly/)), Fusion Power Associates Fusion Program Notes ([//aries.ucsd.edu/fpa/](http://aries.ucsd.edu/fpa/)), Canadian Fusion Fuels Technology Project ([//www.cfftp.com/](http://www.cfftp.com/)), Columbia University ([//www.ap.columbia.edu/plasma/plasmaintro.html/](http://www.ap.columbia.edu/plasma/plasmaintro.html/)), General Atomics ([//fusion.gat.com/](http://fusion.gat.com/) and [//fusioned.gat.com/](http://fusioned.gat.com/)), LBNL ([//fusion.lbl.gov/](http://fusion.lbl.gov/)), IPP-Garching ([//www.ipp.mpg.de/](http://www.ipp.mpg.de/)), JET ([//www.jet.uk/](http://www.jet.uk/)), JT-60 ([//www-jt60.naka.jaeri.go.jp/](http://www-jt60.naka.jaeri.go.jp/)), MIT ([//www.pfc.mit.edu/](http://www.pfc.mit.edu/)), PPPL ([www.pppl.gov/](http://www.pppl.gov/)), U. Rochester ([//www.lle.rochester.edu/](http://www.lle.rochester.edu/)), U. Texas ([//w3fusion.ph.utexas.edu/](http://w3fusion.ph.utexas.edu/)), Interactive Plasma site ([//ippex.pppl.gov/ippex/](http://ippex.pppl.gov/ippex/)).

If your site is not listed here and you would like us to mention it in our next newsletter, send your URL to us by email ([fpa@compuserve.com](mailto:fpa@compuserve.com)).

## FUSION FACILITIES DIRECTORY AVAILABLE

The new 267-page Fusion Facilities Directory is available from Fusion Power Associates. The directory includes phone/fax/email addresses for fusion personnel throughout the U. S. and travel logistics and organizational charts for U. S. fusion sites. Cost is \$50, including shipping within the U. S. and Canada and \$75 for overseas. Contact Fusion Power Associates.

## THOUGHTS FOR THE NEW YEAR

"There is not the slightest indication that (nuclear) energy will ever be obtainable. That would mean that the atom would have to be shattered at will."

- Albert Einstein, 1932

"A journey of a thousand miles begins with a single step."

- Chinese Proverb





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## ANNUAL MEETING SET FOR JUNE 3-5 IN WASHINGTON, DC: PLASMA SCIENCE AND ITS APPLICATIONS

### ANNUAL MEETING, JUNE 3-5

Fusion Power Associates will hold its Annual Meeting and Symposium, June 3-5 in Washington, DC. The theme of this year's symposium will be "Plasma Science and Its Applications." Presentations and discussion at the meeting will center around the importance of plasma science to the Nation, as both a basic and applied discipline. Connections to other fields of science include astrophysics, non-linear dynamics and turbulence, and computational science. Applications include plasma processing of materials, waste processing, plasma electronics and fusion. The conference will be held at the Washington Court Hotel on Capitol Hill. Registration materials will be sent to recipients of this newsletter in a separate mailing. For further information, contact Ruth Watkins: fpa@compuserve.com

### CLINTON BUDGET SNUBS FUSION AS ENERGY OR SCIENCE

On February 2, President Bill Clinton sent his FY 1999 budget request to Congress. Secretary of Energy Federico Peña hailed the budget as "historic," saying it shows "the commitment this administration has made to investing in science and technology." He also said the budget "will boost investment to diversify the Nation's energy portfolio." The budget proposal does indeed request substantial budget increases for all aspects of the energy department's portfolio except fusion. A 1.7 percent decrease in the fusion budget is requested, while increases in other areas of energy and science range from ten to fifty percent, within an overall DOE budget that would grow by 9 percent, to a level of \$18 billion.

The request for the Office of Fusion Energy Sciences would decline from \$232 million appropriated last year to \$228.2 next year, if the President's proposals are adopted by Congress. The total is only the tip of the iceberg, however. Funding for the International Thermonuclear Experimental Reactor (ITER) project would be slashed from this year's level of 52.6 million to a level that could be as low as \$12 million for ITER-specific work, although other so-called "dual purpose" activities that

support both ITER and domestic program goals could arguably increase the ITER-relevant budget to around the \$30 million mark. The money freed up by the ITER reductions would result in forecast increases in other areas of the domestic program, including increased operations of the Alcator C-Mod and DIII-D tokamak experiments at MIT and General Atomics, respectively; theory; experiments other than tokamaks; technology; and enhanced collaborations on international facilities.

The DOE budget, which Secretary Peña said "strengthens investments in science, technology and energy to help America remain the world's economic and scientific leader for the next century," ignored the fact that the fusion efforts in Europe and Japan have far outstripped the U.S. effort, the European effort being approximately twice the U.S. effort and the effort in Japan being about 50 percent larger. The budget asks for a 33 percent increase (to \$1.1 billion) in the Energy Efficiency and Renewable Energy category; a 53 percent increase (to \$560 million) in the Fossil Energy program; a 21 percent increase (to \$326 million) in the fission energy program; a 25 percent increase (to \$836 million) in the Basic Energy Sciences category; and increases of 10-12 percent in Computational, High Energy and Nuclear Physics programs.

### FRELINGHUYSEN URGES FUSION SUPPORT

In a press release dated January 26, Rep. Rodney Frelinghuysen (R-NJ), said "Today, Congressman (Mike) Pappas (R-NJ) and I are asking that President Clinton fully fund the U.S. fusion research program in his annual budget." Frelinghuysen said, "I serve on the House Appropriations Committee on Energy and Water Development, which oversees the budget for the Department of Energy and the fusion research program. Last year, we allocated \$232 million for fusion research. What we are asking the President for is at least that level or more . . ." He said, "If the President's request is not enough to keep the fusion program going at the level we're used to, we will do everything possible to add funding in Congress to make up the difference." He commented, "Fusion energy has the potential to be an unlimited and ultra-clean source of energy for the world. We cannot turn our backs on this now that we have come so far. I'm hoping the President agrees."

## **NIF CONSTRUCTION PROCEEDS APACE**

President Clinton's FY 1999 budget request attaches a high priority to continuing construction of the \$1.2 billion, laser-based, National Ignition Facility, a fusion facility supported as part of the DOE Defense Program's Science-Based Stockpile Stewardship program. The Office of Inertial Confinement Fusion and the NIF Project would receive \$498 million, including \$284.2 million for NIF construction. This compares to this year's funding level of \$413.5 million, including \$197.8 million for NIF construction. Overall, DOE's Defense Programs would increase from \$4.1 billion to \$4.5 billion.

The goals of the inertial confinement fusion program are to demonstrate fusion ignition in the laboratory; to provide access to physics regimes of interest in nuclear weapon science and investigate physics issues; to expand the aboveground simulation capability for nuclear weapons effects; to develop diagnostic instruments applicable to weapons stockpile stewardship research; to develop and experimentally benchmark computational models by developing three-dimensional simulation capabilities; and to attract and retain highly competent scientists and engineers within the nuclear weapons program.

Responsibility for developing the civilian energy applications of inertial confinement fusion rests with the DOE Office of Fusion Energy Sciences. Within their \$228.2 million budget, they estimate spending \$7.1 million on that effort, compared to \$7.0 million in FY 1998.

## **REP. EHLERS HEADS SCIENCE POLICY STUDY**

Rep. Vernon Ehlers (R-MI), a member of the House Committee on Science, is heading a Congressional Science Policy Study, with the aim to "conduct a comprehensive review of our national science policy and develop a new, sensible, coherent long-range science and technology policy." Ehlers says the policy questions are: "1. On what broad national goals should the federal science policy be based? 2. (a) What is the government's role in supporting basic and applied research? (b) How can the government best encourage an effective level of industry investment in pre-competitive research? 3. How can the nation enhance and make the most effective use of government/university/industry research partnerships? 4. What is the most effective role for the states in supporting university research, and how can the federal government best support that role? 5. (a) Given the increasingly international nature of science, how can the nation best benefit from and contribute to international cooperation in research? (b) What types of multilateral science agreements are needed to facilitate international collaboration? 6. How can the federal government best help meet national needs for science and math education at all levels? 7. How can the nation most effectively leverage federally funded R&D in the face of increasingly constrained resources?"

Ehlers says he wants public input for his study and has set up a web site to facilitate an interactive process with the public. The URL is [http://www.house.gov/science/science\\_policy\\_study.htm](http://www.house.gov/science/science_policy_study.htm). He requests that suggestions be concise, preferably a few pages.

The National Science Board provided an 11-page working paper, "Government Funding of Scientific Research." That paper can be viewed at [//www.nsf.gov/home/nsb/pubs/nsb97186/nsb97186.htm/](http://www.nsf.gov/home/nsb/pubs/nsb97186/nsb97186.htm/)

## **ANS FUSION CHAIR PRESENTS FUSION HIGHLIGHTS**

Dr. William Hogan, Lawrence Livermore National Laboratory, is the current chairman of the American Nuclear Society's (ANS) Fusion Energy Division, representing about 1000 fusion nuclear engineers. In a December 1997 letter to members of the division, Hogan said, "The pace of change continues to be rapid. I would like to highlight three areas that will have important impacts on our profession: the National Ignition Facility (NIF) construction activities, the ITER construction decision, and the new ANS strategic plan.

"NIF: The \$1.2 billion NIF project now has \$500 million committed to it through fiscal year 1998. Congress declined to appropriate all the money up front but it has voted the full requested appropriation each year of the project. It hasn't been a shoe-in. Each year there was considerable controversy. The remaining funds are within the \$4.5 billion per year Stockpile Stewardship Program that Congress has supported, but we expect considerable debate each year, even though the Stewardship total is about half what the budget for nuclear weapons was during the 1980's. The fact that the Comprehensive Test Ban Treaty (CTBT) is before the Senate for ratification should, in fact, strengthen Congress's resolve to support the Stewardship program. There is a three-story hole in the ground at LLNL in which the football sized building is being built. Contracts are being inked all over the country. The total ICF Program appropriation for FY98 (including NIF) is \$415 million. Anti-nuclear-weapons organizations filed suit and asked the judge for an injunction to stop construction. While the DOE has agreed to additional environmental studies, the judge has signaled several times that he will not stop construction. Thus, every indication to date is that NIF construction will be completed on schedule with the first cluster of eight beamlines available at the end of FY2001 and full construction complete in 2003. While NIF is being built for National security purposes, it will answer fundamental questions about the viability of inertial fusion as a source of electric power and contribute to fundamental sciences. DOE has accepted the recommendations of several studies and directed the NIF/ICF team to plan for expanded international collaboration on unclassified NIF experiments (about 80 percent of the total).

“ITER: The fact that a three year transition period is being inserted between the end of the Engineering Design Activities and a formal construction decision was a disappointment to many who wanted to see a construction decision immediately. Many of us have devoted much of our careers to trying to make fusion energy happen, and we'd all like to see it progress rapidly. During this period, many will be interacting with Congress to enhance interest in fusion energy. As your chairman, I have participated in the Fusion Energy Sciences Advisory Committee (FESAC) meetings on what to do about the ITER situation. As many of you know, a subcommittee chaired by Herman Grunder of CEBAF recommended strong support of ITER if a construction decision came forth soon. However, if it did not, the panel recommended studying lower cost options with our international partners. OFES (DOE's Office of Fusion Energy Sciences) is currently considering a new international strategy in addition to an ITER participation and will ask the FESAC for its reaction to the new strategy at the end of January. None of us have seen it yet.

“The multi-billion price tag for ITER could be one stumbling block in an era where it is difficult to secure funding for large science projects and new energy sources are just not a Congressional priority. This is one key reason why fusion energy is being approached on an international basis. However, it may be that we should also try to find lower cost ways to continue developing fusion energy. I'm not sure that if NIF had cost even \$2 billion, it would be under construction today, even with the strong National security implications and the pending CTBT debate. Our country, and, it appears to some extent, much of the world is continuing to back away from large science. We must figure out if there is a way to make the fusion energy option available to future generations with smaller budgets, at least until one or more of several factors changes current thinking. Fortunately, there are several scenarios that could cause just such a change in thinking. Fixing global warming could become more of an accepted national issue. Power companies that are operating closer and closer to the margin could suffer more blackouts. Some scientific or technological event could cause another “sputnik” type of awakening to the importance of investing in science and technology. It is hard to predict if or when such things will make the climate more receptive. In the meantime I have found that there are many scientists and engineers who get even cleverer when they are told they cannot have as much money as they assumed was necessary and the whole field benefits from this imaginative thinking in the face of the challenge. I would urge us in the fusion community to respond positively to the current challenge and see how we might meet it.

“ANS: The American Nuclear Society has also been shrinking as the nuclear power industry shrinks. ANS President Stan Hatcher initiated a strategic planning exercise to update the ANS's strategic long-range direction in order to meet this challenge. One of the elements of this rethink process was a pair

of two-day planning sessions involving representatives of the ANS Board, the Staff, the Divisions, and the Committees. I attended, representing FED (Fusion Energy Division). These were very lively sessions and there was much debate about what the major focus of ANS should be. Ultimately, the group did write a new plan. It was submitted to the full Board and adopted at the Winter Meeting in Albuquerque. The new ANS Mission Statement is: The American Nuclear Society serves its members in their efforts to develop and safely apply nuclear science and technology for public benefit through knowledge exchange, professional development, and enhanced public understanding.

“Notice the emphasis on 'serves its members' and the fact that nuclear power is not singled out for emphasis. Four specific goals were adopted to support this mission: By 2003, (1) ANS will be the recognized leader for the advancement of nuclear science and technology; (2) ANS will be its members' primary resource for professional development and knowledge exchange; (3) ANS will be recognized by the public as a credible source of nuclear science and technology information, and (4) ANS will be an active contributor to and participant in nuclear science and technology public policy issues.

“Milestones and strategies were set in order to achieve these goals by 2003. Two Task Forces were established to help implement these goals: (1) Task Force on Infrastructure, Stan Hatcher, Chair, and (2) Task Force on Financial Strategies, Denis O'Brien, Chair.

“This represents a significant change in direction for the ANS with a much stronger emphasis on being a better professional society. Many of the strategies such as stronger student support are things that our Division has emphasized for years. Here is another case where a challenge may bring about positive changes that we would all like to see. I urge those of you who might want to give input on this change in directions to give me your thoughts and/or pass them on to the above two Task Force Chairmen. Anyone wishing a copy of the new ANS Strategic Plan can email Clement Wong, our Secretary/Treasurer at: [wongc@gav.gat.com](mailto:wongc@gav.gat.com)”

Bill Hogan can be reached at: [bill-hogan@llnl.gov](mailto:bill-hogan@llnl.gov).

## WEB SITES OF NOTE

In addition to the web sites noted in our last newsletter, we recommend visiting the following sites: DOE Office of Inertial Fusion and the National Ignition Facility ([//www3.dp.doe.gov/ifnif/icf.htm](http://www3.dp.doe.gov/ifnif/icf.htm)), Georgia Institute of Technology ([//www.frc.gatech.edu/](http://www.frc.gatech.edu/)), ITER Canada ([//www.itercanada.com/](http://www.itercanada.com/)), Sandia National Laboratories Pulsed Power Technology ([//www.sandia.gov/pulspowr/](http://www.sandia.gov/pulspowr/)) and High Energy Density and Inertial Confinement Fusion ([//www.sandia.gov/pulspowr/hedicf/](http://www.sandia.gov/pulspowr/hedicf/)), U.S. Naval Research Laboratory, Plasma Physics Division ([//wwwppd.nrl.navy.mil/](http://wwwppd.nrl.navy.mil/)), University of California at San Diego, Physics Department,

Fusion Research Program ([//www-physics.ucsd.edu/research/plasma/](http://www-physics.ucsd.edu/research/plasma/)). Please also visit our new Fusion Power Associates web page ([//fusionpower.org/](http://fusionpower.org/)) and check to see if our link to your favorite page is listed and working properly on our "Other Fusion Sites" page.

## KREBS ON ITER

The following is a written statement on ITER distributed by DOE Director of Energy Research, Martha Krebs at a meeting of the DOE Fusion Energy Sciences Advisory Committee (FESAC) on January 22:

"International cooperation is, and will continue to be, a vital part of our fusion program. Given any credible budget projection, it is also essential to our ability to participate in large scale experiments and to advance the energy portion of the fusion program. I hope to both continue our ITER cooperation, and to expand our cooperation with our partners in other areas. In particular, I would like to see us work together to define development paths to fusion energy—perhaps a version of our domestic "roadmaps" and to expand our program of cooperation on large machines.

"The ITER framework has proven to be a valuable focusing element in our program both in terms of the technical product and the process by which we work together. We want to continue participation in this process as long as it promises to meet our needs.

"The current ITER design is technically excellent, and I want to compliment the ITER Director, Dr. Aymar, and his supporting teams for producing a design that meets all the specific scientific and engineering objectives set out at the beginning. It was a difficult task, and one that has been very valuable to the progress of fusion -- in fully defining this design, Dr. Aymar has forced the fusion community worldwide to solve many of the specific problems associated with building a fusion reactor to create and control energy producing plasmas.

"Since the beginning of the ITER EDA in 1992, there have been substantial changes in the ability of the ITER partners to finance a project of this magnitude. The funding for the fusion programs of Russia and the United States has been greatly reduced and the expectation that they would fund a substantial portion of ITER construction is in question. Europe and Japan may not be able to make up the shortfall, particularly given the current economic situation.

"We and our partners are coming to the view that, in case we are financially unable to proceed to the construction of the current design, we should plan to evaluate possibilities for reducing the cost of ITER by reducing detailed technical objectives.

"I am please to say that we are having productive discussions with our ITER partners on such an approach to the continuation of the ITER activities. At the next ITER Council meeting, we

will discuss formation of a working group to define and evaluate options for a reduced cost ITER.

"I would emphasize that this evaluation of options would be in addition to the tasks already defined for the next phase of ITER, such as site specific designs, interactions with regulators and prototype testing."

## REPORTS AND PUBLICATIONS

The December 1997 issue of the *Journal of Fusion Energy* (Plenum Press) contains the following reports of interest:

"Report from the Planning Workshop for the Fusion Energy Sciences Program," Stewart Prager, Mohamed Abdou, David Baldwin, Richard Briggs, George Neilson, and Thomas Simonen.

"Complexity and Availability for Fusion Power Plants: The Potential Advantages of Inertial Fusion Energy," L. John Perkins.

"Economic Impacts on the United States of Siting Decisions for the International Thermonuclear Experimental Reactor," J. P. Peerenboom, M. E. Hanson, J. R. Huddleston, and T. D. Wolsko.

## CONFERENCES

**May 18-22**—The 13th International Conference on Plasma Surface Interactions in Controlled Fusion Devices will be held in San Diego, CA. Contact [cerda@ga.gat.com](mailto:cerda@ga.gat.com)

**June 1-4**—The 25th IEEE International Conference on Plasma Science will be held in Raleigh, NC. Contact John Gilligan: [john\\_gilligan@ncsu.edu](mailto:john_gilligan@ncsu.edu)

**June 7-11**—The American Nuclear Society Fusion Energy Division 13th Topical Meeting on the Technology of Fusion Energy will take place in Nashville, TN. Check their web page at [//www.ornl.gov/fed/ans98/ans98.html](http://www.ornl.gov/fed/ans98/ans98.html)

**June 7-11**—The Twelfth Topical Conference on High Temperature Plasma Diagnostics will be held at Princeton University. For information, contact Marilyn Hondorp: [mhondorp@pppl.gov](mailto:mhondorp@pppl.gov)

**June 29-July 3**—The 1998 International Congress on Plasma Physics & 25th EPS Conference on Plasma Physics and Controlled Fusion will be held in Prague, Czech Republic. Check out their web site at [//www.ipp.cas.cz](http://www.ipp.cas.cz) or contact: [plasma98@ipp.cas.cz](mailto:plasma98@ipp.cas.cz)

**July 27-31**—An International Conference on Open Magnetic Systems for Plasma Confinement will be held in Novosibirsk, Russia. Check out their web page at [//www.inp.nsk.su/OS98/](http://www.inp.nsk.su/OS98/) or contact: [os98@inp.nsk.su](mailto:os98@inp.nsk.su)





# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

2 Professional Drive, Suite 249, Gaithersburg, Maryland 20879 • 301-258-0545 • Fax: 301-975-9869 • E-mail: fpa@compuserve.com

<http://fusionpower.org>

**MARCH 1998**

**Vol. 20, No. 3**

## FUSION PROGRESS—EUROPE TAKES THE LEAD

### NEW AFFILIATE

Columbia University Department of Applied Physics has become an Affiliate of Fusion Power Associates. Department Chairman and Professor Gerald A. Navratil will represent the University. The Department has a long history of research and student training in plasma physics and fusion. Professor Navratil can be reached at 500 W. 120th Street, Room 202 S.W. Mudd Bldg., New York, NY 10027; (212)854-4496; fax -8257; email: navratil@columbia.edu. We welcome the participation of Columbia University in the activities of Fusion Power Associates.

### MONTGOMERY NAMED TO ACADEMY

MIT fusion magnet expert D. Bruce Montgomery has been elected to the National Academy of Engineering. Bruce was cited for “the development, design and construction of high-magnetic-field devices for conventional and superconducting applications.” He began his MIT affiliation in 1959 as a Lincoln Laboratory staff member and subsequently held positions at the Francis Bitter National Magnet Laboratory (where he was an associate director), the MIT Plasma Fusion Center (where he was also an associate director) and the MIT Department of Nuclear Engineering. He is currently president of MTechnology, Inc. in Wayland, MA. He received his A.B. in Physics from Williams College, his Masters degree in Electrical Engineering from MIT and his D.Sc. from the University of Lausanne. Congratulations Bruce!

### ITER COSTS CAN BE REDUCED

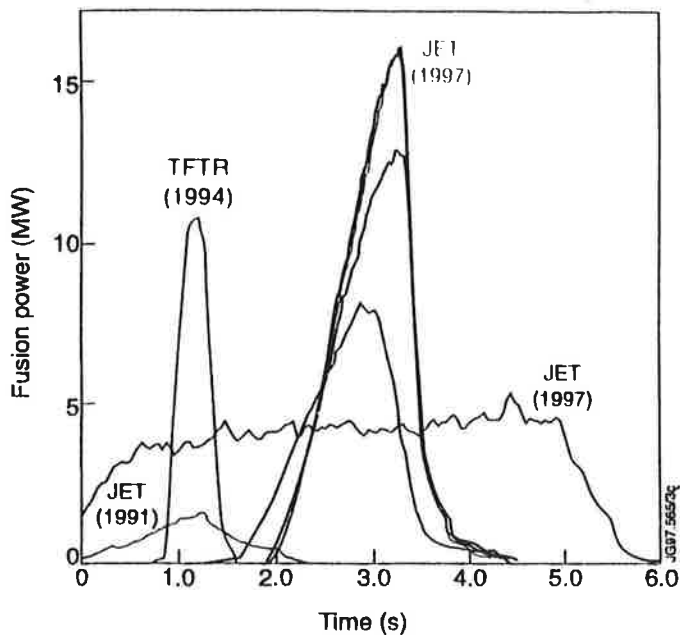
At a meeting February 18-19 in San Diego of the ITER Council (IC), the international body that oversees the design activities for the International Thermonuclear Experimental Reactor, ITER director Robert Aymar reportedly told the Council that the \$8 billion cost of the project could be reduced by almost a third if the Council was willing to relax some of the technical objectives of the project. Specifically, if the device were designed to produce less power, a range of cost reductions are possible. ITER is currently designed to produce 1500 Megawatts of fusion power for 15 minutes at time. The Council agreed to look into such trade-offs and issued the following statement. “The ITER Council, recognizing the budgetary pressures in the Parties have



*Dr. D. Bruce Montgomery*

been growing, decided to take the initiative to use the established bases of the ITER design to examine possible variants of the design which would relax some of the detailed technical objectives while still satisfying the overall programmatic objective of the ITER EDA (Engineering Design Activities) Agreement. Cost estimates and other features, such as technical margins, of one or a small number of these reduced options could thus be produced by the Director on a comparable basis to the ITER reference design. The Council decided to set up a Special Working Group bringing together delegations from each of the Parties to propose technical guidelines for possible changes to the current detailed technical objectives and overall technical margins, with a view to establishing option(s) of minimum cost, while still satisfying the overall programmatic objective of the ITER EDA Agreement.”

In other actions, the ITER Council extended the present 6-year Agreement, which is scheduled to end in July 1998, by an additional three years “to provide the framework for undertaking jointly site(s) specific and other activities with the aim of enabling future decision on construction and operation of ITER.” The Council said that “the ITER parameters and overall design

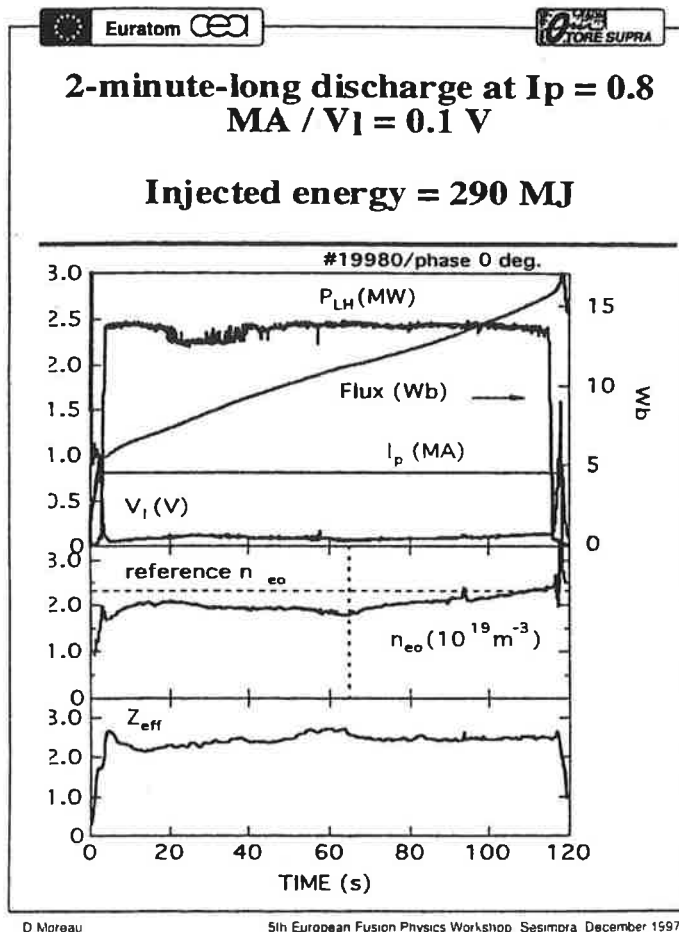


fulfills all of the technical objectives set for it” and “from a technical perspective, the design and accompanying technical data and cost estimate would be sufficient to allow a construction decision to be taken.”

A Press Guideline released after the IC meeting said, “The Parties representatives at the Council expressed shared views that ITER’s overall programmatic objective continues to be valid and central to the fusion energy goals of each Party; the shared results coming from the ITER activities are of direct value to each Party’s fusion energy goals; through participation in the ITER EDA, the ITER Parties have developed efficient modes of international collaboration in which each Party benefits greatly from the sharing of results; and there is a shared interest in jointly progressing further toward a possible decision on the construction/operation of ITER in a collaborative framework.”

### U.S. ANALYZING REDUCED COST ITER OPTIONS

Pressed by the DOE Fusion Energy Advisory Committee (See our November 1997 and February 1998 newsletters) various groups in the U.S. have been analyzing the cost-performance tradeoffs for ITER. At a February 25 meeting of the U.S. ITER Steering Committee (ISCUS), chaired by Bill Stacey of Georgia Institute of Technology, options were discussed in the \$1-5 billion range, compared to the \$8 billion estimate of the current design. The group found that costs could be gotten down into the \$5 billion range, using current physics scaling laws and retaining superconducting magnet technology, by eliminating the ignition requirement, reducing the fusion power by about two-thirds and the neutron wall load by up to one-half that specified in the current design. In order to go down to the \$1 billion range, it appeared necessary to redesign using non-superconducting magnets and to use more advanced physics scaling laws which have not yet been experimentally verified, but which show some promise that they can be utilized in the future.



D Moreau

5th European Fusion Physics Workshop, Sesimbra, December 1997

An open, week-long fusion community meeting is being organized for April 27 - May 1 in Madison, WI, to consider Major Next Step fusion options. For further information, contact Stewart Prager ([prager@juno.physics.wisc.edu](mailto:prager@juno.physics.wisc.edu)).

### EUROPE MAKES GIANT STRIDES

Fusion research programs in Europe have made giant strides toward practical fusion power in the recent past. The results show that fusion plasmas can be sustained, an essential element along the path to a commercial energy system. Scientists working on the Joint European Torus (JET), who last year set a world record of producing over 15 Megawatts of fusion power for a fraction of a second, have also succeeded in sustaining nearly 5 Megawatts for over 5 seconds, the full length of the experimental discharge. In addition, scientists in France, working on the superconducting Tore Supra facility, sustained a high temperature plasma for 2 minutes. Scientists in Europe and elsewhere have also learned how to reduce the input power required to sustain these discharges efficiently using currents spontaneously generated within the fusion plasma, the so-called “bootstrap” current and are learning how to reduce the scale, hence cost, of future facilities.

For further information, contact M. Keilhacker (Fax 44-1235-464465) regards JET and D. Moreau (Fax 334-4225-6421) regards Tore Supra.

## **CLINTON MENTIONS FUSION TO AAAS**

U.S. President Bill Clinton, in remarks delivered to the 150th anniversary meeting of the American Association for the Advancement of Science (AAAS), February 13 in Philadelphia, said "Now, where will we be 50 years from now? By the year 2048, when a future President of the United States addresses your bicentennial meeting, fusion and solar power may yield abundant energy. In any case, I am absolutely convinced that by then we will have discovered how to grow the economy by restoring, not depleting, our planet." Clinton said, "Let me say, I believe in what you do. And I believe in the people who do it. Most important, I believe in the promise of America, in the idea that we must always marry our newest advances and knowledge with our oldest values, and that when we do that, it's worked out pretty well. That is what we owe our children; that is what we must bring to the new century."

Clinton announced the anticipated retirement and resignation of Jack Gibbons as his Science Advisor and the planned appointment of Neal Lane as Gibbon's successor. Lane is currently Director of the National Science Foundation.

## **FUSION MATERIALS PROGRAM UNDER REVIEW**

The DOE Fusion Energy Advisory Committee (FESAC) has set up a panel, under the chairmanship of Sam Harkness (Westinghouse) to review the Materials Research Program of the Office of Fusion Energy Sciences. The panel held its first meeting March 2-3 in Pittsburgh and plans to have a final report in May. In a charge letter dated January 14 to FESAC chairman John Sheffield, DOE Director of Energy Research Martha Krebs said the program "is comprised principally of the low activation structural materials research and our efforts aimed at the associated neutron source test facility." She asked FESAC to address the following seven topics: (1) goals, (2) scientific quality of the work, (3) balance in the various dimensions of the materials program, (4) mix of research performers, (5) balance of effort on candidate materials systems, (6) coordination, collaboration and balance among domestic and international participants, including our involvement in the international fusion materials irradiation facility activities, and (7) outreach activities. She said that the FESAC review "should provide both an evaluation of the program strategy (including scope and priorities for future work) and a technical review/evaluation of the ongoing research in this program element."

In addition to Harkness, the panel members include M. Abdou (UCLA), Charles Baker (UCSD), John Davis (Boeing), Harold Forsen (Bechtel, retired), Bill Hogan (LLNL), Gerald Kulcinski (U. Wisconsin), Michael Mauel (Columbia U.), Carl McHargue (U. Tennessee), Robert Odette (UCSB), David Petti (INEL), Paul Shewmon (Ohio State U.) and Stuart Zweben (PPPL).

## **CONGRESS PANS PRESIDENT'S BUDGET**

Following the release of President Clinton's FY 1999 budget

proposals (See our February newsletter), the House Appropriations Committee issued a four-page statement entitled "President's Failure to Produce Balanced Budget Leaves Congress with Headache." The statement says "While President Clinton contends his budget for FY99 is balanced, the truth of the matter is that it falls at least \$9 billion short on the discretionary side of spending because of its reliance on funding streams that simply don't exist, like the \$3.5 billion tobacco settlement, phony user fees, and legislative initiatives that will never materialize. Cuts in veterans medical care and elderly housing cannot be used to fund the litany of new programs the President proposes." The statement specifically casts doubt on the future funding possibilities of several items in the Department of Energy request: \$400 million increase in Efficiency programs; \$157 million in Basic Energy Sciences for the new Spallation Neutron Source at ORNL; \$99 million increase for Solar and Renewable Resources Technology; \$30 million increase in High Energy Physics for the U.S. contribution to the Large Hadron Collider in Switzerland, and \$29 million for the implementation of the Comprehensive (Nuclear Weapons) Test Ban Treaty, "which has not been ratified by the Senate."

The House and Senate have begun to schedule hearings on the President's requests.

## **EDWARD TELLER CELEBRATES 90TH BIRTHDAY**

Fusion pioneer Edward Teller celebrated his 90th birthday in mid-January. The Hungarian-born physicist, often called the "father" of the hydrogen bomb, said in an interview with the Lawrence Livermore National Laboratory newsletter that the biggest regret of his career was that he did not have more time to spend on basic science. "I could not do all the work that was required of me and still have time to keep my full attention on basic science. I have done very much less than what I would like to have done," Teller said. Teller's press for fusion weapons research led to the founding of the Lawrence Livermore National Laboratory in the early 1950's. He was director of the Laboratory 1958-60.

Teller said, "If this laboratory could become the real unique leader in planetary physics, and some parts of astrophysics, I think this will be something fully as important than what we have done in defense." Teller cited the Lab's many contributions to defense but, talking about the future, Teller enthused about the potential scientific contributions of the National Ignition Facility (NIF), now under construction at the Lab. "All of planetary physics and much of astrophysics may well depend on the findings of NIF," Teller said. While some critics believe NIF will not succeed, Teller said, "I am completely confident it will."

## **MFTF BEING SALVAGED**

Another multi-hundred-million dollar fusion research facility built in the 1980's, the Mirror Fusion Test Facility, or MFTF, is being torn down for salvage at the Lawrence Livermore National Laboratory. The salvage operation began February 5 and is

aimed at freeing up the building for other purposes. Approximately 2,500 tons of material, including the stainless steel and copper vacuum vessel and superconducting magnet structure, will be removed and sold. The facility was completed and checked out in 1986, but never operated for physics experiments due to congressional budget cuts. The salvage operation is expected to take about five months.

Keith Thomassen, director of the magnetic fusion energy program at Livermore, said "The project was conceived in a 'can-do' era when budgets for fusion research were rising. In that era, the fusion program was very different from what it is now." The MFTF superconducting magnets, the largest ever built, weighed 400 tons each and contained 15 miles of niobium-titanium superconducting wire. When operating, the magnets produced a magnetic field 150,000 times stronger than the Earth's magnetic field while using only 50 watts of power. The project took eight years to build and was "a great engineering feat," according to Thomassen. "There was an important transfer of capability to private industry," also according to Thomassen. General Dynamics (later Lockheed Martin) of San Diego constructed the magnets.

Though magnetic mirror research has been non-existent in the U.S. since the demise of MFTF, small programs still exist in Russia and Japan. Today "our hearts are in finding less expensive and less complex fusion approaches," says Thomassen. The group is currently building a small, compact fusion research device called a "spheromac."

## GRANT PROPOSALS SOUGHT

The DOE Office of Fusion Energy Sciences is seeking grant applications for "imaginative research initiatives to be conducted on the NSTX device in furtherance of its research mission. NSTX (the National Spherical Torus Experiment) is under construction at the Princeton Plasma Physics Laboratory and scheduled to begin operations in FY 1999. DOE says that they will "give priority to applications that can produce experimental results that are needed by the NSTX program within the first two years of experimental operations." They say that the "program of collaboration must be developed through cooperation and discussion with the NSTX research team (at Princeton)."

Completed formal applications, referencing Program Notice 98-07 must be submitted to DOE by 4:30 PM, April 23, 1998. For further information, contact Dr. William Dove: [william.dove@mailgw.er.doe.gov](mailto:william.dove@mailgw.er.doe.gov)

## CALENDAR

**March 23-25:** International Sherwood Fusion Theory Conference, Atlanta, GA. Contact: [hanson@physics.auburn.edu](mailto:hanson@physics.auburn.edu)

**March 23-26:** 11th APS Topical Conference on Atomic Processes in Plasmas, Auburn, AL. Contact: [APP98@physics.auburn.edu](mailto:APP98@physics.auburn.edu)

**April 6-9:** Innovative Confinement Concepts Workshop 1998, Princeton University, Princeton, NJ. Contact: [rgoldston@pppl.gov](mailto:rgoldston@pppl.gov)

**April 26-30:** International Symposium on High Power Laser Ablation, Santa Fe, NM. Contact: [spie@spie.org](mailto:spie@spie.org)

**May 18-22:** The 13th International Conference on Plasma Surface Interactions in Controlled Fusion Devices, San Diego, CA. Contact: [cerda@ga.gat.com](mailto:cerda@ga.gat.com)

**May 22-June 1:** Advanced Technologies Based on Wave and Beam Generated Plasmas, Sozopol, Bulgaria. Contact: [hs@plasma.ep2.ruht-uni-bochum.de](mailto:hs@plasma.ep2.ruht-uni-bochum.de)

**May 26-27:** 4th International Workshop on Advance Plasma Tools and Process Engineering, San Francisco, CA. Contact: [dlf@eccs.berkeley.edu](mailto:dlf@eccs.berkeley.edu)

**June 1-4:** The 25th IEEE International Conference on Plasma Science, Raleigh, NC. Contact: John Gilligan: [john\\_gilligan@ncsu.edu](mailto:john_gilligan@ncsu.edu)

**June 3-5:** Fusion Power Associates Annual Meeting and Symposium, "Plasma Science and Its Applications," Washington, D C. Contact: [fpa@compuserve.com](mailto:fpa@compuserve.com)

**June 7-11:** The American Nuclear Society Fusion Energy Division 13th Topical Meeting on the Technology of Fusion Energy, Nashville, TN. Web page: [//www.ornl.gov/fed/ans98/ans98.html](http://www.ornl.gov/fed/ans98/ans98.html)

**June 7-11:** The Twelfth Topical Conference on High Temperature Plasma Diagnostics, Princeton University. Contact: Marilyn Hondorp: [mhondorp@pppl.gov](mailto:mhondorp@pppl.gov)

**June 7-12:** 12th International Conference on High-Power Particle Beams, Haifa, Israel. Contact: [beams98@kenes.com](mailto:beams98@kenes.com)

**June 29-July 3:** The 1998 International Congress on Plasma Physics & 25th EPS Conference on Plasma Physics and Controlled Fusion, Prague, Czech Republic. Web site: [//www.ipp.cas.cz](http://www.ipp.cas.cz) or contact: [plasma98@ipp.cas.cz](mailto:plasma98@ipp.cas.cz)

**July 6-8:** International Workshop on Plasma-Focus Research, Kudowa Zdroj, Poland. Contact: [rysiek@ifpilm.waw.pl](mailto:rysiek@ifpilm.waw.pl)

**July 27-29:** 4th Asia-Pacific Conference on Plasma Science & Technology and 11th Symposium on Plasma Science for Materials, Sydney, Australia. Contact: [rod.boswell@anu.edu.au](mailto:rod.boswell@anu.edu.au)

**July 27-21:** An International Conference on Open Magnetic Systems for Plasma Confinement, Novosibirsk, Russia. Web page: [//www.inp.nsk.su/OS98/](http://www.inp.nsk.su/OS98/) or contact: [os98@inp.nsk.su](mailto:os98@inp.nsk.su)





# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

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Vol. 20, No. 4

## SANDIA UPS X-RAY RECORD AGAIN NIF CONSTRUCTION PROCEEDS APACE

### NEW AFFILIATE

The Nuclear Engineering Department, Massachusetts Institute of Technology, has become an Affiliate of Fusion Power Associates. Professor Jeffrey Freidberg ([freidberg@psfc.mit.edu](mailto:freidberg@psfc.mit.edu)), Chairman, will represent the Department. He can be reached at 77 Massachusetts Avenue, 24-122C, Cambridge, MA 02139-4307. We welcome the participation of the MIT Department of Nuclear Engineering in the activities of Fusion Power Associates.

### NIF RISING

Despite heavy rains during the past winter months, construction of the National Ignition Facility (NIF) at the Lawrence Livermore National Laboratory is proceeding apace. Recently, the Laboratory let a \$65.5 million contract to Hensel Phelps Company for the build-out and finishing of the main laser building, not including the portion of the structure housing the laser fusion target chamber. The \$1.2 billion facility is scheduled for completion in 2003. Mike Campbell, LLNL Associate Director, Laser Programs, calls the NIF "the world's largest precision optical instrument." Readers can follow the progress of NIF on the web by going to Fusion Power Associates home page (<http://fusionpower.org>), clicking on "Links to Other Fusion Sites," then clicking on "Lawrence Livermore National Laboratory—NIF Progress." Persons wishing to receive the LLNL Inertial Confinement Fusion Monthly Highlights report, prepared by Don Correll, should send an email request ([carpenter13@llnl.gov](mailto:carpenter13@llnl.gov)).

### X-RAYS SOARING

Sandia National Laboratories (SNL) has announced further increases in the x-ray output of its productive Z-Machine (previously called the Particle Beam Fusion Accelerator - II). Last summer (see our June 1997 newsletter), Sandia announced the production of 200 terawatts (trillions of watts), 1.9 Megajoules of x-ray output by imploding a cylindrical array of tungsten wires (see our September 1997 newsletter for photo). This was up from 85 terawatts, 0.9 Megajoules produced the previous year (see our June 1996 newsletter). On March 2,



NIF Target Area retaining wall forms and rebar.

1998, SNL announced they had recently produced 290 terawatts, 2.0 Megajoules. The new results were obtained by using two nested (concentric) cylindrical arrays of wires, compared to the one array used previously. The pulse lasts approximately 4 nanoseconds. In another series of experiments, SNL and collaborators from Lawrence Livermore National Laboratory achieved black body radiation temperatures in the implosion of 140 eV (see our September 1997 newsletter), compared to having achieved only about half that a year earlier. Their goal is to up this to 150 eV for fusion target compression experiments.

The concept of nested arrays was first tested at Physics International in 1984 with nested gas puffs and, more recently, by the Russians with gas puffs on a wire array. Two-dimensional computer simulations at Sandia and Los Alamos National Laboratory of the effect of magnetic fields on the behavior of the imploding plasma had indicated that nested wire arrays could reduce the growth of hydrodynamic perturbations. Plasma from the outer array is driven inward by the magnetic field until the inner edge strikes the stationary inner array. The deceleration of the fast moving "bubbles" at the inner edge of the outer plasma ring, as mass is accreted from the inner-wire-array plasma, allows slower moving "spikes" at the back of the outer



plasma ring to catch up and sweep up material in the inner ring. This decreases the width of the combined plasma ring as it moves toward the axis. Sandia vice president Gerry Yonas said, "The (public) announcement does not capture the really nice physics of the nested arrays. The inner array limits the growth of the Rayleigh-Taylor instability and results in the shorter pulse (hence higher power). This was predicted using 2-D codes at Los Alamos and Sandia, and the models allowed us to optimize the system and go from 200 TW to 290 TW during the last year. The amazing thing about all this is that nothing is anomalous or even pseudo-strange. This example of experiments stimulating theory stimulating experiments, leading to improved results, is very exciting and gives us a much stronger basis to proceed with X-1 conceptual design."

X-1 is a proposed larger version of the present Z-machine. Planning for the X-1 is in the preconceptual design phase. The objectives of X-1 are to provide an x-ray environment for radiation effects testing of weapons components and subsystems in the absence of underground tests; to provide a high-yield (200–1000 Megajoule fusion output) facility to address the long-term mission need of the national inertial confinement fusion program, and to provide a flexible, well-characterized x-ray source for weapon physics studies. Designers of X-1 are aiming to achieve 1000 terawatts, 16 Megajoules of x-ray output and radiation temperatures over 250 eV. Sandia is making a proposal to the Department of Energy to formally initiate conceptual design of the facility.

In a related development, *Industry Week* announced that the Sandia Z-pinch program had been selected as one of 25 programs to receive the magazine's "Technologies of the Year 1997" Awards. The award was presented at the third annual "Managing for Innovation Conference," March 30-31 in Chicago. The award states that the SNL Z-pinch program "may have a profound impact on everything from nuclear weapons to microlithography to astronomy to perhaps achieving the dream of tapping fusion reactions for a limitless source of energy." Jeff Quintenz, acting director of SNL's Pulsed Power Sciences Center, said "We're delighted with the recognition afforded us by *Industry Week*. Being recognized as one of the top 25 technology winners of the year makes us proud of the people who have put together these outstanding results. We couldn't be more happy with our people than we are."

Further information on the pulsed power programs at SNL can be found by going to the Fusion Power Associates home page, clicking on Links to Other Fusion Sites and then clicking on either of the two SNL listings. Further details of the Z-Experiments, with downloadable photos and graphics, can be viewed at <http://www.sandia.gov/media/z290.htm>

## ITER CANADA FORMED

ITER Canada Fusion Energy, Inc., a non-profit Canadian corporation dedicated to siting ITER in Canada, has been formed. It is the successor to Canada's ITER Siting Board and the Canadian Fusion Fuels Technology Project (CFFTP), and would be the predecessor of the Canadian legal entity that would take host responsibilities for construction of ITER if it were to be sited in Canada. The corporation's responsibilities include presenting Canada as a potential ITER host country; overseeing ITER staff attachments (Canada currently has 11 persons on attachment), ITER design and testing work, Canadian site-specific design, and preliminary licensing analysis and preparations.

The corporation's key personnel are Peter Barnard (416-240-5000, fax -5020; [peter@fulcrumpartners.com](mailto:peter@fulcrumpartners.com)), Chairman and CEO; Don Dautovich (416-506-2016, fax -4684; [dautovich@hydro.on.ca](mailto:dautovich@hydro.on.ca)), Managing Director; and Paul Gierszewski (416-207-5974, fax -5724; [paul.gierszewski@oht.hydro.on.ca](mailto:paul.gierszewski@oht.hydro.on.ca)), Senior Project Manager. Correspondence should be sent to Dr. Don Dautovich, ITER Canada, 700 University Avenue, A14, Toronto, Canada M5G 1X6.

The following institutions are sponsoring ITER Canada: AGRA, Inc., Acres International, Inc., Bruce County, Canatom, Inc., Canadian Federation of Labour, Canadian Labour Congress, Canadian Nuclear Association, Canadian Nuclear Society, Canadian Nuclear Workers Union, Centre canadien de fusion magnetique, Ernst & Young, Municipality of Clarington, Morwil, Inc., Numet Engineering, Ltd., Northern Telecom Ltd., Ontario Hydro, Osler Hoskin & Harcourt, Royal Bank of Canada, SNC-Lavalin, Spar Aerospace, Ltd., and Wardrop Engineering, Inc.

For further information on ITER Canada, access their web site by going to Fusion Power Associates home page, clicking on Links to Other Fusion Sites, then clicking on ITER Canada.

## APS FELLOWS

Congratulations to the following members of the American Physical Society (APS) Division of Plasma Physics, who were recently elected "Fellows" of the society: Michael Bell (Princeton University), Raymond Fisher (General Atomics), Henry Freund (SAIC), Gurudas Ganguli (NRL), Gregory Hammett (PPPL), Edward Lazarus (General Atomics), Richard Lee (UC, Berkeley), M. Keith Matzen (SNL), Warren Mori (UCLA), Dov Shvarts (NRC-Negev, Israel), Max Tabak (LLNL), Charles Verdon (Univ. of Rochester), and Alan Wootton (Univ. of Texas).

## FPA ANNUAL MEETING UPDATE

Fusion Power Associates Annual Meeting and Symposium, "Plasma Science and Its Applications," will feature presentations on National Science Policy by Rep. Vernon Ehlers (R-MI), a member of the House Science Committee, by Dr. Arthur Bienenstock, Associate Director for Science, Office of Science and Technology Policy, Executive Office of the President, and by Prof. John P. Holdren, Harvard University, who recently chaired an energy panel for the President's Council of Advisors on Science and Technology (see our November 1997 newsletter). The conference will take place June 3-5 in Washington, DC. There will also be a panel on Congressional Perspectives, featuring a number of key Congressional staff.

Topics of special interest at the symposium include sessions on The Role of Plasma Science in Graduate Education; The Relevance of Plasma Science to Other Fields of Science and Engineering; Energy and the Environment: Issues for the 21st Century; Near-Term Applications of Plasma Science and Fusion Research; Plasma Science and Fusion Energy Development; Plasma Science and National Defense; Industrial Interests and Opportunities; Educational Outreach; and Future Directions in Fusion Energy Development.

Registration information and a detailed program can be requested from Fusion Power Associates ([fpa@compuserve.com](mailto:fpa@compuserve.com)).

## RUSSIAN CONFERENCES

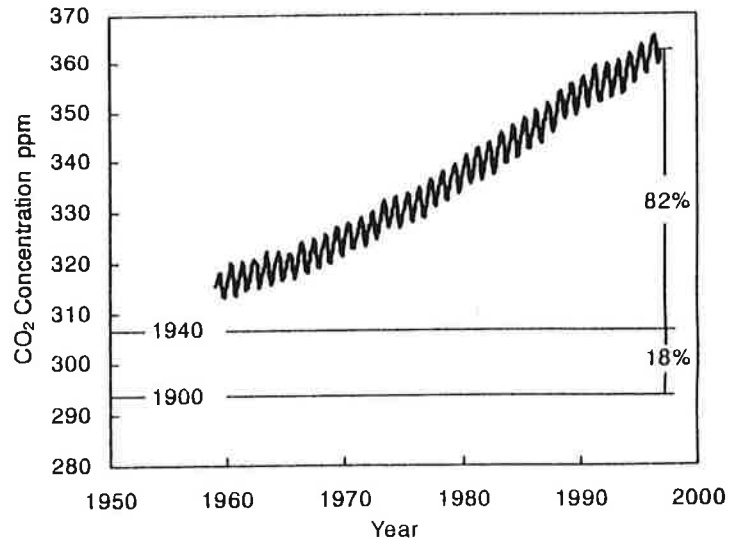
A number of interesting conferences are scheduled in Russia and the Ukraine this year. They include:

June 22-26—Ninth (International) Conference on Laser Optics, St. Petersburg, Russia (web site: [www.ilph.spb.ru](http://www.ilph.spb.ru)). Contact: [mak@ilph.spb.ru](mailto:mak@ilph.spb.ru)

July 27-31—International Conference on Open Magnetic Systems for Plasma Confinement, Novosibirsk, Russia (web site: [www.inp.nsk.su/OS98](http://www.inp.nsk.su/OS98)). Contact: [os98@inp.nsk.su](mailto:os98@inp.nsk.su)

Aug 31-Sep 5—International Symposium on Gas Flow and Chemical Lasers and High Power Laser Conference, St. Petersburg, Russia. Contact: Anatoly Boreisho ([laser@russinnocent.spb.ru](mailto:laser@russinnocent.spb.ru)).

September 14-20—Sixth Ukrainian Conference and School on Plasma Physics and Controlled Fusion, Alushta (near Black Sea), Ukraine. Contact: Dr. Igor Garkusha ([garkusha@ipp.kharkov.ua](mailto:garkusha@ipp.kharkov.ua)).



September 21-25—The Fifth Zababakhin International Conference on High Energy Density Physics, Snezhinsk, Chelyabinsk Region, Russia ([www.ch70.chel.su/vniitf/events/1998/zst](http://www.ch70.chel.su/vniitf/events/1998/zst)). Contact: V. A. Simonenko ([sva@nine.ch70.chel.su](mailto:sva@nine.ch70.chel.su)).

## ATMOSPHERIC CARBON LEVELS RISING

The levels of carbon dioxide concentration in the Earth's atmosphere has increased by 82% since 1900 (see figure), with most of the increase occurring since 1940. During the 1980's the magnitude of atmospheric increase was about 3 gigatons of carbon per year. Currently the magnitude of carbon release to the atmosphere from human activities is about 5.5 gigatons per year. For perspective, the atmosphere contains about 750 gigatons of carbon and the surface of the ocean contains about 1000 gigatons. Each year, the surface of the ocean and the atmosphere exchange about 90 gigatons; vegetation and the atmosphere exchange about 60 gigatons.

## INERTIAL ELECTROSTATIC CONFINEMENT

The December 13 issue of *New Scientist* magazine includes an article entitled "Neutrons for Sale," and says "Forget the idea of endless energy. People could soon be using a fusion machine the size of a football to detect bombs at airports and impurities in ores." The author, freelance science writer Bennett Daviss, describes a small experiment at the University of Illinois, using equipment first used 30 years ago by former U.S. fusion program director Bob Hirsch. George Miley, professor of nuclear, electrical and computer engineering, tells Daviss that the University of Illinois has licensed the technology to Daimler-Benz Aerospace. Miley's spherical plasmas produce neutrons from fusion reactions due to spherically-inwardly-focused colliding beams. Miley's machines

are currently producing 1 billion neutrons per second continuously. A larger version is under construction by weapons researchers at the Los Alamos National Laboratory in New Mexico, under the direction of Rick Nebel. Daviss says the spheres will go on sale next year for as little as \$60,000. Of course the neutron generators consume more energy than they produce, but Daviss quotes Miley as saying, "By marketing inexpensive neutron generators, we hope we can finance the work that might transform these devices into cost-effective power generators." Daviss quotes John Sved, an engineer with Daimler-Benz, as saying, "A small IEC neutron generator could run for decades without creating enough radioactive waste to exceed minimum regulated levels."

Miley ([g-miley@uiuc.edu](mailto:g-miley@uiuc.edu)) has published the details of his experiments in *IEEE Transactions on Plasma Science* (Vol. 25, No. 4, August 1997, 733-739). For product information on the "IEC-PS Neutron Generator," contact Daimler-Benz Aerospace ([IEC@ri.dasa.de](mailto:IEC@ri.dasa.de)). Miley has also published calculations of the use of this technology for producing the isotope helium-3, which does not occur naturally on earth in appreciable quantity, in the *American Nuclear Society journal Fusion Technology* (Vol. 33, March 1998, 182-209).

### PPPL HOSTS REGIONAL SCIENCE BOWL

The Princeton University Plasma Physics Laboratory (PPPL) hosted the New Jersey Regional Competition for the Department of Energy's National Science Bowl on February 28. Competing against twenty other high school teams from New Jersey and Pennsylvania, Millrun (NJ) High School won first place. PPPL Science Education Program Leader Pamela Lucas said, "The Science Bowl is a challenging but fun day for some of the brightest students in the area. These youngsters who excel in science and math face competition that is often steep and answer questions on a variety of topics. It makes for an exciting day." The Millrun team, shown in photo, includes (from left) Nicholas Edwards, Mitchell Step, Stewart Bitter (coach), Ben Myers (captain), Doug Gardner, and Katherine Moran.

PPPL also hosts a popular "Science on Saturdays" event for local students. For more information, contact John DeLooper ([jdelooper@pppl.gov](mailto:jdelooper@pppl.gov)).

### DIRECTORIES AVAILABLE

The International Atomic Energy Agency (IAEA) has published its *World Survey of Activities in Controlled Fusion—1997 Edition*, which contains addresses, etc. for fusion researchers and facilities, worldwide. The directory price is US\$70 and is available from Bernan Associates, 4611-F Assembly Drive, Lanham, MD 20706-4391, or directly from the IAEA ([sales.publications@iaea.org](mailto:sales.publications@iaea.org)).



Fusion Power Associates Fusion Facilities Directory has addresses/phone/fax/email, etc. for U.S. institutions and researchers. The price is \$50 ([fpa@compuserve.com](mailto:fpa@compuserve.com)).

### PEOPLE

**Yevgeny Adamov**, Director of the Research and Development Institute of Power Engineering (Moscow) and a member of the ITER Technical Advisory Committee, has been named Minister for Atomic Energy in the Russian government.

**Paul Garabedian**, Professor of Mathematics at New York University, has received the \$10,000 Award in Applied Mathematics and Numerical Analysis, given every three years by the National Academy of Sciences.

PPPL will honor scientist **Russell Kulsrud** on the occasion of his 70th birthday by sponsoring a symposium in his honor June 5-6. For information contact Barbara Sarfaty ([bsarfaty@pppl.gov](mailto:bsarfaty@pppl.gov)).

**Neal Lane**, Director of the National Science Foundation, has been named to succeed **Jack Gibbons**, who is retiring as Science Advisor to President Bill Clinton.

**Al Narath**, President of Lockheed Martin's Energy and Environment Sector, has retired. He is replaced by **Robert Stevens**.

### QUOTABLE

"Those who come after us will fill up the canvas we have begun."

Thomas Jefferson



# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

2 Professional Drive, Suite 249, Gaithersburg, Maryland 20879 • 301-258-0545 • Fax: 301-975-9869 • E-mail: fpa@compuserve.com

<http://fusionpower.org>

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## MARTHA KREBS TO KEYNOTE FPA SYMPOSIUM, JUNE 3/5 NEW BILLION-DOLLAR FUSION FACILITY STARTS OPERATION IN JAPAN

### NEW AFFILIATE

Climax Research Services, Farmington Hills, Michigan, has become a Small Business Affiliate of Fusion Power Associates. Business Operations Manager James B. Lakin will represent the company. He can be reached at Climax Research Services, 39205 Country Club Drive, Suite C-40, Farmington Hills, MI 48331-5718; (248)489-0720; fax -8997. The company provides a wide range of metallurgical engineering and testing services and has provided engineering design and testing services to the ITER and TPX projects; in the case of ITER they addressed tungsten welds in the divertor system. We welcome their participation in Fusion Power Associates.

### KREBS TO KEYNOTE ANNUAL MEETING

DOE Director of Energy Research Martha A. Krebs will be the keynote speaker at Fusion Power Associates annual meeting and symposium, "Plasma Science and Its Applications," June 3-5 in Washington, DC. Other highlights of the meeting include talks on National Science Policy by Rep. Vernon Ehlers of the House Committee on Science, by Dr. Arthur Bienenstock, Associate Director for Science at the White House Office of Science and Technology Policy, and by Professor John Holdren, Director, Program in Science, Technology and Public Policy, Harvard University. The symposium will treat many topics, including The Role of Plasma Science in Graduate Education, The Relevance of Plasma Science to Other Fields of Science and Engineering, Near-Term Applications of Plasma Science and Fusion Research, Plasma Science and Fusion Energy Development, and Plasma Science and National Defense. Other topics include Energy and the Environment: Issues for the 21st Century, Plasma Science in the University of California System, and Industrial Interest and Opportunities. A panel of Congressional Staff will also offer comments on Congressional Perspectives. Fusion Power Associates will present its annual awards at the symposium, including special Awards for Public Service to three members of Congress.



Dr. Martha A. Krebs

Persons wishing to attend the symposium should contact Fusion Power Associates to register.

### EHLERS POSES POLICY QUESTIONS

Rep. Vernon Ehlers has been charged by House Science Committee chairman James Sensenbrenner to reformulate national science policy. In a guest editorial in Science magazine (January 16, 1998), Ehlers quotes previous Science Committee chairman George Brown as saying "We don't have a science policy, we have a budget policy." Ehlers says, "It is time to wipe the slate clean and decide on a future-based vision of where science can and should take the nation." He quotes House Speaker Newt Gingrich as saying, "Give me a mission which will mobilize a nation . . . then make my problem to go out and figure out how to find the money for it." Ehlers asks, "What are the most important intellectual challenges rising over the scientific horizon in the next half century? What will be the biggest problems facing our nation and our planet in the future,

and how can science and technology help to overcome or avoid them? What should our scientific and technological enterprise strive to be 10, 20, or 50 years from now? And what changes do we need to make in our present system in order to get there?" Ehlers requests input from the scientific community on these question and urges interested parties to view his policy study web site at [http://www.house.gov/science/science\\_policy\\_study.htm](http://www.house.gov/science/science_policy_study.htm)

## **NEW STELLARATOR OPERATES IN JAPAN**

Japan's new billion-dollar superconducting stellarator, the Large Helical Device (LHD), began operation on March 31. The mission of the LHD project is "to develop a scientific basis for a stellarator fusion reactor. The LHD plasma was produced using 150 kilowatts of electron cyclotron heating from 84 GHz gyrotrons developed by the American firm CPI, Inc. (formerly Varian Associates). The device is located at the National Institute for Fusion Science. Further information can be found on their web site, which can be accessed directly from Fusion Power Associates home page (<http://fusionpower.org>). Our congratulations to Osamu Motojima, Head of LHD Experiment, to Masami Fujiwara, Director, Department of Large Helical Device Project and to all members of the LHD team.

## **PEÑA, RAINES RESIGN**

Two key members of the President's Cabinet have announced their resignations. Energy Secretary Federico Peña announced April 6 his intention to leave his post on June 30. Peña said he was leaving for "personal and family reasons." He said that, after five and a half years in the Cabinet, it was time for him and his wife to focus on the future of their children. In listing his accomplishments, Peña noted "Major new projects, like the National Ignition Facility (NIF), are on budget and on schedule and we are making tough decisions on projects that were behind schedule." He said that the National Ignition Facility "will ensure that the U. S. continues world leadership in (this area) of great science." Lawrence Livermore National Laboratory Director Bruce Tartar said that Peña was "very much a man of the people. When he visited here last year for the NIF groundbreaking, he went out of his way to meet with community leaders and later commented on the remarkable degree of support he had observed for the Laboratory.

Office of Management and Budget (OMB) Director Franklin Raines has also announced his resignation to take a job in the private sector. The White House indicated that it would nominate OMB Deputy Director Jack Lew to succeed Raines.

## **LASER FUSION VIRTUAL TOURS**

Interested in learning more about laser fusion? Try a little web browsing as follows: Start at [//lasers.llnl.gov/lasers/inertial.html](http://lasers.llnl.gov/lasers/inertial.html) and then go to [//lasers.llnl.gov/lasers/education/ed.html](http://lasers.llnl.gov/lasers/education/ed.html) To tour the Nova and Beamlet laser facilities at LLNL, go to

[//ep.llnl.gov/nova/nova.html](http://ep.llnl.gov/nova/nova.html) and [//ep.llnl.gov/nova/beamlet.html](http://ep.llnl.gov/nova/beamlet.html) Nova is the largest laser in operation today. Beamlet is a prototype for one of the 192 beamlines of the National Ignition Facility (NIF) currently under construction. To tour the NIF, go to [//www-lasers.llnl.gov/lasers/nif.html](http://www-lasers.llnl.gov/lasers/nif.html) Smooth Sailing!

## **ANOTHER NIF CONTRACT LET**

Nielsen Dillingham Builders of Pleasanton, California, has been awarded a \$58 million contract to construct the target area building for the National Ignition Facility. This latest contract is the last major subcontract to be issued for the NIF buildings. It covers construction of the portion of the facilities that will house the target chamber, final optics and laser switchyard. The contract is expected to last three years. The NIF construction is expected to be complete in 2003.

## **HIGH SCHOOL PLASMA SCIENCE EXPO**

Fusion Power Associates co-sponsored a "Plasma Science Expo" April 2 and 3 at George Washington University in Washington, DC. The event drew over 1800 local students and their teachers to view over a dozen exhibits. Organized through the efforts of General Atomics Washington Office, students were able to "see different types of plasmas being created, watch electromagnetic wave demonstration, and see how magnets can be used to crush cans and levitate a frying pan." They were also able to "visit interactive and computerized displays and exhibits, learn about the latest research, and see how plasma physics makes a difference in our everyday lives." Several major national laboratories and universities participated in the Expo, including LBNL, LLNL, LANL, ORNL, PPPL, MIT, UCSD, University of Maryland and University of Wisconsin.

Another major plasma and fusion exhibition is planned June 17, 4:30 to 7:30 PM, in the foyer of the Rayburn Building of the U. S. House of Representatives. For details, contact Toby Smith of MIT ([toby@mit.edu](mailto:toby@mit.edu)).

## **SANDIA MEETS FINAL MILESTONE**

Researchers in the Pulsed Power Program at Sandia National Laboratories have achieved the fourth of four milestones set for the program and they have done it about 6 months ahead of schedule. Using the Z-Machine, radiation temperatures of 155 eV were reached; surpassing the goal of 150 eV desired for fusion target compression experiments (see our April 1998 newsletter). The accomplishment of all four milestones triggered a letter from Sandia president Paul Robinson to the DOE formally asking permission to begin conceptual design of the X-1, a proposed larger facility that would be capable of achieving a high fusion yield (200 - 1000 Megajoules) using radiation drive temperatures of 250 eV. If funded, X-1 could operate by 2007 and produce high, single shot fusion yields about 2010.



The 155 eV result was obtained using a double nested array of tungsten wires (see our April newsletter). There was an annular plastic target, a 4 cm. diameter outer array of 240 wires and a 2 cm. diameter inner array of 120 wires. For further information contact Jeff Quintenz (jpquint@sandia.gov) or visit //www.sandia.gov/pulspowr/hedict/highlights

### **FESAC TO MEET MAY 26 - 27**

The DOE Fusion Energy Sciences Advisory Committee (FESAC) will meet May 26 - 27 at the Holiday Inn, Gaithersburg, MD, beginning each day at 9 AM and ending at noon on the 27th. The purpose of the meeting is "to allow the full Committee to hear the report of its subcommittee that is reviewing the Fusion Materials Research Program and to prepare a letter on the results of that review to the Department of Energy." The meeting is open to the public. Written statements from the public may be filed with the FESAC either before, during or after the meeting. Persons wishing to make short oral presentations at the meeting should contact Al Opdenaker (albert.opdenaker@mailgw.er.doe.gov) at least 5 days prior to the meeting.

### **US-JAPAN WORKSHOP ON LASER FUSION**

A US - Japan workshop on Laser-Driven Inertial Fusion Energy is being held in San Diego May 11 - 13. General Atomics and the University of California at San Diego are co-hosting the workshop. The theme of the workshop deals with the development of high-efficiency, high-repetition-rate lasers, fusion chambers and power plant design. Specific topics include solid-state laser crystals, laser diode array pumping performance, Krypton-Fluoride laser technology, ablation of first-wall materials, target injection and tracking, direct drive targets and conceptual power plant designs. It is an aim of the workshop to further stimulate international cooperation in this area with the goals of providing international access to existing facilities, avoiding duplication of effort, providing of peer review of ideas and stimulating new ideas. For further information, contact Steve Payne (payne3@llnl.gov) or Masanobu Yamanaka (ile-center@ile.osaka-u.ac.jp).

### **BOOKS AND BOOKLETS**

Max W. Carbon, Emeritus Professor of Nuclear Engineering, University of Wisconsin has written an outstanding monograph, "Nuclear Power: Villain or Victim?" Subtitled "Our Most Misunderstood Source of Electricity," this 100 page book eloquently describes everything an educated layman needs to know about nuclear power, including radiation and health effects, safety, radioactive wastes, diversion of weapons-grade materials and costs. The book is available for \$16.55 (which includes \$2.60 shipping to US destinations) from Pebble Beach Publishers, 914 Pebble Beach Drive, Madison, WI 53717-1173, fax: (608)831-4914.

"Nuclear Energy in the OECD: Towards an Integrated Approach," a report by independent experts to the Secretary-General of the OECD (January 1998), describes the present state of nuclear power in the OECD countries and discusses its future. The report notes that, although nuclear power provides some 24% of OECD electricity with almost no carbon dioxide emission, there will be no new nuclear power plants built in OECD countries, other than Japan and Korea, before 2005. According to a forecast by the European Commission, the import of gas by the European Union, currently at 40% of the EU's consumption, could reach 70% by 2020. Imports of coal, currently at 37% of EU consumption, could be near 80% by 2020. This evolution will weaken the security of energy supply to OECD countries and almost certainly put upward pressure on the prices of oil, gas and coal. Although it is difficult to predict the timing of these impacts, a major shift to non-fossil energy will become unavoidable. Copies of the 21 page report may be requested from William C. Danvers, OECD Washington Representative, 2001 L Street, Suite 650, Washington, DC 20036-4922; fax: (202)785-0350. You may also wish to visit the Washington OECD web site: //www.oecdwash.org

"Sustainable Development and Nuclear Power," a 1996 report from the IAEA on nuclear energy and its role in climate change control, was initially distributed to the participants in the December 1997 United Nations Conference on Climate Change in Kyoto. The report notes that nuclear power already supplies 17% of the world's electricity and avoids the emission of more than 600 million tonnes of carbon (or 2300 million tonnes of carbon dioxide) annually. This represents about 8% of total global carbon dioxide annual emissions. The full text of the report can be viewed at //www.iaea.org

### **COLD FUSION CAPUT?**

A news article in the March 10, 1998 issue of the Salt Lake Tribune states that "nine years after two University of Utah scientists first claimed to produce nuclear energy in a test tube, the U. has officially abandoned its effort to capitalize on cold fusion." The article states that University Research Vice President Richard Koehn announced the University's Research Foundation will no longer pursue patents based on the experiments of U. chemists B. Stanley Pons and Martin Fleischmann. The University first transferred the patent rights to a private firm, ENECO, which eventually gave them back. No other potential licensees have surfaced. Koehn said that Pons and Fleischmann had the option to take up the fight themselves but the U. never heard from them. The article notes, "At a March 23, 1989 press conference, the pair claimed that their simple tabletop device was producing such incredible amounts of heat that it could only be explained by nuclear reactions. That triggered a worldwide scramble to reproduce the experiment. But in the end—when the claims could not be proved—the scientists and the U. found the real heat came from the scorching they received via the scientific establishment."

## UKRAINAIN CONFERENCE

Professor Yaroslav Kolesnichenko, Head of Fusion Theory Division of Scientific Centre "Institute for Nuclear Research," Kyiv, Ukraine points out to us that a conference we listed under the heading "Russian Conferences" in last month's newsletter is a Ukrainian Conference and not a Russian Conference. "Let me inform you that Ukrainian conferences on Plasma Physics and Controlled Fusion are national conferences of Ukrainian scientists, and the first conference was held after Ukraine became independent," he writes. The conference in question is the Sixth Ukrainian Conference and School on Plasma Physics and Controlled Fusion, September 14 - 20. Our apologies to the professor and our Ukrainian colleagues.

## ERRATA

The graph on carbon dioxide levels in the atmosphere in our April newsletter, which was taken from an unpublished paper of Arthur B. Robinson et al., Oregon Institute of Science and Medicine, seems to have label on it that is based on a miscalculation. The label states that carbon dioxide levels have risen 82% from 1900 to the present and grew 18% between 1900 and 1940. However a simple calculation, based on the numbers shown on the ordinate (thanks Tom Shannon), yields about an 24% increase from 1900 to the present and about a 5% increase from 1900 to 1940. An email inquiry to the author, asking for clarification, brought no reply.

## SCIENCE COMMITTEE VIEWS

In its *Views and Estimates for Fiscal Year 1999* submitted to the House Budget Committee, the Science Committee Members proposed sustainable increases at or above the Administration's requested funding level for Research and Development under the Committee's jurisdiction. The Committee members also expressed concern regarding the President's science budget proposal which relies on uncertain revenue sources (including a controversial tobacco settlement) and violates the spending limits agreed to in last year's historic balanced budget agreement. In addition, the Committee expressed support for increased federal investment in science above the Administration's projected funding levels in the years 2000 to 2003. The Administration's proposal for Committee programs in the outyears was lower than the FY 1998 level after adjusting for inflation.

"In order to sustain gains in science funding, any increases now or in the outyears must be justified with a coherent, long-term science policy that is fiscally responsible," Chairman F. James Sensenbrenner, Jr. said. "The real challenge for Congress and the science community is to make wise science investments and increase the priority of R&D funding relevant to other domestic programs."

## CALENDAR

**Jun 1-4**—The 25th IEEE International Conference on Plasma Science, Raleigh, NC. Contact: John Gilligan: john\_gilligan@ncsu.edu

**Jun 3-5**—Fusion Power Associates Annual Meeting and Symposium, "Plasma Science and Its Applications," Washington, D C. Contact: fpa@compuserve.com

**Jun 7-11**—The American Nuclear Society Fusion Energy Division 13th Topical Meeting on the Technology of Fusion Energy, Nashville, TN. Web page: //www.ornl.gov/fed/ans98/ans98.html

**Jun 7-11**—The Twelfth Topical Conference on High Temperature Plasma Diagnostics, Princeton University. Contact: Marilyn Hondorp: mhondorp@pppl.gov

**Jun 7-12**—12th International Conference on High-Power Particle Beams, Haifa, Israel. Contact: beams98@kenes.com

**Jun 28-Jul 2**—Ninth International Conference on Emerging Nuclear Energy Systems, Tel-Aviv, Israel. Contact: meins@tx.technion.ac.il

**Jun 29-July 3**—The 1998 International Congress on Plasma Physics & 25th EPS Conference on Plasma Physics and Controlled Fusion, Prague, Czech Republic. Web site: //www.ipp.cas.cz or contact: plasma98@ipp.cas.cz

**Jul 6-8**—International Workshop on Plasma-Focus Research, Kudowa Zdroj, Poland. Contact: rysiek@ifpilm.waw.pl

**Jul 27-29**—4th Asia-Pacific Conference on Plasma Science & Technology and 11th Symposium on Plasma Science for Materials, Sydney, Australia. Contact: rod.boswell@anu.edu.au

**Jul 27-21**—An International Conference on Open Magnetic Systems for Plasma Confinement, Novosibirsk, Russia. Web page: //www.inp.nsk.su/OS98/ or contact: os98@inp.nsk.su

**Aug 9-14**—Gordon Research Conference on Plasma Processing Science, Tilton School, New Hampshire. Contact: kroesen@discharge.phys.tue.nl

**Aug 31-Sep 4**—Theory of Fusion Plasma, Varenna, Italy. Contact: sindoni@alpha.disat.unimi.it

**Aug 31-Sep 5**—International Symposium on Gas Flow and Chemical Lasers and High Power Laser Conference, St. Petersburg, Russia. Contact: laser@russinnocent.spb.ru

**Sep 1-5**—16th ICFA Beam Dynamics Workshop on Nonlinear and Collective Phenomena in Beam Physics, Arcidosso, Italy. Contact: laraneta@physics.ucla.edu



# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

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## HEADS OF STATE APPLAUD FUSION COLLABORATION INERTIAL FUSION PROGRAM LEADERS ISSUE ENERGY PLAN

### NEW AFFILIATE

TSI Research, Inc. (Solana Beach, CA) has become an Affiliate of Fusion Power Associates. Ed Cheng, Principal Scientist, will represent the corporation. TSI Research is engaged in research activities supporting fusion energy development. Recent projects include neutronics, activation and conceptual designs based on volumetric neutron source studies. Ed can be reached at TSI Research, Inc., 225 Stevens Avenue, Solana Beach, CA 92075; (619)793-3567; fax -0569; etcheng@cts.com

### G8 MEETING ENDORSES ITER EFFORT

The Heads of State or Government of the United States, the United Kingdom, Japan, Germany, France, Italy, Canada and Russia (so-called G8) and the President of the European Commission met in Birmingham, England, in mid-May "to discuss issues affecting people in our own and other countries" and issued a communique on May 17 summarizing the conclusions of their annual Summit Meeting. They said, "In a world of increasing globalisation we are ever more interdependent. Our challenge is to build on and sustain the process of globalisation and to ensure that its benefits are spread more widely to improve the quality of life of people everywhere." They noted, "Of the major challenges facing the world on the threshold of the 21st century, this Summit has focused on three: achieving sustainable economic growth and development throughout the world . . . building lasting growth in our own economies . . . (and) tackling drugs and transnational crime . . ." In point 10 of their 26-point statement, the leaders said, "We acknowledge successful cooperation on the pilot project of the International Thermonuclear Experimental Reactor (ITER) and consider it desirable to continue international cooperation for civil nuclear fusion development."

Sources credit Russian President Boris Yeltsin with proposing that a statement on fusion be included in the summary communique. The next G8 Summit Meeting will take place June 18-20, 1999 in Koln, Germany.

### ITER ANALYSTS "AGREE" ON SMALLER ITER

Members of a "Special Working Group (SWG)," consisting of technical specialists from Europe, Japan, Russia and the United States, in consultation with the ITER Project Director, have concluded that "the direct capital cost of ITER can be reduced significantly by targeting less demanding performance objectives." The Special Working Group was charged last February by the ITER Council (IC) "to propose technical guidelines for possible changes to the current detailed technical objectives and overall technical margins, with a view to establishing option(s) of minimum cost, while still satisfying the overall programmatic objective of the ITER EDA Agreement." (See our March 1998 newsletter).

According to Dave Baldwin (General Atomics), who led the U.S. delegation, reductions of 40-50 percent in the estimated \$8 billion cost of the presently-designed ITER could be achieved by reducing the size of ITER from 8.1 meters major radius to the range of 6.0 to 6.3 meters, with corresponding reductions in plasma current (21 MA to 12-14 MA), neutron wall loading (1.0 to 0.5 Megawatts per square meter), pulse length (1000 seconds to 300-500 seconds) and fusion power (1500 MW to 500-750 MW). Baldwin made his comments at a public meeting of the DOE Fusion Energy Advisory Committee, May 26, in Gaithersburg, MD. The facility would have a ratio of fusion power to auxiliary heating power of at least 10, with the possibility of ignition if optimistic scalings and operating conditions are confirmed.

The Special Working Group will present its report to the ITER Council, with the recommendation "that the ITER Council ask the Director to continue these efforts (to design a reduced-cost ITER) with high priority keeping in mind the desire to make the most cost effective use of existing design solutions and their associated R&D." They also will recommend "that the ITER Council ask the Director to emphasize the following efforts until the end of 1998: propose a set of major parameters and describe

the rationale including information on the performance margins, range of operation and cost drivers, identify engineering design solutions for key components including possibly the need for additional R&D, and describe the flexibility to study advanced tokamak modes.”

U.S. fusion head Anne Davies told the FESAC meeting that the four parties had completed negotiations on a three year extension of the current ITER agreement beyond its July 1998 expiration date and were expected to sign the extension in the near future.

## **INERTIAL FUSION ENERGY PLAN**

Leaders of the U.S. inertial confinement fusion program presented a comprehensive plan to develop a commercial fusion energy source to a group of mostly magnetic fusion scientists meeting in Madison, Wisconsin, during the week of April 27. The meeting, “Forum for Major Next-Step Fusion Experiments” brought together about 150 members of the U.S. “fusion community” to “identify a range of options for major next-step experiments in support of fusion energy development with broad community involvement” and to “establish a broad consensus within the community around the pursuit of a few options whose implementation would be contingent on domestic and international budget developments.”

LLNL Associate Director for Lasers Mike Campbell presented the plan on behalf of himself, Roger Bangerter (LBNL), Stephen Bodner (NRL) and Bob McCrory (U. Rochester). Campbell said we must “address the concerns about the present fusion program, not just the need for good science, but also the need for better end products and lower cost development paths.” He emphasized that the inertial fusion path differs from the path of magnetic fusion and thus provides a real alternative. He also noted that an energy path for inertial fusion “can leverage investment by DOE Defense Programs.” Campbell stated that two IFE (inertial fusion energy) concepts now appear credible candidates for energy application: direct drive using Krypton Fluoride lasers or solid state lasers and indirect drive targets using a heavy ion accelerator.

Campbell proposed a plan that would further develop the required efficient, repetitively-pulsed driver technologies for KrF lasers, diode-pumped solid state lasers and heavy ion accelerators, combined with target design and technology R&D between now and 2002 at a cost of about \$35–40 million per year. At that point a decision would be made to construct an “Integrated Research Experiment” in parallel with continued advanced driver and target R&D and supporting technology R&D at a cost of about \$80 million per year. Around 2011 a decision would be made to construct an Engineering Test Facility at a total project cost of about \$2 billion; followed by a decision around 2023 to construct an IFE demonstration power plant at a total project cost of about \$3 billion. Details were

presented on all elements of the plan.

Campbell told the assembled scientists, “Together we can change the U.S. fusion program image: a broader scientific and technical base, with a larger constituency.” He said that “There is an adequate scientific and technical base to expand IFE now” and that “IFE is wide open for further innovation—we invite broader fusion community participation in shaping the future of IFE.” He also noted the increasingly international character of inertial fusion research and the many “spinoff” applications of the research.

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

## **“NEXT STEP” WORKSHOP**

About 150 persons, mostly from the magnetic fusion scientific community, met for one week, April 27 - May 1, in Madison, Wisconsin, at the “Forum for Major Next-Step Fusion Experiments.”

Following several days of presentations, the participants broke up into 6 working groups, all discussing the broad issues of the forum. The following synopsis is based on a “Summary of Progress” presented by Gerald Navratil (Columbia University) at the final plenary session on May 1.

Navratil said that “general findings” of the Forum were (1) there is a “need to reduce the cost of the individual development steps in our program to develop a scientific and technical basis for a practical fusion energy source;” (2) the “attractiveness of a next step experiment is a primary concern: (we) must emphasize innovation in our plan;” and (3) “exploration of a burning plasma was the primary priority strategy for a major next step experiment.”

Navratil noted that the six breakout groups were in agreement that three strategy options should be considered: (1) the “Single Machine” strategy, i.e., take an integrated step forward now with the tokamak; (2) the “Multiple Machine” strategy, i.e., split the mission elements and take a number of smaller parallel, phased or sequential steps; and (3) the “Defer Major Next Step” strategy, i.e., emphasize existing programs and innovative concept development.

Navratil noted that “both the Single Machine and Multiple Machine strategies had substantial support” but that the “Multiple Machine strategy was preferred over the Single Machine strategy.” He said the Defer strategy “had no broad support and was opposed by several groups.” He said there was a “consensus that we should not withdraw from the ITER process at this time.” He noted that at least one group had suggested a “Combined Parallel Strategy” in which both the

Single Machine and the Multiple Machine options would be developed over the next few years, with a decision point around 2000—2001 on which strategy to pursue. All strategies were proposed to be international in character and the assembled group urged U.S. participants in international discussions of these issues to take the Forum's views into account.

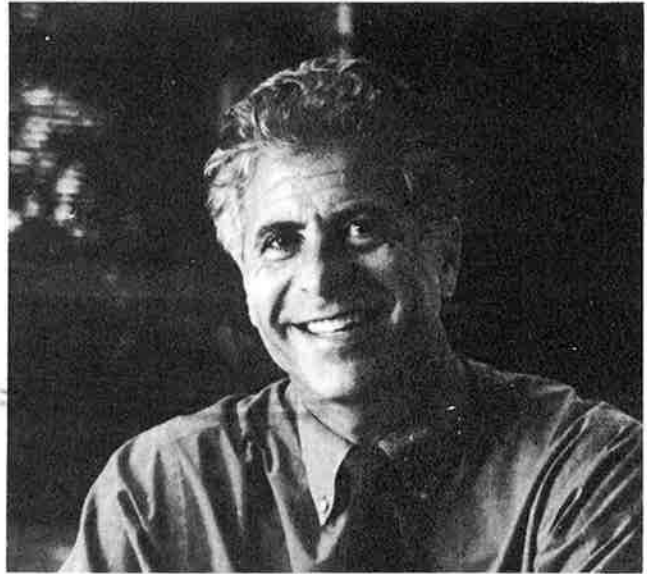
Navratil stated that this meeting was “not the appropriate forum” to consider inertial fusion energy. A follow-on meeting is planned, focused on writing a report, at the University of California at San Diego for June 18 - 20. Contact Charles Baker (cbaker@iter.ucsd.edu) for details. A major, 2-week, forum-like workshop is also being considered for the summer of 1999. Contact Mike Mauel (mauel@columbia.edu). For further information on the Madison meeting, contact Gerald Navratil (navratil@columbia.edu).

## MATERIALS PANEL REPORTS

A panel reviewing the fusion structural materials R&D program (see our March 1998 newsletter), under the chairmanship of Sam Harkness (Westinghouse) made its report to the DOE Fusion Energy Sciences Advisory Committee (FESAC) on May 26. The panel said that the accomplishments of this relatively small (\$6M, 15 FTE) part of the fusion program were “impressive.” Harkness told the FESAC, “Until an attractive confinement approach is defined, it is appropriate that the materials budget remain at or slightly above its current levels.” In its report, the panel said, “In the near-term the materials R&D efforts will emphasize issues related to deuterium/tritium fusion. At the same time, the program needs to account for various possible magnetic and inertial confinement approaches. In the long-term, alternate fusion fuel cycles should also be considered.”

The panel said, “Perhaps the most important ‘key issue’ for fusion materials development is the recognition that the fusion environment and needs for an attractive power system concept present a major challenge involving a wide variety of complex, interacting phenomena and conditions. This implies directly that materials R&D activities should be considered as part of an integrated program along with engineering science research, technology/component development and advanced design and systems assessments.” The panel called for “greater emphasis on data analysis and modeling and pathways to introduce exploratory and innovative materials concepts.”

The FESAC is preparing an interim letter report to DOE Director of Research Martha Krebs and will take final action on the panel report at its next meeting, scheduled for July 30–31 at DOE Headquarters in Germantown, MD. A copy of the panel report can be found on the web at [//aries.ucsd.edu/PUBLIC/INFO/fesacmat.html](http://aries.ucsd.edu/PUBLIC/INFO/fesacmat.html)



**Dr. Don Correll**

## PEOPLE

**Don Correll**, a long-time manager and researcher in both magnetic and inertial fusion programs at LLNL, has been named director of the Lab's Science and Technology Education Program. In his new position, Don will lead the Lab's effort to provide research opportunities for students and teachers, develop new curriculum in areas central to the Lab's mission, forge new ground using the Internet for science education activities and increase science literacy through educational outreach.

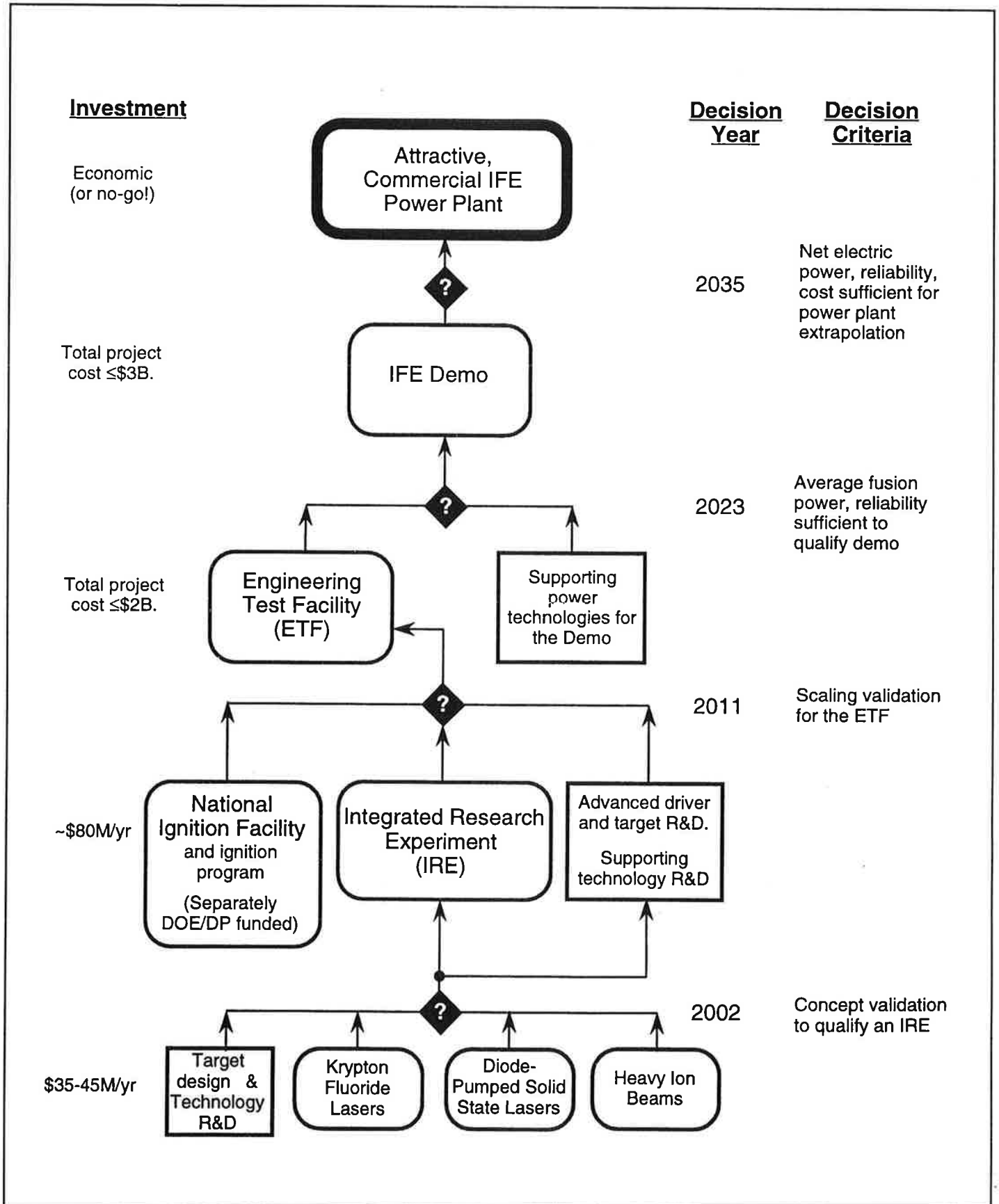
**Douglass E. Post**, formerly a researcher with PPPL and ITER, has accepted a position as an Associate Division Leader in the weapons program at LLNL. He can be reached at (925) 423-6849; [dpost@llnl.gov](mailto:dpost@llnl.gov)

## IN MEMORIAM: JIM SINNIS

Jim Sinnis, long-time fusion researcher, engineer and project manager *par excellence* at PPPL has died at the age of 62. He was Project Manager for construction of the PBX tokamak and a key manager on TFTR and other experimental facilities at the Lab. He had been in ill health for several years. Jim received his Ph.D. in physics from Stevens Institute of Technology in 1963 and worked at PPPL until his retirement in 1997. In 1994 he received the DOE Distinguished Associate Award. Memorial contributions may be made to the International Myeloma Foundation, 2129 Stanley Hills Drive, Los Angeles, CA 90046 or to the Class of 1957 Scholarship Fund of the Stevens Institute of Technology, Office of Development, Castle Point on the Hudson, Hoboken, NJ 07030-9860. His many friends in the fusion program mourn the loss of a dear colleague and friend.



**INERTIAL FUSION ENERGY (IFE) DEVELOPMENT STRATEGY:  
A LOOK BACKWARD FROM THE "END GAME"**





# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

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## FUSION POWER ASSOCIATES AWARDS ANNOUNCED

**LEADERSHIP:** HERMANN GRUNDER, JOHN HOLDREN  
**DISTINGUISHED CAREER:** BRUCE MONTGOMERY, TIHIRO OHKAWA,  
PAUL RUTHERFORD  
**ENGINEERING EXCELLENCE:** STEPHEN PAYNE, MARK TILLACK  
**PUBLIC SERVICE:** ROSCOE BARTLETT, RODNEY FREYLINGHUYSEN,  
TIM ROEMER

### FPA 1998 AWARDS ANNOUNCED

**LEADERSHIP:** The 1998 Leadership Awards were presented to Dr. Hermann A. Grunder, Director of the Thomas Jefferson National Accelerator Facility, and to Prof. John P. Holdren, Director, Program in Science, Technology and Public Policy, John F. Kennedy School of Government, Harvard University.

Dr. Grunder is recognized for his leadership of a panel of the DOE Fusion Energy Sciences Advisory Committee (FESAC) that provided guidance on future U.S. participation in the International Thermonuclear Experimental Reactor (ITER) project. Prof. Holdren is recognized for his leadership of two panels of the President's Committee of Advisors on Science and Technology (PCAST) that assessed fusion and national energy R&D policies.

Fusion Power Associates Leadership Awards have been given annually since 1980 to individuals who have shown outstanding leadership qualities in accelerating the development of fusion.

**DISTINGUISHED CAREER:** The 1998 Distinguished Career Awards were presented to Dr. D. Bruce Montgomery, Dr. Tihiro Ohkawa and Dr. Paul H. Rutherford.

Dr. Montgomery began his career in fusion at MIT in 1969 and became Associate Director of the MIT Plasma Fusion Center in 1978. He is a recognized expert in all aspects of magnet engineering, and contributed to the engineering design of many fusion devices, including ITER. He retired from MIT in 1996 and is currently President of MTECHNOLOGY, Inc., an engineering services company. He was recently elected to the National Academy of Engineering.

Dr. Ohkawa joined the fusion group at General Atomics in 1960, eventually becoming Vice President for Fusion and Advanced Technology. He was the inventor of the Doublet fusion concept that led to the highly successful DIII-D device, the largest U.S. fusion experiment currently in operation. He is well known for his innovative fusion ideas, which are documented in 175 publications and 50 patents. He received the Maxwell Award of the American Physical Society (1979) and the Fusion Power Associates Leadership Award (1984). He is currently President of TOYO Technologies, Inc.

Dr. Rutherford joined the staff of Princeton Plasma Physics Laboratory (PPPL) in 1965. At PPPL, he served as Head of the Theoretical Division (1974–1980) and Associate Director for Research (1980–1995). He has made many outstanding contributions to the theory of fusion plasmas and was a recipient of the Department of Energy's coveted E.O. Lawrence Award (1983). Since 1992, he has served as Chair of the ITER Technical Advisory Committee (TAC), providing advice on difficult scientific and engineering trade-offs during the design phase.

Fusion Power Associates Distinguished Career Awards have been given annually since 1987 to individuals who have made distinguished career contributions to fusion development.

**EXCELLENCE IN FUSION ENGINEERING:** The 1998 Excellence in Fusion Engineering Awards are being presented to Dr. Stephen Payne and Dr. Mark Tillack.

Dr. Payne is leader of a group at the Lawrence Livermore National Laboratory developing advanced solid state lasers that can be both efficient and repetitively pulsed. The award notes

that he has invented new laser materials, studied the survivability of materials under intense radiation, guided an extensive power plant study and has been instrumental in organizing national and international collaborations.

Dr. Tillack is Engineering Group Leader for the U.S. Fusion Power Plant Studies program at the University of California at San Diego. The award notes the key role he has played in several studies, including FINESSE, Prometheus and ARIES, that he has made broad technical contributions in plasma, nuclear, thermal, hydraulic and structural engineering, and has demonstrated leadership in providing broad integration on matters related to fusion power plant design.

Fusion Power Associates Excellence in Fusion Engineering Awards, in memory of MIT Professor David J. Rose, have been given annually since 1987 to recognize and to encourage engineering professionals in the early part of their careers. The recipients are selected for their technical accomplishments and potential to become exceptionally influential leaders in the fusion field.

**PUBLIC SERVICE:** Special Awards for Public Service were presented to Rep. Roscoe G. Bartlett (R-MD), Rep. Rodney P. Frelinghuysen (R-NJ), and Rep. Tim Roemer (D-IN).

Representatives Bartlett and Roemer were recognized for their efforts over the past several years to raise the level of awareness of the promise of fusion as a future energy source among their colleagues in the House of Representatives. In particular, their leadership in securing signatures of their colleagues on joint letters describing the needs and promise of fusion has provided a key public service in educating other members of Congress on fusion issues.

Representative Freylinghuysen was recognized for the key role he has played as a member of the Subcommittee on Energy and Water, House Committee on Appropriations. His knowledge and enthusiasm for fusion research has been crucial in convincing other members of the committee of the value of fusion research and its potential contribution to the nation as a future energy source.

Fusion Power Associates Special Awards have been given out periodically since 1980 to recognize individuals who have made important special contributions to fusion or to Fusion Power Associates.

## **FY 1999 BUDGET ACTIONS**

The Senate and House Appropriations Committees have each "marked up" the FY 1999 DOE budget request and have both earmarked \$232 million for the Office of Fusion Energy Sciences, which is the same as the FY 1998 appropriation and

a slight increase over the \$228.2 requested by the President. Both committees have also accepted the President's full request of \$498 million for DOE Defense Program's inertial confinement fusion program, including \$284.2 million for continued construction of the National Ignition Facility.

The marks must still be incorporated into an appropriations bill that is passed by both houses of Congress and signed by the President before becoming law. Amendments may be offered on the floor of the House and Senate that could affect the final fusion mark. Even if the fusion marks are identical in House and Senate, a conference committee would still be required to settle differences in other parts of the DOE appropriation before being passed.

The Senate and House marks are accompanied by "report language" indicating Committee opinions. The report language will be superseded by conference committee report language, if any.

The Senate report "recommends that the Department, prior to committing to any future magnetic fusion program or facilities, conduct a broader review to determine which fusion technology or technologies the U.S. should pursue to achieve ignition and/or a fusion energy device." The report says, "The Department currently funds four fusion related technologies: pulsed power, lasers, ion drivers and magnetic fusion. The Department has been reluctant or unable to review those technologies as a group because they have different near-term objectives and are managed by different program offices. Regardless of these near-term and management differences, the Committee is aware that scientists within each program have an eye toward ignition and energy applications. The Committee is well aware of the challenges entailed by a review of multiple programs and multiple and possibly competing technologies. However, the Department should conduct an encompassing review of all four technologies prior to making decisions about the next step toward fusion energy, specifically to consider non-magnetic alternatives. At the very least, the review should develop a roadmap that justifies the continued development of each technology." The committee also called for a "schedule and budget for the decommissioning and decontamination of the TFTR."

Commenting on inertial confinement fusion, the Senate committee said "The ICF Program continues to be a major contributor to the science and technology base supporting the nuclear deterrent through improved understanding of the underlying physics of nuclear weapons and computational modeling that will provide the future basis for ensuring safety, reliability, and performance on nuclear components." The report also says, "The Committee continues to be impressed with the significant scientific advancements being made in pulsed

power technology at Sandia National Laboratories Z accelerator. Major increases in energy and temperature production enhance prospects that pulsed power may contribute in a significant way to both weapons and energy applications technology at Sandia National Laboratories Z accelerator. Funds are included to support continued work in pulsed power experiments at the Z accelerator and to fund initial design studies for a larger facility. The Committee understands that this work should help DOE and its laboratories reach a conclusion on the technical and fiscal feasibility of building a larger scale pulsed power facility.”

The House Subcommittee report states that it “continues to be very supportive of the increased emphasis on innovative confinement concepts and university-based experiments.” It says, “The Committee encourages the Department to provide sufficient resources for these efforts. In particular, special emphasis should be placed on funding operations, upgrades, and enhanced design work on both existing research and proposals for new alternative concept experiments at the proof-of-principle level.” The report says, “In addition to magnetic fusion, there are several promising technologies that have potential for producing electricity. The Department is directed to comprehensively review all known technologies and submit a program plan that includes activities funded in this account and potentially-related activities funded elsewhere in the Department. Recognizing the significant advances in Inertial Confinement Fusion (ICF) sponsored by the national security program, the Committee strongly endorses the complementary work to be funded in this account including heavy-ion drivers, high gain target concepts, and reactor concepts.”

The committee report goes on to say regarding the International Thermonuclear Experimental Reactor (ITER) project, “The Congress has been very clear that no obligation exists for future participation in ITER beyond the fiscal year 1998 contribution for engineering and design activities (EDA). The Committee is concerned about the recent announcement that the Department has already proposed to enter into a new agreement to start engineering and design of a newly-conceived, less costly reactor: ‘ITER-Lite.’ The Committee observes that the proponents of ITER have seized upon only one of the concerns the Congress has about ITER. The Committee continues to question whether the tokamak is the most promising technology and whether the current partners in ITER are willing and able to meet their commitments. The Committee observes that after ten years and a U.S. contribution of \$345 million, the partnership has yet to even select a site for this construction project. The Committee objects to the proposed extension of the EDA and has not provided any additional funds for ITER, ITER-Lite or the Joint Central Team. The Department may use prior year funds for closeout costs related to ITER.” The report also calls for a decommissioning plan for TFTR.

In a related action, Rep. Joseph M. McDade, chair of the House Appropriations Subcommittee on Energy and Water, sent a letter dated June 11 to Energy Secretary Federico Peña, urging him “to look into this proposed extension (of the ITER EDA) and determine whether this is a prudent course of action for the Department.” McDade said, “In the report accompanying last year's appropriation bill, the Committee directly listed the questions about ITER: Where will it be built? Is the current design too ambitious? What environmental concerns need to be addressed? What level of confidence can be reached regarding the willingness and ability of our partners to make timely and sufficient contributions to the project? . . . These questions have not been answered.” McDade asks Peña “to refrain from rushing into a new international agreement before there has been sufficient dialogue with our partners and Congress . . . and to let me know of your intentions before the Department takes action on this issue.”

### **ACADEMY REVIEW PLANNED**

The long-promised (see April 1997 newsletter) review of the DOE Fusion Energy Sciences program by the National Academy of Sciences is about to begin. In an April 10 letter to Academy of Sciences president Bruce Alberts, DOE Director of Energy Research Martha Krebs asked for an “assessment of the scientific quality of the Office of Fusion Energy Sciences (OFES) program.” Krebs said, “Among the things you may wish to consider in your assessment are the quality of fusion research itself as evidenced by progress in the understanding of fundamental plasma physics issues in fusion energy; the impact that fusion energy research has had in other scientific areas such as astrophysics, geophysics, computational science, and technological areas such as plasma processing; and the role of fusion research in the academic community including graduate student training.” Krebs commented, “I anticipate that those who carry out the assessment will have the broad scientific expertise necessary to provide the critical judgment required in such a task and that they will represent a broad segment of the scientific community.” Krebs asked that the Academy complete its review by August 1999.

The review will be one of the first carried out by the Academy under the Federal Advisory Committee Act Amendments of 1997 (Public Law 105-153, see January 1998 newsletter). Appointments of panel members and how the reviews were conducted (usually in secret) were previously left entirely to the Academy. The new law requires the Academy to “provide public notice of the names and brief biographies of individuals that the Academy appoints or intends to appoint to serve on the (review) committee,” and to “provide a reasonable opportunity for the public to comment on such appointments before they are made or, if the Academy determines that prior comment is not practicable, in the period immediately following the appointments.” The law further specifies that the “Academy

shall make its best efforts to ensure that (a) no individual appointed to serve on the committee has a conflict of interest that is relevant to the functions to be performed, unless such conflict is promptly and publicly disclosed and the Academy determines that the conflict is unavoidable, (b) the committee membership is fairly balanced as determined by the Academy to be appropriate for the functions to be performed, and (c) the final report of the Academy will be the result of the Academy's independent judgment." The law now requires the Academy to "provide public notice of committee meetings that will be open to the public," and to "ensure that meetings of the committee to gather data from individuals who are not officials, agents or employees of the Academy are open to the public."

## **FUTURE POTENTIAL OF NUCLEAR POWER**

Speaking to the annual meeting of the Federal Energy Bar Association, April 23, in Washington, DC, Fusion Power Associates president Dr. Stephen O. Dean addressed the group on the topic "The Future Potential of Nuclear Power: Fission and Fusion." Dean noted that "today, almost 90% of our energy needs are supplied by the burning of fossil fuels; over half of which is for transportation (about 25%) and for the production of electricity (about 30%), with the balance primarily needed for process heat in industry (about 25%) and heat for homes and buildings (about 20%)." Dean said that "nuclear energy sources (fission and fusion) offer options for the reduction of global dependence on fossil fuels." Nuclear energy based on fission is a practical source of electricity today, he noted, saying "Nuclear power provides about 25% of the electricity of the industrially-developed nations of the world." He noted, however, that several factors impede the growth in this percentage in the near-term, including (1) low cost of competing fossil fuel plants, especially those based on natural gas, (2) the effectiveness of anti-nuclear intervenors concerned with issues of safety, weapons proliferation and radioactive waste disposal; (3) failure of the U.S. government to provide a policy framework for waste processing or storage; (4) failure of the U.S. government to provide a simple, economic and reliable licensing framework.

Dean told the group, "Nuclear energy based on the fusion of light elements is still in the research and development stage. Pound for pound, fusion reactions produce about 8 times more energy than fission, and the fuel for fusion, isotopes of hydrogen, is more universally available and will remain so as long as there is life on the planet. Furthermore, fusion reactions themselves produce no radioactive waste products. Structural components of a fusion power plant will become radioactive and will periodically have to be replaced, but the biological hazard associated with the particular types of radioactive materials involved are much less and the isotopes are shorter-lived (decades rather than thousands of years) compared to fission. It is an aim of fusion researchers to be able to build fusion power

plants using materials that would today qualify as 'low level waste.' Fusion fuel is difficult to ignite and sustain and hence 'fizzles' in the event of an accident, leading to fewer safety concerns compared to the 'runaway' criticality condition concern for fission. Nevertheless, fusion technology is much more complex than fission technology, leading to longer time scales to commercialization and probably a higher cost of electricity."

"Fusion research," he said, "has made systematic technical progress over the past two decades; fusion power produced in the laboratory has increased 100 million-fold over 20 years to over 10 million watts. Experimental devices in the U.S., Europe, and Japan have demonstrated the ability to produce up to 15 megawatts of fusion power for seconds and to sustain high temperature fuel conditions for minutes, feats which were unheard of two decades ago. These accomplishments are consistent with the design capabilities of these experimental facilities. The U.S., Europe, Japan, and Russia have collaborated on the design of an experimental fusion facility, the International Thermonuclear Experimental Reactor (ITER), which could continuously produce 1000 megawatts of fusion power. The facility is ready to proceed to construction but its cost, estimated at \$8 billion, has presently caused the governments involved to suggest a three year delay, combined with a cost-reduction effort."

Dean noted that, "Concurrent with the technical progress of the past two decades has been a systematic reduction in government financial support for the U.S. and Russian fusion programs. Both Europe and Japan have sustained their domestic efforts, with the result that the U.S. has proclaimed itself to be a 'junior partner' in the international effort. The U.S. flagship fusion facility, the Tokamak Fusion Test Reactor (TFTR) at Princeton University, was recently shut down, while comparable facilities in Europe (JET in England) and Japan (JT-60 at Tokai) continue in operation."

Dean concluded, "Time is on the side of nuclear power. In the near-term, fossil fuels will be the energy source of choice, due to availability, familiarity and cost. In the long-term, however, our dependence on fossil fuels must diminish and, at some hard-to-predict time in the future, nuclear power sources, fission and fusion, will become more favored as energy sources for future generations."

A summary of Dr. Dean's remarks is available from Fusion Power Associates ([fpa@compuserve.com](mailto:fpa@compuserve.com)). An audio cassette tape of the session "Emerging Energy Technologies," (Tape number FEBA498-08) including the talk by Dr. Dean, as well as other speakers, is available for \$15 from Wells Walker & Company (800-645-6907). The tape may also be ordered on line ([//www.lifetimecassettes.com](http://www.lifetimecassettes.com)).





# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

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## U.S. FAILS TO SIGN ITER EXTENSION AGREEMENT JET DEMONSTRATES FUSION REMOTE MAINTENANCE

### ITER COLLABORATION UP IN AIR

Although the United States had for several months been prepared to sign an international agreement extending for three years the collaboration on the International Thermonuclear Experimental Reactor (ITER) project (see our June 1998 newsletter), the U.S. Department of Energy, bowing to Congressional pressure, withdrew its support and allowed the agreement to expire on July 21. The European Union, Japan and Russia had all signed the extension agreement. The ITER Council (IC), the governing body of ITER, met in Vienna on July 22-23. At that meeting the officials representing the four Parties agreed that they would keep working together on a voluntary basis on all aspects of the ITER activity, including the activities of the Joint Central Team and Home Teams.

The U.S. delegation indicated that the DOE was attempting to secure the blessing of Congress to sign the extension and hoped to do so at a later date. The IC expressed the hope that the U.S. would sign before October. The Parties to the agreement are not sure whether the agreement can be extended simply at a later date since it has expired. The Parties are looking into the legal aspects of the matter.

The crisis was precipitated by "language" in a report accompanying the FY 1999 DOE Appropriations bill passed by the U.S. House of Representatives. The language, which does not actually have the force of law, notes "The Congress has been very clear that no obligation exists for future participation in ITER beyond the Fiscal Year 1998 contribution for engineering design activities (EDA). The (Appropriations) Committee is concerned about the recent announcement that the Department has already proposed to enter into a new agreement to start engineering and design of a newly-conceived, less-costly reactor: ITER-Lite. The Committee observes that the proponents of ITER have seized upon only one of the concerns the Congress has about ITER. The Committee continues to question whether the tokamak is the most promising technology and whether the current partners in ITER are willing and able to meet their

commitments. The Committee observes that after ten years and a U.S. contribution of \$345 million, the partnership has yet to even select a site for this construction project. The Committee objects to the proposed extension of the EDA and has not provided any additional funds for ITER, ITER-Lite or the Joint Central Team. The Department may use prior year funds for closeout costs related to ITER."

Appropriations Subcommittee chairman, Joseph McDade (R-PA) also sent a June 11 letter to then-Energy Secretary Peña asking him "to refrain from rushing into a new international agreement before there has been sufficient dialogue with our partners and Congress . . . and to let me know of your intentions before the Department takes action on this issue." Peña also received a July 25 letter from Science Committee chairman Rep. James Sensenbrenner (R-WI) stating "Departmental action to extend the ITER collaborative agreement in contradiction to clear instructions by the House and Senate Appropriations Committees during such a critical stage of the FY 1999 appropriations process could have adverse consequences for not only the Fusion Energy Sciences Program, but also for other important science and energy research and development programs. Consequently, I would strongly urge the Department to refrain from entering into any such agreement until Congressional concurrence can be obtained." Although DOE Under Secretary Ernest Moniz subsequently arranged several meetings with the key Congressional personnel, no such concurrence was obtained.

The collapse of the ITER agreement threatens to bring to an end a formal collaboration first begun in late 1985 at the first Reagan - Gorbachev Summit Meeting. The two leaders agreed to work together to design and construct the world's first operating fusion experimental reactor. The agreement was subsequently enlarged to include the European Union and Japan. Several other countries, including Canada, have also participated in the collaboration. The engineering design of ITER was completed last December. Critics argued that the cost

to construct, estimated at \$8 billion, was prohibitive. The Parties had recently agreed to descope the project during a three year extension period, aiming for approximately a 50% cost reduction. However, a group of U.S. fusion scientists, meeting in Madison, Wisconsin, in late April (see our June 1998 newsletter), urged a so-called "Multiple Machine Strategy" in which an even lower cost "burning plasma physics" device would replace the ITER-like options. Congressional critics sensed a lessening of interest in ITER among U.S. fusion scientists and also noted explicitly the growing momentum of the DOE Defense Program's Inertial Confinement Fusion Program (see our June 1998 newsletter).

### **SENATE COMMITTEE CALLS FOR MAGNETIC-INERTIAL FUSION COMPARISON STUDY**

"Language" accompanying the DOE FY 1999 appropriations bill passed recently in the Senate, "recommends that the Department, prior to committing to any future magnetic fusion program or facilities, conduct a broader review to determine which fusion technology or technologies the U.S. should pursue to achieve ignition and/or a fusion energy device." The report says, "The Department currently funds four fusion related technologies: pulsed power, lasers, ion drivers and magnetic fusion. The Department has been reluctant or unable to review those technologies as a group because they have different near-term objectives and are managed by different program offices. Regardless of these near-term and management differences, the Committee is aware that scientists within each program have an eye toward ignition and energy applications. The Committee is well aware of the challenges entailed by a review of multiple programs and multiple and possibly competing technologies. However, the Department should conduct an encompassing review of all four technologies prior to making decisions about the next step toward fusion energy, specifically to consider non-magnetic alternatives. At the very least, the review should develop a roadmap that justifies the continued development of each technology."

The DOE is currently considering how to carry out such a review.

### **U.S. FUSION GROUP URGES IGNITOR**

A group of U.S. fusion researchers has written a June 17 letter to DOE fusion chief Dr. N. Anne Davies urging her to undertake "a mutually beneficial collaboration with the IGNITOR project, which is actively moving towards achieving ignition and an initial understanding of critical burning plasma phenomena." IGNITOR is a facility proposed by MIT Professor Bruno Coppi that has been under design and development in Italy for over a decade. The group recommends "that a workshop be held at the earliest possible time to more fully explore the scientific and technological basis for the IGNITOR design, and to develop a

plan identifying specific areas for fruitful collaboration," because "the U.S. fusion community is not fully aware of the opportunities that a collaboration with IGNITOR represents." The group is responding to a widespread opinion that a tokamak project much cheaper than ITER is required if burning plasma physics is to be studied in the near-term. The letter is signed by 25 fusion scientists, including Dick Aamodt (Lodestar Corp.), John Dawson (UCLA), Ken Fowler (UC, Berkeley), Richard Hazeltine (U. Texas), Dale Meade (PPPL), Gerald Navratil (Columbia), Marshall Rosenbluth (UCSD), Bill Tang, (PPPL), Jim Van Dam (Texas), Harold Weitzner (NYU), Alan Wootton (U. Texas) and Stewart Zweben (PPPL).

### **JET DEMONSTRATES REMOTE MAINTENANCE**

The Joint European Torus (JET), the world's only tokamak using fusion fuel, conducted a series of highly successful experiments in 1997 using mixed deuterium-tritium fuel such as will be used eventually in fusion power stations (see our October 1997 newsletter). The JET physics programme then required that in the period February to May 1998 one of the major systems inside the Torus, the divertor that handles the fuel exhaust, should be replaced by an alternative configuration known as the Mark II gas box. This has now been accomplished using remote maintenance, the first ever performed on a major fusion device.

The operation was performed using the JET Mascot servo-manipulator, using a Human-Machine Interface which provides the maintenance engineer a sense of presence inside the Torus. Similar procedures will be required in fusion power plants of the future. A news release from the JET project states, "This highly successful operation has shown clearly that the remote handling maintenance of fusion devices is realistic." For further information, visit the JET web site: [//www.jet.uk/](http://www.jet.uk/)

### **AMERICAN NUCLEAR SOCIETY AWARDS**

The American Nuclear Society Fusion Energy Division has presented its 1998 Awards to Prof. Nasr Ghoniem (Outstanding Achievement), John Wesley (Outstanding Technical Accomplishment) and Jonathan Menard (Best Student Paper).

Prof. Ghoniem was cited for his "long-standing research in the area of fusion materials," particularly low activation ferritic steels and SiC. Dr. Wesley was cited for "his outstanding accomplishments in the engineering design of the International Thermonuclear Experimental Reactor," particularly his contributions to the design of the poloidal field coils and the plasma control system. Dr. Menard was recognized for his paper, "Ideal MHD Stability Limits of Low Aspect Ratio Tokamak Plasmas" (Nucl. Fusion, Vol. 37, No. 5, p. 595, 1997).

## FPA SNOWMASS PROCEEDINGS PUBLISHED

The proceedings of Fusion Power Associates 1997 Annual Meeting and Symposium, "Pathways to Fusion Power," held in Snowmass, CO, have been published in the Journal of Fusion Energy (Vol. 17, No. 1, March 1998, Plenum Press). The issue contains a summary of the meeting by FPA president Steve Dean and papers by David Baldwin ("Science and the Pathways to Fusion Power"), J. W. Anderson ("What is the Nature of the Future Marketplace in Which Fusion Will Compete?: The Potential Marketplace for Fusion"), G. L. Kulcinski and J. F. Santarius ("Reducing the Barriers to Fusion Electric Power"), W. M. Nevins ("A Review of Confinement Requirements for Advance Fuels"), J.F. Santarius, G. L. Kulcinski, L. A. El-Guelbaly, and H. Y. Khater ("Could Advanced Fusion Fuels be Used with Today's Technology"), Thomas R. James ("ITER is a Great Opportunity that the U. S. Should Pursue"), and Martin Peng ("Spherical Torus Pathway to Fusion Power"). The issue also contains a summary of The Sixth All-Russian Conference on Engineering Problems of Thermonuclear Reactors (EPTR-6) by B. V. Ljublin.

## RICHARDSON NOMINATED AS ENERGY SECRETARY

President Bill Clinton has nominated U.N. Ambassador Bill Richardson to succeed Federico Peña as Secretary of Energy. Richardson had previously succeeded U.N. ambassador Madeleine Albright when she became Secretary of State. Richardson is a former member of the U.S. House of Representatives (1983-1997) from New Mexico. Outgoing Secretary Peña said of Richardson, "He has the experience to tackle the important energy security, national security, science and technology and environmental cleanup work of the department." President Clinton said, "If there is one word that comes to mind when I think of Bill Richardson, it really is energy."

## FUSION SPINOFF IN CHINA

The following article appeared in newspapers in China: "CHENGDU (June 5) XINHUA - CHINESE SCIENTISTS HAVE SUCCESSFULLY APPLIED NUCLEAR TECHNOLOGY IN RECYCLING WASTE WATER FROM PAPER MILLS

"Scientists of nuclear fusion studies at the Sichuan-based Southwest Research Institute of Physics attached to the China National Nuclear Corporation developed a system that uses plasma to purify and recycle paper mill waste water. They said the system and research processes are similar to that of nuclear fusion studies. So far, only a few countries have the technology.

"The system has recently passed appraisal by experts. Scientists said they can produce soda, carbon powder and burnable gas

from the waste water with the system. They said the recovered soda could be reused for paper making while the gas and carbon powder could be utilized either as fuel or raw materials for chemical industry. The disposed waste water will no longer cause pollution. Southwest China's Sichuan Province is to build a demonstration factory to recycle paper mill waste water with the nuclear technology. Experts believe that the wide application of the system could both benefit environmental protection and production of paper mills."

## CALENDAR

- Aug 31-Sep 4: Theory of Fusion Plasma, Varenna, Italy. Contact: sindoni@alpha.disat.unimi.it
- Aug 31-Sep 5: International Symposium on Gas Flow and Chemical Lasers and High Power Laser Conference, St. Petersburg, Russia. Contact: laser@russinnocent.spb.ru
- Sep 1-5: 16th ICFA Beam Dynamics Workshop on Nonlinear and Collective Phenomena in Beam Physics, Arcidosso, Italy. Contact: laraneta@physics.ucla.edu
- Sep 6-11: 9th International Workshop on the Physics of Non-Ideal Plasma (PNP-9), Rostock Germany. Contact: pnp9@darss.mpg.uni-rostock.de
- Sep 7-11: 20th Symposium on Fusion Technology (SOFT98), Marseille, France. Contact: <http://www.tvf.frlsoft98/>
- Sep 14-20: 6th Ukrainian Conference on Plasma Physics and Controlled Fusion, Alushta, Crimea, Ukraine. Contact: tereshin@ipp.kharkov.ua
- Sep 19-24: 5th International Symposium on Fusion Nuclear Technology, Rome, Italy. Contact: polidoro@frascati.enea.it
- Sep 21-25: First General Assembly of Asian Plasma and Fusion Association, joint with Third Asia Pacific Plasma Theory Conference (APPTC'98), Beijing, China. Contact: xthe@mail.iapcm.ac.cn
- Sep 21-25: 5th Zababakhin Scientific Talks on High Energy Density Physics, Snezhinsk, Chelyabinsk Region, Russia. Contact: bkv@vniitf.ch70.chel.su
- Oct 19-22: Plasma Treatment of Exhaust Gasses for Emission Reduction, San Francisco, CA. Contact: jhoard@ford.com
- Oct 19-23: 4th International Conference on Reactive Plasmas, Hawaii. Contact: kono@nuee.nagoya-u.ac.jp
- Oct 19-24: 17th IAEA Fusion Energy Conference, Yokohama, Japan. Contact: t.dolan@iaea.org

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TSI Research, Inc.	Edward T. Cheng	619-793-3567



# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

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## BORIS KADOMTSEV DIES ACADEMICIAN ADMIRER AND LOVED BY ALL

### BORIS B. KADOMTSEV (1928–1998)

Academician Boris B. Kadomtsev, a pioneer researcher of the world fusion program and one of its most prolific scientists, passed away on August 18 in Moscow. At the time of his death he was Director of the Institute of Nuclear Fusion at the Russian Research Centre "Kurchatov Institute." An announcement from the Kurchatov stated, "We announce with great sadness that, after a long and severe illness, Academician B. Kadomtsev passed away on Tuesday 18 August 1998. This is an immense loss for his wife, Antonine, and his family, for the fusion community and for all of us. We have lost an outstanding physicist, one of the founders of thermonuclear plasma physics, one of the leaders of the Russian theoretical school, and a stalwart supporter of the ITER project. The funeral will take place in Moscow on 24th August. Messages of sympathy and condolences should be sent to the Russian Academy of Science and to the Kurchatov Institute and will be forwarded to the family." (RSC Kurchatov Institute, Kurchatov Square 1, 123182 Moscow, Russia; fax: 95-943-0073; email to G. Eliseev: [geliss@qq.nfi.kiae.su](mailto:geliss@qq.nfi.kiae.su)).

Boris graduated in physics from Moscow University in 1951 and worked at the Institute of Physics and Energetics in Obninsk until 1956. In 1956 he joined M. A. Leontovich's theory group at Kurchatov Institute. In 1970 he became Academician of the USSR Academy of Sciences and was awarded the State Prize of the USSR in the same year. Since 1971 he also held a Chair of Plasma Physics at Moscow Institute of Physics and Technology. After the death of L. A. Artsimovich, he became Director of the fusion program at Kurchatov Institute. He was awarded the Lenin Prize in 1984. In 1990 he was presented with Fusion Power Associates Leadership Award. Recently he was notified that he had been selected by the American Physical Society Division of Plasma Physics to be the recipient of its 1998 Maxwell Prize.

Boris was well known to fusion scientists throughout the world, not only for his key scientific contributions but also for his warm, outgoing personality and engaging human qualities. He



*Boris B. Kadomtsev*

was a man whom it was impossible not to love. Princeton scientist Paul Rutherford commented, "Boris Kadomtsev provided the inspiration to an entire generation of plasma theorists by his genius in applying the most advanced theoretical techniques to the most practical problems of actual fusion plasmas." Fred Ribe, former director of the U.S. fusion program at Los Alamos, said, "I have the greatest admiration for Boris as a great scientist and an outstanding human being. I feel a personal loss." Livermore National Laboratory fusion pioneer Dick Post said, "All of us in the fusion community will miss him, as he consistently 'stayed the course' in fusion and contributed enormously to our field in all its aspects." MIT professor Bruno Coppi said, "His ability was truly exceptional. There are no words to express the depth of this loss." University of California professor emeritus Marshall Rosenbluth said, "Al Simon (University of Rochester) tells a story about a scientist who every day would look in his mirror and ask: 'Mirror, mirror on the wall, who is the smartest of us all?' But the image he saw was always of Boris! He was not only the smartest but one of the nicest, and a friend and colleague of total integrity." Tadashi Sekiguchi, Tokyo University professor emeritus, said "I have received with the greatest sorrow the notification on Academician Boris Kadomtsev's death. He was really one of the



giant theoretical leaders in our academic society and was yet a scientist of warmhearted personality. Together with my Japanese colleagues, I wish to present our deepest condolences toward his family.” They speak for us all.

## **SENSENBRENNER VISITS JAPAN**

Rep. James Sensenbrenner, Chair of the Committee on Science of the U. S. House of Representatives, spent a good fraction of his August recess visiting officials and fusion facilities in Japan. Sensenbrenner’s August 10–14 trip was motivated largely by the controversy over the future of the International Thermonuclear Experimental Reactor (ITER) project, spawned by report language associated with the DOE FY 1999 Appropriations bills about to be passed in Congress (see our August 1998 newsletter). The language orders DOE to close out the project.

Before departing, Sensenbrenner cautioned that he was not going to Japan to negotiate the terms of extending the ITER Agreement but was simply on a “fact finding mission.” On his return to the U. S., Sensenbrenner issued no statement. However, congressional sources indicated that he intended to await any new proposal or initiative that might come to him from the DOE on how to proceed. They said that Sensenbrenner felt it was DOE’s responsibility, not his, to propose solutions. Nevertheless, prior to leaving for Japan and in response to an inquiry, Sensenbrenner sent a letter, dated August 7, to Fusion Power Associates president Steve Dean in which he states:

“I believe it is clear that ITER—as originally envisioned and specifically defined in the 1992 ITER agreement—will not be built, and that there appears to be consensus among the ITER Parties that alternatives to the current design need to be explored. However, it is not clear that there is a consensus in either the U.S. or the international fusion communities of what these alternatives should be or how a simple extension of the current ITER agreement—which was designed for a specific project—would accomplish this.

“When I assumed the Chair of the Science Committee in January of 1997, I defined several guiding principles that have been applied to the Committee’s work in order to reach our goal of enabling the United States and its scientists to remain the world’s preeminent intellectual and economic leaders in the 21st Century. One of my principles is centered on the need to nurture international scientific partnerships to leverage scarce federal dollars. However, any agreement for international cooperation requires well-defined and enforceable terms from the outset. This is essential to maintain existing relationships and promote future projects. Without well-defined and accepted parameters, international cooperation will not succeed.

“I can assure you, however, that I support international cooperation in fusion. To this end, I intend to consult with other

Members of Congress and the U.S. and international fusion communities and am willing to work with the Department of Energy to help craft an agreement that ensures this cooperation can continue.”

Sensenbrenner was responding to a July 15 letter from Dean which said:

“Yesterday the Government of Japan signed the three year extension agreement to continue the ITER international collaboration on fusion energy development. The European Union and Russia signed previously, leaving the United States the only Party whose signature is not on the line.

“I have read your June 25 letter to then Secretary Pena urging him to delay signing the extension agreement and I ask you to reconsider your view and to assist Under Secretary Moniz in his efforts to secure Congressional blessing on this agreement extension.

“It has been largely the United States that has urged that fusion energy development, for the global benefit of mankind, be undertaken as an international venture. For good reason, other countries have often questioned whether the United States is a reliable partner. I cannot think of anything that will more harm the United States reputation as a reliable partner than failure of the United States to sign the extension agreement before its expiration.

“Nothing in the extension agreement commits the Parties to the construction of ITER. Nothing in the agreement commits the United States to contribute any specific amount of funds to the ITER effort. The agreement does commit the United States to work in good faith with the other Parties to develop fusion as a future energy source and I hope that you will agree with me that it is in the interest of our children and grandchildren that we do this. I thank you for your past support of the United States fusion effort.”

## **FESAC TO GET NEW CHARGE; NEW MEMBERS**

The DOE Fusion Energy Sciences Advisory Committee reviewed three proposals to construct new “Proof of Principle” for so-called “alternative (to the tokamak) concepts” at its July 30–31 meeting in Gaithersburg, MD. The proposals were from Princeton Plasma Physics Laboratory (for a “Compact Stellarator”), from Los Alamos National Laboratory (for “Magnetized Target Fusion”), and from the University of Wisconsin (for a “Reversed Field Pinch”). The proposals had received technical peer review by a group of experts convened by DOE and all had been endorsed. DOE Director of Energy Research Martha Krebs asked FESAC for “consideration of the results of recent peer reviews of (the) three proposed proof-of-principle programs,” noting that “one of the thrusts of

the restructured fusion program recommended by FESAC in 1996 was to be the development of a larger, more vigorous innovative confinement concepts program." Krebs said, "I would like FESAC's advice as to how we should incorporate such new or expanded programs into the Fusion Energy Sciences program, given the current fiscal constraints." Krebs said "I realize that a complete answer to the question requires an in-depth review of the entire fusion program. Nevertheless, I would appreciate receiving any comments from FESAC at the upcoming meeting to help as we formulate our FY 2000 OMB budget request, which includes a five-year budget plan."

In response, the FESAC told Krebs in a letter, "The FESAC is encouraged by the exciting possibilities embodied in these proposals. The diversity of scientific work among the proposed programs is precisely what was envisioned when the recommendation for restructuring the program were made. The peer review process, using a single review committee, and the iterative approach, allowing the proposers to provide written responses were particularly informative. As anticipated in your charge letter, the FESAC is not able to make specific recommendations regarding these proposals without an in-depth review of the entire Fusion Energy Sciences program. In this situation, the FESAC recommends that the DOE provide sufficient support in FY 1999 to allow all three innovative programs to maintain their momentum and be ready in FY 2000 for implementation, if selected in the broader program review proposed for the next fiscal year."

The FESAC also said it "strongly supports the DOE proposal to conduct a study of the whole Fusion Energy Sciences program, which would provide a basis for addressing such opportunities." They noted that the "DOE also proposes to undertake a number of other reviews of the Fusion Energy Sciences program in FY 1999" and said, "In support of all these reviews, we recommend strongly that the OFES commission a data gathering exercise on the various opportunities for on-going and proposed research, to meet the goals identified in the restructured program, that could be undertaken in the future Fusion Energy Sciences program." They said, "In addition, a synthesis document should be written to show how each potential opportunity fits the goals," and recommended that DOE "should prepare a list of the objectives and criteria for judging all the major areas of the program." DOE is expected to charge the FESAC to carry out the called-for study of the whole fusion program in the Spring of 1999.

The FESAC told Krebs that the "discussions in our meeting highlighted the exciting progress and opportunities for scientific advances in the Fusion Energy Sciences program," citing "major opportunities for computer modeling and development of advanced materials . . . significant progress on the DIII-D in developing the physics basis for advanced tokamaks . . . (and)

major advances in the inertial fusion program which has resulted in supportive language from the Congressional committees."

The DOE has added 4 new members to its Fusion Energy Sciences Advisory Committee (FESAC) and rotated 9 members off, thus reducing the size of the committee from 22 to 17. The move is part of a plan to have a staggered rotation of FESAC members.

The new members are: Charles Baker (UCSD), Jeffrey Freidberg (MIT), Gerald Navarati (Columbia University), and Cynthia Phillips (PPPL),

Those leaving FESAC are: Ira Bernstein (Yale University), James Callen (University of Wisconsin), Melissa Cray (LANL), Sam Harkness (Westinghouse), Michael Knotek (DOE), Earl Marmor (MIT), Bruce Montgomery (MIT), Nermin Uckan (ORNL), and Stewart Zweben (PPPL).

John Sheffield (ORNL) will continue to chair the FESAC. Other members continuing to serve are: Richard Briggs (SAIC), Robert Conn (UCSD), Katharine Gebbie (NIST), Richard Hazeltine (University of Texas at Austin), Joseph Johnson (Florida A&M), Charles Kennel (Scripps Institution of Oceanography), John Lindl (LLNL), Marshall Rosenbluth (UCSD), and Tony Taylor (General Atomics). There are three ex-officio members of FESAC, representing three professional societies. They are, Nat Fisch (American Physical Society Division of Plasma Physics), Wayne Houlberg (American Nuclear Society Fusion Energy Division) and Ned Sauthoff (Institute of Electrical and Electronics Engineers).

## IN MEMORIAM

Carl Haussmann, an early leader and prime mover of the Inertial Confinement Fusion program at the Lawrence Livermore National Laboratory died July 25 after a short bout with cancer. He was 73. At the time, he was an associate director-at-large at the laboratory. Lab director Bruce Tartar called Haussmann "one of the major figures of the Laboratory's history, a mentor to directors and program leaders, and a scientist with a truly remarkable ability to separate the important from the unimportant." At various times Haussmann served as head of the Laboratories Military Applications, Lasers and Planning programs. He joined LLNL in 1953, shortly after its founding.

Hiroshi Shibata, Director of Fusion Energy, Atomic Energy Bureau, Science and Technology Agency, Government of Japan, passed away on June 5, at the age of 37. He had been in his position since October 1997. In spite of the relatively brief period of time in the position, associates said he had shown an outstanding capacity of leadership in the Japanese fusion program and had contributed much to the ITER activity.

## **LEADERSHIP AWARD**

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

1980	S. J. Buchsbaum R. L. Hirsch M. McCormack P. Tsongas
1981	E. E. Kintner
1982	H. P. Furth J. H. Nuckolls
1983	J. L. Emmett T. K. Fowler
1984	T. Ohkawa G. Yonas
1985	E. P. Velikhov C. Yamanaka
1986	R. C. Davidson
1987	M. N. Rosenbluth
1988	J. F. Clarke
1989	P-H. Rebut
1990	B. B. Kadomtsev
1991	B. Coppi E. Storm
1992	R. W. Conn G. L. Kulcinski
1993	D. L. Cook J. Sheffield
1994	C. A. Baker S. E. Koonin
1995	E. M. Campbell D. O. Overskei
1996	M. Abdou R. L. McCrory
1997	D. E. Baldwin
1998	H. Grunder J. Holdren

## **DISTINGUISHED CAREER AWARD**

Distinguished Career Awards are presented to those individuals who have made extraordinary lifelong career contributions to fusion development.

1987	M. B. Gottlieb D. Kerst R. F. Post L. Spitzer, Jr.	1992	R. Bickerton A. Bishop V. Glukhikh S. Mori
1988	K. Husimi D. Palumbo R. S. Pease	1993	R. A. Gross M. W. Rosenthal
1989	F. H. Coensgen D. J. Grove F. L. Ribe	1994	C. A. Flanagan W. G. Kunkel
1990	N. G. Basov T. Sekiguchi	1995	T. K. Fowler H. P. Furth
1991	H. K. Forsen J. W. Landis R. L. Sproull H. G. Stever	1996	J. G. Gavin J. H. Nuckolls
		1997	M. N. Rosenbluth
		1998	D. B. Montgomery T. Ohkawa P. H. Rutherford

## **EXCELLENCE IN ENGINEERING AWARD**

Excellence in Fusion Engineering Awards are presented to those individuals who, in the early part of their careers, have shown both outstanding technical accomplishment and potential to become exceptionally influential leaders in the fusion field.

1987	S. J. Piet	1994	C. E. Kessel K. A. McCarthy
1988	M. A. Ulrichson	1995	F. Najmabadi
1989	D. Ehst Y-K. M. Peng	1996	G. G. Denisov P. J. Gierszewski
1990	W. Reiersen	1997	P. Barabaschi
1991	J. Santarius	1998	S. Payne M. Tillack
1992	O. Filatov S. Zinkle		
1993	J. D. Galambos S. W. Haney		



# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

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## U.S. SIGNS ONE-YEAR EXTENSION OF ITER AGREEMENT JAPAN SETS NEW FUSION RECORD

### U.S. SIGNS ITER EXTENSION

On September 22, two months after the 6-year ITER (International Thermonuclear Experimental Reactor) EDA (Engineering Design Activities) agreement had expired, U.S. Department of Energy (DOE) Secretary Bill Richardson signed an agreement pledging the United States "to continue participation in the ongoing (ITER) process established by the Agreement for a period of one year from July 22, 1998. The European Community, Japan and Russia had previously signed a three year extension of the Agreement (See our August 1998 newsletter).

Richardson signed the agreement in Vienna, Austria, at the headquarters of the International Atomic Energy Agency (IAEA) in the presence of representatives from Russia, Japan, the European Union and the IAEA. The Agreement is titled: AGREEMENT ON CONTINUED UNITED STATES PARTICIPATION IN THE PROCESS ESTABLISHED BY THE AGREEMENT AMONG THE EUROPEAN ATOMIC ENERGY COMMUNITY, THE GOVERNMENT OF JAPAN, THE GOVERNMENT OF THE RUSSIAN FEDERATION, AND THE GOVERNMENT OF THE UNITED STATES OF AMERICA ON COOPERATION IN THE ENGINEERING DESIGN ACTIVITIES FOR THE INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR. It reads as follows: "The Government of the United States of America, Recognizing the desire of the European Atomic Energy Community, the Government of Japan, and the Government of the Russian Federation to continue cooperation in the engineering design activities for the International Thermonuclear Experimental Reactor; Desiring to complete the ongoing activities and to negotiate a new agreement on international collaboration on fusion science; Has agreed to continue participation in the ongoing process established by the Agreement for a period of one year from July 22, 1998. Participation in this process will be subject to the availability of appropriated funds and is not a commitment to construct a device. Done at Vienna on 22 September, 1998. Bill Richardson FOR THE UNITED STATES OF AMERICA."

In a prepared statement, Richardson said, "Over the past eleven years of ITER cooperation, we have made significant advances in physics research, engineering design and technology development. Supporting the ITER Agreement is the best way for the United States and our international partners to continue to benefit from these past accomplishments and collaborations." In a press release, the DOE said, "An extension of the current Agreement is needed to complete the research and development of sophisticated technologies that could be used in the experimental reactor should the partners decide to build it in the future."

Considerable opposition to signing the Agreement had surfaced in the U.S. Congress (See our August 1998 newsletter). Indeed, House Science Committee chairman James Sensenbrenner visited Japan on a "fact finding" mission in late August. Reports of his visit indicated that Japanese government officials and scientists expressed strong support for ITER and fusion collaboration, while Sensenbrenner expressed firm opposition to ITER. Russian officials also reportedly expressed strong support for ITER and fusion collaboration during the September 1-2 Summit Meeting between Presidents Clinton and Yeltsin in Moscow. Secretary Richardson and Senator Domenici accompanied President Clinton on that trip. In the September 22 press release, DOE states, "Secretary Richardson discussed this issue (signing the ITER extension agreement) with Congressman Joseph McDade, Chairman of the House Appropriations Committee's Subcommittee on Energy and Water Development, prior to releasing the agreement." Regarding his discussion with Chairman McDade, Richardson said, "We both strongly support international fusion collaboration and would like to see the U.S. and our partners complete the testing on the component prototypes."

### SMALL BUSINESS OPPORTUNITIES

The U.S. Department of Energy will be releasing October 1 its annual solicitation for proposals from small business for its Small Business Technology Transfer (STTR) program. The research must be performed jointly between a small business and

a non-profit institution (such as a national laboratory, university or other non-profit). The DOE expects to have about \$4.5 million for the grants. Phase I grants are aimed at "determining feasibility," Phase II grants "to conduct the bulk of the R&D," and Phase III grants "to pursue commercialization." The STTR topics for FY 1999 are (1) Advanced Sensor Technology for Energy Efficiency and Renewable Energy, (2) Instrumentation for Sampling, Measuring, and Monitoring Green House Gases, Coal-Fired Related Pollutants, and Hydrogen, (3) Carbon Management, (4) In Situ Stabilization of Hazardous and Radioactive Wastes, and (5) Organic-Based Missive Devices for Flat Panel Display Technology." Further information is available on the web at [//sttr.er.doe.gov/sttr/](http://sttr.er.doe.gov/sttr/)

On December 1, DOE will also release its annual solicitation for Small Business Innovation Research (SBIR) proposals. These grants are similar to the STTR grants except that the research does not have to be conducted jointly with a non-profit institution. Forty topical areas have been designated for FY 1999, including (1) Fusion Plasma Science Research, (2) Enabling Technologies for Fusion Plasma Research, and (3) Advanced Technologies and Materials for Fusion Research. Further information is available on the web at [//sbir.er.doe.gov/sbir/](http://sbir.er.doe.gov/sbir/)

Interested parties can also be added to the electronic mailing list for news on these solicitations by sending name, company name, address and email address to DOE by email ([sbir-sttr@oer.doe.gov](mailto:sbir-sttr@oer.doe.gov)).

## FUSION SPINOFFS WIN AWARDS

Integrated Environmental Technologies (IET), Inc. has won a 1998 R&D 100 Award for its Plasma Enhanced Melter (PEM). Dan Cohn, president and CEO, and long-time fusion researcher, stated, "The PEM builds upon basic research on plasma processing of waste that we conducted for years at MIT's Plasma Science and Fusion Center." Dr. Cohn also noted that two related monitoring devices developed at the MIT Plasma Science and Fusion Center had previously won R&D 100 Awards and have been licensed by IET for use with the PEM. The PEM converts a variety of wastes, including those bound for a landfill or incinerator, into useful byproducts such as fuels and reusable glass. Plasma heating breaks the chemical bonds of the waste material and is used in combination with more traditional forms of joule heating. The combination allows for more rapid processing rates, according to Dr. Cohn. Cohn said, "The plasma/joule combination makes it possible to treat just about any type of waste. This includes radioactive, hazardous, medical and municipal wastes." For further information, contact Dan Cohn ([cohn@psfc.mit.edu](mailto:cohn@psfc.mit.edu)).

Another fusion-related technology at MIT has also won a 1999 R&D 100 Award. Developed by Dr. Paul Woskov and

colleagues at the MIT Plasma Science and Fusion Center (PSFC) and Pacific Northwest Laboratories, it is a Metals Emission Monitor for detecting hazardous metals in smokestack emissions. The ability to detect and quantify such pollutants is key to feedback controls that could limit such emissions and insure compliance with environmental regulations. The monitor was originally developed at the MIT PSFC to monitor emission from a plasma furnace. For further information, contact Paul Woskov ([ppw@psfc.mit.edu](mailto:ppw@psfc.mit.edu)).

## COMPUTER SIMULATIONS ADVANCE

An article in the September 18 issue of *Science* by several Princeton Plasma Physics Laboratory (PPPL) scientists describes a major advance in the use of Massively Parallel Processing computers at the National Energy Research Scientific Computing Center (NERSC) at the Lawrence Berkeley National Laboratory to simulate fusion plasma confinement and transport. The scientists, Z. Lin, T.S. Hahn, W.W. Lee, W.M. Tang and R. B. White used the computers to create three-dimensional nonlinear particle simulations of microturbulence in the plasma. Scientists have shown, experimentally, that such turbulence leads to enhanced losses in magnetically confined fusion plasmas. In a related article in the same issue, General Atomics scientist Keith Burrell explains how the knowledge gained is used to suppress turbulence and to the discovery of enhanced confinement regimes.

PPPL Chief Scientist, Bill Tang, said, "The information obtained from these advanced computer simulations is providing valuable new physics insights and correlates well with trends observed in experiments." William Kramer, Deputy Director of the NERSC said, "These results are exciting in that they again demonstrate the value of computational science as a complement to experimental science. It's particularly exciting that this significant fusion result was achieved using a highly parallel computing system. We're also pleased to see that NERSC continues to play a critical role in helping plasma physics scientists make new advances in the field. Collaborations such as this really are the future of large-scale scientific research."

## JT-60U ACHIEVES HIGHER EQUIVALENT PLASMA Q

Scientists at the Japan Atomic Energy Research Institute, using the JT-60U tokamak with deuterium plasma, have apparently set a new world record for high temperature plasma performance. The scientists report the performance achieved was such that, had a 50-50 deuterium-tritium mixture been used, an equivalent ratio of fusion power to neutral beam heating power of 1.25 was transiently achieved in a "reversed shear configuration." (See our September 1995 issue for a discussion of the reversed shear mode.) U.S. scientists cautioned that this Q value does not



correspond to the usual definition of Q, which includes the ohmic input power, so that "equivalent scientific breakeven" has still not been achieved. Nevertheless, the results maybe a new world record of plasma performance.

The plasma conditions reported were: Central ion temperature of 16.1 keV, central ion density of 4.8 times ten to the nineteenth, confinement time of 1.1 sec, H-factor of 3.21, plasma current of 2.61 MA, neutral beam heating power of 11.8 MW. The JAERI scientists said that a ten percent reduction of plasma impurities, using a pumped divertor system, contributed to the success. For further information, contact Dr. K. Ushigusa ([ushigusa@naka.jaeri.go.jp](mailto:ushigusa@naka.jaeri.go.jp)) or visit the JAERI web site ([//www-jt60.naka.jaeri.go.jp](http://www-jt60.naka.jaeri.go.jp)).

## **LIVERMORE LAB FORMS LASER ALLIANCE WITH PENN STATE**

Officials from the Lawrence Livermore National Laboratory (LLNL) and Pennsylvania State University have signed an agreement forming a "National Laser Technology Alliance." The agreement was signed on June 16 by Mike Campbell, LLNL Associate Director for Laser Programs and L. Raymond Hetteche, Director of Penn State's Applied Research Laboratory (ARL). ARL is an international leader in laser technology and applications. LLNL is especially interested in ARL's expertise in laser processing of materials.

Among the projects the Alliance may consider are programs to develop new lasers for medical applications including dental drilling and middle ear, eye and brain surgery. Such programs would be conducted in cooperation with Penn State's College of Medicine. "Extremely short-pulsed lasers can cut or perforate human teeth, bones or tissue without heating the surrounding tissues and show great promise for applications as safe and painless surgical tools," said Henry Watson, ARL associate director of the alliance program at Penn State. Watson added, "ARL's laser program, which began in 1986, was designated a National Center of Excellence in laser processing of materials by the Navy in 1993. Since then, ARL has been the Navy's principal developer of laser processing technology." Another potential alliance project could focus on high-powered lasers to be used for high-speed metal drilling in the construction of military equipment, including tanks, helicopters and ships. A third possible alliance project could focus on using lasers to cut up obsolete weapons without the risk of explosion.

The Alliance is one more example of a growing trend in both the magnetic and inertial fusion programs at DOE laboratories to foster so-called "dual use" (military-civilian) or "spinoff" applications of fusion research. The LLNL laser program, which has been primarily oriented toward producing fusion in the laboratory, has traditionally been at the forefront of fostering

other applications of the technology. "Lawrence Livermore is thrilled to join Applied Research Laboratory in a partnership to advance laser manufacturing technology," said LLNL's Mike Campbell. "I believe the results of our collaboration will have a revolutionary impact on industry, providing tremendous benefit to society at many levels."

In addition to sharing expertise and access to each other's commercial affiliates programs, ARL and LLNL will use each other's facilities on a reciprocal basis. ARL had previously formed a Laser Consortium, a group of commercial laser manufacturers and users to facilitate dual-use efforts.

## **JUDGE AGAIN RULES FOR NIF**

U.S. District Court Judge Stanley Sporkin, who has been dealing with a series of legal challenges to the construction of the National Ignition Facility (NIF) brought by the National Resources Defense Council (NRDC) (See our December 1997 newsletter), has once again ruled in NIF's favor. NRDC had challenged the adequacy of the DOE's environmental impact studies, charging specifically that it failed to analyze possible planned experiments with various materials such as plutonium. DOE replied that such studies would be premature since it was not known whether such experiments indeed would be conducted. The Judge agreed. DOE said they would decide whether any such experiments would be performed on NIF by January 1, 2004.

This latest ruling is one in a series of decisions on the lawsuit in which Sporkin has consistently allowed construction of the NIF to proceed. In an earlier decision, Sporkin rejected the plaintiff's request that NIF be halted after discarded capacitors were unearthed at the NIF construction site. Instead Sporkin required DOE to perform additional environmental surveys to determine whether there are any more undiscovered capacitors around the site. Those surveys have been performed and are being addressed in a supplemental impact statement.

## **OIL CRISIS LOOMING?**

According to an article in the 21 August 1998 issue of *Science*, a report of the Paris-based International Energy Agency (IEA) of the Organization for Economic Cooperation and Development (OECD), predicts that world oil production will peak sometime between 2010 and 2020 at around 80 million barrels per day and then begin a "steady, inevitable decline." The article by journalist Richard Kerr predicts that around the time of peak production higher prices will be the norm for the foreseeable future, as the marketplace adjusts and more expensive sources are exploited. To those who debunk such projections, Kerr notes the 1956 projection of M. King Hubbard of Shell Oil who correctly predicted that U.S. oil production would peak between 1965 and 1970. Kerr notes that contrary to many of the worlds

experts who are predicting peak production before 2020, DOE's Energy Information Administration is still predicting that peak production will not occur until after 2020. (Our thanks to former fusion researcher Art Sleeper, M.D., for bringing this article to our attention.)

## GOVERNMENT SPENDING FACTOIDS

According to the August issue of *Physics Today*, the U.S. spent \$5.5 trillion for nuclear weapons between 1940 and 1996, while spending \$0.3 trillion on energy research and development (calculated in inflation-adjusted 1996 dollars). In addition to the money spent on nuclear weapons, the government spent \$13.2 trillion on national defense. The article is based on a Brookings Institution report, "Atomic Audit: The Costs and Consequences of US Nuclear Weapons since 1940," issued June 30. Of the total \$5.5 trillion, only \$0.4 trillion was spent on design and development, most of the expenses were for manufacture and deployment. In all, the U.S. built more than 70,000 nuclear weapons, the article by Irwin Goodwin states.

The Brookings report takes issue with the current \$4.5 billion annual cost of DOE's Stockpile Stewardship program, asking why it needs to be higher than the \$3.6 billion they estimate as the average cost of the equivalent program during the 1948 - 1991 period.

## BEAMLET GOES TO SANDIA

The prototype beamline for the National Ignition Facility (NIF) laser at Lawrence Livermore National Laboratory (LLNL) has completed four years of successful experiments and is being shipped to Sandia National Laboratories (SNL) in Albuquerque for use in the Z Machine. (See our April 1998 newsletter.) Beamlet was the first substantial demonstration of the new multi-pass laser architecture required for NIF. Beamlet was also used to test a variety of NIF components. Howard Powell, program leader for Laser Science and Technology at LLNL said that with Beamlet, "We have been able to demonstrate NIF conditions all the way to the focal point," i.e., where the NIF target would be located. "We have thoroughly validated the NIF laser design," he said. (Editors Note: LLNL also recently announced that a fully integrated NIF preamplifier module prototype had successfully operated, producing 29 Joules compared to its design requirement of 22 Joules.)

At Sandia, the \$30 million renamed Z/Beamlet will be used to form a "backlighter" diagnostic tool to produce a bright X-ray source to take X-ray photographs of the plasmas produced by the Z-Machine. Sandia Inertial Confinement Fusion program manager Jeff Quintenz said, "The critical missing diagnostic on Z today is an X-ray backlighter. Beamlet's proven performance history will allow us to fill that gap exceedingly well." Quintenz praised the "successful teamwork" between LLNL and SNL that led to the Beamlet transfer. It is expected to take about a year to make Beamlet operational on the Z Machine.

## RUSSIAN TOKAMAK AVAILABLE

Russian scientists are disassembling the T-3M tokamak. Persons interested in all or some of the equipment, which includes coils, capacitor banks and diagnostics, should contact Sergie Mirnov (mirnov@fly.trinity.troitsk.ru). The T-3M has a major radius of 1 meter, produced a plasma of radius 0.25 meters in a magnetic field of up to 4 T with a current of 0.15 - 0.4 MA. The capacitor bank is 1 MJ.

## CALENDAR

**Oct 15-16:** International Workshop on Hydrogen Recycling at Plasma Facing Materials, Japan. Contact: yamag@tokai.u-tokyo.ac.jp

**Oct 18-23:** 8<sup>th</sup> International Conference on Megagauss Magnetic Field Generation and Related Topics, Florida. Contact: megagauss@magnet.fus.edu

**Oct 19-22:** Plasma Treatment of Exhaust Gasses for Emission Reduction, San Francisco, CA. Contact: jhoard@ford.com

**Oct 19-23:** 51<sup>st</sup> Annual Gaseous Electronics Conference and 4th International Conference on Reactive Plasmas, Hawaii. Contact: kono@nuee.nagoya-u.ac.jp or web site: //www.gec.org/gec/

**Oct 19-24:** 17th IAEA Fusion Energy Conference, Yokohama, Japan. Contact: t.dolan@iaea.org

**Oct 19-Nov 6:** Experimental Workshop on High Temperature Superconductors and Related Materials, Argentina. Contact: smr1074@ictp.trieste.it

**Oct 26-28:** IAEA Technical Committee Meeting on Spherical Tori and Fourth International Workshop on Spherical Tori, Tokyo. Contact: katurai@katurai.t.u-tokyo.ac.jp

**Nov 2-6:** 45th International Symposium of American Vacuum Society, Baltimore, MD. Contact: avs98@avsSymposium.org

**Nov 16-20:** 40th APS Division of Plasma Physics Annual Meeting, New Orleans, LA. Contact: meetings@aps.org

**Nov 16-27:** 8<sup>th</sup> Latin American Workshop on Plasma Physics, Argentina. Contact: lawpp98@tinfiplfp.uba.ar

**Jan 25-27, 1999:** Fusion Power Associates Annual Meeting and Symposium, "Workshop on Cost-Effective Steps to Fusion Power," including tour of fusion facilities at UCLA. Los Angeles. Discussions will revolve around how to resolve critical science, technology and development path issues. Contact: fpa@compuserve.com



# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

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## U.S. LAUNCHES MAJOR FUSION ENERGY REVIEWS

### NEW MEMBER

The University of California at San Diego has become an institutional Member of Fusion Power Associates. Dr. Charles C. Baker, Associate Director for Fusion and Adjunct Professor, School of Engineering, will represent the university. He can be reached at email (cbaker@iter.ucsd.edu). We welcome UCSD's participation in Fusion Power Associates.

### FPA ANNOUNCES RESTRUCTURING

Fusion Power Associates Board of Directors has voted a major restructuring in membership categories and dues in the association. Effective immediately, all non-voting institutional Affiliates are granted voting Member status. Effective January 1, 1999, non-voting Affiliate status will be limited to institutions having no more than \$1 million per year in fusion contract funding. The current category of Small Business Affiliate remains unchanged. Annual dues for voting Members will be \$1,600 per year; dues for non-voting Affiliates will be \$900; and dues for Small Business Affiliates will be \$400. Currently, Fusion Power Associates has 28 institutional Members and 10 Small Business Affiliates.

### DOE INITIATES MAJOR FUSION REVIEWS

The U.S. Department of Energy has disclosed plans to carry out, in parallel, three major assessments of the U. S. Fusion Energy Sciences program during the coming 12 months. In an October 9, 1998 letter to DOE Fusion Energy Sciences Advisory Committee (FESAC) chairman John Sheffield, of Oak Ridge National Laboratory, DOE Director of Energy Research Martha Krebs asked the FESAC to undertake one of the three studies. The other two, she said, would be carried out by the DOE Secretary of Energy Advisory Board (SEAB) and by the National Research Council (NRC), respectively.

The FESAC review is to consist of two related reports, one due "by the end of December 1998, if at all possible;" the other due by September 1999. The first report is to summarize "the opportunities and the requirements of a fusion energy science

program, including the technical requirements for fusion energy;" while the second report is to provide "recommendations as to the proof of principle experiments now under review (See our September 1998 newsletter), as well as your recommendations regarding the balance of the program between tokamak and non-tokamak physics, and between magnetic and inertial fusion energy."

In her letter, Dr. Krebs indicated that she would expect the first phase of the FESAC study to be used "for the upcoming SEAB review of the Magnetic and Inertial Fusion Energy Programs." DOE is initiating this review in response to language contained in a Senate Appropriations subcommittee report that "recommends that the Department prior to committing to any future magnetic fusion program or facilities, conduct a broader review to determine which fusion technology or technologies the U.S. should pursue to achieve ignition and/or a fusion energy device (See August 1998 newsletter). The Senate report says, "The Department currently funds four fusion related technologies: pulsed power, lasers, ion drivers and magnetic fusion. The Department has been reluctant or unable to review those technologies as a group because they have different near-term objectives and are managed by different program offices. Regardless of these near-term and management differences, the Committee is aware that scientists within each program have an eye toward ignition and energy applications. The Committee is well aware of the challenges entailed by a review of multiple programs and multiple and possibly competing technologies. However, the Department should conduct an encompassing review of all four technologies prior to making decisions about the next step toward fusion energy, specifically to consider non-magnetic alternatives. At the very least, the review should develop a roadmap that justifies the continued development of each technology." DOE has decided that this review should be performed by a group having a broader charter than the FESAC, and hence is seeking concurrence from Energy Secretary Bill Richardson to use his SEAB advisory panel.

The third major fusion review has been assigned by DOE to the National Research Council (an operative arm of the National Academy of Sciences and the National Academy of Engineering). The NRC has been asked to set up an independent committee (See July 1998 newsletter) to conduct "an assessment of the scientific quality of the Office of Fusion Energy Sciences (OFES) program." This review was requested by Dr. Krebs in an April 10, 1998 letter to Academy of Sciences president Bruce Alberts. In the letter, Dr. Krebs said, "Among the things you may wish to consider in your assessment are the quality of fusion research itself as evidenced by progress in the understanding of fundamental plasma physics issues in fusion energy; the impact that fusion energy research has had in other scientific areas such as astrophysics, geophysics, computational science, and technological areas such as plasma processing; and the role of fusion research in the academic community including graduate student training." Krebs asked that the review be completed by August 1999. The review panel is in the process of being formed. The review will be conducted under the auspices of the Plasma Science Committee (Prof. Chuan Liu, University of Maryland, Chairman) of the Board on Physics and Astronomy, (Donald Shapero, Director), National Research Council. For further information, contact Shapero (bpa@nas.edu) or Liu (cslu@glue.umd.edu).

## FESAC REVIEW

In her charge letter to FESAC, DOE Director of Energy Research Martha Krebs stated, "I would like to ask the FESAC's help in two steps. First, please prepare a report on the opportunities and the requirements of a fusion energy science program, including the technical requirements for fusion energy. In preparing the report, please consider three timescales: near-term, e.g. 5 years; mid-term, e.g. 20 years; and the longer term. It would also be useful to have an assessment of the technical status of the various program elements of the existing program. This document should not exceed 70 pages and should be completed by the end of December 1998, if at all possible. I would expect to use this work, as it progresses, as input for the upcoming SEAB review of the Magnetic and Inertial Fusion Energy programs."

Krebs continues, "Using this effort as a starting point, I would like FESAC to lead a community assessment of the restructured program thus far, including recommendations for further redirection given projected flat budgets for fusion. With this assessment as background, I would like your recommendations as to the proof-of-principle experiments now under review, as well as your recommendations regarding the balance of the program between tokamak and non-tokamak physics, and between magnetic and inertial fusion energy. Working with the Office of Fusion Energy Sciences, please develop goals and metrics to use in making your recommendations. I would also welcome any other recommendations on program content,

emphasis, or balance."

Krebs also says, "This effort, I realize, is a large undertaking. I believe it will be helped by the community workshop planned for next summer, by the SEAB review, and by the National Research Council review of the scientific quality of the program. I would like to receive this second report by September 1999, so that we can use it to prepare a program plan/roadmap for submission to Congress with our FY 2001 budget."

In her letter, Krebs notes "In FY 1999 we will suspend our ITER design efforts but still complete important and related technology research. At the same time we will work with our ITER partners to identify complementary international collaborations." Krebs notes the recent restructuring of the program towards more of a science emphasis but states, "However, fusion will never be simply a science program; it must have an energy vision, as well. This dual nature of the program will always cause tension within the community. The continued call for clearly defined progress toward energy application, from Congress and others, will highlight that tension."

To take on the first task, that of preparing "a report on the opportunities and the requirements of a fusion energy science program," by the end of the year, "if at all possible," FESAC chairman John Sheffield has assembled a panel, which he will personally chair. The other members of the panel are: Charles C. Baker (UCSD), Stephen O. Dean (Fusion Power Associates), Nathaniel Fisch (PPPL), Jeffrey Freidberg (MIT), Richard Hazeltine (U. Texas), Gerald Kulcinski (U. Wisconsin), John Lindl (LLNL), Gerald Navratil (Columbia U.), Cynthia Phillips (PPPL), Stewart Prager (U. Wisconsin) Don Rej (LANL), John Soures (U. Rochester), and Ronald Stambaugh (General Atomics). Others may be added. The panel held its first meeting October 13-14 in Washington. It is the panel's intent to ask for "2-pagers," describing the major elements of the fusion program. A format for the 2-pagers has been prepared and will be available for distribution. Inquiries on how to interface with the panel should be addressed to the panel's executive secretary, Bob Benson of ORNL (eee@ornl.gov). The complete text of Dr. Krebs letter is posted on the web ([//aries.ucsd.edu/PUBLIC/INFO/](http://aries.ucsd.edu/PUBLIC/INFO/)) thanks to Dr. Mark Tillack.

## FPA ANNUAL MEETING AND SYMPOSIUM

Fusion Power Associates annual meeting and symposium, "Workshop on Cost-Effective Steps to Fusion Power," will take place January 25-27, 1999, at the Marina del Rey Hotel, located on the marina, about midway between the Los Angeles airport and UCLA. The Workshop will be co-sponsored by UCLA. This year's theme is motivated, in part, by projected continued low U.S. fusion budgets and current inability of the U.S. to meaningfully participate in possible international fusion plans

to construct large new fusion engineering facilities. Thus it seems imperative that new ways be found to cost-effectively resolve critical science and technology issues associated with the development of fusion commercial power.

At this workshop, which will be limited to 120 participants, we will identify and discuss the elements of an affordable fusion development path. Topics will include how to cost-effectively resolve critical issues for the tokamak concept, alternative magnetic concepts, inertial fusion energy, nuclear and plasma technologies, materials, power plant designs, and development pathways. The workshop will expand on the themes developed at Fusion Power Associates 1996 annual meeting, "Pathways to Fusion Power," (*Journal of Fusion Energy*, March 1998, summarized in FPA December 1997 Executive Newsletter). The workshop will build on information developed at recent Innovative Confinement Concepts (ICC) workshops and it is hoped that the workshop will also provide a useful prelude to the fusion community two-week summer study, which is currently being planned for Snowmass, Colorado, in July 1999.

Persons wishing to participate should contact Fusion Power Associates ([fpa@compuserve.com](mailto:fpa@compuserve.com)) to receive registration information. All participants will be expected to provide 1-3 page summaries of their ideas by December 31. In order to provide ample time for discussions, formal presentations will be limited to 5-10 minutes per speaker. The organizing committee consists of Mohamed Abdou (UCLA), Steve Dean (FPA), and Bob Taylor (UCLA).

### **FPA DISTINGUISHED CAREER AWARD**

Fusion Power Associates Distinguished Career Award has been presented posthumously to Academician Boris Kadomtsev of the Kurchatov Institute, Moscow. Kadomtsev passed away August 18 (See September 1998 newsletter). The award was presented October 24 to Academician E. P. Velikhov, president of the Kurchatov Institute, at the closing ceremonies of the 17th IAEA Fusion Energy Conference in Yokohama, Japan, by Dr. David E. Baldwin, a member of FPA's Board of Directors. In presenting the award, Dr. Baldwin said, in part, "On behalf of Fusion Power Associates, I am pleased to present this plaque commemorating the pioneering and influential work of Dr. Boris B. Kadomtsev in the field of theoretical fusion plasma physics. Both as a prominent theorist and as a model of the international character of fusion research, Boris was a dominant figure throughout his career. By his genius in applying the most advanced theoretical techniques to the most practical problems of actual fusion plasmas, he provided inspiration to an entire generation of plasma theorists. We remember Boris Kadomtsev for his insightful contributions to MHD stability, to trapped-particle modes, to reconnection and disruptions, to self-organization in plasma performance, and to the early work on turbulence limiting energy confinement in fusion plasmas.

We also remember him for his warmth as a human being, for his grace and for his courtly manner. He cared deeply for fusion. He leaves us both a rich legacy and a challenge to continue and complete this work so important to the future of mankind."

### **DOE CLOSING OUT ITER PARTICIPATION**

Although Energy Secretary Bill Richardson signed an agreement on September 22, pledging the United States to continue participation in the ongoing ITER process for a period of one year from July 22, 1998 (See our October 1998 newsletter), the Department of Energy moved quickly to begin the process of U.S. withdrawal from the ITER project. In a letter dated October 7 to ITER Council Members and the IAEA Director-General, DOE Director of Energy Research Martha Krebs noted that Congress had just passed the DOE FY 1999 appropriations bill, including provisions "that direct the Department to complete ITER-related activities including research and development in the base technology program, particularly the central solenoid magnet coil (and providing) limited funding for an orderly closeout of our design activities."

Krebs said that, therefore, the Department was "taking the following actions to begin implementation: (1) To complete our ongoing activities, we are working toward completing our principal R&D obligations, in particular the Central Solenoid Model Coil, by the end of FY 1999; (2) To provide for an orderly close out of ITER design activities within the constraint of appropriated funds, we have acted to suspend participation of US secondees at the Joint Work Sites and have instructed them to complete their current activities in the next few weeks. As appropriate for the professional completion and transfer of these activities, those US Joint Central Team members who were being relied upon to make presentations at the IAEA Fusion Energy Conference later this month will do so. Over the next three months, we will explore the opportunities for using the ITER Joint Work Site for other international cooperative activities. The Joint Work Site will remain open to minimize the disruption to the work of the Joint Central Team; (3) We also want to work with you to develop a new arrangement which will provide a basis for international collaboration on fusion science. We anticipate this process will begin immediately with a draft available by March 1999."

On October 11, U.S. fusion program head Dr. N. Anne Davies advised all U.S. ITER secondees that the DOE "has determined that it is necessary to implement the following actions: (1) Recall all U. S. secondees to their home institutions; and (2) Recall U. S. Visiting Home Team Personnel to their home institutions." Davies said, "To implement an orderly suspension, we are asking each secondee by October 23, 1998 to transfer, as best they can, their activities to other people as designated by JCT (Joint Central Team) management. In parallel, each secondee should initiate as soon as possible the



necessary personal steps to return to their seconding institution. We are asking each secondee to report back to their seconding institution or their next work assignment no later than November 16, 1998, with the exception noted below (persons with children in school were given until January 4, 1999)." Davies noted that "DOE will pay all appropriate costs for this activity (bringing the secondees home)."

## FUSION BUDGETS

Congress has passed, and President Clinton has signed, the DOE FY 1999 Appropriations Bill., including funds for the Office of Fusion Energy Sciences and the Inertial Confinement Fusion program within DOE's Defense Programs. The Bill provides \$229.75 million for the Office of Fusion Energy Sciences, slightly more than the \$228.2 million the President had requested. The bill specifically includes \$12.2 million "as directly related to completion of ITER-related activities, including funds to complete research and development in the base technology program and to provide for orderly ITER closeout costs."

The Bill provides \$508 million for the Inertial Confinement Fusion (ICF) program within DOE's Defense Program's Stockpile Stewardship Program. These funds provide full funding for continued construction of the laser-based National Ignition Facility (NIF), being built at the Lawrence Livermore National Laboratory. The bill provides \$10 million more for ICF than the President asked for, with the additional funds earmarked "to further development of high average power lasers." These latter funds, which are expected to go for development of high efficiency, repetitively-pulsed Krypton-Fluoride and diode-pumped solid state lasers, would be of value to the energy application potential of inertial confinement fusion.

The report language accompanying the Bill, on the Office of Fusion Energy Sciences funding, reads, in part, as follows:

"The conferees have provided a total of \$229,750,000 for fusion energy sciences, a \$1,590,000 increase over the amount in the budget request. The conference agreement includes \$223,300,000 for the fusion energy sciences program. Funding for this program has been provided in the Science account as recommended by the Senate instead of the Energy Supply account as recommended by the House. The conferees have provided up to \$6,450,000 for all program direction expenses related to the fusion program within the \$49,800,000 provided in the Science account for program direction. The conferees note that the Department continues to emphasize tokamak development at the expense of other promising technologies. The conferees continue to be very supportive of the increased emphasis on innovative confinement concepts and university-based experiments. The conferees encourage the Secretary to

provide sufficient resources for these efforts. In particular, special emphasis should be placed on funding operations, upgrades, and enhanced design work on both existing and proposed alternative concept experiments at the proof-of-principle level, including an increase for inertial confinement.

"International Thermonuclear Experimental Reactor (ITER).-- The conferees note that the ITER agreement expired on July 21, 1998. For the past several years, Congress has been clear that the U.S. commitment to ITER extended only through fiscal year 1998. The Department is directed not to sign an extension of this agreement without the written consent of the authorizing and appropriations committees of the House and Senate. The conferees understand and support the value of international collaboration. The Department is encouraged to consider the possibility of utilizing the existing international fusion center in San Diego in future collaborations.

"The conferees have included \$12,200,000 as directly related to completion of ITER-related activities, including funds to complete research and development in the base technology program and to provide for orderly ITER closeout costs. The Department must submit a reprogramming request if requirements exceed the \$12,200,000 provided."

## PEOPLE

Fusion researcher **Dr. Kathryn A. McCarthy** has been promoted to Department Manager of Nuclear Engineering Technologies at Idaho National Engineering and Environmental Laboratory (INTEL), Idaho Falls, Idaho. Please join us in congratulating Kathy by email ([K3@inell.gov](mailto:K3@inell.gov)).

Sandia National Laboratories VP, **Dr. Gerold Yonas**, is the recipient of the 1998 Beams Prize Award of the International Conference on High-Power Particle Beams, "in recognition of his leadership in the area of pulsed power, high-power particle beams, and intense sources of radiation, and his nurturing and encouragement of the pulsed power community for more than 20 years." Yonas initiated this conference series in 1975.

Fusion researcher **Paul Vandenplas**, Director, Plasma Physics Laboratory, Ecole Royale Militaire, Brussels, Belgium, has been knighted, with the title of Chevalier. He was recognized, in part, for his pioneering work in fusion over the years.

## QUOTABLE

"Good ideas are not adopted automatically. They must be driven into practice with courageous patience."

Admiral Hyman Rickover



# FUSION POWER ASSOCIATES

## EXECUTIVE NEWSLETTER

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## RUSH HOLT ELECTED TO CONGRESS

### HOLT WINS

Rush Holt, former Assistant Director of the Princeton Plasma Physics Laboratory (PPPL), was elected to the U.S. Congress November 3. His two-year term begins in January. A Democrat, he joins Michigan Republican Vernon Ehlers, as one of two Ph.D. physicists in Congress. Holt, who received his Ph.D. in physics from New York University in 1981, taught at Swarthmore College and subsequently served as Director of the nuclear arms control office at the U.S. State Department. He has been actively engaged in the fusion effort at PPPL since 1989.

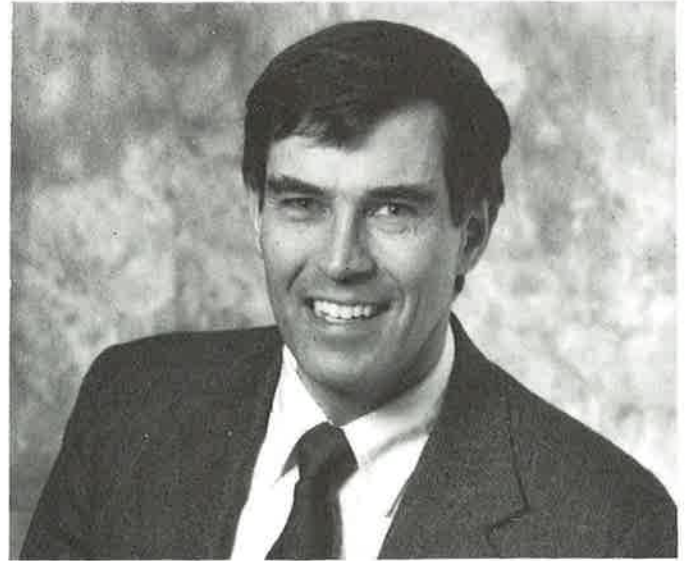
Rush said, "I am campaigning to carry a positive message of hope and fairness and trust in government. Throughout my career, I have worked to improve the environment, educate young people, promote respect for women, enhance productivity through research and development, and promote human rights." After the election, which was considered an upset (he won by a 51-49% margin), Rush said, "Throughout the campaign, we tried to talk about the issues that were close to home, education, health care reform, a patient's bill of rights, protection of Social Security and efforts to remove the tools of violence from the country."

Rush comes from a politically active family. His father was, at age 29, the youngest person ever elected to the U.S. Senate, representing West Virginia for one term in the 1930's. His mother served as West Virginia's Secretary of State. "I was raised to think that politics was an honorable calling," he told the New York Times earlier this year.

All his friends in the fusion community wish Rush well in his new career.

### NEW PCAST STUDY INITIATED

President Clinton has asked his Science Advisor, Neal Lane, to prepare a report on international cooperation in energy research, development and deployment. The study will be conducted by a panel of the President's Committee of Advisors on Science and Technology (PCAST). The panel will be chaired by



**Dr. Rush Holt**

Professor John P. Holdren, Harvard University, who chaired a previous PCAST panel on "Federal Energy Research and Development for the Challenges of the Twenty-First Century," in 1997. Other members of the panel include, Richard Balzhiser (EPRI), John Boright (National Research Council), William Chandler (Battelle), John Deutch (MIT), Howard Geller (American Council for an Energy Efficient Economy), John Gibbons (former Science Advisor to the President), Larry Papay (Bechtel), Nathan Rosenberg (Stanford University), Maxine Savitz (AlliedSignal), Bruce Stram (Enron), Robert Williams (Princeton University), Lilian Wu (IBM), and John Young (PCAST Co-Chair). The study is to be provided to PCAST by March 31 and to the President by May 1, 1999.

The President requested that his Science Advisor "review the U.S. international energy R&D portfolio and to report to me by May 1, 1999, on ways to improve the U.S. program of international cooperation on energy R&D to best support our nation's priorities and address the key global energy and environmental challenges of the next century." The Panel is specifically asked to address the following issues:

“(1) Identify the key challenges facing the United States and the world in the first several decades of the 21st century and analyze their implications with respect to national and global economic vitality, local and global environmental quality, and national security.

“(2) Provide a synopsis of international energy R&D experience within the principal U.S. agencies, with particular attention given to the lessons that have been learned and their implications for the design and operation of future activities. Include discussion of opportunities and effective mechanisms for multi-agency initiatives.

“(3) Review foreign bilateral and multilateral (e.g., Multilateral Development Banks, United Nations, etc.) public and private international energy R&D activities, examine their strategic role in meeting national goals, and identify the key lessons for U.S. international energy R&D activities.

“(4) Identify important international energy efficiency, renewable, fossil and nuclear energy technology R&D opportunities and their associated budget and programmatic requirements within a balanced R&D portfolio that would make the U.S. role more responsive to the global energy-linked challenges of the next several decades, building on work done in the previous PCAST Energy R&D Study.

“(5) Identify innovative mechanisms for large-scale publicly leveraged market-driven deployment of advanced energy technologies. Examine the relationships between R&D cooperation and international market competition in international energy programs. Evaluate experience with institutional learning in the R&D and deployment of advanced energy technologies and synthesize the lessons learned. Identify factors that limit the effectiveness of public R&D and deployment efforts.

“(6) Develop a strategic framework and action agenda that could help meet national and global challenges through international energy R&D and identify collaborative and competitive components.”

## **DRAFT FUSION ROADMAP ISSUED**

A group of 16 individuals from both the magnetic and inertial fusion communities in the U.S., under the lead authorship of Rob Goldston (PPPL), has posted “A Discussion Draft Roadmap for Fusion Energy: A Portfolio Approach” on the web ([//www.fusionscience.org/](http://www.fusionscience.org/)). Mike Campbell (LLNL) was also an active participant in formulating the draft. Goldston and Campbell presented the draft to DOE Under Secretary Ernest Moniz and to OSTP staff member Bob Marianelli on November 10.

The document can be downloaded in PDF format. Comments are requested from the general fusion community by email ([roadmap@fusionscience.org](mailto:roadmap@fusionscience.org))

The document states, “This Roadmap includes both magnetic fusion energy (MFE) and inertial fusion energy (IFE) approaches within a unified framework, designed to build on the successes in each of these programs. The experimental results of the last decade indicate that fusion can be an energy source, and the challenge now is to optimize the science to make it practical and affordable. This is the central focus of this roadmap.”

The document states that it is based on a three element strategy:

- (1) National Stewardship of Plasma Science and Technology
- (2) Concept Innovation as the Centerpiece of the Domestic Program
- (3) Energy-Producing Plasmas and Fusion Energy Technology, Pursued Internationally.

The document promises “a key assessment in 2003-4 of whether and how to move into a more aggressive fusion energy development program.” It states, “Success with one or more of the present front-running MFE or IFE concepts will provide the technical justification for such a (major next) step (device).” If no such step is justified, the document states, “other concepts in the portfolio, which look potentially more attractive at that time, would move into the lead roles in a rebalanced portfolio.” The 2003-4 assessment is predicated on a budget increase of \$66 million starting in FY 1999 and maintained throughout the period.

Other members of the “Working Group” of authors of the draft are listed as: Charles Baker (UCSD), David Baldwin (GA), Roger Bangerter (LBNL), William Barletta (LBNL), Stephen Bodner (NRL), Michael Mauer (Columbia U.), Robert McCrory (U.Rochester), Gerald Navratil (Columbia U.), Miklos Porkolab (MIT), Stewart Prager (U. Wisconsin), Jeffrey Quintenz (SNL), Michael Saltmarsh (ORNL), Kurt Schoenberg (LANL), and Keith Thomassen (LLNL).

## **NEXT STEP OPTIONS STUDY UNDERWAY**

In a letter dated November 13, 1998, to Dr. Charles Baker (UCSD) in his capacity of Director of the Virtual Laboratory for Technology, DOE fusion head Dr. N. Anne Davies asks Baker to initiate and oversee a “Next Step Options” activity, at a level of \$3.5 million in FY 1999. Davies suggests that Baker “take real advantage of the experience gained by those individuals were involved with ITER,” in carrying out the activity. She asks Baker “to work with the community to develop specific recommendations, including proposed institutional relationships, to OFES by November 30 for tasks to be

performed during FY99 including key milestones for deliverable products during the year.”

Davies says, “The purpose of this Next Step Options activity is to investigate and assess various opportunities for advancing the scientific understanding of fusion energy, with emphasis on plasma behavior at high energy gain and for long duration.” She indicates that examples of specific tasks to be pursued are:

- (1) preparation of a common set of technical assumptions and criteria for comparing design options;
- (2) assessment of implications of advanced physics on recent fusion facility designs such as BPX;
- (3) assessment of existing design information through interactions with projects such as KSTAR, Ignitor, JT-60SU, JET enhancements and as a reference, the reduced-cost ITER, and determination of relevance of all this information to Next Step Options; and
- (4) exploratory design for a modular program pathway, with initial emphasis on the burning plasma module.

Davies notes, “While recognizing that our fusion partners are today primarily interested in the reduced-cost ITER, our efforts should be considered complementary to theirs, and, in fact, I think we can expect some modest interest and participation by our partners in this work. I want to emphasize that any deliberate pursuit of one of the Next Step Options, beyond this exploratory design effort, would have to be addressed in an international context after the other major fusion programs have determined a course of action on construction of the reduced-cost ITER.”

## ICF NEWSLETTERS AND REPORTS

General Atomics, partnered with Schafer Corporation, serves as Target Support Contractor for the Inertial Confinement Fusion (ICF) program at five ICF labs: LLNL, LANL, NRL, SNL and UR/LLE. An informal newsletter, providing highlights of the activity, can be requested from Ken Schultz ([ken.schultz@gat.com](mailto:ken.schultz@gat.com)). The August 1998 newsletter indicates the team has “fabricated, machined, assembled and characterized more than 180 targets of various kinds for experiments on Nova, Omega, Trident, and Z” and that they “fabricated, characterized, and delivered about 290 targets and target components, including micromachined hohlraums, witness plates, and foams to LLNL, LANL, and UR/LLE for shots on Nova and Omega, and flat foil targets of various materials and configurations to NRL and UR/LLE for experiments on Nike and Omega.”

LLNL maintains a mailing list for an ICF Monthly Highlights Report, an ICF Quarterly Report, and an ICF Annual Report.

Persons wishing to receive one or more of these reports can make their request by email ([carpenter13@llnl.gov](mailto:carpenter13@llnl.gov)).

## NSTX TEAM SELECTED

Members of the National Spherical Torus Experiment (NSTX) national research team from outside of the Princeton Plasma Physics Laboratory have been selected following peer reviews. A total of 45 proposals from labs and universities were submitted following DOE announcement 98-07. Fifteen proposals representing seven universities, four national laboratories and two industries were selected. The universities selected were: UCLA, UCSD, UC Davis, Johns Hopkins, MIT, Columbia and Washington. The labs selected were: ORNL, LANL, LLNL, and SNL. The industries selected were: General Atomics and Fusion Physics and Technology.

## NEW PULSED POWER MACHINE AUTHORIZED

The Department of Energy, Defense Programs, has recently authorized Los Alamos National Laboratory to begin construction of a 30 Megampere pulsed power machine, called Atlas, that will be used for the nuclear weapons stockpile stewardship program and other scientific research, including plasma physics, materials science, geophysics, and ultra-high field magnetic field experiments. The total project cost is \$43 million. For further information contact Mark Parsons ([mparsons@lanl.gov](mailto:mparsons@lanl.gov)).

## GA SENIOR VISITING FELLOW PROGRAM

General Atomics (GA) has a Senior Visiting Fellow Program to facilitate sabbatical visits by senior university faculty to work in the DIII-D program. Visits of three months to one year duration are possible. GA provides travel and living expenses and can provide salary assistance if necessary. Interested persons should contact Ron Stambaugh ([stambaugh@gav.gat.com](mailto:stambaugh@gav.gat.com)).

## NEW BOOKS AND PROCEEDINGS

*Inertial Confinement Fusion -- The Quest for Ignition and Energy Gain Using Indirect Drive*, Springer-Verlag, by John Lindl (LLNL).

*Introduction to Nuclear Concepts for Engineers*, American Nuclear Society, by Robert M. Mayo (North Carolina State University). For ordering information on web (<http://www.ans.org/>), “new textbook.”

*Plasma Chemistry*, Cambridge International Science Publishing, by L. S. Polak and Yu A. Lebedev.

*The Physics of Ionized Gases*, Institute of Physics (Yugoslavia), by B. Vujicis, S. Djurovic and J. Puric. For ordering information by email ([fizika@uns.ns.ac.yu](mailto:fizika@uns.ns.ac.yu)).

*Final Report of the 19th Summer School and International Symposium on the Physics of Ionized Gases (1998).* For ordering information by email ([ivid@rudger.ff.bg.ac.yu](mailto:ivid@rudger.ff.bg.ac.yu)).

*Proceedings of the 1998 International Congress on Plasma Physics and 25th European Physical Society Conference on Controlled Fusion and Plasma Physics.* Available on the web ([//www.ipp.cas.cz/conference/98icpp/](http://www.ipp.cas.cz/conference/98icpp/))

## FPA/UCLA WORKSHOP JAN 25–27

Fusion Power Associates and UCLA will co-sponsor a "Workshop on Cost-Effective Steps to Fusion Power," January 25–27, 1998 in Marina del Rey, CA. Dr. N. Anne Davies, Associate Director for Fusion Energy Sciences, DOE, will keynote the workshop. The purpose of the workshop is to identify critical issues for the development of fusion power and to propose ways to address and resolve the issues in a cost-effective manner. The issues will be discussed in the following topical sessions: (1) Power Plants and Pathways, (2) Fusion Concepts, (3) Science Issues, (4) Technology Issues. Discussion leaders for the four topical areas, respectively, are (1) Charles Baker (UCSD) and Mike Campbell (LLNL), (2) Rob Goldston (PPPL) and Steve Bodner (NRL), (3) Gerald Navratil (Columbia U.) and John Lindl (LLNL), and (4) Mohamed Abdou (UCLA) and Grant Logan (LLNL). For registration information, contact Fusion Power Associates ([fpa@compuserve.com](mailto:fpa@compuserve.com)).

## NEW WEB SITES

Mark Tillack (UCSD) has set up a new web page for public information on fusion, including a table of historic fusion budgets ([//aries.ucsd.edu/PUBLIC/INFO/](http://aries.ucsd.edu/PUBLIC/INFO/)). Mark also archives Fusion Power Associates Fusion Program Notes [Thanks! Mark] ([//aries.ucsd.edu/fpa/](http://aries.ucsd.edu/fpa/)).

The U.S. Virtual Laboratory for Technology (VTL), Charles C. Baker, Director, has established a web site ([//vtl.ucsd.edu/](http://vtl.ucsd.edu/)) and is soliciting comments and suggestions for a logo there.

## PEOPLE

**Steve Koonin**, California Institute of Technology, has been selected by the DOE to receive its prestigious E. O. Lawrence Award.

**Richard A. Bolton**, former Director of the Centre Canadien de Fusion Magnetique and a member of Fusion Power Associates Board of Directors, has been named a Fellow of the Canadian Nuclear Society for "outstanding contributions in founding, promoting, building, and managing the Tokamak de Varennes; extensive involvement in establishing the Quebec Branch and serving on the Program Committee in several CNS Conferences."

**Masaji Yoshikawa** has retired as President of the Japan Atomic Energy Research Institute. He is succeeded by **S. Matsuura**. Messages may be sent to Dr. Yoshikawa by email ([yamane@koma.jaeri.go.jp](mailto:yamane@koma.jaeri.go.jp)).

**J. Bryan Taylor** will be honored on the occasion of his 70th birthday by a symposium entitled "Fusion, Turbulence, and Topology," January 11–12, at the University of Texas at Austin. For information, contact Saralyn Stewart ([stewart@peaches.ph.utexas.edu](mailto:stewart@peaches.ph.utexas.edu)).

**William "Wei-Li" Lee** and **Ernesto Mazzucato** have been named Distinguished Research Fellows and **Long-Poe Ku** has been named Distinguished Engineering Fellow at PPPL.

**Guo-Yong Fu** and **Raffi Nazikan** have been named as the 1998 recipients of the Kaul Foundation Prize for Excellence in Plasma Physics and Technology Development at PPPL.

The following persons have been named Fellows of the American Physical Society: **James Chen** (NRL), **Steven Cowley** (UCLA), **Luiz Da Silva** (LLNL), **Roderick Boswell** (Australian National University), **Guy DiMonte** (LLNL), **Sharon Glendinning** (LLNL), **Steven Gold** (NRL), **Ieuan Jones** (Flinders University, S. Australia), **Michael Kotschenreuther** (University of Texas), **George H. Neilson** (PPPL), **Harvey Rose** (LANL), **Dmitri Ryutov** (LLNL), **Steven Scott** (PPPL), **Antonio Ting** (NRL).

## CALENDAR

**Jan 13–15:** Public Meeting of the DOE Fusion Energy Sciences Advisory Committee (FESAC), Livermore, CA. Contact: Al Opendaker ([albert.opdenaker@mailgw.er.doe.gov](mailto:albert.opdenaker@mailgw.er.doe.gov)).

**Jan 25–27:** Fusion Power Associates/UCLA Workshop on Cost Effective Steps to Fusion Power, including reception and tour of fusion research facilities at UCLA, Marina del Rey, CA. Contact: [fpa@compuserve.com](mailto:fpa@compuserve.com)

**Feb 15–19:** Workshop on Frontiers in Low Temperature Plasma Diagnostics III, Saillon, Switzerland. Contact [plasma@epfe.ch](mailto:plasma@epfe.ch)

**Mar 8–12:** 3rd Symposium on Current Trends in International Fusion Research: Review and Assessment, Washington, DC. Contact: [rck@RT66.com](mailto:rck@RT66.com)

**Mar 20–26:** American Physical Society Centennial Celebration, Atlanta Georgia, ([//www.aps.org/meet/CENT99/](http://www.aps.org/meet/CENT99/)).

**Mar 20–26:** 1999 Sherwood International Fusion/Plasma Theory Conference, Atlanta Georgia, ([//www.ornl.gov/fed/Sherwood99/Sherwood.html](http://www.ornl.gov/fed/Sherwood99/Sherwood.html)).