Fusion Power Report

Complete Coverage Of Worldwide Fusion Developments

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General Atomics Fusion Effort Leads to Navy Application

The Naval Air Warfare Center Aircraft Division awarded General Atomics (GA) a contract for the System Development and Demonstration phase of the Electromagnetic Aircraft Launch System (EMALS).

EMALS will replace the existing steam-driven catapults, providing a revolutionary advance in carrier launch operations. According to a GA press release, "the design will provide significant reductions in workload, greatly reducing manning for future launcher operations and maintenance. It will be less stressful to the aircrew and aircraft; and will require significantly less maintenance and onboard personnel, with correspondingly greatly reduced life-cycle costs." The EMALS system's first deployment will be on the next-generation carrier, the CVN-21.

Mike Reed, Vice President of General Atomics' Electromagnetic Systems Division, stated, "Our team is thrilled with the award of the EMALS SDD phase contract and at having the opportunity to place this major advanced electric EMALS system on the next-generation carrier. We appreciate the significance of changing this vital aircraft launch system from steam to electric power.

Reed went on to credit the development of GA's winning EMALS technology to the skills and basic technologies developed under General Atomics' fusion research program. General Atomics operates and is the host institution for the Department of Energy's DIII-D National Fusion Facility. DIII-D is the nation's largest magnetic fusion experiment.

The GA press release states, "The purpose of the DIII-D device and program is to further the fundamental science of reaching and maintaining the conditions necessary for fusion (the energy source of the stars) on earth. While steady progress toward the ultimate goal of practical fusion energy is being made, the advances made on DIII-D and other facilities like it around the world have yielded important benefits in many other areas. The EMALS project is perhaps one of the more striking examples of this."

"The attainment of fusion conditions in a device such as DIII-D requires extremely precise control of the discharge of large amounts of pulsed power" said David Baldwin, Senior Vice President and leader of General Atomics' Energy Group. "The major challenge of the EMALS system is exactly that: delivering precisely controlled amounts of pulsed power to the electromagnetic system that accelerates the airplanes off of the carrier deck. The unique skills developed by DIII-D technicians and scientists in this and related areas led directly to GA's winning approach to this challenge."

Baldwin continued: "I am extremely proud of this latest example of fusion energy research yielding unexpected benefits to the nation."

General Atomics, founded in 1955, specializes in diversified research, development, and manufacturing in defense, energy, and other advanced technologies. Affiliated manufacturing and commercial service companies include General Atomics Aeronautical Systems, Inc., which builds the Predator(r) family of unmanned aerial vehicles, and General Atomics Electronic Systems, Inc.

For further information contact: David Baldwin (David.Baldwin@gat.com).

Plasmatron in the News

The Plasmatron device, licensed by MIT to the ArvinMeritor auto supply company, is featured in the June 21, 2004 issue of Forbes magazine (http://www.forbes.com/forbes/2004/0621/170_print.html). Author Joann Muller states that the "funny sounding invention may solve one of the auto industry's most intractable problems: how to rid the air of those noxious diesel fumes from trucks and buses." Forbes estimates the market for such devices at $10 billion.

The plasmatron is a beer can sized device that ignites an air-diesel fuel mixture into a plasma that releases hydrogen and carbon monoxide that reacts with the noxious NOx, transforming it into nitrogen, carbon dioxide and water.

Devices such as the plasmatron will be needed in the commercial trucking industry to meet strict new emission laws going into effect in Europe soon and in the U. S. by 2007. The Environmental Protection Agency has mandated a 92% reduction in the amount of NOx emitted from a truck tailpipe by that time.

An extensive article on the plasmatron also appeared in the June 7 issue of the Indianapolis Star (http://www.indystar.com/articles/8/152874-3348-P.html). The article quotes fusion researcher Dan Cohn of MIT, one of the inventors of the Plasmatron, as saying the device could reduce tailpipe emission by 90% and improve mileage as much as 25%.

ITER Update

The good ship ITER remains at sea without a port in sight. A site was to have been chosen in December 2003 but the six ITER participants (European Union [EU], Japan, China, Russia, Republic of Korea and the United States) remain split down the middle, with the EU, China and Russia supporting a site in France and the other three supporting a site in Japan.

There have been several meetings between EU and Japanese officials, to no avail. The most serious proposal to break the deadlock, having a major ITER supporting research center with capability to conduct experiments on ITER remotely at one site and the device itself at the other, is popular in Japan only if the device itself is in Japan and popular in the EU only if the device itself is in France.

The participants have reportedly agreed on how to share the construction costs and to a large degree on how to distribute the component construction tasks. Decisions on key personnel and organizational logistics await the site decision.

At a meeting of the the USDOE Fusion Energy Sciences Advisory Committee March 29-30, USDOE Office of Science Director Ray Orbach told the committee that the U.S. was not playing an active role in trying to break the deadlock, believing it was a matter for the EU and Japan to resolve. Asked if the U.S. would consider changing its site preference to help break the deadlock, Orbach responded in the negative.

Officials at the vice-ministerial level from the European Union (EU), Japan, China, Korea, Russia and the United States, failed to reach an agreement on where to site the $10 billion International Thermonuclear Experimental Reactor (ITER) at a June 18 meeting in Vienna.

According to news reports, Japan offered to increase its contribution to the construction cost of ITER from 48% to 50% and also to pay half of an estimated $800 million cost for an auxiliary fusion facility to be built in Europe. The European Union representative reportedly matched the offer.

These reports have not been officially confirmed by either the EU or the Japanese government, but one news account states that the additional funds from Japan would be offered in part to help pay the cost of providing a remote ITER research center in France and in part as a reserve in case any of the participants backs out of the project. One news account states that during recent talks between EU and Japanese officials, "the EU suggested that the plant could be built in Japan if Japan was willing to increase its contribution to help cover the construction cost of ITER-related facilities to be built in France."

At the conclusion of the June 18 meeting the parties issued the following official statement:

"Common Message from 3rd Preparatory Meeting for ITER Decision Making (IAEA Vienna, 18 June 2004) Delegations from China, European Union, Japan, the Republic of Korea, the Russian Federation, and the United States met at the IAEA headquarters in Vienna on 18 June 2004 to advance the ITER negotiations. The two potential Host Parties, European Union and Japan, presented their positions, taking account of recent bilateral discussions on a broader approach to realising fusion energy. The parties noted that the contents of these offers were essentially symmetrical and showed a readiness of each of the potential Host Parties to contribute significantly to the realisation of elements of the Broader Approach other than ITER in addition to their contributions to ITER itself. All Parties stressed the urgency of reaching a rapid resolution of the siting issue so as to move forward to implementation of ITER in a framework of international collaboration."

In September 2002, the USDOE's Fusion Energy Sciences Advisory Committee reiterated a position it had taken a year before that if the ITER project "does not move forward" by July 2004, then the U.S. should put forth the less ambitious FIRE project "as a U.S.-based burning plasma experiment with strong encouragement of international participation." However, the USDOE has indicated it plans to terminate its FIRE activities shortly and

has already begun to redirect millions of dollars of its current fusion research effort in support of ITER on the assumption that ITER is going to proceed.

ITER news is posted at http://fire.pppl.gov

House Committee Urges Increased Fusion Funds

The Appropriations Committee of the U. S. House of Representatives has "marked up" the FY2005 appropriations bill and sent it to the full House for a vote. The bill provides $276 million to the DOE Office of Fusion Energy Sciences, $12 million more than requested by the President. The report states:

"The Committee recommendation for fusion energy sciences is $276,110,000, an increase of $12,000,000 over the budget request. The additional $12,000,000 is to be used to increase the utilization of existing large and small experiments; further work in inertial fusion technology; take advantage of opportunities in High Energy Density Physics, including research on fast ignition, and large-scale scientific computing; and provide for cost-effective construction and development of the National Compact Stellarator Experiment. The Committee notes the delay in site selection for the International Thermonuclear Experimental Reactor (ITER) and expects the Department to reduce its planned expenditures on ITER in fiscal year 2005 in consideration of this delay."

The Committee also added funds to the President's request for Inertial Confinement Fusion in DOE's National Nuclear Security Administration's budget. Construction of the National Ignition Facility (NIF) is fully funded at the request level of $130 million, but advised to focus on ignition by 2010. The University of Rochester would receive $28 million over the President's request level for Omega EP (Extended Performance) for stockpile stewardship and the High Average Power Laser Program (HAPL) for which the President once more asked for nothing would receive $25 million. Regarding the HAPL program, the Committee said, "The Committee recommendation includes $25,000,000 to continue development of high average power lasers and supporting science and technology within the Inertial Fusion Technology line."

In marking up the President's FY 2005 budget request for inertial confinement fusion in the Department of Energy's National Nuclear Security Administration's budget, the U. S. House of Representatives Committee on Appropriations issued the following report:

"Inertial Confinement Fusion Ignition and High Yield Campaign.--The Committee recommends $545,034,000 for the inertial confinement fusion program, an increase of $53,000,000 over the budget request of $492,034,000.

"The Committee is greatly concerned by the Department's fiscal year 2005 budget justification as it related to the program goals for the National Ignition Facility (NIF). In the budget justification, the NNSA seemed to waiver in its commitment to NIF by delaying the proposed date for achieving ignition from 2010 to 2014. The Committee views ignition as the sole benchmark for success in this program and is very concerned the four-year slip in the ignition milestone buried in the NNSA's budget justification documents represents a change in the Department's commitment to ignition in favor of less challenging goals for the NIF. The Committee's priority is on completion of the project in 2008 and achieving the functional requirement of first ignition in 2010. The Committee directs that no funds be expended, directly or indirectly, for additional capabilities for NIF that are not specified in the current baseline until the NIF project is completed in 2008 and ignition attempted in 2010. Any diversions represent significant risk to a project that has already experienced well-publicized cost and schedule problems. The Committee's appropriation for the ICF campaign will be controlled at the major technical effort (MTE) subprogram level noted in the Committee Report tables. Neither the Department nor the national laboratory will divert funds from within the control levels as appropriated without first submitting a formal reprogramming request to the Appropriations and Armed Services Committees.

"The Committee directs the NNSA to develop a management process that is consistent with DOE Order 413.3 and manages the ignition, diagnostic, cryogenic and experimental subprograms as projects incorporating a work breakdown structure to track scope, cost, schedule, and key milestones within a management control system. The Committee directs the NNSA to report quarterly on the milestone cost and schedule variance within the

respective experimental programs from the NIF 2000 rebaselined program.

"The Committee notes that the Defense Science Board (DSB) has been asked to review the NIF Activation and Early Use Plan. The Committee expects the NNSA to submit a copy of the NIF Activation and Early Use Plan to the Committee by September 30, 2004, and a copy of the DSB report when it is completed. The Committee expects the NNSA to insist on a review body that represents the best independent external review capability, free of professional or personal relationships that may lead to the appearance of partiality in the content of the report. The Committee recommendation provides $130,000,000 for construction of the National Ignition Facility (NIF), the same as the budget request.

"The Committee recommendation includes $25,000,000 to continue development of high average power lasers and supporting science and technology within the Inertial Fusion Technology line. The Committee recommendation includes the budget request of $11,049,000 for the Naval Research Laboratory, and $73,469,000 for the University of Rochester, an increase of $28,000,000 over the budget request. The additional funding has been provided for the University of Rochester's Laboratory for Laser Energetics within the High-Energy Petawatt Laser Development MTE to accelerate the OMEGA Extended Performance capability, a four beam super-high-intensity, high-energy laser facility for support of the nation's stockpile stewardship program. The Committee notes that, other than the few operational beams of NIF, the OMEGA facility is the only large laser implosion facility available for NNSA weapons work and will continue to be a primary laser facility for NNSA Stockpile Stewardship activities. The Committee notes that the University of Rochester is providing over $20 million for the building to house the OMEGA extended performance."

The Committee provided the Department of Energy as a whole $22.5 billion, a decrease of $670 million from the President's request, but $511 million above FY2004.The DOE Office of Science was provided $3.6 billion, $168 million over both the President's request and the FY2004 level. The Committee also provided an increase of $53 million for nuclear energy programs.

The Committee has passed the full House of Representatives but must be merged with a parallel bill which has not yet been passed in the Senate. It must then be signed by the President before becoming law.

Korean Fusion Program

After a period of small-scale basic plasma experiments in university laboratories in the 1970s and 1980s, the fusion program of the Republic of Korea initiated the KSTAR (Korea Superconducting Tokamak Advanced Research) project in 1995. The mission of the project is to develop a tokamak similar in size to ASDEX-U in Germany and DIII-D in the United States, but with superconducting magnets and capable of studying plasmas up to 300 seconds in duration.

A primary goal of the Korean fusion program is to contribute to the world fusion energy development program through participation as a partner in the joint implementation of the ITER project, to contribute useful scientific and technological information, and to join other potential international fusion projects. Korea expects to participate in ITER construction by providing, like other partners, a significant number of components contributed "in kind," and then to participate fully in the research operations. KSTAR is expected to serve as a useful pilot device for ITER operations due to its long pulse and D-shaped plasma.

Korea has joined other international fusion cooperative agreements, including the International Energy Agency (IEA) ASDEX Implementing Agreement and plans to participate in IEA fusion materials and technology agreements.

After joining the ITER Negotiations in June 2003, the Korean fusion program began a transitional period of shifting from basic science to atomic energy development. The Korean nuclear energy sector, which currently supplies 40% of Korea's electricity, is being mobilized and is in the process of reorganizing part of its R&D infrastructure for ITER development, including establishment of a dedicated unit for ITER.

The above report is drawn from an article written by Dr. Jung-Hoon Han, Head, International Cooperation Unit, National Fusion R&D Center, Korea Basic Science Institute, and published in the January 2004 ITER ITA Newsletter (available from c.basaldella@iaea.org).

New Fusion Science Centers Planned

The U. S. Department of Energy has selected the University of Maryland/University of California, Los Angeles (UCLA) and the University of Rochester to host two new Fusion Science Centers,

The universities will establish academic centers of excellence that will focus on fundamental issues in fusion plasma science. The centers are intended to strengthen the connection between the fusion research community and the broader scientific community. Education and training will be an integral part of each center's research program.

Total Department of Energy funding for the two centers over their five-year duration is expected to be nearly $12 million. Each of the selected centers also will be supported by matching funds. Each grant may be renewed once for an additional five years.

"These two Fusion Science Centers will strengthen basic research into the frontiers of fusion science, a central mission of the department's fusion energy sciences program," DOE Office of Science Director Ray Orbach said. "The centers will train students to meet the U.S. fusion program's future needs and help our fusion program communicate about our progress and accomplishments with the broader scientific community."

The University of Maryland and UCLA will jointly host a Center for Multiscale Plasma Dynamics using facilities at both of the schools. With participation from Princeton University, the Massachusetts Institute of Technology (MIT) and the University of Michigan, the center will bring together scientists with expertise in applied mathematics, theoretical and computational plasma physics and basic and performance-dominated plasma experiments. The researchers will study the interaction of microscale and macroscale dynamics in key plasma physics problems. DOE funding for the University of Maryland/UCLA-led Fusion Science Center will total $6.4 million over five years.

The University of Rochester will host the Fusion Center for Extreme States of Matter and Fast Ignition Physics. The center will develop an understanding of the physics of creating extreme states of matter using a combination of high-energy "drivers" to provide compression and high intensity lasers to provide heat. The center will involve participation of MIT, General Atomics, University of California at San Diego, Ohio State University, UCLA and the University of Texas at Austin, and it will include collaboration with the Department of Energy's National Nuclear Security Administration programs at Rochester and Lawrence Livermore National Laboratory. DOE funding for the University of Rochester-led Fusion Science Center will total $5.5 million over five years.

The Fusion Science Centers program is a response to recommendations of the National Research Council's Report, "An Assessment of the Department of Energy's Office of Fusion Energy Sciences Program."

Frascati Tokamak Upgrade

The American Nuclear Society journal, Fusion Science and Technology, edited by Nermin Uckan, has published a Special Issue (May 2004) devoted to an extensive set of papers describing the studies of tokamak physics in the Frascati Tokamak Upgrade (FTU) facility in Frascati, Italy.

Papers include an Overview, descriptions of machine design and operation, and a variety of tokamak physics studies and results, all written by the scientists working on FTU. The issue includes an appendix giving the bios of the scientists. The issue was edited by Claude Gormezano.

For further information on obtaining access to this issue, contact Nermin Uckan (uckanna@ornl.gov) or visit the journal site at http://www.ans.org/pubs/journals/fst/

Fusion Symposium in Denmark

A Symposium on Fusion Energy was held March 24, 2004 in The Niels Bohr Auditorium of the Riso National Laboratory in Denmark. The symposium, which was open to the public, was of "particular interest to those concerned with research, energy technology and supply." The symposium consisted of four presentations by prominent speakers from the European fusion research community to "motivate the need for developing fusion energy (and) present the present state of fusion research and outline the future course."

Prof. Hardo Bruhns, European Commission, spoke on the topic "What is fusion and why do we develop it?" Dr. Jerome Pamela, Associate Leader for the Joint European Torus, spoke on "JET, Europe's world leading fusion experiment." Dr. M. Chatelier, Euratom-CEA, Caderache, spoke on "ITER, an essential step towards fusion power." Dr. Gunter Janeschitz, Euratom-FZK. Karlsruhe, spoke on "The fast track to fusion power."

The agenda for the meeting is posted at http://www.risoe.dk/euratom/FusionSymposium/FusionSymposium.htm

A summary of the talks is provided in the June 2004 EFDA Newsletter, posted at http://www.efda.org

Andrew Post-Zwicker Named Education Head at PPPL

Andrew Post-Zwicker has been appointed Head of the Science Education Program at the U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL). As Head, Post-Zwicker is responsible for overseeing educational programs for teachers and kindergarten through college undergraduate students, as well as for implementing new educational initiatives at the Laboratory. Present programs range from comprehensive workshops for students and teachers, to the National Undergraduate Fellowship Research Program and the Science Undergraduate Laboratory Internships, to the New Jersey regional competition of the National Science Bowl(r) and the Science-on-Saturday lecture series.

Post-Zwicker joined PPPL's Science Education Program in 1997 as a Senior Program Leader and became Lead Scientist for the program in 2000. Since coming on board, he has created the Plasma Science Education Laboratory at PPPL, as well as the Plasma Camp and Plasma Academy programs, which are intensive summer programs for high school teachers and students, respectively.

Post-Zwicker's first goal as Head is to expand the Plasma Science Education Laboratory and to increase internal and external collaborations in the science education arena. "We began the Plasma Science Education Laboratory at PPPL two years ago as a unique resource for students and educators -- a place where they can conduct experiments and learn firsthand about the beauty of plasmas (hot, ionized gases used as the fuel for the production of fusion energy). I'm looking forward to expanding the center by better tapping into PPPL's resources -- which are made up of an amazing blend of people, equipment, and expertise -- and by increasing the number of partnerships we have with outside entities," said Post-Zwicker.

Post-Zwicker is also an Individual Affiliate of Fusion Power Associates.

In Memoriam: Bill Barr and Torkil Jensen

The U. S. fusion community lost two of its early researchers recently, Bill Barr (Lawrence Livermore National Laboratory) and Torkil Jensen (General Atomics).

Bill Barr died April 6 at age 79. He served in the U. S. army in World War II and participated in the D-Day landing at Omaha Beach. He was later wounded by a German hand grenade and received the Purple Heart. After completing a BS in Physics at the University of Washington and a Ph.D. at UC-Berkeley, he joined LLNL in 1957 and was a key research scientist there throughout his career. He specialized in developing diagnostics and making careful measurements on a series of magnetic mirror devices. He later worked on tokamak edge physics. He had a close working relationship with many, including Ralph Moir, Dick Post and Kiyoshi Yoshikawa (Kyoto University). He retired in 1989, but continued working at LLNL part time until 1995.

Torkil Jensen died May 1 in San Diego after a long bout with cancer. He was 70. Torkil was born and educated in Denmark. After being drafted into the Danish army, he was assigned to work at a new facility in Riso of the Danish Atomic Energy Commission, where he worked with the plasma physics group. He spent two years at General Atomics as a visiting scientist beginning in 1960 and later returned there permanently in 1964. He performed pioneering work on non-circular cross section plasma devices with Tihiro Ohkawa, making fundamental contributions in the areas of plasma equilibrium and stability. His passion for physics made him a great teacher and mentor, especially to the large number of new fusion scientists who entered the field during its rapid expansion in the mid-1970s. He had a close working relationship

with many, including John Gilleland and Masaji Yoshikawa (JAERI).

The fusion community will be ever grateful for their many contributions to the field.

Calendar

July 26-27 U. S. Fusion Energy Sciences Advisory Committee Meeting. Gaithersburg, Maryland. Contact: albert.opdenaker@science.doe.gov

July 26 – Aug 1 International School of Fusion Reactor Technology; 9th Course on Technology of Fusion Tokamak Reactors. Erice, Sicily. http://www.isfrt-erice.enea.it

Aug 30 – Sep 3 Theory of Fusion Plasmas. Varenna, Italy. http://varenna-lausanne.epfl.ch/

Sep 6-9 10th EU-US Transport Task Force. Varenna, Italy. http://www.ifp.cnr.it/TT04

Sep 12-17 7th International Conference on Tritium Science and Technology. Baden-Baden, Germany. http://tritium2004.fzk.de

Sep 13-17 9th International Conference on Plasma Surface Engineering. Garmisch-Partenkirchen, Germany. http://www.akplasma.org/pse2004.php3

Sep 13-18 10th International Conference and School on Plasma Physics and Controlled Fusion. Alushta (Crimea), Ukraine. Contact: garkusha@ipp.kharkov.ua

Sep 14-16 16th Topical Meeting on the Technology of Fusion Energy. Madison, Wisconsin. http://fti.neep.wisc.edu/tofe

Sep 20-22 US-Japan Workshop on New Developments in Compact Torus Research. Santa Fe, New Mexico. Contact: intrator@lanl.gov

Sep 20-24 23rd Symposium on Fusion Technology (SOFT). Venice, Italy. http://soft2004.igi.cnr.it

Sep 27 – Oct 1 2nd International School of Advanced Plasma Technology. Varenna, Italy. Contact: plasma@net.nagasaki-u.ac.jp

Oct 5-8 14th International Toki Conference on Plasma Physics and Controlled Nuclear Fusion and 4th International Conference on Atomic and Molecular Date and Their Applications. http://itc14.nifs.ac.jp

October 25-29 12 International Congress on Plasma Physics. Nice, France. http://www-fusion-magnetique.ces.fr/ICPP2004/

Nov 1-6 20th IAEA Fusion Energy Conference. Tivoli Marinotel, Vilamoura, Portugal. http://www.cfn.ist.utl.pt U.S. Participants contact: steve.eckstrand@science.doe.gov

Nov 15-18 American Nuclear Society Winter Meeting. Washington, DC. http://ans.org

Nov 15-19 46th Annual Meeting of the APS Division of Plasma Physics. Savannah, Georgia, USA. Contact: stewart@physics.utexas.edu