



# Fusion Power Report

Complete Coverage Of Worldwide Fusion Developments

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## SLANTS & TRENDS

**The European Union** chose France over Spain as their proposed site for ITER.

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**ITER Negotiators** reached agreement on cost-sharing formula for ITER construction.

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## EU Offers France for ITER Site

European Union (EU) research ministers chose France to host an ambitious project to replicate the Sun's nuclear fusion, beating a Spanish bid. The southern French town of Cadarache in southern France had been bidding against Vandellos in Spain to host the International Thermonuclear Experimental Reactor (ITER). As of November 2003, Canada and Japan were also pitching for the 4.5-billion-euro project, which will seek to replicate the kind of nuclear fusion seen in the Sun to deliver clean energy from hydrogen.

Project partners, which include the EU, Japan, the United States, Canada, China, Russia and South Korea, were expected to announce their chosen site for the reactor at a Washington meeting in December.

## ITER Negotiators Communiqué

Delegations from Canada, China, European Union, Japan, the Republic of Korea, the Russian Federation, and the United States met in Vienna on 4-5th December, 2003 to advance the ITER negotiations. The meeting was held at the headquarters of the IAEA; the meeting was moderated by IAEA Deputy Director General Werner Burkart.

The delegations said they have achieved a major milestone in the ITER negotiations, namely, full coverage of cost-sharing for the two candidate sites in the European Union and Japan.

The delegations said they are confident that this achievement provides the basis for reaching consensus on the preferred site at the Ministerial Meeting for ITER. on 20th December, 2003 in Washington, DC.

## Canada Withdraws from Negotiations

According to a posting on the ITER web site (<http://www.iter.org>), on December 23rd Canada officially announced its withdrawal from the ITER negotiations and the ITER Transitional Arrangements. Writing to the heads of the negotiating delegations, Dr. P. Busquin (for Euratom), Mr. X. Guanhua (China), Mr. T.Kawamura (Japan), Minister H-K. Park (Korea), Mr. A. Romyantsev (Rus-

sian Federation), and Mr. S. Abraham (USA), the Hon. R. J. Efford (PC, MP) of Canada stated:

"I am writing to advise you of the decision by the Government of Canada to withdraw from the ITER negotiations. As you know, Canada participated in the design phase of the project and has been a party to the subsequent international negotiations. Iter Canada, a private-sector consortium, developed an offer (the Iter Canada Plan to Host ITER) to locate the project at Clarington, Ontario. Based on the excellent attributes of the Clarington site, which include major technical and cost advantages, the offer was presented by Canada to the international Parties at the June 2001 ITER meeting in Moscow. In June 2002, the European Union presented the French site at Cadarache and the Spanish site at Vandellos while Japan tabled its site at Rokkashomura. In light of the competitive offers submitted, including significant government financial backing, Canada indicated in December 2002 that it would review the ITER Canada Plan to Host and consider whether to table a revised offer.

"Further to discussions conducted with the Government of Ontario and Iter Canada, a decision has been made that Canada will not table a revised offer to host the project, nor participate as non-host. Given present priorities and other demands, Canada is not in a position to table a competitive package that would lead to Canada becoming the host to the ITER project. It has been a difficult decision to reach, and it is with regret that Canada is withdrawing from the ongoing negotiations. Canada is also notifying the International Atomic Energy Agency that Canada will be withdrawing from the ITER Transitional Arrangements.

"I understand that the international negotiation process is reaching the final stage. I would like to send my strong encouragement and best wishes to you and the other parties for a successful implementation of the ITER project."

## ITER Site Decision Delayed

Government officials from the European Union, Russia, Japan, United States, China and Republic of Korea, met December 20 in Washington, DC, with hopes of selecting a site for the International Thermonuclear Experimental Reactor (ITER) project, but the "ministerial level" delegates postponed the decision until February 2004.

Officially the delegates stated that both the European site in France and the Japanese site were "excellent" and that more information would be sought before a site was chosen

Unofficial reports from the meeting indicated that the six parties were split down the middle, with Europe, Russia and China favoring the European site, while Japan, the US and Korea favored the Japanese site. One news report indicated that Korea moved to a neutral position during the day-long meeting.

The official communiqué from the meeting reads as follows:

"The Six Parties have reached a strong consensus on a number of points.

"We have two excellent sites for ITER, so excellent in fact that we need further evaluation before making our decisions based on consensus.

"We have agreed to provide the remaining questions to the candidate host parties by the end of December for their answers by the end of January.

"We will ask the ITER team in conjunction with the ITER Parties to conduct a rapid exploration of the advantages of a broader approach to fusion power. This work will be done on the same schedule.

"With all this information, we plan to hold a follow-up Ministerial meeting to reach consensus as quickly as possible, likely to be in February."

The Official communiqué and other reports on the meeting are posted at <http://fire.pppl.gov>

To respond to the request for "to conduct a rapid exploration of the advantages of a broader approach to fusion power," a meeting of technical experts from the six parties met in Garching, Germany, January 8-9 to discuss technical opportunities for broader collaborations. A second meeting, involving government personnel is planned for late January, with the expectation that these discussions will provide, in part, the necessary elements for a second ministerial meeting in February.

## Abraham Endorses Japan as ITER Site

On January 9, the United States, for the first time publicly, backed Japan to host the ITER multi-billion-dollar experimental nuclear fusion reactor instead of France, saying it offered a superior site. The project will either be sited in the French town of Cadarache or the northern Japanese village of Rokkasho-mura.

"I am proud to say today that the United States strongly supports building ITER here in Japan. From a technical standpoint you offer the superior site," US Secretary of Energy Spencer Abraham told a gathering of Japanese business leaders during a visit to Tokyo. "The location of Rokkasho is superbly situated to receive the large materials needed for ITER. Your technical and engineering skills are known and admired in every corner of the world. What is more, the local community clearly welcomes this project and has always gone out of its way to encourage the siting of ITER in Rokkasho," Abraham said.

A spokesman for the US embassy in Tokyo confirmed it was the first time that Washington had gone on record in support of the Japanese bid. "We feel extremely encouraged by his comment," an official from Japan's science and technology ministry commented. "We will continue to work with other countries so that we can build ITER in Rokkasho-mura."

A French source close to ITER said it would have been better for Abraham to have waited for the completion of ongoing technical studies before commenting saying, "The remarks of the US secretary amount to a questionable way of disrupting the study."

Links to other ITER reports are posted at the Fire web site: <http://fire.pppl.gov>

## ITER Tops DOE New Facilities Priority List

Energy Secretary Spencer Abraham, on November 10, unveiled plans to build 28 new major science facilities over the next 20 years. ITER, the International Thermonuclear Experimental Reactor, tops the prioritized list, which was prepared under the direction of DOE Office of Science Director Ray

Orbach. "Investment in these facilities will yield extraordinary scientific breakthroughs -- and vital societal and economic benefits," Abraham said.

Abraham said, "The list identifies 12 facilities as near-term priorities. Priority one is ITER, an international collaboration to build the first fusion science experiment capable of producing a self-sustaining fusion reaction, called a "burning plasma."

Further details can be found at:

[http://www.sc.doe.gov/Sub/Facilities\\_for\\_future/sc20-year\\_facilities\\_plan\\_overview.doc](http://www.sc.doe.gov/Sub/Facilities_for_future/sc20-year_facilities_plan_overview.doc)

## Orbach Speaks to FPA Meeting

Speaking at Fusion Power Associates annual meeting and symposium, Forum on the Future of Fusion, November 19 in Washington, DC, U.S. Department of Energy (DOE) Office of Science director Dr. Raymond L. Orbach told the meeting that he was committed to getting the ITER agreement done.

ITER, he said, is "first of a kind," and "precedent-setting," in terms of collaboration on a major scientific experiment and in learning how to negotiate with international partners.

Orbach said "The case for fusion was given by President Bush in a speech on February 6, 2003," noting that the President said, at the same time, the U.S. would rejoin ITER and described the role of ITER in the energy future of the U.S. and the world. He noted that "now we also have a statement of support for ITER from Congress as well."

He noted that he had ranked ITER as the "number one" priority on his list of DOE science facilities marked for future construction, in a recently completed DOE planning document.

He also noted that a next step Spherical Torus was on the list of priorities for the long term, as well as a "Fusion Contingency" project to take advantage of results following ITER.

Regarding the contingency project, Orbach said we will need to have a way of testing materials and components for fusion applications. We do not know for sure what kind of facility or facilities will

be required, he said. He said he has asked for a workshop to be held in the Spring of 2004 to look specifically at whether it is possible to develop a model based on fission neutron irradiation and Spallation Neutron Source irradiation, coupled with the capabilities ultrascale computing. We are also using nanoscience to create new materials, with low or no activation, he said.

Orbach said he recognized the need to develop materials for future fusion plants and had asked that a workshop be convened in the Spring of 2004 to consider this issue.

Finally, he noted that both the Energy Bill now before Congress and recent Appropriations Committee actions showed strong Congressional support for fusion.

A summary of his remarks, as reported by Office of Fusion Energy Sciences director, Dr. N. Anne Davies, is posted at [http://fire.pppl.gov/fpa\\_annual03.html](http://fire.pppl.gov/fpa_annual03.html)

## FPA Annual Meeting Presentations Posted

Presentations at Fusion Power Associates November 19-21, 2003, annual meeting and symposium, Forum on the Future of Fusion, are posted at [http://fire.pppl.gov/fpa\\_annual03.html](http://fire.pppl.gov/fpa_annual03.html)

The presentations include a perspective on fusion within the U.S. government from Dr. Ray Orbach, director of the DOE Office of Science, and from Dr. Joel Parriott, fusion budget examiner at the White House Office of Management and Budget.

A comprehensive set of presentations on the status of ITER is included, as well as a series of talks on the status of burning plasma and tokamak physics, and also an overview of the innovative concepts program and spherical torus research.

A comprehensive set of presentations is also included on all aspects of inertial fusion, including the present status of the National Ignition Facility (NIF).

Overviews are also presented of both the Office of Fusion Energy Sciences programs and the inertial confinement fusion program of the National Nuclear Security Administration.

A summary of the symposium will be published in the Journal of Fusion Energy at a later date.

## Parriott Provides OMB Perspective

Dr. Joel Parriott, fusion program budget examiner at the White House Office of Management and Budget, told Fusion Power Associates annual meeting that "The (fusion) community's push for ITER, and the President's ultimate decision to re-enter negotiations, irrevocably changed the context for the U.S. fusion program within the Executive Branch." He said, "The Administration is attempting to ensure a successful conclusion to the negotiations, but this change in context will remain no matter the outcome." Parriott cautioned, however, "Interest in ITER does not necessarily imply interest in FIRE or other fusion projects."

Parriott noted that "perspectives can differ" between Congress and the Executive Branch. He noted that a recent appropriations bill conference report stated "The conferees strongly caution the Department against submitting any future budget requests for ITER that are funded at the expense of domestic research." But Parriott said that, to him, "Comparing ITER with domestic research is a distinction without a difference." His view is "There's ONE internationally-aware scientific program, with burning plasma issues as the top priority."

Referring to the recently announced fusion priorities study being conducted by DOE's Fusion Energy Sciences Advisory Committee (FESAC), Parriott said the fusion community should not "underestimate the importance of this effort." He said "this study should explicitly prioritize the science by ranking questions that you want to answer, not machines you already have or want to build." He said the study, if done properly, will provide "the tools to build a science-based case with true budget and performance integration."

Parriott said that, in his opinion, "It is not credible to promise date-certain delivery of commercial fusion power." Fusion is "a basic research program, not an energy development program," he said.

Parriott said that "high energy density physics (not energy delivery) should be the driver for inertial fusion energy investments, and public in-fighting with magnetic fusion energy on which technology

can get to fusion power sooner/cheaper is not a fruitful path to follow."

## NIF Progress Continues

Dr. Bruce Warner of the Lawrence Livermore National Laboratory told Fusion Power Associates annual meeting that construction of the laser-based National Ignition Facility (NIF) "continues to meet its technical performance, cost and schedule milestones." Also, NIF has been conducting initial experimental operations using the first four of its eventual 192 laser beams. During November 2003, NIF Commissioning and Operations teams executed more than 25 laser shots to measure amplifier performance under various system configurations. These shots successfully mapped laser efficiency across many operating parameters, including amplifier slab configurations and flashlamp input voltages, and demonstrated a single beam pulse energy of 26 kJ and peak power of 8 TW. The initial operations, termed "NIF Early Light," have fired more than 200 system shots. The 18-month effort to NIF Early Light is accelerating NIF's transition to an experimental facility and providing critical engineering feedback on the design and assembly of laser components.

## Inertial Fusion for National Security Described

Dr. David Crandall, Assistant Deputy Administrator for Research, Development & Simulation, at DOE's National Nuclear Security Administration (NNSA), told Fusion Power Associates annual meeting that fusion ignition "is a major goal for NNSA/Defense Programs and will be a major focus." He said that although "Defense Programs does not have an energy mission, ignition supports the DOE's Office of Fusion Energy Sciences (OFES) mission and OFES use of NNSA's inertial confinement fusion facilities is accepted." He said that "inertial fusion will be achieved, probably in various forms" and that the "precise nature of technology best suited to exploit ignition for energy will depend on what approach works best."

Crandall noted that "ignition appears feasible over a wider range of target and laser conditions and that range may widen further within a few years." "Predicted gains (fusion energy produced/laser energy input) have increased," he said. He said that "direct drive ignition shows promise," and that "recent ex-

periments have shown improved target performance" for both direct and indirect drive. He also noted that "significant progress has been made in producing cryogenic targets for both x-ray and direct drive."

Crandall reported that a refurbishment of the Z facility at Sandia National Laboratories is in progress at a total cost of \$57 million over 4-5 years. The facility, to be called ZR, will have somewhat higher current and energy per pulse than the present Z facility. He also noted that plans are underway for a \$45-55 million "extended performance" upgrade to the Omega laser at the University of Rochester. Two high-energy petawatt lasers will be added to Omega for advanced backlighting and fast ignition experiments. Crandall said "a worldwide race for high-energy petawatt lasers is in progress."

## House, Senate Conferees Agree on FY04 Fusion Funding

House and Senate Conferees have resolved differences in their separate appropriations bills to provide FY04 funding to fusion and other Department of Energy Programs. The agreement is expected to be passed shortly and signed by the President.

The agreement provides \$264.1 M, to DOE's Office of Fusion Energy Sciences, an increase of \$6.8 M over the President's request. It directs this money be provided to non-ITER-related activities to domestic fusion programs that had been largely eliminated in the fusion technology areas in the President's budget. It also provides \$517.3 M to DOE's National Nuclear Security Administration's inertial confinement fusion program, an increase of \$50.5 M over the President's request.

The agreement provides \$25 M to continue the high average power laser program. For several years DOE has consistently refused to request funds for this program and Congress has consistently added the funds for this excellent program. The agreement also provides \$4 M to "initiate assessments and initial development and testing of Z-pinch inertial fusion energy. These two programs are to be funded within the DOE's National Nuclear Security Administration's inertial confinement fusion program.

The text of the conferee's report is as follows:

Fusion energy sciences.--The conference agreement includes \$264,110,000 for fusion energy sciences, an increase of \$6,800,000 over the budget request. The budget request proposed \$12,000,000 for the International Thermonuclear Experimental Reactor (ITER), but did so by displacing \$10,800,000 of ongoing domestic fusion research. The conference agreement provides \$8,000,000 for ITER activities in fiscal year 2004, and restores \$6,800,000 to domestic fusion research. The conferees strongly caution the Department against submitting any future budget requests for ITER that are funded at the expense of domestic research.

Inertial Confinement Fusion (ICF) Ignition and High Yield.--The conferees include \$517,269,000 for the inertial confinement fusion ignition and high yield program, an increase of \$50,500,000 over the budget request.

National Ignition Facility.--Within the funds provided, \$150,000,000 is for National Ignition Facility (NIF) construction, Project 96-D-111, and \$367,269,000 is for the ICF ignition and high yield program. Within the funds provided for the NIF program, the conferees direct the Department to fund a public-private research and development activity focused on damage resistant gratings at not less than \$1,000,000.

The conferees note that NIF construction funds and NIF program funds have been provided consistent with the Administration's request, but are concerned that these budget figures are not consistent with the revised NIF baseline due to the Department's decision to fund a variety of NIF-related projects and programs within the overall NIF program. While the conferees are supportive of these activities and believe them necessary to achieve the goal of ignition, they strongly recommend that the Department submit future budgets that fund these activities as one or more separate line items.

Inertial Fusion Technology.--The conferees also include \$25,000,000 to continue development of high average power lasers and supporting science and technology, the budget request of \$10,467,000 for the Naval Research Laboratory, and \$63,132,000 for the University of Rochester, an increase of \$20,000,000 over the budget request. The additional funding is provided to the University of Rochester's Laboratory for Laser Energetics for the OMEGA Extended Performance (EP) facility in support of the Nation's stockpile steward-

ship program. The conferees expect additional funding requirements to complete Omega EP construction will be included by the Department in future budget requests. Additionally, the conferees provide funding of \$4,000,000 to initiate assessments and initial development and testing of Z-Pinch inertial fusion energy.

Petawatt Lasers.--The conferees also include an additional \$4,500,000 for university grants and other support. Within this amount, \$2,500,000 is provided for the continued development of an ultra short-pulse petawatt laser at the University of Texas; and \$2,000,000 is provided to continue short-pulse laser development and research at the University of Nevada-Reno.

The conferees agree with the Senate position that high intensity laser physics enables major new areas of science and engineering endeavor in the United States and that advances in this field will enable important progress in critical aspects of basic science, fusion energy, and national security. A robust, coordinated program in high intensity lasers will affordably maintain U.S. leadership in this critically important area. Accordingly, the conferees direct the Department to pursue a joint high intensity laser program with the National Science Foundation. The conferees further direct the NNSA and the Department's Office of Science to develop, in collaboration with the NSF, a report that identifies the benefits and disadvantages of multi-agency coordinated research in high intensity laser science and delineates how a joint program in this area will be structured. This report shall be delivered to the House and Senate Committees on Appropriations no later than April 15, 2004.

The President subsequently signed the appropriations into law.

## Asdex Upgrade

The American Nuclear Society journal, Fusion Science and Technology, edited by Nermin Uckan, has published a Special Issue devoted to an extensive set of papers describing the studies of tokamak physics in the Asdex Upgrade facility in Garching, Germany.

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 Asdex-U. The issue includes

an appendix giving the bios of the scientists. The issue was edited by Albrecht Herrmann.

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

## Position Available at General Atomics

General Atomics in San Diego is seeking candidates for the 2004 General Atomics (GA) Rosenbluth Award for Fusion Theory for scientists in their early careers.

This is a visiting or post-doc position working on a mutually agreed on theory topic. The salary for the post-doc will come from their usual funding sources. In addition, GA will provide a stipend of \$25K/year to be used toward living expenses and other costs.

The details can be found at:  
<http://web.gat.com/awards/rosenbluth.html>

The 2003 award recipient can be found at:  
<http://web.gat.com/theory/>

The deadline for application is February 1, 2004.

For further information, contact:

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fax: (858)455-3586

## APS Names New Fellows

The American Physical Society (APS) has named Dr. N. Anne Davies, head of the Department of Energy's Office of Fusion Energy Sciences, as a Fellow of the Society. Davies, whose nomination was sponsored by the APS Forum on Physics and Society, citation reads "for her successful efforts guiding the fusion research community through a difficult transition from a program of energy technology development to a healthy program focused

on the critical scientific and technology foundations of fusion energy research."

Other new Fellows, sponsored by the APS Division of Plasma Physics, include Y. Aglitskiy (U.S. Naval Research Laboratory), D. Brower (UCLA), R. Fitzpatrick (U. Texas, Austin), S. Hatchett (LLNL), C. Hegna (U. Wisconsin), M. Horanyi (U. Colorado), A. Hubbard (MIT), R. Kaita (PPPL), P. Kintner (Cornell U.), R. La Haye (General Atomics), R. Petrasso (MIT), N. Pomphrey (PPPL), and K Tanaka(Osaka U.).

## Calendar

Feb 1-5 13<sup>th</sup> Gaseous Electronics Meeting. Bateman's Bay, NSW. <http://www.physics.mq.edu.au/gem2004>

Mar 10-13 5<sup>th</sup> International Conference on High Energy Density Laboratory Astrophysics. Tucson, Arizona. Contact: [afrank@pas.rochester.edu](mailto:afrank@pas.rochester.edu)

April 19-22 15<sup>th</sup> Topical Conference on High-temperature Plasma Diagnostics. San Diego. <http://fusion.gat.com/conferences/htpd2004>

April 26-28 International Sherwood Theory Conference. Missoula, Montana. Contact: [aware@selway.umt.edu](mailto:aware@selway.umt.edu)

May 25-28 Innovative Confinement Concepts Workshop (ICC2004). Madison, Wisconsin. Contact: [hooper1@llnl.gov](mailto:hooper1@llnl.gov)

June 7-11 2004 International Symposium on Heavy Ion Inertial Fusion. <http://nonneutral.pppl.gov/HIF04>

June 13-17 2004 International Congress on Advances in Nuclear Power Plants. Pittsburgh, PA. <http://www.ans.org/goto/icapp04>

June 27 – July 1 Thirty-first IEEE International Conference on Plasma Science (ICOPS2004). Hyatt Regency, Baltimore, Maryland. Contact: [commisso@suzie.nrl.navy.mil](mailto:commisso@suzie.nrl.navy.mil)

July 5-9 5<sup>th</sup> International Conference on Open Magnetic Systems for Plasma Con-

finement. Novosibirsk, Russia. <http://0s2004.inp.nsk.su>

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

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

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

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

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