stellarator news

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NCSX design review

The National Compact Stellarator Experiment (NCSX) project completed a successful preliminary design review (PDR) October 7–9 at Princeton Plasma Physics Laboratory (PPPL). The review focused on the project's design and R&D progress, and its cost and schedule estimates. The review team brought a diverse background in project engineering and management, with members from Auburn University, Brookhaven National Laboratory, Boeing Company, Fermi National Accelerator Laboratory (FermiLab), General Atomics, Max Planck Institut für Plasmaphysik (IPP) Garching, Germany, Los Alamos National Laboratory, Massachusetts Institute of Technology (MIT), Oak Ridge National Laboratory (ORNL), PPPL, and the University of Wisconsin. Among them were four of world's leading stellarator builders: Jörg Sapper (W7-AS), David Anderson (HSX), Ray Johnson (ATF), and Steve Knowlton (CTH). A photograph of the review panel and project team members, taken in the NCSX test cell (from which the PLT and PBX-M tokamaks were recently removed) is shown at right.

The PDR is the key technical review in a series of reviews leading up to Critical Decision 2 (CD-2), approval of the project baseline, by the U.S. Department of Energy (DOE). The primary objectives were to establish the technical soundness of the project and to obtain feedback and recommendations from experts on how the design, plans, and cost and schedule estimates could be improved. At the review, the project presented the self-consistent performance, scope, cost, and schedule parameters, and the technical basis in design and R&D. The modular coils and the vacuum vessel were highlighted, since these subsystems are the most technically challenging and contain the greatest risk. All other subsystems have much lower risk—they are either adaptations of existing equipment or new equipment based on proven designs.

Attendees at the NCSX preliminary design review, Oct. 7–9, 2003, photographed at the future site of the stellarator device. From left to right, Charlie Gentile, Erik Perry, Pamela Hampton, Gene Nardella (DOE-OFES), Dave Anderson* (U. Wisconsin), Tom Brown, Ron Strykowsky, Rod Templon, Mike Zarnstorff, Charles Neumeyer*, Mike Viola, Dave Williamson (ORNL), Mike Cole (ORNL), Bob Simmons, Dave Mikkelsen, Judy Malsbury, Jim Anderson* (LANL), Jim Lyon (ORNL), Carl Strawbridge* (ORNL), Peter Wanderer* (Brookhaven), Brad Nelson (ORNL), Paul Goranson (ORNL), Suneel Kapur (DOE-OECM), Jörg Sapper* (IPP-Germany), Ray Johnson* (ORNL), Kin Chao (DOE-SC), Jim Irby* (MIT), Steve Knowlton* (Auburn U.), Long Poe Ku, Jim Chrzanowski, Paul Anderson* (General Atomics), Greg Pitonak (DOE-PAO), Bill Blanchard, John Schmidt, Dave Rasmussen* (ORNL), Tom Nicol* (FermiLab.), Irving Zatz, Raki Ramakrishnan, Dan Driemeyer* (Boeing Co.), Jerry Levine, Hutch Neilson. Those without institutional identification are from PPPL.
* Members of the review panel.

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In their final report, the members of the review panel stated, "The Preliminary Design Review (PDR) committee found that the NCSX design is technically sound, the management plans and budget are adequate, and the project is ready for CD-2." Concerning the critical subsystems, they concluded, "The present state of the modular coil design is very well developed and the technical basis is sound. Proposed budgets to develop and fabricate the modular and conventional coils are sufficient, although the schedule is tight," and "The vacuum vessel design is also very well advanced, has incorporated lessons-learned from previous projects, and meets the NCSX performance parameters. The fabrication approach is well founded and budgets appear adequate." The report included 24 recommendations for improving the design and plans, including recommendations for more R&D on the copper-epoxy conductor composite, for expediting delivery of the first complete vacuum vessel sector for detailed evaluation, and for demonstrating crucial field-period assembly operations with a full-scale mockup. They concluded that the recommendations from the May 2002 conceptual design review have been satisfactorily addressed. The full text of the report is available at http://www.pppl.gov/ncsx/Meetings/PDR/NCSX_PDR_Panel_Report.pdf. The project now moves to the next step in the review process, a DOE Performance Baseline Review November 18–20, conducted jointly by the Office of Science (D. Lehman's organization) and an independent review team of outside experts reporting to DOE's Budget Office.

The mission of NCSX is to acquire the scientific and technological knowledge needed for understanding the behavior of a compact stellarator plasma, evaluating the attractiveness of this fusion concept, and advancing the state-of-the-art, three-dimensional analysis of fusion plasmas. The compact stellarator is one of several innovative magnetic fusion plasma configurations supported by the U.S. Fusion Energy Sciences Program and has the attractive potential of operating continuously and without plasma disruptions. Also, when extrapolated to a fusion power plant, the compact stellarator is projected to require low operating power compared with that produced by the power plant. The NCSX project involves the construction of the stellarator core device and various auxiliary power, heating, cooling, vacuum, cryogenic, and control systems, as well as a set of startup diagnostics. All of this equipment plus a control room will be located in existing buildings at PPPL that were previously used for other fusion experiments. The project is led by PPPL and ORNL in partnership and will be operated as a national facility for fusion and plasma physics research. Further information about NCSX is available on the project's web site http://www.pppl.gov/ncsx/ or by contacting Hutch Neilson, PPPL, at hneilson@pppl.gov.

International Stellarator Workshop

More than 140 stellarator researchers from Germany, Japan, Spain, the United States, Australia, Sweden, Ukraine, Russia, and Austria gathered at IPP-Greifswald for the 14th Stellarator Workshop the week of 22 September–1 October 2003.

This was the first in this series of biannual workshops—which date back nearly 30 years—to be held in the new Institute, in Greifswald. Because of the significance of the new Wendelstein VII-X project now under construction, it will not be the last.

More than 50 oral papers and nearly 100 poster papers were presented. The topics presented included overall summaries of results from major devices like the Japanese LHD and German WVII-AS and targeted experiments on these and many smaller devices, theoretical work on plasma stability and transport, and design and engineering activities for the new generation of stellarator devices.

Experiments are now being conducted on nine stellarators around the world. These range from low-power (a few kW) experiments on devices like TJ-K (Kiel) and Wega (Greifswald) to moderate power (50 kW–1 MW) experiments on HSX (USA), H-1NF (Australia), TJ-II (Spain), and Heliotron-J (Kyoto, Japan) to high power (MW and more) on CHS (NIFS, Japan) and LHD (NIFS, Japan). A major purpose of the Stellarator Workshops is to bring together results from these experiments and supporting and fundamental theory so as to form a composite picture of confinement in stellarators and how to develop the stellarator as a fusion power reactor.

This synthesis is increasingly important because the size, power, and complexity of the next-generation experiments under construction, such as Wendelstein VII-X and NCSX (USA) has extended construction times to more than five years, so that researchers must anticipate experiments well in advance and take advantage of all the existing information from presently operating devices. The informal program of the Workshop, involving private discussions and planning for joint research projects, plays an essential role in this process.

The research presented at the Workshop covered topics such as energy confinement scaling; magnetic configuration optimization and its experimental effects; plasma turbulence, transport, and flows; high-pressure plasma stability; plasma-wall interactions; and advanced stellarator engineering. The Workshop also featured a number of papers summarizing closely related research on tokamak confinement. Papers from the workshop are available on line at

http://www.ipp.mpg.de/eng/for/veranstaltungen/workshops/stellarator_2003/index.html

The Workshop also served as an introduction to IPP-Greifswald for many of the international researchers, who will become collaborating researchers on Wendelstein VII-X over the next decade.

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Stellarator News has moved!

As shown in the header, *Stellarator News* has a new web page and address. The address change reflects the October move of the ORNL Fusion Energy Division to the new Research Office Building at the main ORNL site.