SPALLATION NEUTRON SOURCE
A U.S. Department of Energy Multilaboratory Project
SNS

THE NEUTRON PULSE

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Inside This Issue

The SNS site changes daily as great progress continues. As of February 2002, 24% of the technical hardware and 22% of the conventional construction are complete. Overall, the project is about 40% complete, with 91% of the research and development (R&D) and 75% of the design complete. Procurements for more than $315M in equipment and services have been placed. Major procurements during the past year include general construction for some key buildings; accelerator structures, radio-frequency systems, and power supplies; ring magnets and power supplies; and target core vessel structures.

Since the initial June 2001 concrete pour for the Front-End Building foundation, there have been many days when most of the concrete trucks in this region were delivering to SNS. Concrete for the initial pour of the Target Building foundation was delivered in one day to two pumper trucks by 78 10-yard trucks. This event was captured on video and can be viewed on the web at http://media.cind.ornl.gov:558/ramgen/SNS/SNS_Cpour.rm. The 5-foot-thick foundation is nearing completion, and the basement walls are going up. Concrete pouring for the front end and linac tunnel is complete, and pours for the Klystron Building and proton accumulator ring tunnel are progressing. Concrete shielding from Lawrence Berkeley National Lab has arrived and awaits placement in the Front-End Building. In addition, steel erection is complete on the Front-End Building and is extending into the Klystron Building. Turnover of the Front-End Building for installation of technical hardware is scheduled for May.

The Tennessee Valley Authority is constructing the switchyard for delivery of 70 MW of operating power, equivalent to power for 35,000 homes. Structural steel shop drawings for the Ring, Central Utility, Central Helium Liquefier (CHL), and Target buildings are being prepared. More than 5500 tons of rebar–steel reinforcing rods–will be used for project structures. The Target Building deep foundation alone contains 937 concrete pilings, reinforced with steel pipe. These pilings range from 35 to 181 feet deep and are seated 10 feet deep into bedrock. Five tests were conducted on the pilings; both tension and compression were tested to 800,000 lb. In addition, water tower construction is complete, and painting is beginning. Design of the cooling tower is near completion, with construction to begin soon.

Contracts were awarded for the Central Utilities Building, the CHL, and site utilities, and construction on these is under way. In January, contracts for the ring general construction, air-handling units, and fire alarm system were awarded. The two largest individual construction contracts to be awarded (general construction of the Target Building and the Central Laboratory and Office Building) will be awarded this summer.

Director's Comments

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The SNS project continues to be on schedule and on budget. The project emphasizes safety, with encouraging results. With over one-half million construction hours logged through March, major on-site construction continued safely with no lost work days and just seven minor recordable injuries.

On the financial front, SNS continues on its planned funding profile. Congress approved full funding of $291M for FY 2002, which is the peak annual funding for the project, and the administration has requested $225M in the FY 2003 budget. At this funding rate, construction will be about 60% complete at the end of FY 2003.

Two other U.S. Department of Energy (DOE) proposals include an additional $5M for development of instrumentation to exploit the scientific potential of SNS; this is part of DOE's multiyear package for instrument development at neutron and x-ray facilities. We are also pleased that DOE has selected Oak Ridge National Laboratory (ORNL) as the location for the Center for Nanophase Materials Science. The center will be collocated with the SNS Central Laboratory and Office (CLO) Building and will be completed in 2006. Discussions in Congress on these appropriations will continue through the summer.

Aerial view of the SNS site.

Recent issues of *The Pulse* have described many of the SNS instruments and technical infrastructure. In this issue, we focus on two sister facilities (the Center for Nanophase Materials Sciences and the High Flux Isotope Reactor) that will complement SNS and be of interest to our users.

You should be able to see the outline of SNS from the air as you visit Knoxville for the American Conference on Neutron Scattering, and we look forward to seeing you there.

Ian Anderson Leads Experimental Facilities Division

Ian Anderson succeeds Thom Mason as director of the SNS Experimental Facilities Division (XFD). Ian received his bachelors and masters degrees from the University of Cambridge and an M.S. and Ph.D. in physics from the University of Birmingham. He was a research scientist at the Institut Laue Langevin (ILL) in Grenoble, France, from 1979 to 1984. In 1985 and 1986, he worked for the National Institute of Standards and Technology in Maryland to develop and improve instrumentation for neutron research. From 1986 to 1991, he served as head of the Neutron Guide Project of the SINQ Spallation Source at the Paul Scherrer Institut in Switzerland. Ian returned to the ILL in 1992 to become head of the Neutron Optics Laboratory. In this effort, he led a team of 20 scientists and technicians who were responsible for the development and production of optical elements for neutron and x-ray beam lines.

As director of the XFD, Ian will be responsible for the R&D, construction, installation, preoperations, and operations of the instrument and target systems. He will be responsible for establishing, coordinating, and enhancing close ties to the neutron science user community. Currently, XFD has more than 100 staff located at ORNL and Argonne, with a budget of ~$180M.

CNMS

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Artist's conception of the CNMS office and laboratory buildings.

The Center for Nanophase Materials Sciences (CNMS) is a multidisciplinary and highly collaborative nanoscience research center being developed by DOE's Office of Basic Energy Sciences (BES). The CNMS will be located at the SNS site along with the Joint Institute for Neutron Sciences. The CNMS will integrate nanoscale research with neutron science, synthesis science, and theory/modeling/simulation, bringing together four areas in which the United States has clear national research and educational needs.

The center's research will be organized under three scientific thrusts: (1) nano-dimensioned "soft" materials (including organic, hybrid, and interfacial nanophases), (2) complex "hard" materials systems (including the crosscutting areas of interfaces and reduced dimensionality that become scientifically critical on the nanoscale), and (3) theory/modeling/simulation. Distributed over these thrusts will be about ten evolving collaborative research focus areas, which are being developed in collaboration with the scientific community through a series of workshops.

The intense neutron beams available at SNS and the upgraded High Flux Isotope Reactor will be used to make broad classes of nanoscale phenomena accessible for fundamental study. The CNMS will help the neutron science R&D community assume a leadership role in emerging research on nanoscale materials and processes. The Nanomaterials Theory Institute will help stimulate U.S. leadership in the use of theory/modeling/simulation to design new materials and investigate new pathways for their synthesis.

The CNMS will occupy an 80,000 ft^2 building specially designed for collaborative nanoscience research. The four-story main building will include wet/dry laboratories and offices for ~190 staff. A connected single-story Nanofabrication Research Laboratory will include clean-room facilities for nanomaterials fabrication, as well as spaces that meet the low electromagnetic field, vibration, and acoustic noise requirements of electron-beam instruments. Synthesis (and subsequent characterization) of nanophase materials will be an essential component of CNMS.

Location of the CNMS on the SNS site.

The CNMS will provide a multidisciplinary environment for research and for the education of students and postdoctoral scholars. The core research staff will be a mix of ORNL and long-term visiting staff, many from universities. Financial support for these staff will come from CNMS and the staff members' ongoing research grants. Postdoctoral researchers will be supported jointly with collaborating (mainly university) research groups. Graduate students and short-term visitors will apply for access to CNMS through a proposal selection committee using a simple peer-review system. CNMS will provide scholarships covering local living expenses for graduate students and short-term visitors whose proposals are selected.

The center's second planning workshop is scheduled for June 22–25, 2002, in Knoxville, Tennessee. More information is available at www.ms.ornl.gov/nanoworkshop/nanointro.htm.

HFIR Completes Maintenance Outage, Resumes Operation

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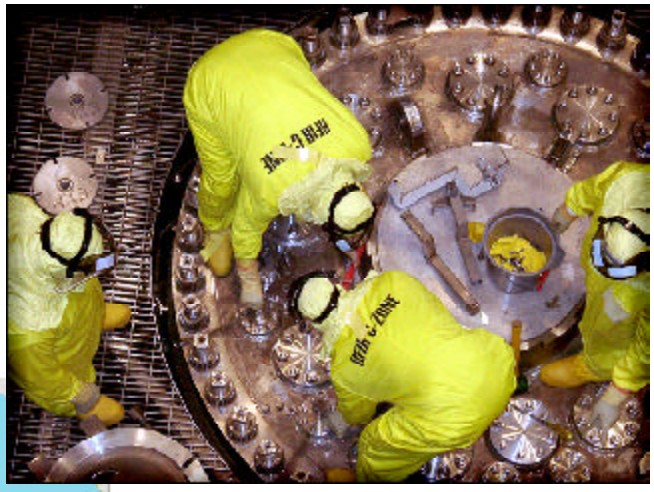
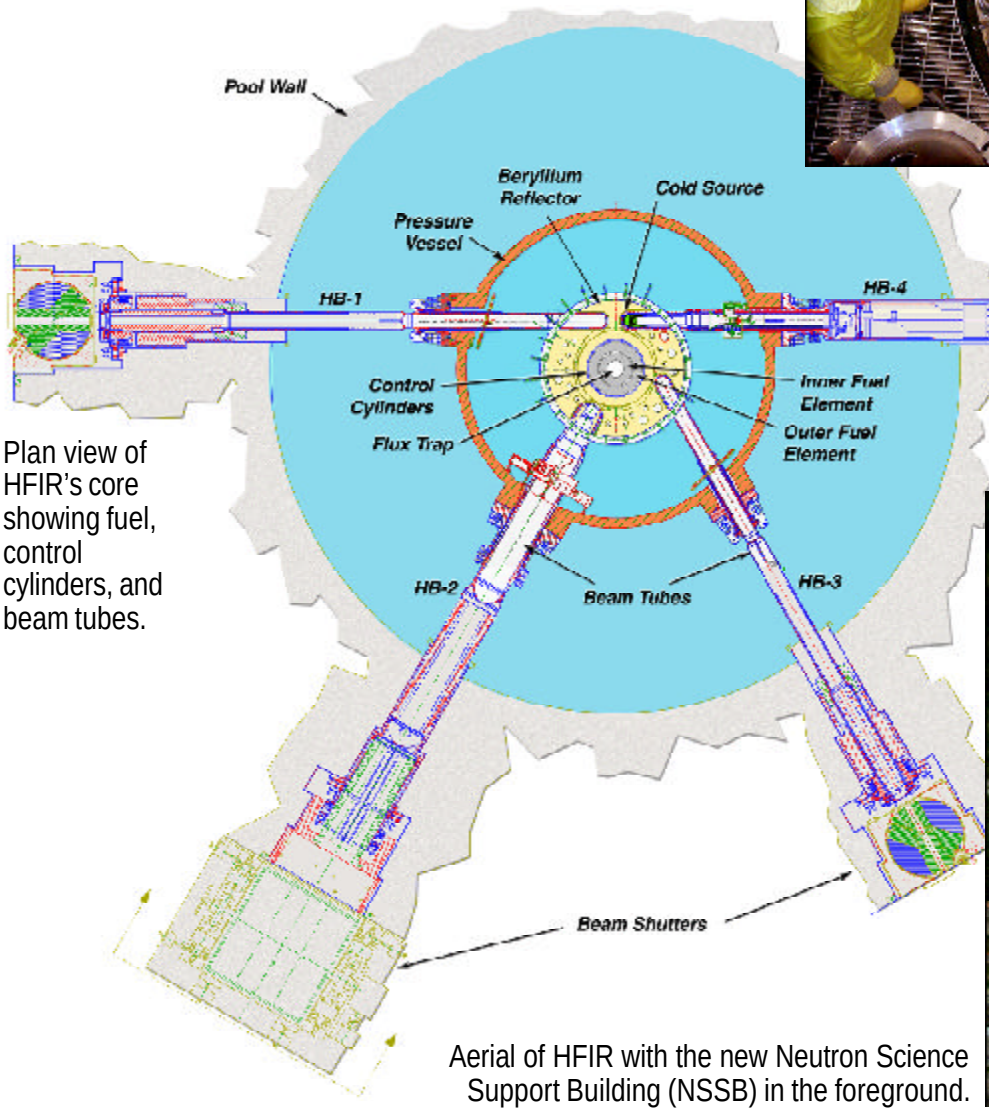
The ORNL High Flux Isotope Reactor (HFIR) resumed full-power (85-MW) operations in December 2001, following a 14-month outage to replace the reactor's permanent beryllium reflector. This maintenance, which is performed every 10-year equivalent of full-power operation, requires disassembly of the reactor core and removal of the beam tubes and associated neutron-scattering instrumentation. The outage provided an excellent opportunity to improve HFIR's neutron-scattering capabilities. Larger beam tubes were installed, instrumentation was upgraded, and one beam tube was modified to accommodate a high-brightness cold neutron source, which is currently under construction.

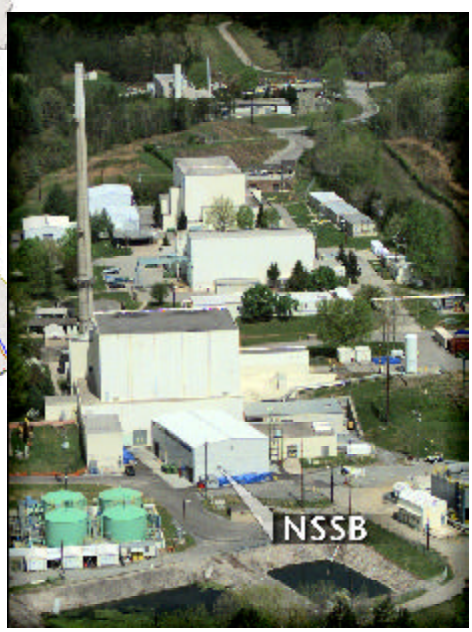
Other improvements include a new cooling tower and upgrades to the hydraulic rabbit facility used in the production of medical isotopes. In addition, tests of the pressure vessel provide assurance that it can be safely operated through 2035. All of this work will result in greater reliability and availability of the reactor and its facilities.



The reactor was disassembled and the beryllium reflector replaced.



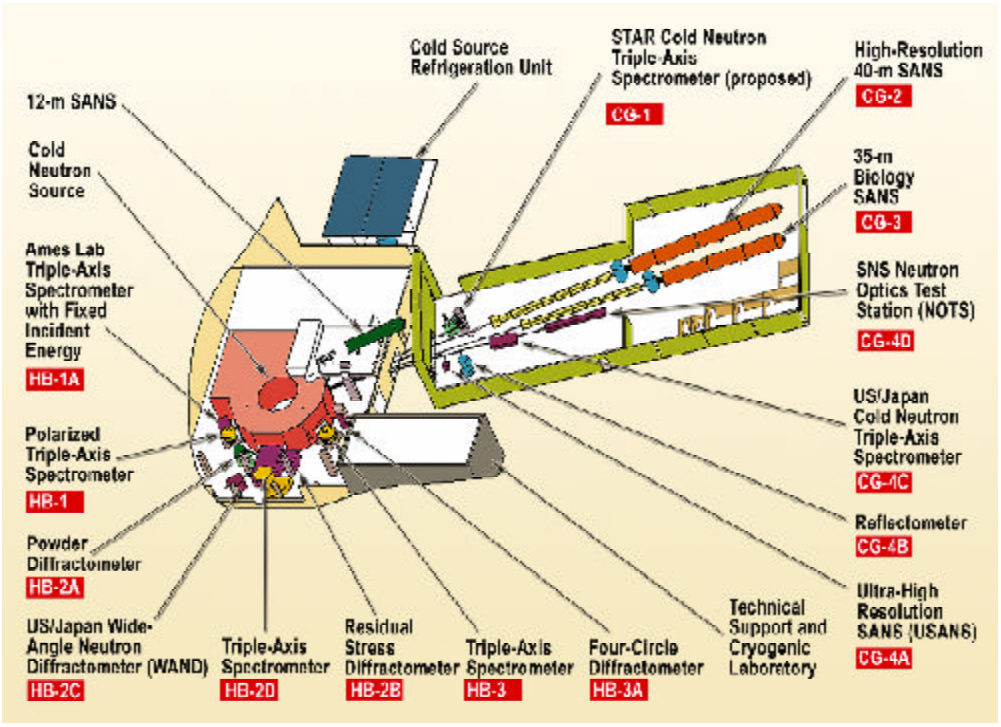
Plan view of HFIR's core showing fuel, control cylinders, and beam tubes.



Aerial of HFIR with the new Neutron Science Support Building (NSSB) in the foreground.

Neutron-Scattering Upgrades at HFIR

During the 14-month outage, several projects supported by the DOE BES were undertaken to improve HFIR's neutron-scattering capabilities. Larger beam tubes were installed that will permit 15-cm-high beams—2 1/2 times the previous height—to be used with focusing monochromators, which will yield significantly higher incident flux at the sample positions. New monochromator drums, each weighing 27 metric tons, were fabricated for the triple-axis spectrometers. The triple-axis spectrometers at HB-1 and HB-3 were upgraded to allow sample arcs and translations to be stepped under computer control. New computer control systems with user-friendly software are also being installed elsewhere. A 20-cm-diameter beam tube with beryllium inserts will support four beam lines at HB-2. These will serve a powder diffractometer, the U.S./Japan WAND spectrometer, a triple-axis spectrometer, and a dedicated residual stress diffractometer. A supermirror guide will illuminate the HB-2 triple-axis spectrometer. A side port off of HB-3 will serve a four-circle diffractometer for single-crystal studies. A new doubly bent silicon monochromator will provide a much more intense beam than was previously available for this instrument.



The upgraded HFIR will have 15 state-of-the-art neutron-scattering instruments that will be among the world's best. Full descriptions of these instruments are available at http://neutrons.ornl.gov.

The triple-axis spectrometers at HB-1 and HB-3 are being installed and should be operational by this summer and early fall, respectively. The other instruments at HB-1 and HB-3 should also be operational by fall. The beam tube at HB-2 was installed recently, and the triple-axis spectrometer should be operational by fall 2002, when installation of the other spectrometers at HB-2 will occur.

Improvements to HFIR's research capabilities will continue into FY 2003. A small-angle neutron scattering (SANS) guide hall is being built to house a high-resolution, 40-m SANS facility and a 35-m biology SANS facility. The 35-m SANS facility will be the cornerstone of the Center for Structural Molecular Biology, which is funded by the Office of Biological and Environmental Research. The new cold neutron source will be located at HB-4 and will provide cold neutrons to the instruments on CG-1, CG-2, CG-3, and CG-4.

Installation of the cold guides will begin in November 2002. The guide hall will be complete in early 2003, with the cold source installation scheduled for April 2003. The SANS instruments are scheduled to be operational in late 2003.

New monochromator shield and rail-support system at HB-1.

HFIR User Program Resumes Soon

In anticipation of increased numbers of users coming to the upgraded HFIR, the user program is undergoing an upgrade of its own. A full-time user coordinator has been hired, and the entire program is being overhauled. We are committed to providing a pleasant and productive experience for every visiting scientist. The HFIR user program will be a pilot for the SNS user program. A web-based training and proposal system will be used, and new user-friendly control software is being written for all instruments. Proposals will be solicited in a phased manner as each instrument is installed and commissioned. Full details will be available at http://neutrons.ornl.gov.

JINS Workshop

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The Joint Institute for Neutron Sciences (JINS) held a workshop entitled "Using Neutrons to Probe Structure and Dynamics in Biological Systems," on April 8–10 at the Pollard Auditorium in Oak Ridge, Tennessee.

The purpose of this workshop was to introduce the biological community to new capabilities for the study of biological molecules that are planned at HFIR and SNS. Eminent structural biologists assessed the strengths of neutron scattering for biological systems, including hydrogen/deuterium contrast, penetration depth, and accessible length and timescales. These talks also assessed important issues in the biological sciences where next-generation neutron-scattering capabilities can provide key answers.

Tutorial-style presentations introduced the fundamentals of elastic neutron scattering—for the study of structure—and quasi and inelastic neutron scattering for the study of dynamics. The complementarity of neutrons to other scattering techniques (e.g., light and X rays), nuclear magnetic resonance spectroscopy, and electron microscopy was discussed, as was the interplay between computer simulations and experiment. These tutorial lectures were designed to introduce biologists to neutron-scattering techniques and their applications to biological experiments. Additional presentations and posters covered forefront scientific results obtained using neutron scattering on biological systems.

Presentations were made on the capabilities of the new neutron-scattering instruments being constructed at SNS and HFIR. The workshop provided an opportunity for both prospective and experienced users of neutron beams from the biological sciences to advise SNS and HFIR scientific leaders on the community's educational needs and on needs for on-site facilities such as sample preparation labs, ancillary characterization techniques, and assistance from instrument scientists.

In addition, a users' meeting was held for the SANS instrument being constructed at HFIR as part of the Center for Structural and Molecular Biology. Initial plans for this instrument, which should be operational in late 2003, were discussed.

Selected speakers included:

- **Structure:** D. Ringe
- **Dynamics:** J. Zaccai
- **SANS:** S. Krueger and J. Krueger
- **Crystallography:** D. Myles and A. Snijder
- **Diffraction:** J. Katsaras and S. White
- **Reflectometry:** D. Vaknin and G. Smith
- **Inelastic scattering:** D. Neumann and A. Pivovar

SHUG Update

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As the incoming chair of the SNS and HFIR User Group (SHUG) Executive Committee, I look forward to seeing many of you at the first American Conference on Neutron Scattering, to be held in Knoxville on June 23–27. Sponsored by the Neutron Scattering Society of America and SHUG, together with all of the major U.S. neutron facilities, this will be the first nationally organized user meeting for neutron scatterers. There will be a diverse program of scientific talks, as well as opportunities to visit the SNS site and HFIR. Of particular interest to SHUG members (and potential members) will be the breakout sessions for instrument development and advisory teams, facility issues such as plans for sample-environment support at SNS, etc. The conference organizers, Rob Briber (University of Maryland), Julie Borchers (National Institute for Standards and Technology), and Paul Butler (ORNL), together with many committee members, have been working hard to make this inaugural conference a great success. For details on the program and how to register, please see www.sns.gov/acns.

Scholarships are available to attend ACNS. For more information, see http://www.sns.gov/acns.

As construction at the SNS site progresses, plans for additional instruments are also developing rapidly. I encourage anyone who has an interest in new instruments to get involved now, before the beam lines are fully committed. As things progress, new issues regarding access, participation, support, etc., are likely to arise, and we hope that SHUG can play a constructive role in communicating user needs and concerns to SNS management.

There is also good news at HFIR, which restarted in December 2001. The neutron-scattering instruments are now in the process of being reinstalled in the beam room. Information on the schedule for the cold source and guide hall is included in this issue of *The Pulse*. We look forward to the restart of the user program later this year.

The SHUG Executive Committee membership has remained unchanged except for the addition of a postdoctoral member. The new vice chair (and chair elect) is Takeshi Egami (University of Pennsylvania), and Paul Butler has graciously agreed to continue as secretary. For a list of committee members and contact information, see our web site at www.sns.gov/shug/. I would also like to thank Dave Belanger (University of California, Santa Cruz) for the great job he did as the first chair of the SHUG Executive Committee.

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For the latest user updates, see the SNS users web site at www.sns.gov/users/users.htm.