NSTX National Spherical Torus Experiment • PROGRAM HIGHLIGHTS

OCTOBER 2000

Powerful Neutral Beam Injector Operational on NSTX

On September 13, NSTX's Neutral Beam Injection (NBI) system began operation, meeting the Department of Energy's project milestone, within budget and ahead of schedule. Thus a major plasma heating system has been added to the NSTX repertoire. Wherever appropriate, the NSTX NBI system is making use of components remaining from the Tokamak Fusion Test Reactor (TFTR). The NSTX neutral-beam installation, which drew heavily on TFTR design and operating experience, cost nearly $6 million and took two years to complete.

The NSTX neutral-beam injector will enable tests of the efficiency with which a spherical torus plasma can retain its energy at very high ratios of plasma pressure to magnetic field pressure. The system will deliver a 5-MW, 80-keV deuterium beam for 5 seconds — performance that is well within TFTR neutral-beam specifications. In fact, the NSTX system retains the TFTR design capability of 120 keV for possible future use at higher voltage and power.

TFTR components in use on NSTX NBI include the test-stand beam-line and cryogenic panels; the cryogenic plant which provides liquid nitrogen and liquid helium; high-voltage power supplies; the control system; and parts of the cooling water system. These components did not require tritium decontamination. Three TFTR ion sources were dismantled, refurbished, and tested before use on NSTX. Each now operates at 50 Amperes in ion current.

Staff responsible for the installation of the third and final long-pulse ion source on the NSTX neutral beam. From left: Paul Ernst, Len Halvorsen, Martin Wisowaty, Mark Cropper, Kris Gilton, and Ed Bush.

About NSTX

NSTX is a new national magnetic fusion experimental facility, located at the U.S. Department of Energy's Princeton Plasma Physics Laboratory, to test the physics principles of the innovative Spherical Torus (ST) confinement concept. The ST concept promises new opportunities for exciting scientific discoveries toward an optimized confinement system and an affordable energy development path. The NSTX National Research and Facility Operations Teams have produced exceptional results since the start of experimentation in 1999 and continue striving to improve in expertise and capability to produce high-quality scientific results and excellent plasma performance. For additional information, please contact: Information Services, Princeton Plasma Physics Laboratory, P.O. Box 451, Princeton, NJ 08543 (609-243-2750); e-mail: pppl_info@pppl.gov or visit our web site at: http://www.pppl.gov

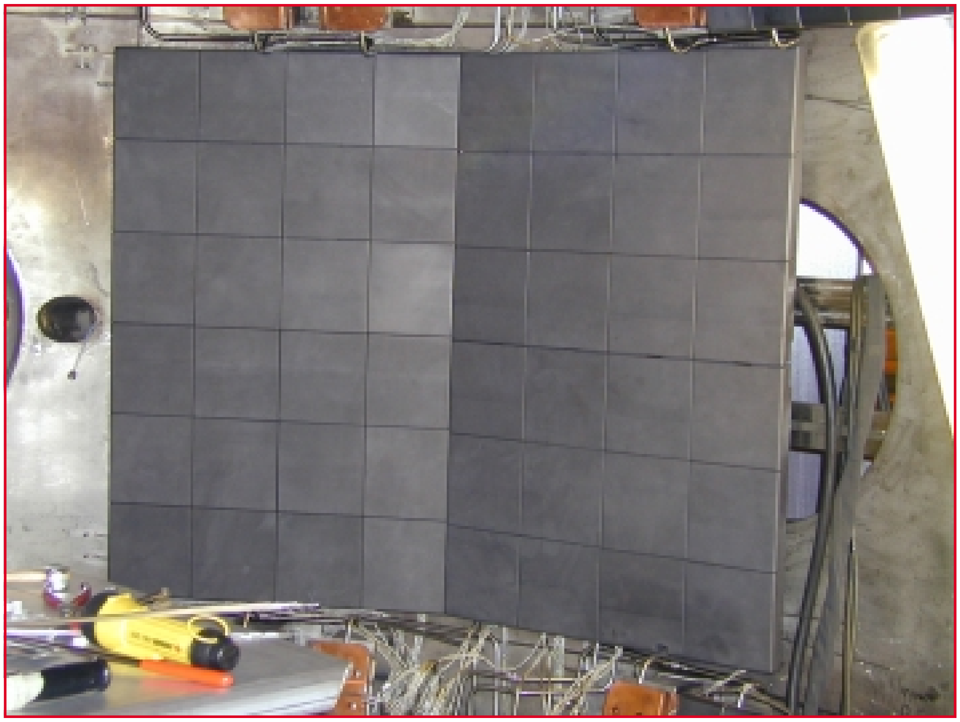

Figure 2. Protective armor was installed inside the NSTX vacuum vessel. It consists of carbon tiles backed by stainless steel plates. Each tile has thermocouple instrumentation for monitoring temperature and water lines for cooling.

Relocation of the TFTR beam-line to the NSTX Test Cell necessitated modifications, including the redesign and relocation of coolant pipes, instrumentation and control systems, power and control cables, and vacuum systems. Protective armor was installed in the NSTX vessel (Figure 2). Power supply modifications included a new resistive divider for the gradient grid system, replacing the original divider which used a freon bath. This improvement is reducing the cost of operation and eliminating the potential environmental impact associated with freon release.

Initial results are shown in Figure 3. The system injected a deuterium beam with up to 2.5 MW power for up to 200 milliseconds. A rapid rise in the plasma stored energy at a rate of ~1.2 MW was detected.

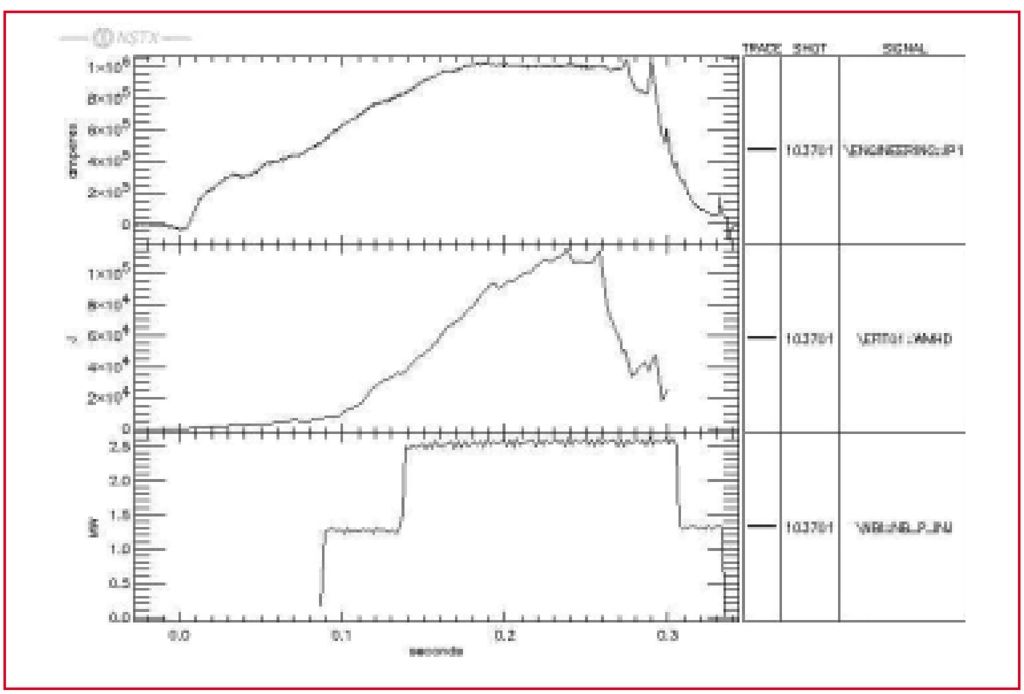

Figure 3. Rapid plasma energy build-up was detected in NSTX during NBI heating with 2.5 MW of beam power.