First neutrons produced by DOE's Spallation Neutron Source

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A jubilant gathering of Spallation Neutron Source team members watched in the control room Friday, April 28, as the SNS generated its first neutrons. The Department of Energy facility, located at Oak Ridge National Laboratory, will be the world's top destination for neutron research. Credit: Curtis Boles

One of the largest and most anticipated U.S. science construction projects of the past several decades has passed its most significant performance test. The Department of Energy's Spallation Neutron Source, located at Oak Ridge National Laboratory, has generated its first neutrons.

Research conducted at the SNS will lay the groundwork for the next generation of materials research. Scientists believe that the greatly improved ability to understand the structure of materials could lead to a

virtually limitless number of innovations, including stronger and lighter airplanes, a new generation of batteries and fuel cells, and time-released drugs that target a specific body organ.

Just after 2 p.m. Friday, a pulse of protons from the SNS's accelerator complex, traveling at nearly the speed of light, struck its mercury target. The protons "spalled" neutrons from the nuclei of mercury circulating inside the target. These first neutrons were recorded on equipment specially installed for the commissioning.

"To have observed 'first neutrons' on the initial SNS run is a tribute to the men and women who have worked so hard to design, construct, and now operate this magnificent facility," said Dr. Raymond L. Orbach, Director of the DOE Office of Science. "To bring a project of this scale and cost to completion on budget and ahead of schedule represents a model for all future large scale scientific projects to emulate. All of us owe all who have contributed to this achievement sincere thanks and appreciation for the opportunities you have now created for our world. It is a great moment for science."

With the linac operating initially at a much lower power than its eventual 1.4 megawatts, the target nevertheless was struck by trillions of protons, generating the first of what will become the world's most intense beams of neutrons for materials research.

"These first neutrons are representative of the technological breakthroughs required to establish the SNS as the world's leading facility for neutron research," said SNS Director Thom Mason. "We took on the challenges and technical risks involved in designing and delivering the linac, ring and target because we knew how much the scientific user community would benefit from the results."

The SNS's mercury target is the first of its kind. Researchers chose

mercury for the target medium because, as a relatively heavy element, it is rich in neutrons. Mercury also has the capacity to absorb the powerful pulses from the linear accelerator (linac) and accumulator ring. Conventional target materials such as tungsten require cooling with water, which limits power and intensity.

The $1.4 billion SNS will have about eight times the beam power of the world's currently leading pulsed spallation source. This increase in power, when combined with the advanced instrument technology developed at SNS, will give researchers a net improvement in measured neutron beam intensity of factors of 50 to 100.

The SNS has been commissioned in stages, beginning with the 1,000-foot linac's front end and continuing through its "warm" and "cold" linac sections to the accumulator ring and, now, the target station, which will direct neutrons eventually to 24 highly specialized instruments. A power upgrade and second target station are already in the conceptual stages.

Operating with more than 100,000 separate and interdependent parts, the SNS is the product of an unprecedented collaboration among six DOE laboratories. Lawrence Berkeley National Laboratory was responsible for the front-end system that generates the proton beam, Los Alamos National Laboratory and Thomas Jefferson National Accelerator Facility designed and built the room-temperature and superconducting sections of the linac, Brookhaven National Laboratory designed the accumulator ring, Argonne National Laboratory is responsible for the initial suite of scientific instrumentation and ORNL designed and built the target station and is ultimately responsible for operating the SNS.

DOE's Office of Science coordinated the partnership, which is on track to complete the SNS on time and on budget with no compromise in the project's scope. The seven-year construction of the SNS included a

safety record of four million hours without a lost work day due to accidents.

The SNS's specialized, state-of-the-art instruments will make possible the study of a broad range of materials from superconducting metals to biological tissues. The SNS and ORNL's recently upgraded High Flux Isotope Reactor together will make Oak Ridge the world's leading center for studying the structure and dynamics of materials. The SNS will operate as a user facility that each year will enable 2,000 researchers from the United States and abroad to study the science of materials that form the basis for new technologies in energy, telecommunications, manufacturing, transportation, information technology, biotechnology and health.

Source: Oak Ridge National Laboratory