Revamped, renewed, restarted -- Oak Ridge High Flux Isotope Reactor back on line

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The research reactor at the Department of Energy's Oak Ridge National Laboratory is back in action and better than ever.

After $70 million in renovations and more than a year of meticulous system checks, ORNL's High Flux Isotope Reactor was restarted this week, taken to 10 percent power, and reached its peak power of 85 megawatts Wednesday.

"The restart has gone well," said Kelly Beierschmitt, HFIR executive director. "This reactor's design is rigorous and robust. Its performance has been stellar from both an operational and a safety perspective.

"We still have work to do, but we are extremely pleased with our progress so far."

Built in 1966, HFIR is internationally known as a neutron source for materials studies and isotope production. The reactor returns with a suite of new experiment instruments, beam lines to channel neutrons, a new beryllium reflector, and other upgrades.

In October, powerful refrigeration systems were added to cool the reactor's neutron beams to minus 425 degrees Fahrenheit. The intense cold slows the neutrons and lengthens their wavelength, allowing scientists to study "soft" materials such as proteins and polymers and to analyze materials with certain magnetic properties.

The restart marks HFIR's 408th cycle. Each cycle represents about 25 days, the time it takes for the reactor to use up its uranium fuel.

Greg Smith, who leads ORNL's Low Q Neutron Scattering Group, said 49 science experiments are scheduled for this summer, including:

-- Experiments to create new materials with beneficial properties, based on polymer nano-composites, which are "hard" nanoparticles surrounded by a "soft" polymer matrix.

-- Studies to make crystals from membrane proteins, which determine interaction and communication between living cells, to better understand the membrane proteins' structure and function.

-- Examination of how high-pressure carbon dioxide is absorbed by and migrates through different types of coal to help develop new, more efficient ways to sequester CO2 to reduce greenhouse gas emissions.

"We anticipate eventually providing neutron beams for eight to ten reactor cycles per year and no major shutdown for a beryllium reflector replacement until after 2020," Smith said. "In the meantime, HFIR users will soon be able to access thermal and cold neutron beams of world-class brightness."

Neutrons are vital to research in physics, chemistry, engineering and other materials-related fields. At room temperature, they are ideal for use in special instruments to illuminate the atomic structure and dynamics of hard, dense materials.

HFIR's cold source will complement the capabilities of ORNL's recently completed Spallation Neutron Source, the world's premier neutron science facility.

While SNS also has cold-neutron capabilities, the continuous neutron flow from a reactor such as HFIR, as opposed to pulsed beams from accelerators like SNS, offers advantages for certain types of neutron experiments.

The new cold neutron source is part of an Office of Science-funded renovation that represents a major new direction for the reactor and revitalizes its role to the nation's science and research community.

The fully instrumented HFIR will include 15 state-of-the-art neutron-scattering instruments, seven designed exclusively for cold neutron experiments; new computer control systems; and a new guide hall facility. Particularly prominent in the guide hall are the two new small-angle neutron scattering instruments, each terminating in a 70-foot long evacuated cylinder containing a large moveable neutron detector.

The reactor also produces radioisotopes used in nuclear medicine. HFIR is the only domestic source of californium-252, an isotope used in industrial analysis. These nuclear materials are processed and refined at the nearby Radiochemical Development and Engineering Center.

Source: Oak Ridge National Laboratory