HFIR
High Flux Isotope Reactor

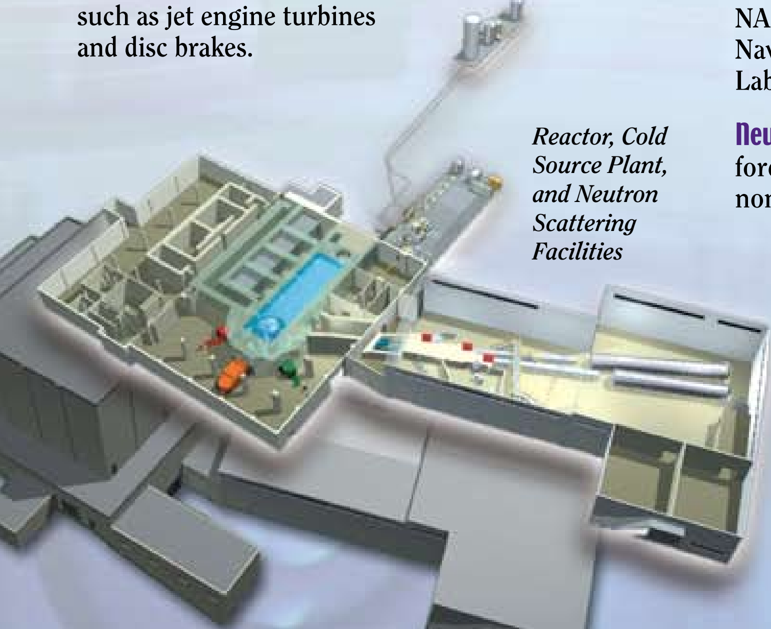
HFIR CAPABILITIES

Neutron Scattering research facilities at HFIR contain a world-class collection of instruments and unique thermal-neutron and cold neutron scattering capabilities used for fundamental and applied research on the structure and dynamics of matter. Scientists can count scattered neutrons and measure their energies and the angles at which they scatter to obtain information about the nature of materials.

Understanding how proteins work is the key to unlocking the secrets of life. Proteins defend us against infection, but in their mutant forms they contribute to the development of diseases such as cancer and AIDS. The key to understanding how individual proteins work is by uncovering their shape and structure. Cold neutron scattering in the HFIR Bio-SANS instrument will play a vital role in this research.

Applied technology resulting from neutron scattering research includes the following:

- Development of better superconducting materials to provide less expensive electrical transmissions.
- Development of better magnetic recording media for computer hard drives.
- Improvements in the material characteristics and production of plastics.
- Mapping weld stresses in materials such as jet engine turbines and disc brakes.



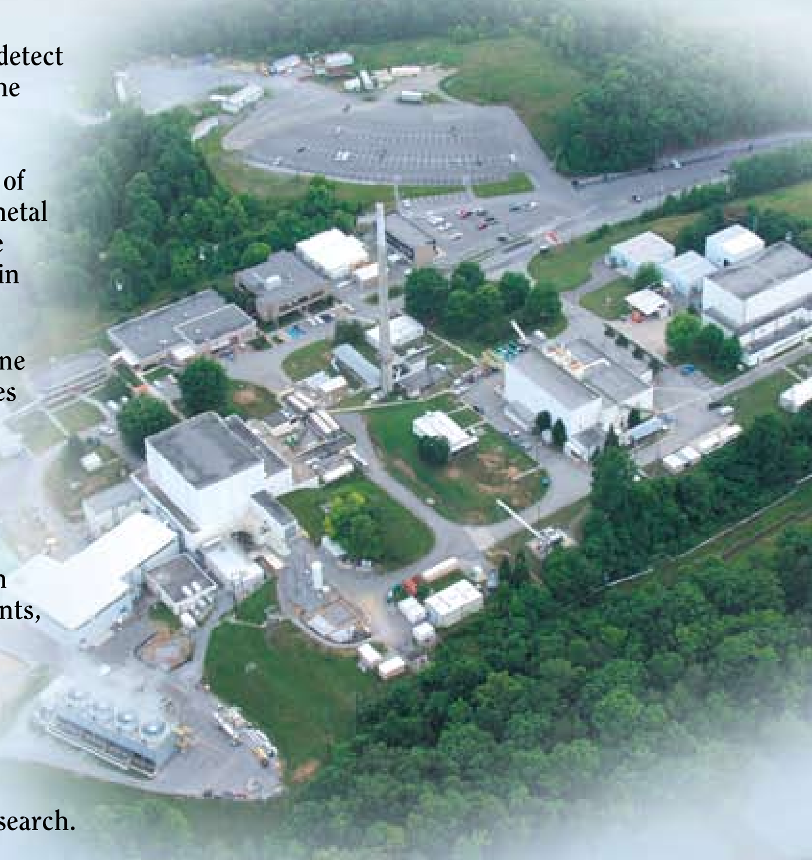
Reactor, Cold Source Plant, and Neutron Scattering Facilities

Isotope Production

- *Rhenium-188* (for the treatment of cancer, arthritis, and the prevention of the restenosis or closure of arteries following angioplasty).
- *Iridium-192* (for cancer treatment therapy to reduce metastasis, for oil-well exploration, and to conduct geological surveys and radiographic inspection of components).
- *Sn-117*m (for pallative bone cancer treatment).
- *Nickel-63* (electron capture technology used to detect explosives and drugs at airport checkpoints by the Department of Homeland Security).
- *Californium-252* (used as a neutron source for reactor startups, in nondestructive examination of welds in oil and gas pipelines, for determining metal stress in military aircraft, for detecting explosive devices in aircraft luggage, and in treating certain types of cervical and brain cancer).

Materials Irradiation Facilities are used to determine the effects of neutron irradiation on the properties and behavior of materials. Materials irradiation experiments are conducted to support programs such as the evaluation of new materials planned for use in advanced fission reactor concepts and in NASA deep space power programs. Materials irradiation at HFIR supports programs for Fusion Energy Science, US/Japan Collaborative agreements, NASA, DOE-NE Generation IV reactor research, Naval Reactor programs, Knoll Atomic Power Laboratory, and Bettis Laboratory.

Neutron Activation Analysis provides support for forensic science, environmental soil monitoring, nonproliferation, homeland security, and basic research.



INFORMATION

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HFIR Center for Neutron Scattering

> *"If at sometime a heavenly angel should ask what the laboratory in the hills of East Tennessee did to enlarge man's life and make it better, I daresay the production of radioisotopes for scientific research and medical treatment will surely rate as a candidate for the very first place."* — **Alvin Weinberg**

OPERATIONAL MISSION

"Provide safe, reliable, predictable and efficient HFIR operation to support the neutron science mission."

HISTORY and FUTURE

The High Flux Isotope Reactor (HFIR) first went critical on August 25, 1965. The HFIR's initial science mission was the production of transuranic isotopes. HFIR quickly became the nation's best isotope production reactor. In 1970, the first pneumatic irradiation facility was installed to provide neutron activation analysis capabilities. In 1986, the number and size of HFIR's material irradiation facilities were expanded. In 1987, a second pneumatic irradiation facility was added to further enhance its world-class neutron activation analysis capabilities. In 2000, the three original thermal beams were outfitted with new, enlarged tubes, which resulted in a three-fold increase in thermal neutron fluxes on sample, on par or better than any facility in the world. In addition to these upgrades, the permanent beryllium reflector was replaced; therefore, the need for another extended outage will not be required again until 2021. In May of 2007, a new cold neutron beam facility was placed into operation, providing cold neutron beams with world-class brightness.

HFIR Control Room

HFIR Reactor Vessel

HFIR's future is most certainly bright. The expected life of HFIR is estimated to last until 2040 or beyond. Continued upgrades have made HFIR facilities and science instruments world class in both thermal and cold neutron scattering, in isotope production, in materials irradiation testing and in neutron activation analysis.

DESCRIPTION

The HFIR is one of the most powerful research reactor facilities. It is a versatile, 85-MW isotope production and test reactor, with the capability and facilities for performing a wide variety of irradiation experiments. It has a peak thermal neutron flux of 2.6×10^{15} neutrons per square centimeter per second, which is the highest in the western world. The HFIR is a beryllium-reflected, light-water-cooled and moderated flux-trap-type reactor that uses highly enriched uranium-235 as the fuel. A fuel cycle normally consists of full-power operation for a period of 23 to 27 days at 85 MW.

SCIENCE MISSION

The HFIR has three main neutron science missions. The first mission of the reactor is to provide neutrons to support its neutron scattering facilities and instruments. This activity has grown in both scientific and economic importance and today provides much of the knowledge about the molecular and magnetic structures and behavior of materials. The second key mission of the HFIR is to produce isotopes, including transuranic isotopes such as californium. These isotopes are used in research, industrial, and medical applications. The third mission of the reactor is to provide facilities used to investigate the effects of neutron irradiation on the properties of materials and to provide neutron activation analysis.

Rendering of Reactor and Cold Source

Cold Neutron Guide Hall