"My curiosity is the greatest inspiration. Could a new idea make the process better?"

Susan Hogle, Nuclear Engineer

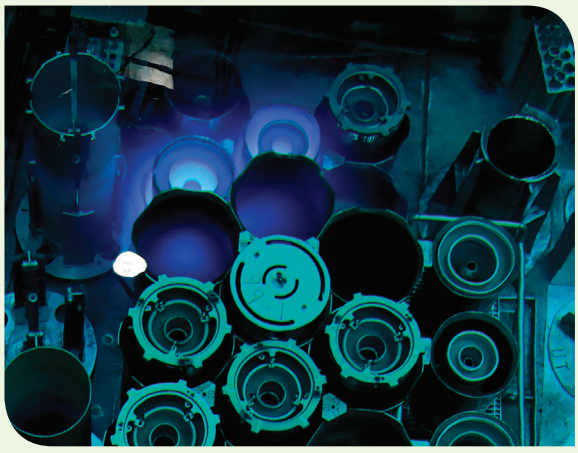
Innovation Through Nuclear Science and Technology

Since building the first continuously operating nuclear reactor and ushering in the nuclear age, Oak Ridge National Laboratory (ORNL) has pioneered world-changing technologies and applications enabled by harnessing the atom. Born in the Manhattan Project, the Lab has developed cutting-edge cancer treatments; produced materials to power deep space missions; invented, tested, and improved reactor technology; and even discovered new elements.

Real-World Impacts

Researchers use ORNL's High Flux Isotope Reactor (HFIR) to irradiate materials with a steady stream of neutrons. Researchers can then examine and test the material specimens or perform radiochemical processing to extract and purify isotopes in ORNL's shielded "hot cells." This unique research and development environment supports a range of science and technology activities, including the following.

- Producing isotopes crucial to medicine, global security, energy, and industry
- Studying material performance and developing new materials for fission and fusion power systems, including next-generation nuclear reactors
- Identifying microscopic elements for environmental studies, criminal investigations, and nonproliferation efforts



The Gamma Irradiation Facility located at HFIR provides high gamma doses for studying the effects of radiation on materials.

2015

Year ORNL produced plutonium-238, the nation's first in more than 25 years

70%

Total of world's californium-252 that is produced at ORNL

85 megawatts

Operational power at HFIR, the nation's highest flux reactor-based neutron source

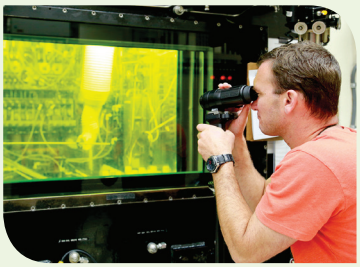
36

Hot cells at ORNL enable safe handling of isotopes and materials

Current Isotope Production

Californium-252	Detects impurities in coal and cement, determines potential productivity of oil wells, calibrates radiation detection instruments in port security operations. ORNL is the only US producer of californium-252.
Plutonium-238	Full-scale production—expected by 2025—will fuel NASA's deep space missions such as the New Horizons Pluto probe.
Actinium-225	Promising clinical trials show actinium-225 as a possible treatment for leukemia and glioblastoma.
Actinium-227	Actinium-227 is the source for an FDA-approved treatment for metastasized prostate cancer. ORNL is the only near-term production site for actinium-227.
Berkelium-249	A by-product of californium-252 production, berkelium-249 was essential in the discovery of tennessine, one of four new elements on the periodic table.
Selenium-75	Selenium-75 is used by industry for weld inspections and other nondestructive tests.
Nickel-63	Explosives detectors at airports and narcotics detectors use nickel-63.
Tungsten-188	Researchers continue to use tungsten-188 in numerous clinical trials, with promising treatments for bone pain and lung and liver cancers.

Researchers pictured at left work with medical radioisotopes produced in HFIR, which was constructed in the mid-1960s to fulfill a need for production of transuranic isotopes (i.e., "heavy" elements such as plutonium and curium). Since then, its mission has grown to include materials irradiation; neutron activation; and, most recently, neutron scattering. Its neutron scattering instruments are used for fundamental and applied research on the structure and dynamics of matter.



The Radiochemical Engineering Development Center is the largest hot cell facility at ORNL, with 15 hot cells for scientists to safely handle radioactive materials for processing, testing, recovery, and purification. ORNL's hot cells are constructed of high-density concrete and include specialized glass windows and various manipulators. At left, a researcher processes plutonium-238 for use in NASA deep space missions.

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