ORNL

Directory of Nuclear Science and Technology Capabilities at Oak Ridge National Laboratory

Oak Ridge National Laboratory

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Nonreactor Nuclear Facilities Division

MISSION

The mission of the Nonreactor Nuclear Facilities Division is to serve as a stable and cost-competitive platform for conducting nuclear programs by providing facilities ready to accomplish programmatic work while maintaining compliance and teaming with science to respond to expanding, multifaceted nuclear program needs.

HISTORY

Oak Ridge National Laboratory (ORNL) is the largest and most diverse Department of Energy (DOE) research laboratory. ORNL was part of the overall nuclear complex that evolved from the Manhattan Project in the 1940s. ORNL has played a prominent role in developing science and technology for nuclear power programs, nuclear propulsion, nuclear medicine, and the nation's nuclear weapon program among others. Many nuclear reactors have been constructed at ORNL since the early 1940s and have supported several research and development mission activities. Several nonreactor nuclear facilities were constructed and operated over the years by different research and development divisions. Some of these facilities have already been deactivated and turned over to the Environmental Management Program.

On April 1, 2000, UT-Battelle became the management and operating contractor for ORNL and began a transition to a building manager/occupant model of facility operations at the Laboratory. Under this Facility Management Model, a nonreactor facility (or group of nonreactor facilities) is managed and maintained by the Nonreactor Nuclear Facilities Division (NNFD) to achieve the Laboratory's overall tactical and strategic objectives for facility management, maintenance, and operation and to satisfy the Laboratory's needs for space management. The expected benefits of this new approach to facility management include improvements in customer satisfaction, work control processes, and safety performance. Successful implementation will also reduce costs and ensure faster delivery of services. In this way, the occupants are free to focus on scientific research and development while the building management and maintenance organizations focus on ensuring that the facilities are available for their intended use in accordance with the Laboratory's vision and mission.

North and west cell walls at the Irradiated Fuel Examination Laboratory

The Division organization and operations are designed to efficiently implement the landlord-tenant model and enable the following:

- Free up research line management to focus on research
- Improve conduct of operations of ORNL nuclear facilities
- Make the facilities safer, more efficient, and cost-effective
- Provide a means to accurately estimate the cost of nuclear work
- Support achievement of ORNL Programmatic Performance Objectives

NNFD's primary customers are ORNL Energy and Engineering Sciences Directorate, Nuclear Science and Technology Division (NSTD); ORNL Physical Sciences Directorate, Materials Science and Technology Division, and Chemical Sciences Division (CSD); DOE Office of Nuclear Energy (NE), and DOE Office of Science and Technology (SC).

PURPOSE

The NNFD is responsible for (a) ensuring that each facility can be operated within the approved authorization envelope, (b) providing agreed-upon resources and services to support the mission work, and (c) ensuring that formal Facility Use Agreements (FUAs) are in place to describe agreed-upon roles, responsibilities, authorities, and accountabilities of the program (occupant) and NNFD personnel.

DESCRIPTION

Radiochemical Engineering Development Center Control Room

NAC-LWT Fuel Cask mated to hot cell

ORNL 2010-G01341/mhr

Nonreactor Nuclear Facilities Division

NNFD FACTS

- Special projects support:
  - Disassembly and disposition of TSF-SNAP reactor
  - Disposition support for "Atoms for Peace" demonstration reactor, including packaging and shipment of fuel for reuse
  - Disassembly of NS-Savannah fuel, including packaging and shipment of fuel for reuse
  - Global Nuclear Energy Partnership (GNEP) Coupled End-to-End Demonstration of proposed GNEP advanced fuel reprocessing and transmutation fuel fabrication technologies
- Isotopes production and processing:
  - *Selenium-75* (for processing and encapsulation)
  - *Cobalt-60* (for processing and encapsulation)
  - *Actinium-225* generator production (for clinical treatments of acute myeloid leukemia)
  - *Transuranic actinides* (production, separations, and storage)
  - Formal loan agreements in place for over 200 neutron sources with almost 70 institutions
  - Annual sales of *Californium-252* in 25 to 35 mg range to commercial encapsulators with forecasted increases
  - *Californium-252* source fabrication available in a variety of designs, sizes, and materials in single or double encapsulation configurations
- Examination and testing:
  - Postirradiation examination of MOX fuel assemblies
  - LWR full-length fuel examination
  - Clad and structural analysis activities for various government, research, and commercial parties (U.S. and Japan fusion, NRC, Defense Department, HFIR, commercial WFO R&D, etc.)
  - Capsule disassembly and specimen transloading
  - Planned support for SNS R&D activities

Actinium Processing Glove Box Line

NNFD's INSTRUMENTS

- IFEL, Irradiated Fuel Examination Laboratory
- East Hot Cell, Advanced Diagnostics and Evaluation Platform
- East Hot Cell, LWR Full Length Fuel Rod Loading
- West Hot Cell, Remote Capsule Disassembly System
- SEM Cell, SEM/Microprobe
- IMGA Cell, Irradiated Micro-Sphere Gamma Analyzer
- CCCTF Cell, Core Conduction Cooldown Test Facility
- IMET, Irradiated Materials Examination and Testing Facility
- Irradiated Materials Examination and Testing
- Se Processing and Encapsulation
- REDC, Radiochemical Engineering Development Center
- Hot Cells 1–3, Target Fabrication Operations
- Hot Cells 4–7, Transuranium Element Processing
- UREX+3 Demo, Continuous Solvent Extraction Test Facility
- Analytical Chemistry Operations, High-Activity-Level Analytical Chemistry Support
- Limited Access Area (LAA) and Hot Cell Support Area Operations (HCSA)
- Ac Laboratories, Actinium Processing
- Alpha Laboratories, Product Finishing and Chemical Development Operations
- Californium Facility, Californium Processing Operations
- CUF, Californium User Facility
- SNMV, Special Nuclear Material Vault

INFORMATION

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Nonreactor Nuclear Facilities Division

FACILITY Fact Sheet

FACILITY

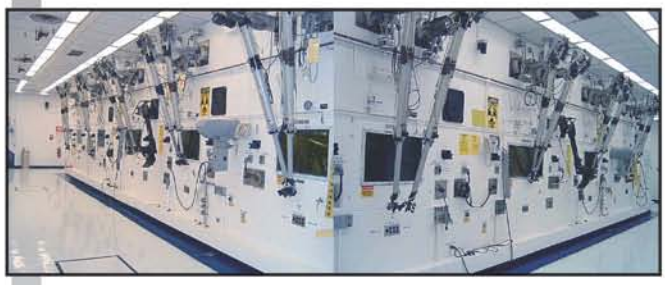
IFEL

IRRADIATED FUELS EXAMINATION LABORATORY

OAK RIDGE NATIONAL LABORATORY

DESCRIPTION

The Irradiated Fuels Examination Laboratory (IFEL) was initially designed and constructed to permit the safe handling of increasing levels of radiation in the chemical, physical, and metallurgical examination of nuclear reactor fuel elements and reactor parts. The IFEL was constructed in 1963 and is a two-story brick building with a partial basement. The front or northern-most section is a single-story office area. The two-story area to the immediate rear houses the cell complex, the operating areas, and other supporting activities. The office area is isolated from the main part of the building, so the office area can be excluded from the secondary containment zone. The facility has a gross floor area of about 27,000 ft^2.



APPLICATIONS

- Receipt and handling of irradiated materials (fuel or nonfuel in shielded casks)
- Capsule disassembly
- Nondestructive and destructive testing of irradiated materials
- Full-length LWR fuel examination
- Repackaging of spent nuclear fuel
- Packaging and shipment of irradiated materials (on-site and off-site)
- Examination and testing activities such as metrology; metallographic sample preparation by sectioning, grinding, and polishing; optical and electron microscopy; gamma spectrometry; and other physical and mechanical properties evaluations as appropriate to the experimental objectives of a particular program

SPECIFICATIONS

Hot Cells	6 - Hot Cells 1 - SEM Cell
Viewing Window	Lead glass and mineral oil
Cell Construction	High-density concrete used for front, rear, and top shielding.
Ventilation	HEPA filtered
Services Available	Process and service compressed gases, air, demineralized water, process water, recirculating cooler water, recirculating heating water, steam, vacuum, and electrical services.
Intercell Movement	Two small diameter horizontal transfer stations are used for small objects while larger items are transferred through the shielded air lock door system.
Material Handling	Master-slave manipulators

FOR MORE INFORMATION, CONTACT THE IFEL TEAM:
Facility Manager: Dale Caquelin, caquelinda@ornl.gov, 865.576.1353

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Instrument Fact Sheet

HOT CELLS

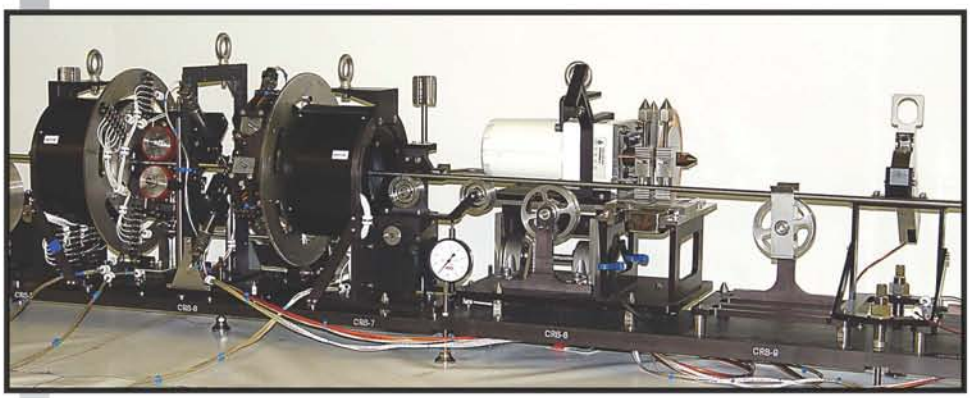
East Hot Cell

IRRADIATED FUELS EXAMINATION LABORATORY

The Advanced Diagnostics and Evaluation Platform

Description

The Advanced Diagnostics and Evaluation Platform (ADEPT) is a modular testing arrangement for advanced postirradiation examination of LWR fuel rods. The modern modular design provides a rod drive assembly to provide metrology (length and diameter) measurements, along with the ability to incorporate various additional work stations as desired. This modular design incorporates a strong back raceway and instrument clusters with integrated data acquisition and control. Work station modules include Eddy Current and LVDT Assembly, Rod Segmentation, Thermocouple Station, Rod Puncture and Gas Sampling Station, and Adjustable Collimator for 1-D Gamma-Ray Scanning. A module providing advanced thermal imaging is planned as a future addition.



Applications

- Postirradiation examination of commercial LWR full length fuel rods.

Specifications

Operation	Shielded hot cell environment
Metrology	Length and diameter (3/8" to 1/2" fuel rods approx 14 ft long)
Gamma-ray Scanning	1-Dimensional
Eddy Current	Pancake and loop coil arrangements
Surface Temperature	RT up to approximately 100°C
Pressure	Typical of high–burn-up LWR rods
Volume	Typical of LWR fuel; calibrated leak method used
Gas Sampling	Max sample volume (50cc sample bottle, mass spec analysis)
Segmenting	User variable, 0–10 ft

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For more information, contact the Test Bed team:

Instrument Scientist: Robert Morris, morrisrn@ornl.gov, 865.241.4237
Instrument Scientist: Charles Baldwin, baldwinca@ornl.gov, 865.574.6552
Facility Manager: Dale Caquelin, caquelinda@ornl.gov, 865.576.1353

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Instrument East Hot Cell

Hot Cells

Irradiated Fuels Examination Laboratory

LWR Full Length Rod Loading

Description

The Irradiated Fuels Examination Laboratory has the capability to unload a NAC-LWT cask and mate the cask to the East Hot Cell for unloading. Up to 25 full length commercial fuel rods can be handled using a specially configured inner canister designed for this application. Once unloaded, the rods can be stored in the hot cell and individually examined.

Specifications

Facility Access	Reinforced concrete dock Exterior hinged door opening: 12' w x 11.5' h Interior door openings: 9.5' x 7' h
In Building Cask Transport	Air pallets: support up to 50,000 lb
Hot Cell Mating Arrangement Method	Mating collar for NAC-LWT cask

Applications

- Postirradiation examination of commercial LWR full length fuel rods.

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For more information, contact the LWR Rod Loading team:

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Facility Manager: Dale Caquelin, caquelinda@ornl.gov, 865.576.1353

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Instrument West Hot Cell

Hot Cells

Irradiated Fuels Examination Laboratory

Remote Capsule Disassembly System

Description

The Remote Capsule Disassembly System provides the capability to remotely disassemble a postirradiation capsule. Precision cuts can be made in both vertical or horizontal orientations. Cutting is performed with abrasive and diamond blade saws without the need for coolant. A dust collection system helps control contamination during cutting operations. The system can easily be adapted to accommodate various irradiation capsule configurations.

Specifications

Operation	Shielded hot cell environment
X-axis Control	Manual
Y-axis Control	Manual
Z-axis Control	Computer
Rotational Control	Computer
Mill-head Orientation	Vertical and horizontal
Cutting Blades	Abrasive and diamond without coolant
Contamination Control	Dust collection system
Ease of Reconfiguration	Easily adapted

Application

- Postirradiation disassembly of capsules

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For more information, contact the Capsule Disassembly team:
Instrument Scientist: Robert Morris, morrisrn@ornl.gov, 865.241.4237
Instrument Scientist: Charles Baldwin, baldwinca@ornl.gov, 865.574.6552
Facility Manager: Dale Caquelin, caquelinda@ornl.gov, 865.576.1353

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Instrument Fact Sheet

Hot Cells

SEM Cell

Irradiated Fuels Examination Laboratory

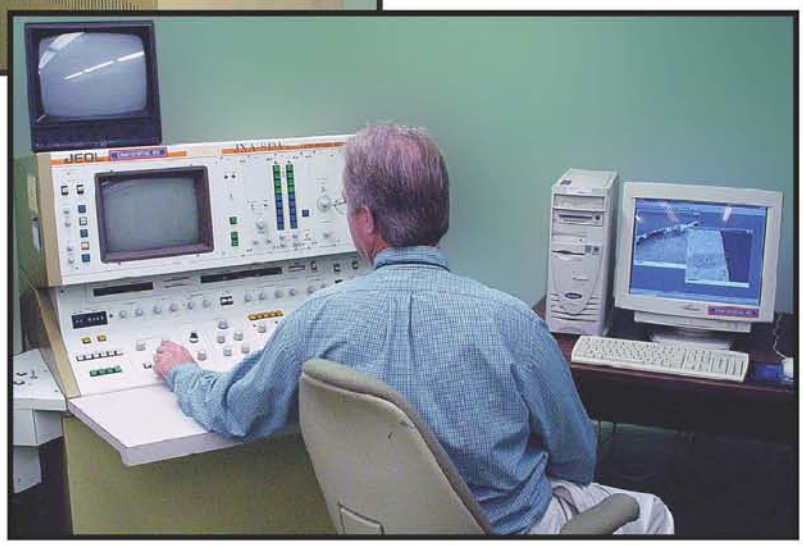
SEM/Microprobe

Description

The SEM/Microprobe provides the ability to perform postirradiation examination of samples that have radiation levels below 2 R/h at contact and have limited surface contamination. A polished cross section of the sample is prepared and examined at high magnification.

Applications

- Irradiated reactor fuels
- Irradiated structural materials
- Low, and high-activity samples with limited surface contamination



Specifications

Operation	Shielded cubicle
RAD Limit	< 2 R/h at contact
Imaging System	Geller MicroAnalytical
Modes	Secondary Electron (SE), Backscatter Electron (BE), Energy Dispersive Spectrometry (EDS), and Wavelength Dispersive Spectrometry (WDS)

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For more information, contact the SEM/Microprobe team:

Instrument Scientist: Robert Morris, morrisrn@ornl.gov, 865.241.4237
Instrument Scientist: Charles Baldwin, baldwinca@ornl.gov, 865.574.6552
Facility Manager: Dale Caquelin, caquelinda@ornl.gov, 865.576.1353

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Instrument Fact Sheet

Hot Cells

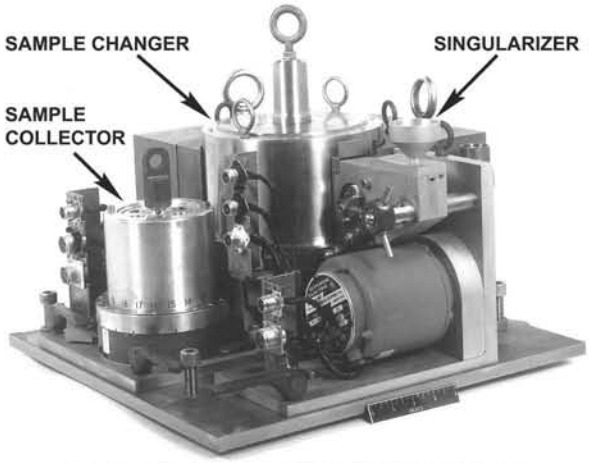
IMGA Cell

Irradiated Fuels Examination Laboratory

IMGA- Irradiated Micro-Sphere Gamma Analyzer

Description

IMGA provides the capability of examining individual particles from deconsolidated compacts. The particles are poured into a hopper, and the singularizer feeds each particle into the sample changer for acquisition and analysis of the gamma spectrum. Each particle's gamma-ray spectrum is analyzed to determine isotopic inventories. Particles are then binned based upon key isotopic ratio ($^{137}Cs/^{144}Ce$) with failed particles isolated in the sample collector for more advanced PIE analysis. Measurement data from a large number of particles can then be analyzed to produce particle frequency distributions with ratios of key radioisotopes used to compensate for any variation of kernel size and burnup.



IRRADIATED MICRO-SPHERE GAMMA ANALYZER
AUTOMATED PARTICLE HANDLER

Specifications

Examination Technique	Non destructive
Operation	Automatic after initial setup in a shielded hot cell environment
Spectrometry	High-resolution gamma using a high-purity germanium photon spectrometer
Analyzer System	Computer-based multichannel

Applications

- High-resolution spectrometry of individual HTGR fuel particles
- Measure absolute isotopic inventories in fuel particles
- Separation of particles based upon ability to retain key isotopes
- Basic statistical analysis of fuel performance

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For more information, contact the IMGA team:

Instrument Scientist: Robert Morris, morrisrn@ornl.gov, 865.241.4237
Instrument Scientist: Charles Baldwin, baldwinca@ornl.gov, 865.574.6552
Facility Manager: Dale Caquelin, caquelinda@ornl.gov, 865.576.1353

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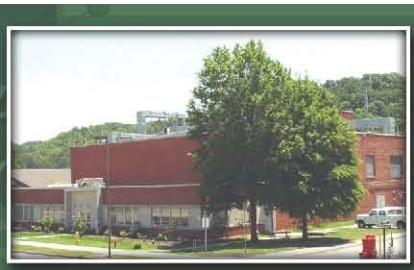
Instrument Fact Sheet

Hot Cells

CCCTF Cell

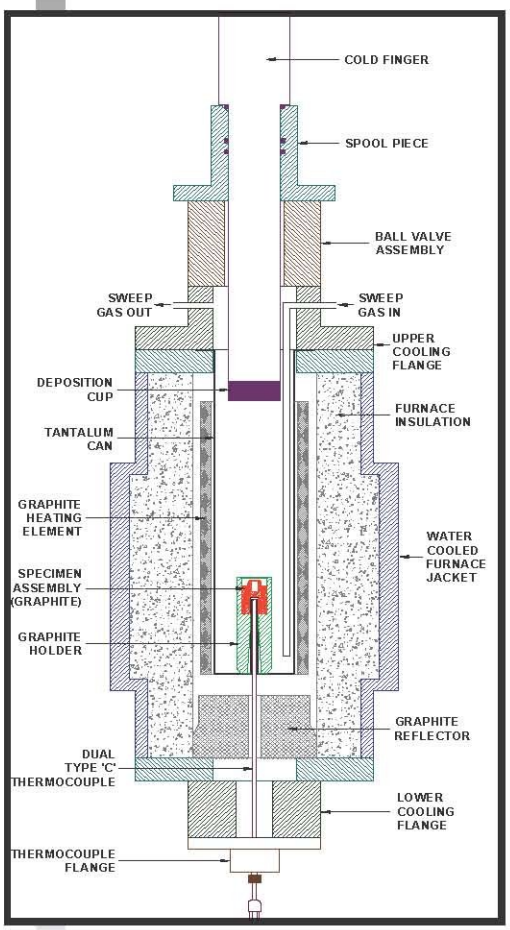
Irradiated Fuels Examination Laboratory



CCCTF – Core Conduction Cooldown Test Facility

Description

The CCCTF provides accident simulation testing of HTGR type fuel. It operates in a shielded hot cell environment with an inert ultrahigh-purity research-grade helium atmosphere. Measurements of fission gas release (real time) and metallic fission product release (intermittent) can be achieved. Experiment temperatures are fully programmable up to 2000° C and test duration can extend for weeks. Sensitivity can be adjusted to detect a fraction of a single particle inventory.



Application

- Accident simulation testing of HTGR type fuel

Specifications

Operation	Shielded hot cell environment
	Ultrahigh-purity research grade Helium
Temperature	Up to 2000 deg C (programmable)
Real Tiime Measurements	Fission gas release (^{85}Kr)
Intermittent Measurements	Metallic fission product release (Cs, Ag, Eu)
Charcoal Trap	Liquid nitrogen cooled to -190° C
Trap Purge Control	Traps can be taken offline and purged independently

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For more information, contact the CCCTF team:
Instrument Scientist: Robert Morris. morrisrn@ornl.gov, 865.241.4237
Instrument Scientist: Charles Baldwin, baldwinca@ornl.gov, 865.574.6552
Facility Manager: Dale Caquelin, caquelinda@ornl.gov, 865.576.1353

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Facility Fact Sheet

FACILITY

IMET

IRRADIATED MATERIALS EXAMINATION AND TESTING FACILITY

OAK RIDGE NATIONAL LABORATORY

Description

The Irradiated Material Examination and Testing (IMET) Facility was designed and built as a hot cell facility. It is a two-story block and brick structure with a two-story high bay that houses six heavily shielded cells and an array of sixty shielded storage wells. It includes the Specimen Prep Lab (SPL) with its associated laboratory hood and glove boxes, an Operating Area, where the control and monitoring instruments supporting the in-cell test equipment are staged, a utility corridor, a hot equipment storage area, a tank vault room, office space, a trucking area with access to the high bay, and an outside steel building for storage. The tests and examinations are conducted in six examination "hot" cells and/or in a laboratory hood or modified glove boxes in the SPL.

Specifications

Hot Cells	6 hot cells
Viewing Window	Lead glass and mineral oil
Cell Construction	High-density concrete used for front, rear, and top shielding.
Ventilation	HEPA filtered
Services Available	Process and service compressed gases, air, demineralized water, process water, recirculating cooling water, recirculating heating water, steam, vacuum, and electrical services
Intercell Movement	Intercell conveyor system
Material Handling	Master-slave manipulators

Applications

- Physical and mechanical properties testing
- Examination of irradiated materials
- Irradiated specimen storage
- Sample preparation

For more information, contact the IMET team:

Facility Manager: Dale Caquelin, caquelinda@ornl.gov, 865.576.1353

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Nonreactor Nuclear Facilities Division

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Instrument Fact Sheet

HOT CELLS

IMT

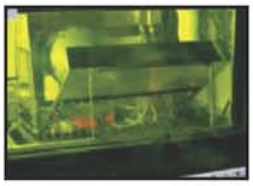
Irradiated Materials Examination and Testing Facility

Irradiated Materials Examination and Testing

Description

Irradiated Materials Examination and Testing plays a key role in the characterization of radiation effects on structural materials. A broad range of testing capabilities for highly irradiated materials has been located in adjacent hot cells to facilitate research activities. Cell 1 provides the capability to sort and identify specimens of various geometries as well as for the conduct of specialized tests such as profilometry. Cell 2 provides high-temperature, high-vacuum testing, along with ball indentation and hardness testing capabilities. An automated Charpy impact system in Cell 3 is available for testing standard and subsize impact specimens while servohydraulic test system are available in Cells 3 and 4 for fracture toughness and fatigue testing at both cryogenic and elevated temperatures. An analytical SEM is available in Cell 5 for characterization of highly radioactive materials. Sample machining using a CNC milling machine and diamond saws can be performed in Cell 6. Preparation of lower radiation level samples can be performed in a hood located in the Sample Preparation Laboratory before being tested.

In addition, a storage well array is available for long-term specimen storage. The array consists of sixty stainless steel cylinders, each 6 in. in diameter and 10 ft long, uniformly spaced 12 in. apart, and placed vertically in a 6 ft wide × 23 ft long × 10 ft deep concrete pit.



Application

- Postirradiation examination, testing, and storage of structural specimens/materials

Specifications

Hot Cell Usages	Cell 1: Sample sorting and identification, and specialized tests, such as profilometry Cell 2: High-temperature, high-vacuum testing Cell 3: Impact testing and fatigue and fracture toughness testing Cell 4: Fatigue and fracture toughness testing Cell 5: Highly radioactive material characterization Cell 6: Sample machining Storage wells: 60
Specialized Equipment in Hot Cells	Cell 1: Annealing furnace, and profilometer Cell 2: Instron tensile machine with high-vacuum chamber, automated ball indentation, Mitutoyo automated micro-hardness indenter Cell 3: Charpy impact system and computer controlled fracture toughness and fatigue systems Cell 4: Computer controlled fracture toughness and fatigue systems Cell 5: Philips XL30 Analytical SEM Cell 6: CNC milling machine, diamond saws
Services Available	Process and service compressed gases, air, demineralized water, recirculating cooling water, recirculating heating water, steam, vacuum, and electrical services
Intercell Movement	Horizontal conveyor transfer system
Material Handling	Master-slave manipulators

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For more information, contact the Irradiated Materials Testing team:

Research Scientist: Dr. Randy Nanstad, nanstadrk@ornl.gov, 865.574.4471
Facility Manager: Dale Caquelin, caquelinda@ornl.gov, 865.576.1353

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10-G01351/mhr

Instrument Fact Sheet

HOT CELLS

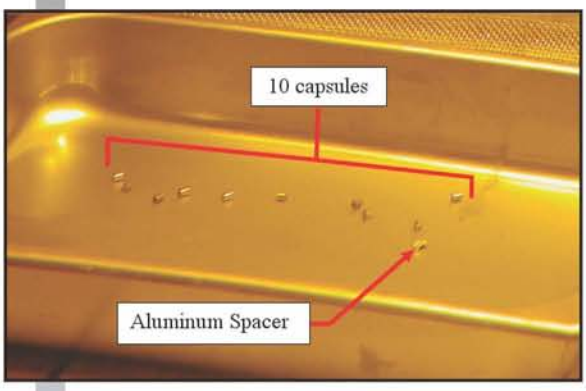
Se Processing

Irradiated Materials Examination and Testing Facility

Selenium Processing and Encapsulation

Description

Selenium-75 (^{75}Se) is produced at ORNL through High Flux Isotope Reactor (HFIR) irradiation of enriched ^{74}Se (stable) encapsulated in titanium or vanadium capsules. Each capsule can contain from 2 to 70-mg (approximately) of the enriched selenium. The specific activity achieved through HFIR irradiation is ~1,500 Ci/g. Present HFIR target design, as a hydraulic tube (HT) rabbit, will hold as many as 20 of the 70-mg capsules. Approximately 2,400 curies of ^{75}Se can be produced from a 20-capsule loading. The current HT rabbit is a cylindrical aluminum container and is sealed by welding an end plug into place.



After irradiation, the targets are transferred from the HFIR pool, via a shielded cask, to a hot cell. Each target is cut open, and the ^{75}Se capsules are removed by a simple dumping action. After decontamination, the capsules are loaded into a capsule meeting DOT Special Form requirements and welded shut. The decontaminated special form capsule(s) is loaded into the customer's cask and transferred to Isotopes Shipping for final documentation and transport to the customer.

^{75}Se is used exclusively in gamma radiography. Over the past 10 years, ORNL has assisted a private company in developing this viable commercial product. ^{75}Se is a much improved source over the former ^{192}Ir gamma source of choice for radiography work for some applications. The ^{75}Se source provides advantages of longer half-life (almost double that of ^{192}Ir), improved operational safety, smaller exclusion zone, and higher image quality, particularly in the 5-30 mm steel working range.

Application

- Se source production for commercial use

Specifications

Specialized Equipment in Hot Cell	Automated welder, vacuum test system, ultrasonic cleaner, Isomet saw, Sugarman cask handling system, ½-ton jib hoist, video monitoring
Intercell Movement	Horizontal conveyor transfer system
Material Handling	Master-slave manipulators

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For more information, contact the Selenium Processing team:

Research Scientist: Mitch Ferren, ferrendm@ornl.gov, 865.574.6602
Facility Manager: Dale Caquelin, caquelinda@ornl.gov, 865.576.1353

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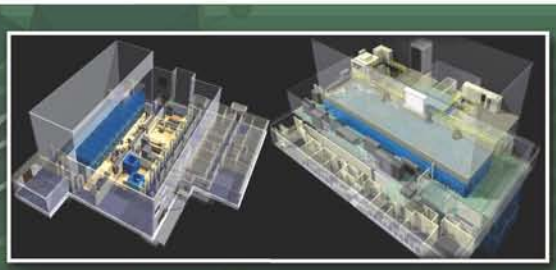
FACILITY Fact Sheet

REDC

RADIOCHEMICAL ENGINEERING DEVELOPMENT CENTER



OAK RIDGE NATIONAL LABORATORY

DESCRIPTION

The Radiochemical Engineering Development Center (REDC) comprises two facilities – Building 7920 and Building 7930.

Building 7920 was designed and built as a hot cell facility that also houses glove box laboratories for radiological work, laboratories for nonradiological work, and a chemical make up area. Building 7920 is classified as a Category 2 nuclear facility. The building is a two-level structure containing heavily shielded hot cells, hot cell support areas, laboratories, a high bay area, and an office wing.

Building 7930 was designed and built as a hot cell facility with glove box laboratory capabilities for radiological work and chemical makeup laboratories. Building 7930 is classified as a Category 2 nuclear facility. The building is a three-level structure with a basement containing heavily shielded hot cells, hot cell support areas, laboratories, a high bay area, and an office wing.

Both facilities are served by many of the same utility supply systems and support organizations that serve the Melton Valley Area.

APPLICATIONS

- Transuranium element product recovery
- Cf, Bk, Es, and Fm production and research
- Am/Cm separations and purification processing
- Target design and fabrication
- Research and development of miscellaneous radiochemical processing operations
- Distribution of select radioisotopes throughout the world

SPECIFICATIONS

Hot Cell	7920: 9 hot cells with associated tanks 7930: 7 hot cells
Viewing Window	7920: Lead glass and mineral oil 7930: Lead glass with zinc bromide
Cell Construction	High-density concrete used for front, rear, side, and top shielding
Ventilation	All primary and secondary confinement systems exhaust streams are HEPA filtered
Services Available	Process and service compressed gases, compressed air, demineralized water, process water, recirculating heating and cooling water, steam vacuum, and electrical services
Intercell Movement	7920: Pneumatic motor driven intercell conveyer system 7930: Pneumatic transfer tube system 7920/7930: Pneumatic transfer system between facilities
Material Handling	Master-slave manipulators and glove boxes

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FOR MORE INFORMATION, CONTACT THE REDC TEAM:

Facility Manager: Allen Smith, smithaw@ornl.gov, 865.576.7953

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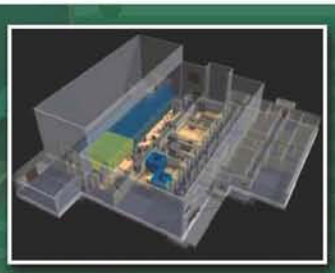
Instrument Hot Cells 1-3

Hot Cells

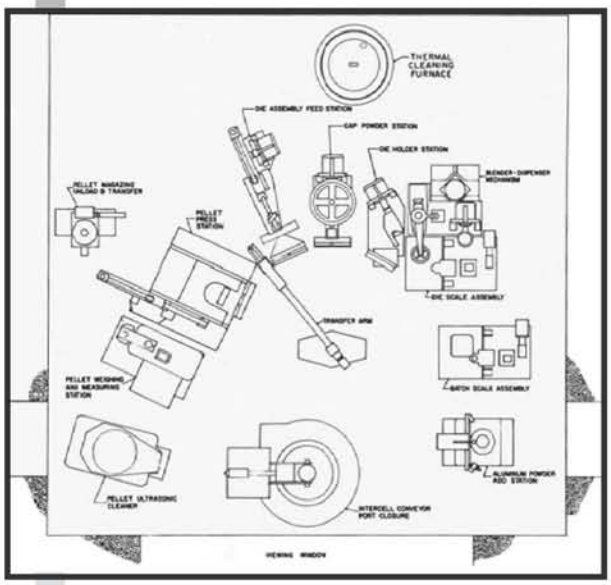
Radiochemical Engineering Development Center (7920)



Target Fabrication Operations

Description

Actinide oxide produced by the resin loading-calcination technique is fabricated into aluminum target rods for irradiation in the High Flux Isotope Reactor (HFIR). The target fabrication equipment is located in three adjacent hot cell cubicles. A series of mechanical operations is used to fabricate the targets and to perform quality assurance inspections of target components at designated steps in the procedure. The operations and inspections include (1) pellet forming, (2) weighing and physical measurements to establish pellet density, (3) thermal cleaning, (4) calorimetry, (5) target loading, (6) welding, (7) X-ray examination, (8) helium leak testing, (9) dimensional inspections, (10) hydrostatic compression of the aluminum tube around the pellets, (11) coolant shroud attachment, (12) decontamination, and (13) carrier loading for transfer to HFIR. The in-cell system is design to minimize the spread of contamination and to facilitate repair or replacement of components. Generally, loose powder operations (e.g. pellet forming) are performed in one cubicle, target assembly is done in a separate cubicle, and final assembly and inspection operations with sealed target rods are performed in another cubicle.



Applications

- Target rod fabrication for transuranium production

Specifications

Hot Cells Usage	Cells 1-3: target Fabrication Note: Cells 1-3 each have an associated tank pit containing metal and metal alloy process tanks and piping.
Hot Cell Sizes	Cells 1-3: 7 ft square by 8.5 ft high
Viewing Window	Lead glass and mineral oil
Cell Construction	High-density concrete used for front, rear, and top shielding. Concrete density is 210 lb/ft^3
Ventilation	HEPA filtered
Services Available	Process and service compressed gases, air, demineralized water, process water, recirculating cooling water, recirculating heating water, steam, vacuum, and electrical services
Intercell Movement	Conveyer system
Material Handling	Master-slave manipulators; Pneumatic transfer line from 7920 to 7930. Slug Chute in Cell 1.

NNFD
Nonreactor Nuclear Facilities Division

For more information, contact the Target Fabrication Operations team:

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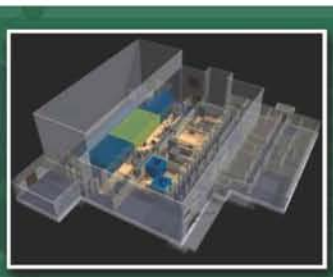
10-G01354/mhr

Instrument Hot Cells 4-7

Hot Cells

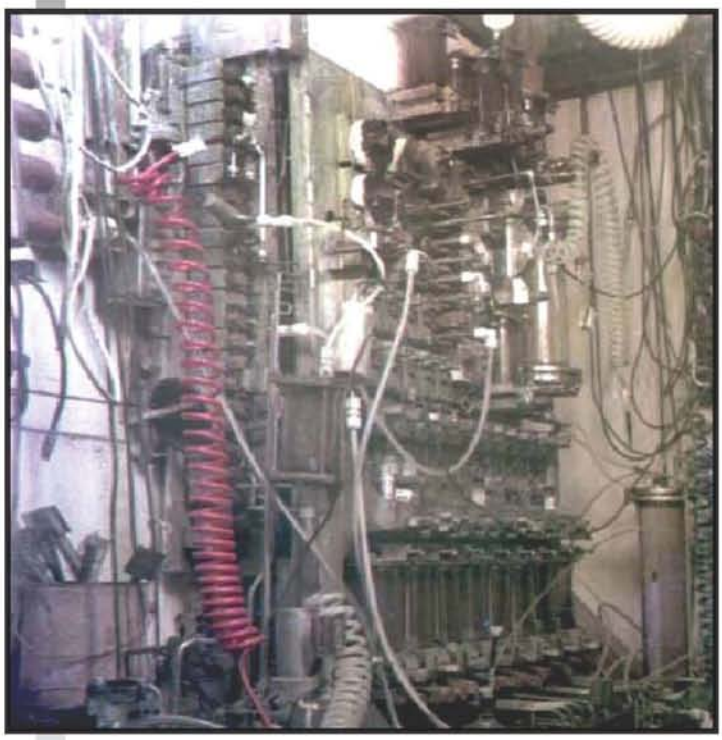
Radiochemical Engineering Development Center (7920)



Transuranium Element Processing

Description

Transuranium element processing is carried out primarily in the hot cells and includes dissolution of irradiated targets and the separation of the actinide elements from each other. These steps are accomplished by the application of dissolution, solvent extraction, and ion exchange processes that are performed in a sequence called a "processing campaign." Ancillary operations such as evaporation, filtration, precipitation, and furnace heating operations are also performed during the processing sequence.



The procedures for individual process steps are designed to allow for flexibility in the recovery of selected products from various irradiated targets. Numerous process changes have been made to meet new processing requirements, utilize improved chemistry and equipment, and provide improved instrumentation for both process and facility operations. The flexibility of the original design and use of remote operated process and maintenance equipment have provided a platform for decades of successful radiochemical processing. Products from the transuraninum element process have been used as target material for new elements discovery and provided materials for basic chemistry property studies of these important radionuclides.

Applications

- Transuranium element product recovery

Specifications

Hot Cells Usage	Cells 4-7: chemical process equipment Note: Cells 4-7 each have an associated tank pit containing metal and metal alloy process tanks and piping.
Hot Cell Sizes	Cells 4-7: 7 ft square by 8.5 ft high
Viewing Window	Lead glass and mineral oil
Cell Construction	High-density concrete used for front, rear, and top shielding. Concrete density is 210 lb/ft^3. Wall thickness of 4.5 ft.
Ventilation	HEPA filtered
Services Available	Process and service compressed gases, air, demineralized water, process water, recirculating cooling water, recirculating heating water, steam, vacuum, and electrical services
Intercell Movement	Conveyer system
Material Handling	Remote operated manipulators; Slug Chute in Cell 7

NNFD

Nonreactor Nuclear Facilities Division

For more information, contact the Transuranium Element Processing team:

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10-G01355/mhr

Instrument

Hot Cells

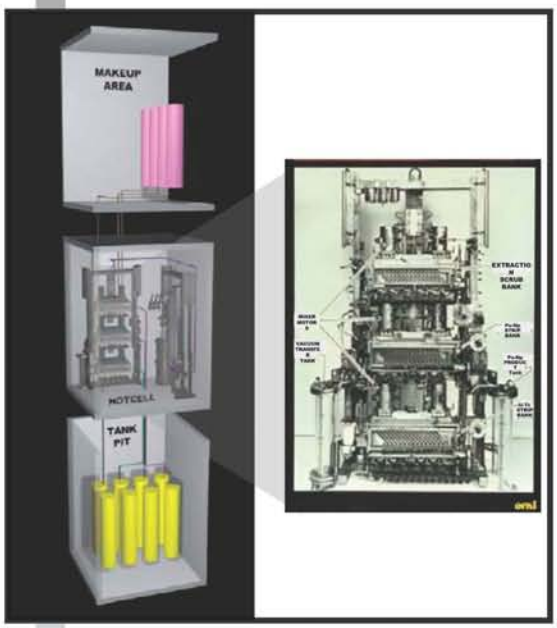
UREX+3 Demo

Radiochemical Engineering Development Center (7920)

CSETF – Continuous Solvent Extraction Test Facility

Description

The Continuous Solvent Extraction Test Facility provides the ability to demonstrate voloxidation of sheared fuel to remove volatiles, characterization of low acid dissolution of fuel powder, testing of UREX+1a flow sheets, and raffinate streams to be further tested in the TALSPEAK process. This will include TALSPEAK process optimization for comparison of a baseline process with alkaline-side separation, including production of a small batch of Am-Cm-Re oxide for use in fuel/target fabrication test studies. Uranium and U/TRU co-conversion studies will include denitration of the product stream, and process equipment design and scale-up, including investigation of pellet fabrication from U/TRU powder pressing and sintering and sphere-pac fuel forms. The bench-scale process demonstration will a means to address remaining development needs of the GNEP program and to estimate the scale needed to obtain sufficient material for testing. All steps of spent fuel processing, up to and including fabrication of transmutation fuel, will be demonstrated in a coupled end-to-end operating mode.



Applications

- Spent fuel receipt and examination
- Fuel disassembly and chopping
- Voloxidation (volatile fission product removal)
- Dissolution
- Separations based on UREX+ suite of processes
- Waste conversion and solidification
- Product co-conversion of transuranium actinides
- Fabrication of tranmutation fuels/targets

NNFD
Nonreactor Nuclear Facilities Division

For more information, contact the CSETF team:

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Research Scientist: Guillermo DelCul, delculgd@ornl.gov, 865.241.3596
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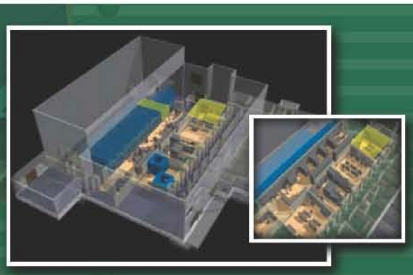
Instrument Analytical Chemistry Operations

Hot Cells

Radiochemical Engineering Development Center (7920)



High-Activity-Level Analytical Chemistry Support

Description

High-activity-level analytical chemistry support is provided for production, research, and development programs. Support for environmental and waste management activities at ORNL through analyses of low-level radioactive samples that are brought from other areas of the plant site is also provided.

One hot cell cubicle (Cell 8) is used exclusively to collect and store samples from the hot cells, to perform analyses that must be made without dilution on highly irradiated samples, and to make dilutions for analyses that are made in the two alpha glove box laboratories and counting room assigned to the analytical chemistry activities.

Applications

- Analytical chemistry operations

Specifications

Hot Cells Usage	Cell 8: analytical chemistry
Hot Cell Size	7 ft square by 8.5 ft high
Viewing Window	Lead glass and mineral oil
Cell Construction	High-density concrete used for front, rear, and top shielding. Concrete density is 210 lb/ft^3
Ventilation	HEPA filtered
Services Available	Process and service compressed gases, air, demineralized water, process water, recirculating cooling water, recirculating heating water, steam, vacuum, and electrical services
Intercell Movement	Conveyer system
Material Handling	Master-slave manipulators

NNFD
Nonreactor Nuclear Facilities Division

For more information, contact the Analytical Chemistry Operatons team:

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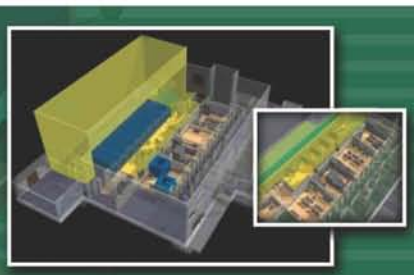
Instrument Fact Sheet

Hot Cells

LAA & HCSA

Radiochemical Engineering Development Center (7920)



Limited Access Area (LAA) and Hot Cell Support Area (HCSA) Operations

Description

A large number of diverse operations are performed in support of facility operations and systems in the LAA and in the HCSA (which includes the transfer area, the decontamination glove box area, the makeup area (MUA), and the operations control room). Generally, the operations include work in support of the processing and development activities in the cell bank and laboratories.

Operations, processes, and activities directly involving radioactive materials occur during movements of material into, out of, and within the LAA and HCSA, including transfers of materials across primary confinement boundaries. Transfer and decontamination facility (TDF) operation in the LAA include material transfers, decontamination and cleaning of targets and packages, and ^{252}Cf assaying. Transfers of large equipment into and out of the hot cell cubicles is done in the LAA using an equipment transfer case. Remotely handled transuranic waste cask loading and other solid waste handling activities occur in the LAA. Removal of solid waste from the cubicles is generally done through the transfer cubicle in the transfer area but may also occur from the top of the cells using the transfer case in the LAA. Other activities in the HCSA include chemical solution make-up and addition (from the MUA) to process vessels in the hot cells, control of activities and equipment in the cubicles and hot cells, and master-slave manipulation of in-cubicle tasks (from the control room and the transfer area).

Applications

- Operations support activities
- Material handling

Specifications

Hot Cells Usage	Cells 1-3: target fabrication Note: Cells 1-3 each have an associated tank pit containing metal and metal alloy process tanks and piping.
Hot Cell Sizes	1-3: 7 ft square by 8.5 ft high
Viewing Window	Lead glass and mineral oil
Cell Construction	High-density concrete used for front, rear, and top shielding. Concrete density is 210 lb/ft^3
Ventilation	HEPA filtered
Services Available	Process and service compressed gases, air, demineralized water, process water, recirculating cooling water, recirculating heating water, steam, vacuum, and electrical services
Intercell Movement	Conveyer system
Material Handling	Master-slave manipulators

NNFD
Nonreactor Nuclear Facilities Division

For more information, contact the LAA & HCSA team:

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Instrument Fact Sheet

Hot Cells

Ac Laboratories

Radiochemical Engineering Development Center (7920)

Actinium Processing

Description

Actinium-225 is produced routinely at ORNL from the decay of long-lived thorium-229 (half life = 7340 years) through the intermediate radium-225 radionuclide (^{225}Ra, half life = 15 days). The separation of radium and actinium from thorium and the initial separation of actinium from the bulk of radium are performed in the Cell A area, which includes an attached glovebox. The final separation and purification of actinium-225 from radium stock and the steps for loading the ^{225}Ac/^{213}Bi biomedical generator or preparing the actinium as solid nitrate for shipping is performed in the glove boxes located in Lab 201.

Specifications

Ac Operations	Alpha Lab 111: 325 ft^2; Cave A shielded cubicle currently contains the thorium cow processing operation. Chemical Lab 201: 540 ft^2; Glove box line currently contains actinium processing operations
Work Area	Cave A: 23 ft^2 x 3.5 ft high with 2 ft thick concrete shielding wall, light-duty master-slave manipulators, and a shielding viewing window Process glove box: 8 ft^2 x 2 ft high each (total of 3 in series)
Services Available	Alpha Lab 111 and Chemical Lab 201: process and service compressed gases, recirculating heating and cooling water, and electrical service
Ventilation	HEPA filtered

Applications

- Actinium-225 processing for medical applications/active clinical trials

NNFD
Nonreactor Nuclear Facilities Division

For more information, contact the Actinium Process team:

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Research Scientist: Saed Mirzadeh, mirzadehs@ornl.gov, 865.574.8399
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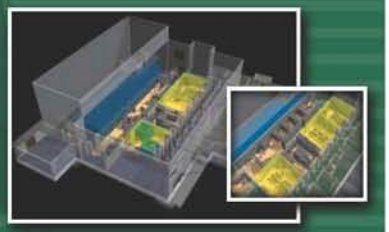
Instrument Fact Sheet

Hot Cells

Alpha Laboratories

Radiochemical Engineering Development Center (7920)

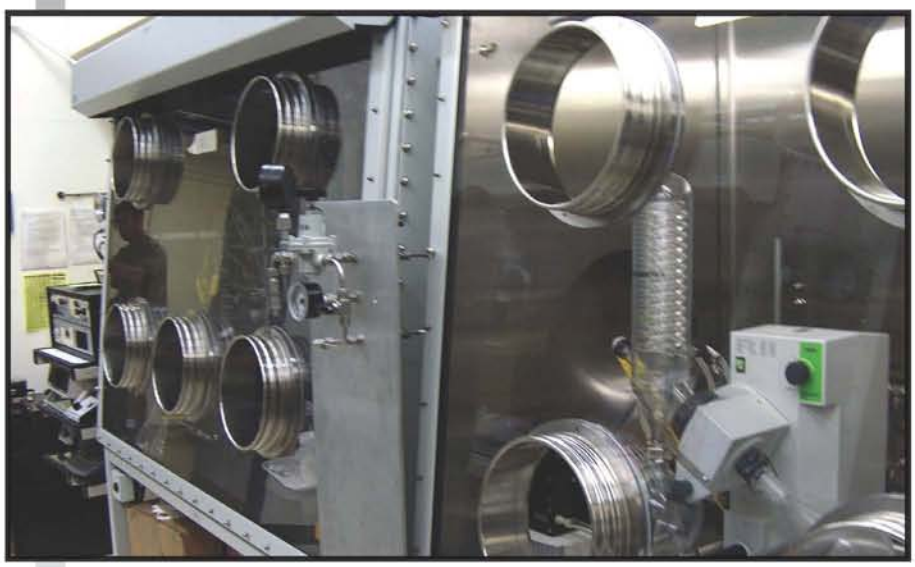


Nuclear Materials Processing

Description

The Alpha Laboratories are used for transuranium element product finishing operations and for elemental studies and chemical process development. Small-scale processes and operations similar in type or identical to those done in the hot cells may be performed in the glove boxes and the shielded caves. The purification and finishing steps involve additional cycles of ion exchange performed on berkelium, einsteinium, and fermium products following their separation from most of the curium and californium in the hot cell bank. The purified products are packaged for shipment in the same facilities.

The current fundamental research and process development work is concerned with process support and development of waste separations processes. Also, two conventional laboratories are used for nonradioactive chemistry studies and for very low-radioactivity support and research operations in laboratory hoods. Emphasis is on precipitation, solvent extraction, and ion exchange techniques. However, any operation normally conducted in an inorganic chemistry laboratory might be adapted for use.



Applications

- Transuranium product finishing
- Elemental studies
- Chemical process development
- Nonradioactive chemistry
- General inorganic chemistry

Specifications

Alpha Laboratories	Alpha Lab 109, 209, and 211: 540 ft^2; No permanent furniture Alpha Lab 111: 325 ft^2; Contains two shielded caves (Cave A and Cave B). Cave B contains a movable glove box for use in processing and experimental chemical operations. Cave A currently contains the actinium processing operation
Conventional Laboratories	Analytical Labs 108 and 208: 540 ft^2; Laboratory benches, fume hoods, movable glove boxes, and confinement box facilities
Ventilation	HEPA filtered
Services Available	Alpha Labs 109 and 211: process and service compressed gases, air, demineralized water, process water, recirculating heating and cooling water, and electrical service. Analytical Labs 108 and 208: air, process water, demineralized water, and electrical service Alpha Labs 111 and 210: Cold Chemical Support Labs

NNFD
Nonreactor Nuclear Facilities Division

For more information, contact the Product Finishing and Chemical Development team:

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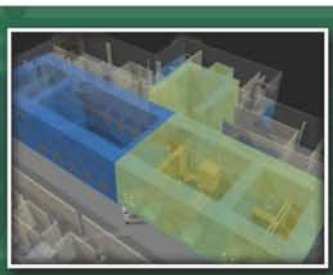
Instrument Fact Sheet

Hot Cells

Californium Facility

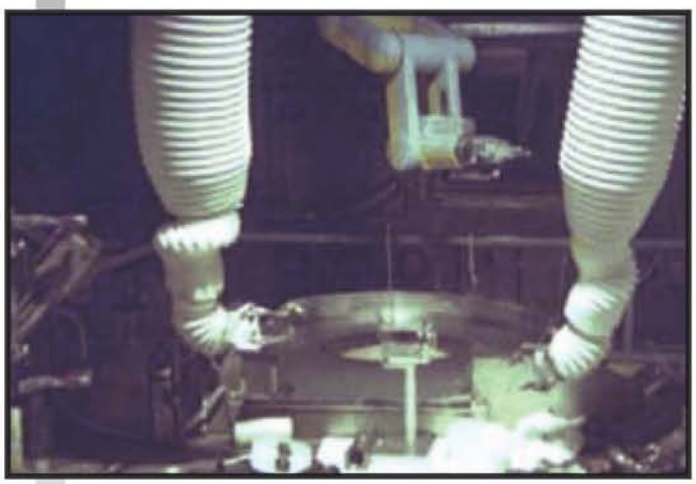
Radiochemical Engineering Development Center (7930)



Californium Processing Operations

Description

Californium chemical processing is performed in Cells A, B, C, and G. Operations include pressurized ion exchange, pressurized extraction chromatography, resin loading-calcination, and oxalate precipitation-calcination. Fabrication of special ^{252}Cf neutron source forms and encapsulation and packaging of radioactive materials is also done. The fabrication of neutron source forms involves pellet pressing, annealing, rolling, and swaging. The encapsulation and packaging activities involve the loading, assembly, and welding of capsules and shipping packages, x-ray examination, helium leak testing, decontamination of the capsules and packages, and assaying the contents of the capsules and packages by neutron counting. Hot cells are also utilized for (1) final decontamination of sealed sources; (2) assembly and welding of outer capsules and packages for sealed sources; (3) X-ray examination, helium leak testing, and smear testing of capsules and packages; (4) assaying sealed sources by neutron counting; and (5) loading and unloading of sealed sources into/from shipping casks.



Applications

- Chemical processing of californium
- ^{252}Cf neutron source form fabrication
- Encapsulation and packaging of radioactive materials

NNFD
Nonreactor Nuclear Facilities Division

For more information, contact the Californium Process team:

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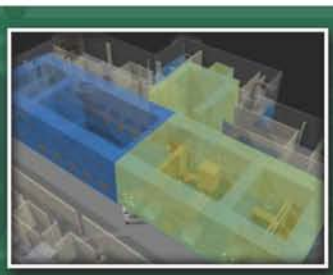
INSTRUMENT CUF Fact Sheet

HOT CELLS

RADIOCHEMICAL ENGINEERING DEVELOPMENT CENTER (7930)



CUF – CALIFORNIUM USER FACILITY

DESCRIPTION

The Californium Facility processes and encapsulates the national supply of ^{252}Cf produced at the neighboring High Flux Isotope Reactor (HFIR) and stores the national inventory of ^{252}Cf neutron sources for the Californium Industrial, University, and Medical Loan Programs of the U.S. Department of Energy (DOE).

The Californium User Facility for Neutron Science was established to promote research and applications of ^{252}Cf by taking advantage of the existing Californium Facility infrastructure. It offers:

- hands-on experimental setup in uncontaminated hot cells,
- pneumatic source transfer and remote handling of sources,
- a large inventory of various source intensities, and
- routine in-cell irradiations using up to 60 mg of ^{252}Cf; i.e., >1011
- neutrons/s with available thermal and fast neutron fluxes up to ~109 cm^{-2} s^{-1}.

Users can obtain real-time electronic data acquisition during sample irradiation. Small samples can be transferred into or out of the hot cell during irradiation. Irradiations within the water-filled storage pool can use REDC's available ^{252}Cf inventory, up to several hundred milligrams.

APPLICATIONS

- Neutron irradiation
- Radiography
- Sealed source loading/unloading

SPECIFICATIONS

Hot Cells Usage	Cell B: Loading/unloading of sealed sources Cell C: Final Inspection of sealed sources Pool Storage Facility: Underwater storage of sources
Hot Cell Size	Cell B: 16 ft wide x 23 ft long x 22 ft high Cell C: 20 ft wide x 33 ft long x 24 ft high Pool Storage Facility: 10 ft wide x 20 ft long x 22 ft deep (min)
Viewing Window (where available)	Cell B: Lead glass with oil Cell C: Lead glass with zinc bromide
Cell Construction	Cells B & C: Reinforced concrete; Stainless steel lined walls and ceiling; Pool Storage Facility: Monolithic concrete with stainless steel lined floor
Ventilation	HEPA filtered
Services Available	Electrical, equipment service plugs, welding power, argon and helium gases
Intercell Movement	Pneumatic transfer system between Cells B and C Pneumatic transfer system between Cell C and Pool Storage Facility
Material Handling	Cell B: Master-slave and electromechanical Cell C: Master-slave manipulators

NNFD
Nonreactor Nuclear Facilities Division

FOR MORE INFORMATION, CONTACT THE CUF TEAM:

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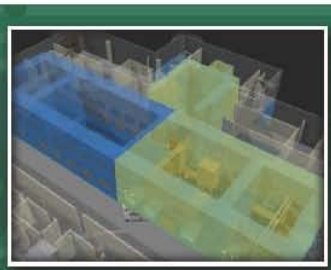
Instrument Fact Sheet

Hot Cells

SNMV

Radiochemical Engineering Development Center (7930)



SNMV–Special Nuclear Material Vault

Description

Special Nuclear Material Storage Vault is a central storage area for nuclear material (e.g., ^{239}Pu, ^{238}Pu, ^{235}U, ^{232}Th). The facility provides both security and a safe environment to prevent a release or theft. The facility provides storage of materials for various projects and divisions at ORNL.

Applications

- Storage of special nuclear material

NNFD
Nonreactor Nuclear Facilities Division

For more information, contact the SNMV team:

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OAK RIDGE
National Laboratory