NIDC | NATIONAL ISOTOPE DEVELOPMENT CENTER
MANAGED BY THE U.S. DEPARTMENT OF ENERGY ISOTOPE PROGRAM

Newsletter

Spring 2020

Domestic Production of Americium-241 Restarted

After more than 30 years, the U.S. Department of Energy Isotope Program (DOE IP) has re-established routine recovery of the radioisotope americium-241 (Am-241, $t_{1/2}$ = 432 years to Np-237), transforming a nuclear waste constituent into a valuable industrial and research product.

Packaging of Am-241 in LANL glovebox. (Image courtesy of LANL.)

Americium-241 is most commonly combined with beryllium to make an americium-beryllium source for well logging in the oil and gas industry to help companies gauge geological properties of boreholes—deep, narrow holes made in the ground to help locate oil or water. With this data, strategic decisions can be made about future well development. The radioisotope is also used commercially in smoke detectors and moisture gauges and is being evaluated for use as heat sources in radioisotope thermoelectric generators, in place of plutonium-238.

In the 1970s and 1980s, DOE produced Am-241 as an oxide powder at multiple government sites, sufficiently addressing the industry's demand while accumulating a considerable surplus. When domestic production ceased in 1984, this surplus sustained the market through the early 2000s. Eventually, industrial customers became dependent on a single foreign supplier, leaving them vulnerable to potential supply disruptions and price volatility.

The DOE IP realized the importance of restoring a long-term domestic supply of Am-241 and, in 2012, chose to fund a small team of researchers at Los Alamos National Laboratory (LANL), with the help of a consortium in the oil and gas community, to re-establish a domestic production capability. Managed by the National Nuclear Security Administration, LANL is home to substantial quantities of plutonium salt residues from decades of defense program work. The Am-241 in these residues increases the radiation dose of the material and makes downstream processing a challenge. Before disposing of these materials, the DOE IP extracts the Am-241 for industrial use, facilitating the reuse or disposal of remaining plutonium.

The LANL team began the first chemical processing of a batch of Am-241 in August 2017, and to date it has recovered approximately 180 grams of the material with an isotopic purity exceeding 99% and a plutonium content of less than 1%. With the new demonstration of production capability, the LANL team has helped the DOE IP revive the domestic supply of Am-241. Routine production activities have started to generate additional batches of material for industrial use. **Request a quote for Am-241.**

INSIDE THIS ISSUE

High Activity Copper-67 in Routine Production

In the fall of 2019, researchers at Argonne National Laboratory began routine production of high specific activity copper-67 (Cu-67, t1/2 = 61.83 hours to Zn-67). This is the first time in the history of the program that the high specific activity radionuclide has been available for purchase, and it represents a huge accomplishment for Argonne and the DOE IP.

Copper-67 is known as a dual-purpose therapeutic–diagnostic, or theranostic , radioisotope and is highly sought after by the medical community for targeted cancer treatments. Copper-67 has a gamma-ray emission suitable for diagnostic singe-photon computed tomography imaging and beta emissions suitable for cancer therapy.

Argonne staff scientists prepare Cu-67 shipments for customers.

"We are now routinely producing 1 Ci batches of Cu-67 for distribution through the DOE IP. The average specific activity has been >250 Ci/mg (Cu-67/all Cu) with average labeling efficiencies of 2.61 mCi/nmole (TETA) and 1.40 mCi/nmole (DOTA). Customers who have done their own in-house labeling are happy with the results. We are excited to make this exciting theranostic radioisotope available."

Current demand for the isotope is high, with multiple orders placed each month. Presently, approximately 1 Ci of Cu-67 is available for shipment per month. The Argonne team is preparing to increase the number of batches per month as customer demand increases.

The Cu-67 will provide material for numerous research investigations and clinical trials. Researchers and doctors around the world are studying various types of pediatric and adult cancers using the isotope, including breast cancer, prostate cancer, neuroblastoma, glioma, lymphoma, neuroendocrine tumors, ovarian, and bladder cancers.

Researchers are also investigating its complementary use with copper-64, an isotope useful for positron emission tomography imaging. When paired, copper-64 acts as a diagnostic and dosimetry tool to determine the appropriate copper-67 dose required for therapy. Having these two radioisotopes available allows doctors and radiologists to simultaneously image and treat various types of cancers. **Request a quote for Cu-67**.

Isotope Availability News

Newly Available

- Actinium-225 (accel.-produced)
- Actinium-227
- Aluminum-26
- Americium-241
- Astatine-211
- Barium-133
- Copper-67
- Lutetium-177
- Mercury-194
- Rubidium-83
- Ruthenium-96
- Selenium-75
- Silicon-32
- Strontium-89
- Tellurium-119m
- Thorium-228
- Thorium-232
- Titanium-44

Coming Soon

- Uranium-234
- Beryllium-7
- Cadmium-109
- Cerium-134
- Carbon-14
- Cerium-139
- Iridium-192
- Iron-55
- Iron-59
- Holmium-163
- Promethium-147
- Selenium-72
- Yttrium-86
- Zinc-65

Under Investigation

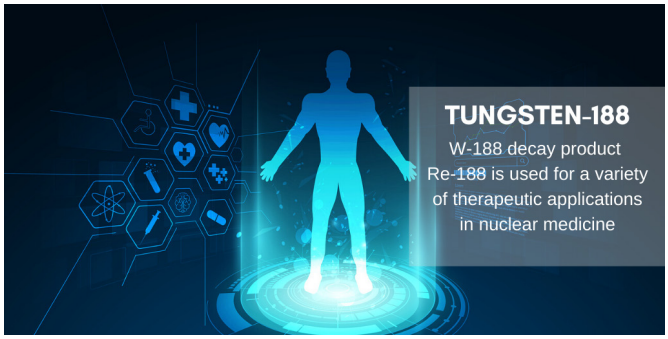
- Argon-39
- Gadolinium-153
- Heavy water (D_2O)
- Lithium-7
- Manganese-52
- Molybdenum-98
- Molybdenum-100
- Niobium-93m
- Platinum-195
- Scandium-47
- Silicon-28
- Silver-111
- Uranium-230
- Xenon-129
- Ytterbium-176

Medical Isotope Availability: W-188, Ti-44, and Te-119m/Sb-119

The DOE IP is currently funding several projects for different isotopes to be used for medical purposes.

Tungsten-188 and Tungsten-188/Rhenium-188 Generators

The DOE IP has begun replenishing its inventory of tungsten-188 (W-188) and made material available for purchase in January 2020. Because of the unexpected shutdown of the High Flux Isotope Reactor (HFIR) in November 2018, routine production was halted until the reactor could be brought back online.



Since restarting HFIR, teams at Oak Ridge National Laboratory (ORNL) have been working on loading the W-188 ($t_{1/2}$ = 69.78 days to Re-188) onto W-188/Re-188 generators for use in medical settings. Rhenium-188 ($t_{1/2}$ = 16.98 hours) is a high-energy beta-emitting radioisotope that has proven successful in a variety of applications in nuclear medicine, oncology, and radiation/cardiology. Rhenium-188's high-energy beta emission is particularly well suited for penetrating solid tumors, making this an ideal isotope for therapy of skeletal metastases. **Request a quote for W-188 or a W-188/Re-188 generator.**

Availability Notice: New Batches of Strontium-89

Because of increased demand, the DOE IP has recently restarted production of strontium-89 (Sr-89) and began offering the product for sale again in January 2020. The radioactive isotope is most commonly used to relieve pain associated with cancer that has spread to the bone. **Currently, the DOE IP is the only U.S. domestic supplier of Sr-89.**

Strontium-89 ($t_{1/2}$ = 50.563 days) is produced via neutron capture on an enriched strontium-88 oxide target using HFIR, located at ORNL. After radiochemical processing, the product has a radionuclidic purity of >99.8% and is sold as strontium chloride solution in 0.1 N HCl.

For further inquiries about Sr-89 contact the NIDC at **contact@isotopes.gov** or visit **www.isotopes.gov/catalog.**

Titanium-44/Scandium-44

The DOE IP has begun working with select organizations to receive test batches of titanium-44 (Ti-44). Because of its nearly 60 year half-life, the material will be on loan and used to develop a generator for scandium-44 ($t_{1/2}$ = 4.042 hours), a radioactive isotope used in PET imaging as an alternative to germanium-68.

Titanium-44 is produced at the Isotope Production Facility at LANL and the Brookhaven Linac Isotope Producer at BNL through the irradiation of scandium targets. **If you are interested in receiving Ti-44, contact the NIDC at contact@isotopes.gov.**

Tellurium-119m /Antimony-119

The DOE IP is working to increase the availability of antimony-119 (Sb-119) through access to the parent isotope, tellurium-119m (Te-119m). Created at the Isotope Production Facility at LANL, the Te-119m ($t_{1/2}$ = 4.69 days) helps alleviate the issue of Sb-119 ($t_{1/2}$ = 38.1 hours) accessibility due to its short half-life. The DOE IP is also developing a Te-199m/Sb-119 generator and anticipates making this product available at a future date.

Antimony-119 has been identified as a potential isotope for cancer therapy due to its Auger emissions, which can deliver a high radiation dose to a cancer cell but leave the surrounding tissues largely untouched. Routine access to Te-119m will enable easier access to Sb-119 for researching and testing. **If you are interested in receiving Te-119m, contact the NIDC at contact@isotopes.gov.**

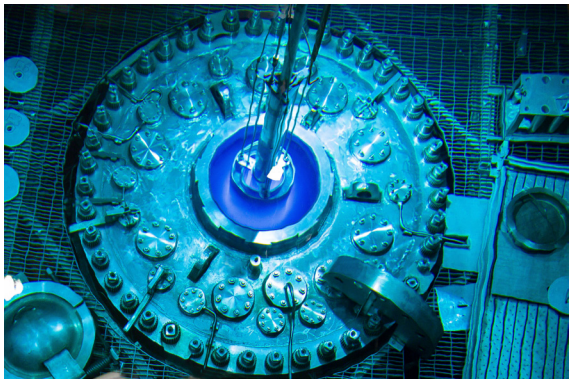
Actinium-225 Drug Master File Submitted to Food and Drug Administration

In January 2020, the NIDC and DOE IP received confirmation that the submission of a Drug Master File (DMF) for accelerator-produced actinium-225 nitrate had been accepted by the U.S. Food and Drug Administration.

A DMF is a confidential, detailed document that is submitted to the Food and Drug Administration with information about facilities, processes, or articles used in the manufacturing, processing, packaging, and storing of human drug products. An active DMF enables clinical investigators or pharmaceutical companies to reference the filing in their regulatory submissions.

This is an important step for facilitating the use of actinium-225 (Ac-225) in medical treatments intended for humans. It is also a landmark in the roadmap set forth by the Actinium-225 Tri-Lab Effort, as it works toward developing alternative methods for Ac-225 production.

High Flux Isotope Reactor Restarts



HFIR's cooling water gives off a blue glow due to Cherenkov radiation.

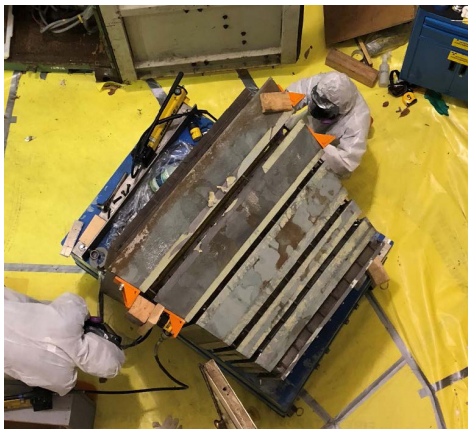
After nearly a 1-year outage, the HFIR at ORNL restarted on October 29, 2019. Because of a fuel assembly issue, the reactor was shut down in November 2018. Management decided to keep the reactor down for an extended period of time and perform facility improvements and upgrades to ensure continuing reactor operations for the next several years.

Instrument improvements included more advanced beam delivery systems, enhanced sample environments, better optics, and improved data acquisition systems and detectors.

During the outage, several important facility updates were performed including upgrades to the coolant supply pipes, maintenance on control rod and extension tube assemblies, upgrades to the reactor pool heating system, installation of concrete electrical duct banks for future improvements, and repair or replacement of valves, actuators, sensors, electrical switches, filters, and cables, as well as inspections of hundreds of existing systems to ensure proper and reliable operation.

For more information about improvements at HFIR, see Boisvert, *"HFIR Upgrades Ensure Continued World-Leading Neutron Research,"* Neutrons.ornl.gov, Oak Ridge National Laboratory, November 4, 2019.

Actinium-225 Tri-Lab Effort Update

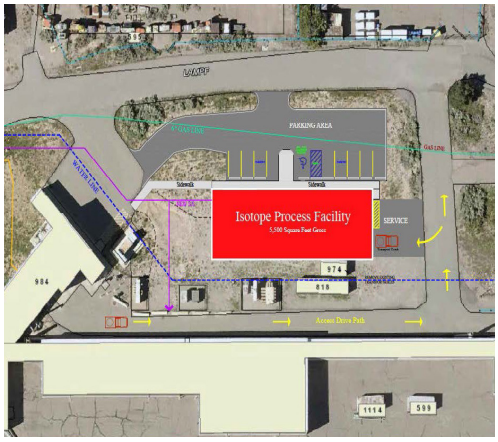


Workers at BNL remove the window of an old glovebox and prepare to replace it.

Progress toward developing a routine and reliable supply of Ac-225 continues to be a large focus for the DOE IP. During the latest Ac-225 Tri-Lab Effort production annual review, progress toward producing 100 mCi batches of the medical isotope were discussed in addition to a road map to demonstrating 1,000 mCi batches by the 2024–2025 time frame.

For the program to produce curie-level batches on this scale, development of co-located target irradiation and processing/distribution facilities were identified. Tri-Lab participants have also proposed building various new processing facilities at Brookhaven National Laboratory (BNL), LANL, and ORNL with each of the facilities in various stages of development.

Leading the way is BNL, which is completely refurbishing the existing multipurpose Hot Cell Resource facility. The project includes the decontamination of hot cells, refurbishment of six manipulators and three shielded viewing windows, installation of a dedicated air ventilation and filtration system, a new electrical system and other general architectural and construction improvements. Initially the project was anticipated to be completed in December 2020, but because of accelerated demolition and other fast-tracked items, the new completion date is scheduled for earlier in the year.



Future plans show the new Alpha Target Processing Facility at LANL adjacent to the beam line, providing a convenient space to prepare Ac-225 for distribution.

In addition to the refurbishment of the BNL facility, a proposal detailing the suite of programmatic equipment that will be placed in a new processing facility at LANL was recently awarded in anticipation of increased accelerator-produced Ac-225 production. Known as the Alpha Target Processing Facility, this new project will include four new hot cells, a mini-hot cell, and gloveboxes, changing rooms, truck access, a control room, and additional space for multiprogram use. The current timeline estimates that operations could begin as early as the summer of 2024.

Lastly ORNL is also proposing to either construct a new processing facility or refurbish current facilities. During the next several months, ORNL program leadership and the DOE IP will work toward the design and funding of these facilities.

DOE IP 2020 Events

This year the NIDC and DOE IP have big plans for participating in industry events! Details about events we are attending and sessions that DOE IP–supported researchers are chairing or presenting are below.

Society of Nuclear Medicine and Molecular Imaging 2020 Annual Meeting - VIRTUAL MEETINGS

The Society of Nuclear Medicine and Molecular Imaging (SNMMI) 2020 Annual Meeting is changing course due to COVID-19 and offering this as a 4-day virtual conference. Attendees will log in and watch online presentations of the latest research and development in the field, and gain insights into practical clinical applications.

The DOE IP has decided to move most of our meetings to an online forum including our isotope-specific user group meetings, and one-on-one stakeholder meetings. More information on dates and times for each of our sessions will become available in the coming weeks. If you or your organization is interested in scheduling a one-on-one stakeholder meeting, email **sikeskg@ornl.gov** to request your meeting date and time.

DOE IP and NIDC Virtual Meetings

European Association of Nuclear Medicine 2020 Annual Congress | October 17–21 | Vienna, Austria

European Association of Nuclear Medicine 2020 Annual Congress

With more than 150 sessions, the European Association of Nuclear Medicine Annual Congress is one of the most valuable nuclear medicine meetings worldwide. Each year, more than 6,200 participants have the possibility to network, engage, and discuss the newest trends and findings in the field of nuclear medicine.

Join the DOE IP and NIDC at our booth in the exhibition hall to discuss your specific isotope needs and to find informational material on our latest products and services, R&D initiatives, and more. Or join us for a one-on-one customer meeting during the conference.

International Chemical Congress of Pacific Basin Societies 2020

During this year's 2020 International Chemical Congress of Pacific Basin Societies (PACIFICHEM), the DOE IP will sponsor a full-day symposium titled **"Advancements in Isotope Production—Providing Important Materials for Research and Applications"** divided into three presentation sessions tentatively scheduled for Wednesday, December 16, 2020. Stay tuned for more information as we finalize our topics, presenters, and details.

PACIFICHEM 2020 | December 15–20 | Honolulu, Hawaii

ISOtopics

RESEARCH EXCELLENCE

Congratulations to ORNL's **Julie Ezold** who was recognized by the American Nuclear Society at its annual Winter Meeting and Nuclear Technology Expo in Washington D.C.

Julie, of ORNL's Isotope and Fuel Cycle Technology Division, received the E. Gail de Planque Medal for the advancement of radioisotope production that led to the synthesis of new elements, for contributions to space exploration, and to the training of a new generation of nuclear scientists. Julie has been an American Nuclear Society member since 1992.

STAFF ADDITIONS

The NIDC recently welcomed two new staff to the ORNL office.

Eva Hickman joined the NIDC as a product distribution specialist. Her new role includes coordinating customer orders and contracts for both stable and radioactive products.

Before joining the NIDC, Eva worked as a process engineer in ORNL's Stable Isotopes Group where she performed target fabrications, custom conversions of isotopes to alternate chemical forms, isotope dispensing, and quotations for technical services. She brings 24 years of experience from the ORNL Isotope Program to this role.

Jack McCollister has also joined the NIDC as a product distribution specialist. His new role includes coordinating customer orders and contracts for both stable and radioactive products.

Previously Jack worked as a chemist and provided technical support for development activities to reestablish stable isotope enrichment technologies in ORNL's Stable Isotope Group. Before that he was the team lead for the ORNL Hazardous Waste Facility and HAZMAT team. Jack is a retired military veteran, having served 23 years with the U.S. Marine Corps and Tennessee Air National Guard.

FEATURED PUBLICATION

Featured in *Scientific Reports*, is "Development of an Autonomous Solvent Extraction System to Isolate Astatine-211 from Dissolved Cyclotron Bombarded Bismuth Targets." Researcher **Matt O'Hara (PNNL)** contributed to the development of the autonomous system for the time-consuming task of extracting astatine-211 from bimuth-209.

This system allows scientists to efficiently recover astatine-211, an alpha emitter that is showing tremendous promise as a targeted alpha therapy treatment. **To read the full research article, click here.**

UPCOMING EVENTS

SNMMI 2020 Annual Meeting

June 13–16, 2020, New Orleans, Louisiana. Join the DOE IP and NIDC in booth #321 and for numerous sessions and meetings including the Annual Program Overview Meeting, isotope-specific user group sessions, and one-on-one stakeholder meetings.

2020 EANM Annual Congress

October 17–21, 2020, Vienna, Austria. Join the DOE IP and NIDC at our booth in the exhibition hall or schedule a one-on-one customer meeting during the conference.

PACIFICHEM 2020

December 15–20, 2020, Honolulu, Hawaii. Join the DOE IP for a full-day symposium titled "Advancements in Isotope Production—Providing Important Materials for Research and Applications," which is divided into three presentation sessions tentatively scheduled for Wednesday, December 16, 2020.

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