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Meet An Isotope Program Staff Member



Eva Birnbaum, LANL Isotope Program Staff Member

Dr. Eva Birnbaum graduated from the California Institute of Technology with a PhD in Inorganic Chemistry and came to Los Alamos National Laboratory as a postdoc in 1995, working in the areas of catalysis and environmental remediation. She became a staff member in 1998, focusing on trace metal analysis and conducting field work assessing and mitigating contamination from dynamic experiments. After a short stint at a local start-up company, Eva returned to LANL in 2010 as the team leader for the LANL Isotope Program, where her broad experience has allowed her to approach issues with a fresh viewpoint. Eva transitioned to the position of LANL Isotope Program Manager in June 2014, and hopes to continue to enable a robust production program, novel nuclear physics research, and production of new therapeutic isotopes. She has over 30 peer-reviewed publications and 6 issued patents across a diverse range of scientific fields. She has received numerous LANL Distinguished Performance Awards, a LANL Distinguished Mentor Award, and an FDA Group Award for assisting in the "Medical Isotope Contamination Investigation", and has served on a number of DOE and NIH review panels.

Status of the Domestic and International Helium-3 (^3He) Shortage

In early 2009 the U.S. Government recognized a critical ^3He shortage that would significantly impact vital government programs. Federal action was quickly taken by the National Security Council Interagency Policy Committee (IPC). The IPC examined the ^3He supply, demand, and related technology research to establish priorities and guidance for allocation of ^3He . These actions formed the basis for establishment of federal agencies policies and practices that have resulted in a significant reduction in federal demand for ^3He . Only by continued diligent mitigation efforts across the federal complex will limited federal production and current inventory of ^3He satisfy high priority federal needs well into the future. These mitigation efforts include use of alternative technologies, ^3He reuse and recycle, annual review and prioritization of ^3He allocations, and continued adherence to established guidance.

^3He Shortage Background

The shortage of ^3He came to light in the summer of 2008 and by early 2009 was recognized as a critical shortage that would impact many applications, including neutron detection and cryogenics. The United States supply of ^3He comes from the decay of tritium (^3H), which the Nation had in large quantities because of our nuclear weapons complex; however, the tritium stockpile has declined in recent years through radioactive decay and is expected to decline in the future because of reduced demand for tritium.



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³He Shortage Status (continued)

In March 2009, DOE, DHS, and DOD formed an interagency group to examine ³He supply, demand, and potential alternative technologies for neutron detection through research and development (R&D). This group determined that further allocations of ³He would be made only by interagency agreement. In July 2009, the interagency group evolved to the ³He InterAgency Policy Team (IPT) led by White House National Security Staff. The IPT had broad federal representation, and investigated strategies for decreasing ³He demand while increasing ³He supply, as well as making recommendations about allocation of the existing supply. In September 2009, the IPT established the initial ³He allocation strategy. The ³He IPT is now called the InterAgency Group (IAG) with representation from eleven different federal agencies and fourteen ³He allocation categories.

The current allocation priorities for ³He made available through the federal allocation process are:

- 1) Domestic requests championed through a federal agency have first priority:
 - a. Those programs requiring the unique physical properties of ³He have first priority.
 - b. Those programs that secure the threat furthest away from U.S. territory and interests have second priority.
 - c. Those programs for which substantial costs have been incurred have third priority.
- 2) International requests championed through a federal agency have second priority:
 - a. ³He will be used in an international research project with direct U.S. involvement. This provides direct benefit to U.S. researchers and the U.S. research enterprise.
 - b. ³He will be used at a scientific facility for which there is U.S. research participation. This provides direct benefit to the U.S. research enterprise and it will contribute positively to international cooperation and relations. In addition, the research complements that carried out by U.S. scientists and has strong U.S. support.
 - c. ³He will be used by an international entity for research that does not directly involve U.S. scientists but the research complements that carried out by U.S. scientists and has strong U.S. support. This provides an indirect or direct benefit to the U.S. research enterprise and it will contribute positively to international cooperation and relations.

Alternative Technologies to ³He for Neutron Detection

A Technology Working Group (TWG) within the IPT was formed with representation from the Department of Defense/Defense Threat Reduction Agency (DoD/DTRA),

the Department of Energy/National Nuclear Security Administration (DOE/NNSA), and the Department of Homeland Security/Domestic Nuclear Detection Office (DHS/DNDO). The primary mission of the TWG was to identify alternative technologies to ³He-based neutron detectors as soon as possible. A significant number of interagency test campaigns were performed with significant financial investments, which resulted in a number of break-through technologies being commercialized for open market sales. For example, radiation portal monitors now have four different alternative technologies equal to the performance of the ³He based portals, three different technologies for Mobil/Vehicle Mounted Detection Systems (MDS), two Backpack configurations which soon will be on the U.S. commercial market (foreign sales are now available) and two handheld ³He free technologies soon to be commercialized and are being sold in foreign countries.

Current Status

The Director of the DOE Isotope Program currently chairs the activities of the ³He IAG. Annually, the IAG collects ³He demand information from U.S. Federal agencies, identifying and scrutinizing the requests for gas needed to accomplish U.S. Federal missions across all activities. As a result of the deliberations of the IAG and close interagency coordination, impacts of the 2008 shortage are assuaged because the current demand for ³He is well below the 8,000 liter per year goal and continues to drop for the reasons discussed below.

Over the past several years, the IAG considered strategies to increase supply including: (1) seeking ³He from foreign countries, (2) encouraging ³He recycling and reuse, (3) investigating techniques to increase ³He extraction efficiency, (4) seeking new ³He production methods and (5) working with industry partners to develop alternative technologies to replace the ³He gas in neutron detectors. Through the efforts of the IAG, domestic demand has decreased dramatically by a combination of actions including prioritization, alternative technologies research and deployment, more efficient applications, reuse and recycling. Federal demand has decreased from an annual requirement of 70,000 liters to less than 8,000 liters. The allocation of ³He gas will continue to be tracked by the IAG for distribution. Alternative technologies for ³He applications, in particular neutron detectors for national security, nonproliferation, defense, border security, and homeland security, will continue to be encouraged and implemented. With the continued mitigation efforts fostered by the ³He IAG, the current ³He supply is estimated to meet the federal domestic demand for several decades as long as the demand remains at or below the current low levels and the IPC guidelines are followed.

NIDC Implements Improved Business System



On July 1, 2014, the NIDC Isotope Business Office (IBO) began the transition to an improved business operations system, which will provide enhanced efficiencies to both the operations of the office and to the services provided to the Isotope Program customers. Phase 1 of the planned business operations improvement initiative was successfully completed ahead of schedule as the existing daily business tasks were transitioned to SAP accounting software at the beginning of July. Utilizing SAP, the IBO is already realizing improvements in efficiencies by streamlining functionality for quotes, orders, shipments, billings, collections and inventory tracking into one, consolidated accounting system supported by the existing ORNL SAP business system. Isotope Program customers may notice the revised appearance of forms and information now produced through the SAP system. Upcoming enhancements soon to be implemented will include new capabilities provided through the NIDC website, which will provide improved customer services through website interaction for the processing of quotes and orders. Future enhancements to continue the development of the NIDC business operations system will include continued integration of business operations between the various Isotope Program sites and continued improvements to customer service capabilities offered through the NIDC website. This initiative for improvements to the business system reflects the goal of the NIDC to provide improved services to Isotope Program customers while performing its mission to manage the sale and distribution of isotopes from the DOE Isotope Program facilities.



DOE Launches New University Business Partnership Opportunities



The Isotope Development and Production for Research and Applications Program (IDPRA) managed by DOE's Office of Nuclear Physics will be partnering with universities that have unique isotope production and processing capabilities. These capabilities will be used by IDPRA to supply isotopes that are in short supply and have a potential for expanded applications. The NIDC's Isotope Business Office will be managing the production orders with the universities and establishing contracts for distribution to the end-use researchers.



Plans are underway to kick off the process in partnership with the University of Washington's (UW) Department of Radiation Oncology located at the UW Medical Center to supply astatine-211 (At-211) for medical research. The Department's cyclotron facilities in conjunction with the complimentary processing laboratories and technical staff are poised to provide regional distribution of highly pure At-211.

If you are interested in obtaining At-211, please contact Alexandr M. Sokolov, at the NIDC's Isotope Business Office (IBO) at 865-574-7415, or email to sokolovam@ornl.gov.

The Department of Energy's Isotope Program Community Outreach

The Department of Energy's Isotope Program is pleased to be attending the 8th International Conference on Isotopes and Expo. The Isotope program will be setting up a booth at this expo from August 24-27th. For more information about this conference please go to <http://8ici.org/>.

Successful Electrodeposition of the Highest Activity Californium-252 (Cf-252) Research Source

Researchers at Oak Ridge National Laboratory (ORNL) produced a 1.7 Ci Cf-252 electrodeposition, containing the most Cf-252 ever deposited as a single source.



Figure 1. Cf-252 is produced at the High Flux Isotope Reactor (HFIR) at ORNL.

The Science

Californium-252 is a unique radioisotope that primarily decays by emitting alpha particles, but also spontaneously fissions. The spontaneous fissions result in the production of neutrons and fission fragments, which are smaller, neutron-rich isotopes. The short half-life (2.645 years) and the emission of these intense, highly energetic particles make the deposition chemistry difficult and require shielded work facilities. During the past 5 years, ORNL staff have been researching and developing the techniques necessary for this deposition. Until November 2013, the maximum activity of a Cf-252 source that had been electrodeposited was 0.5 Ci. The success of depositing more than three times that activity will enable researchers to expand the study and use of fission fragments in scientific research.



Figure 2. (Top) 1.7 Ci Cf-252 electrodeposition inside the hot cell at ORNL's Radiochemical Engineering Development Center



Electrodeposition unit: (left) open showing the stainless steel plate imbedded in the copper cathode; (right) assembled with the platinum anode.

The electrodeposition method used an ammonium acetate buffered solution adjusted to pH 3.0 with hydrochloric acid. The deposition was a 7.2 cm² rectangular area on a stainless steel plate. A current of 1.0 amp was passed through the solution between the stainless steel plate (imbedded in a copper cathode) and a platinum anode. A distance of 1.0 cm was maintained between the anode and the cathode during the 4-hour deposition.

The Impact

This Cf-252 electrodeposition has been shipped to Argonne National Laboratory (ANL) for use as a source of neutron-rich fission fragments for the Californium Rare Isotope Breeder Upgrade (CARIBU) project. The CARIBU project creates special beams that feed into the Argonne Tandem-Linac Accelerator System, a superconducting accelerator that uses magnets to direct and focus beams of isotopes traveling at high speeds. This combined system is expected to produce a variety of neutron-rich nuclei that may hold the key to better understanding of several aspects of nature such as supernova explosions, forces that hold nuclei together, and insights into what happens inside aging nuclear reactors.

Summary

A highly successful electrodeposition of Cf-252 was produced by researchers at ORNL. Five years of research and development have resulted in the production of a thin layer of material containing more than three times the amount of Cf-252 ever before deposited as a single source. The 1.7 Ci Cf-252 source will be used in the CARIBU project at ANL for the production and study of neutron-rich nuclei.

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Contact

Rose Boll
Oak Ridge National Laboratory
bollra@ornl.gov.