NNSA’s Mo-99 Program:  
Accelerating Reliable, Non-HEU Mo-99 Production Capabilities in the United States

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Presentation Overview

• Overview of NNSA Mo-99 Program
• Program Budgets
• American Medical Isotopes Production Act (AMIPA) Requirements
• Domestic Technology Neutral Program
• National Laboratory Program
• Sunset Provision to End HEU Exports for Medical Isotope Production
• Uranium Lease and Take-Back Program
• Public Participation, Reports and Public Meeting Strategy
The NNSA Program

**Convert**
- Eliminate demand for Highly Enriched Uranium (HEU) in civilian applications
- Research Reactor Conversion
- Mo-99 Production

**Remove**
- Eliminate weapons-useable material
- U.S.-Origin Program
- Russian-Origin Program
- Gap Program
- Emerging Threats

**Dispose**
- Eliminate weapons-useable material
- HEU and Plutonium Disposition
- Low-Enriched Uranium (LEU) Supply for Peaceful Uses
The NNSA Goal

Goal: HEU Minimization with Mo-99

International Efforts
Assisting global Mo-99 production facilities to convert to use LEU targets

U.S. Domestic Efforts
Accelerating the establishment of commercial non-HEU-based Mo-99 production in the United States

Reliable supplies of Mo-99 produced w/o HEU
The Issue

• Molybdenum-99 (Mo-99) is the parent isotope of Tc-99m, a radioisotope used in approximately 40,000 medical diagnostic tests per day in the United States

• Mo-99 has a short half life (66 hours) and cannot be stockpiled

• U.S. demand is approximately 50% of the world market

• There are four major global producers of Mo-99, all outside the United States

• Historically, much of the global Mo-99 supply was produced using HEU

• Shortages of Mo-99 in 2009 and 2010 due to the unexpected shut down of two major production facilities highlighted the need for new, non-HEU-based Mo-99 production in the United States
The American Medical Isotopes Production Act of 2012

Domestic Program Guided by AMIPA

- Domestic Technology Neutral Program
- Public Participation & Reports
- Uranium Lease & Takeback Program (ULTB)
- Sunset Provision to End HEU Exports for Medical Isotope Production
Mo-99 Program Budget

• In Fiscal Year 2019, Congress appropriated $35 million
  – $15 million for national laboratory and contractor technical support
  – $20 million to add to the new competitively awarded cooperative agreements

• Fiscal year 2020
  – President’s request included $10 million for national laboratory and contractor support
  – House mark includes:
    ➢ $5 million for national laboratory and contractor support
    ➢ $35 million for a new funding opportunity announcement for additional cooperative agreements
  – Awaiting Fiscal Year 2020 Appropriations Bill for final guidance
Domestic Technology Neutral Program: Cooperative Agreements

• Issued a Funding Opportunity Announcement in July 2018 for new cooperative agreements
  – Four U.S. companies competitively awarded new cooperative agreements
    ➢ NorthStar Medical Radioisotopes, Beloit, WI
      o Neutron capture technology
    ➢ SHINE Medical Technologies, LLC, Janesville, WI
      o Accelerator-driven LEU solution target technology
    ➢ Northwest Medical Isotopes, LLC, Corvallis, OR
      o LEU particle target technology
    ➢ Niowave, Inc., Lansing, MI
      o Accelerator coupled to a subcritical uranium assembly technology

• Each new cooperative agreement award:
  • Specifies $30 million in total scope of work
  • Requires 50/50 industry cost-sharing
  • Has period of performance of 3 years

• Period of performance of NorthStar Medical Radioisotopes’ existing cooperative agreement for its accelerator technology was extended until December 2021
NNSA ensures the expertise of the U.S. National Laboratories are available to:

• Support technical development of the Mo-99 cooperative agreement technical pathways as well as other potential technologies
• Ensure the expertise and equipment at the national laboratories are available to support the acceleration of commercial projects using non-HEU technologies
• All work packages are funded by NNSA outside of the cooperative agreement funding and results are available in the public-domain
Since 2012, NNSA has provided over $100 million in non-proprietary technical support at the national laboratories to 10 companies to accelerate the development of a diverse set of Mo-99 production technologies.

Currently, NNSA is providing non-proprietary laboratory support to assist in development of Mo-99 production technologies at:

- NorthStar Medical Radioisotopes
- SHINE Medical Technologies
- Northwest Medical Isotopes
- Niowave
- BWX Technologies
- Coqui Radiopharmaceuticals
- Global Medical Isotopes Systems
- Magneto-Intertial Fusion Technologies
- Eden Radioisotopes
- Flibe Energy
NNSA and National Labs

- Neutron Capture Technology
- Accelerator Technology
- Mo-98/Mo-100 Target Technology
- Solution Target Technology
- LEU Target Technology
- International Conversions
- Low Energy Accelerator Facility

- Neutron Capture Technology
- Accelerator Technology
- Mo-98/Mo-100 Target Technology
- Solution Target Technology

- LEU Target Technology
- Solution Target Technology

- Accelerator Technology
- Solution Target Technology
- Tritium Purification Technology

- Emissions Technology
- International Conversions
Sunset Provision to End HEU Exports for Medical Isotope Production

• The American Medical Isotope Production Act (AMIPA) contains a sunset provision to end the export of HEU from the United States for use in medical isotope production on January 2, 2020

• DOE/NNSA is working closely with the Department of Health and Human Services and DOE’s Isotope Production Office to review the market supplies of Mo-99 and other medical isotopes in order to make a determination on whether to enact the ban in January 2020, or whether to extend the ban, in accordance with AMIPA
# Uranium Lease and Take-Back Program

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<th>HQ Management</th>
<th>Office of Conversion is the Programmatic lead for ULTB</th>
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<tr>
<td>Make LEU Available</td>
<td>NNSA Production Office (NPO) at Y-12 leases LEU required for domestic Mo-99 production</td>
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<td>Spent Fuel &amp; Waste Management</td>
<td>DOE Office of Environmental Management (EM) manages the Take-Back program for the disposition of spent nuclear fuel and radioactive waste without a commercial disposal path</td>
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<td>Costs</td>
<td>Contracts are negotiated to ensure U.S. government recovers costs of chosen waste disposal path</td>
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Public Participation and Reports

- **Public meetings**
  - Annual Mo-99 topical meetings or symposiums
  - Annual Mo-99 Stakeholder meeting

- **Public Reports**
  - Annual Report to Congress
  - National Academy of Sciences Report

- Annual oversight by the Nuclear Science Advisory Committee (NSAC)
Public Meeting Strategy

• Annual U.S. Stakeholder Meeting
  – One day workshop focused on U.S. Mo-99 industry and U.S. supply issues

• International Mo-99 Symposium
  – All plans are tentative pending receipt of final DOE approvals
  – Week of April 26, 2020
  – Intercontinental Hotel, Czech Republic
  – Meeting in cooperation with the IAEA
  – Build global awareness of U.S. and international industry capabilities, foster discussions on ways to address Mo-99 supply issues, and reinforce the viability of, and options for, non-HEU produced Mo-99
  – Three day symposium will focus on relevant global Mo-99 topics and issues
  – Optional tours of relevant Mo-99 related facilities (LVR-15 proposed)
Public Reports

• Report to Congress
  – Required within 1 year after enactment of AMIPA, and annually thereafter for 5 years

• Report covering Mo-99 activities in calendar year 2018
  – Signed in April 2019
  – Final annual Report to Congress required by AMIPA

• National Academy of Sciences Report
  – Published in 2016
  – https://www.nap.edu/catalog/23563/molybdenum-99-for-medical-imaging
Oversight

• Use the NSAC to conduct annual reviews of the progress made in achieving program goals and make recommendations to improve program effectiveness

• Charged by DOE’s Office of Science

• Held annually in the Washington, DC area as a public meeting in the December timeframe

• NSAC report regarding 2018 program activities published and posted on April 17, 2019
  - https://science.energy.gov/np/nsac/
  - Included two recommendations:
    1) NNSA must encourage cooperative agreement partners and others interested in the ULTB program to engage with them early on, so plans including take-back can be developed in a timely fashion;
    2) NNSA must develop a waste take-back process document to formalize the commitment to this process, including a model timeline and an estimate of costs under a set of well-defined scenario templates, to formalize communications with potential users. This must be presented to the subcommittee in advance of the next meeting.
Inter-Agency Coordination

Accomplishing the NNSA mission requires cooperation with other governmental agencies, including:

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<td>State Department</td>
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THANK YOU FOR YOUR ATTENTION!
QUESTIONS

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