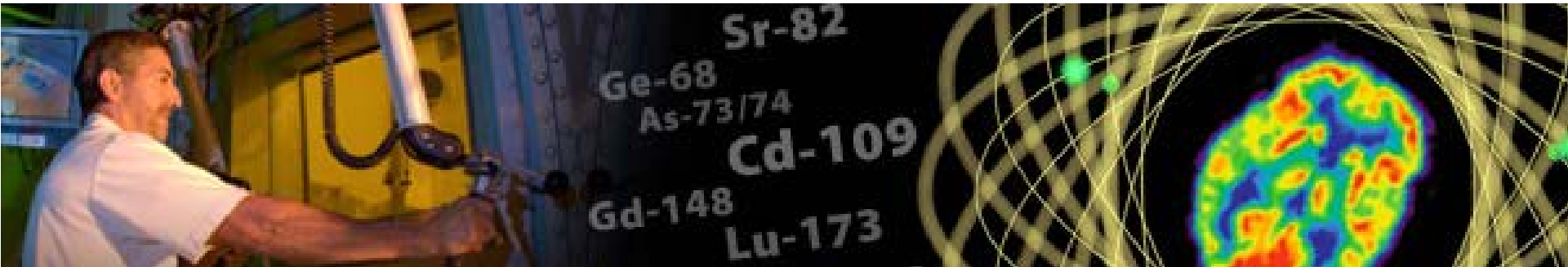


NP Isotope Program and Facilities and the SBIR/STTR Program



2013 DOE-NP SBIR/STTR Exchange Meeting

November 6-7, 2013

Dr. Dennis Phillips

Program Manager for DOE Isotope Production R&D

DOE Isotope Program

Office of Nuclear Physics, Office of Science, U.S. Department of Energy

<http://science.energy.gov/np/research/idpra/>

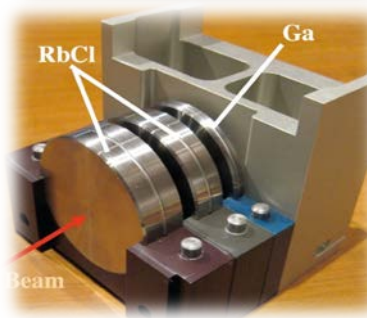
- Atomic Energy Act of 1946
- Atomic Energy Act of 1954
 - provides the statutory and legal authorities under which the DOE can produce its products and provide related services
- AEC Policy Statement-- 2 March, 1965
 - “The Commission’s policy is to refrain from competing with private sources of materials when they are reasonably available commercially.”
- Public Law 101-101 (September, 1989)
 - An appropriation establishing a revolving fund “...to cover necessary expenses...related to the production distribution, and sale of isotopes and related services”.
 - “...fees shall be set...to provide full cost recovery”
 - Administered in the DOE Office of Nuclear Energy
- Public Law 102-104 (August, 1991)
 - provides borrowing authority if at any time the amounts available to the fund are insufficient to enable DOE to discharge its responsibilities with respect to isotope production and distribution.
- Public Law 103-316 (August, 1994)
 - Allowed flexibility in the setting of fees so that isotopes used for research could be more affordable; provided an annual appropriation to cover infrastructure costs.
- Public Law 111-8 (March, 2009)
 - Transferred management of Isotope Program to Office of Nuclear Physics in the DOE Office of Science

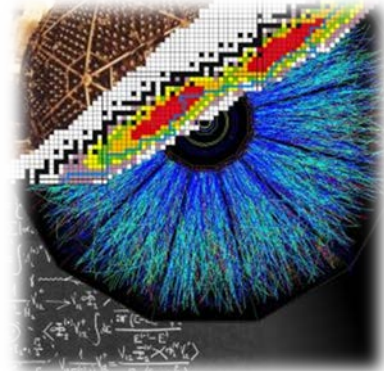
Isotope Program Mission

- Produce and/or distribute priority radioactive and enriched stable isotopes that are in short supply, including valuable by-products, surplus materials and related isotope services.
- Maintain the infrastructure required to produce and supply isotope products and related services.
- Conduct R&D on new and improved isotope production and processing techniques which can make available new isotopes for research and applications.
 - Core R&D at Key Laboratories where there are Programmatically stewarded activities
 - Competitive R&D
 - SBIR/STTR, Early Career Award Program



U 227 1,1 m	U 228 9,1 m	U 230 58 m	U 231 20,8 d	U 232 4,2 d	U 233 68,9 a	U 234 1,592 · 10 ⁵ a	U 235 0,0055 a
Pa 226 1,8 m	Pa 227 38,3 m	Pa 228 22 h	Pa 229 1,50 a	Pa 230 17,4 d	Pa 231 3,270 · 10 ⁴ a	Pa 232 1,24 · 10 ⁵ a	Pa 233 5,0 d
Th 225 8,72 d	Th 226 18,72 d	Th 227 18,72 d	Th 228 1,913 a	Th 229 7880 a	Th 230 7,54 · 10 ⁴ a	Th 231 25,5 h	Th 232 1,405 · 10 ¹⁰ a
Ac 224 2,9 h	Ac 225 10 d	Ac 226 29 h	Ac 227 21,773 a	Ac 228 6,13 h	Ac 229 62,7 m	Ac 230 122 s	Ac 231 7,5 m
Ra 223 11,43 d	Ra 224 3,66 d	Ra 225 4,8 m	Ra 226 1600 a	Ra 227 42,2 m	Ra 228 5,75 a	Ra 229 4,0 m	Ra 230 93 m





Office of Nuclear Physics
<http://science.energy.gov/np/>
 Tim Hallman, Director

Nuclear Physics Research Division
 Tim Hallman, Acting Director

Facilities & Project Management Division
 Jehanne Gillo, Director

***National Isotope
Development Center***
<http://www.isotopes.gov/>

***Low Energy, Medium Energy, Heavy Ion,
Theoretical, Accelerator Physics***

Support
 Luisa Romero, Program Analyst
 (budgets, reports, performance)

Isotope Facilities
 Marc Garland
 (Production, facility needs)

Isotope Research
 Dennis Phillips
 (Research needs, R&D)

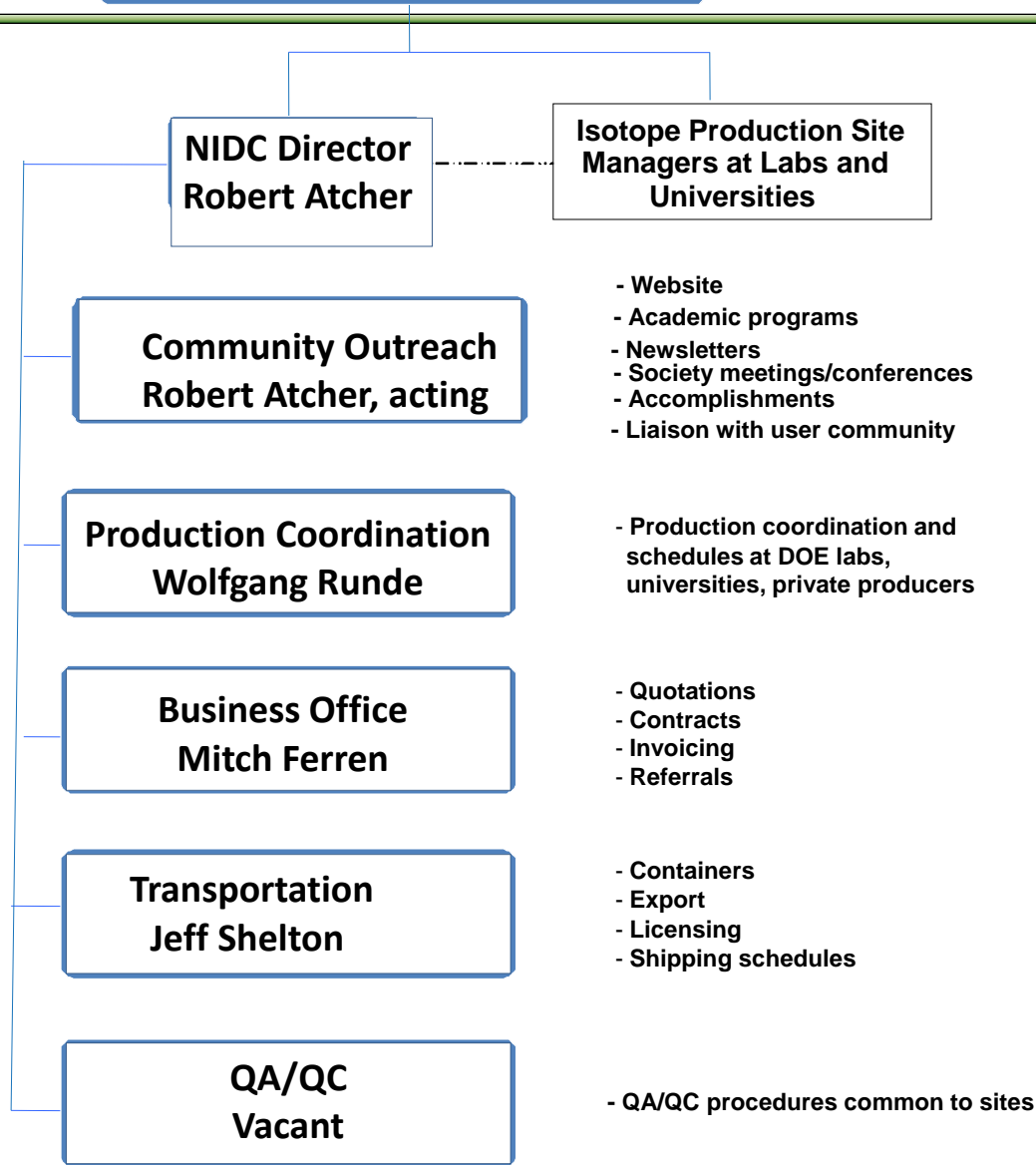
***Stable Isotopes and
Accountable Materials***
 Joel Grimm
 (Stable, accountable materials)

e-mail: *firstname.lastname@science.doe.gov*

**Office of Nuclear Physics Isotope
Production and Applications**

**National
Isotope
Development
Center**

IBO has evolved into
NIDC

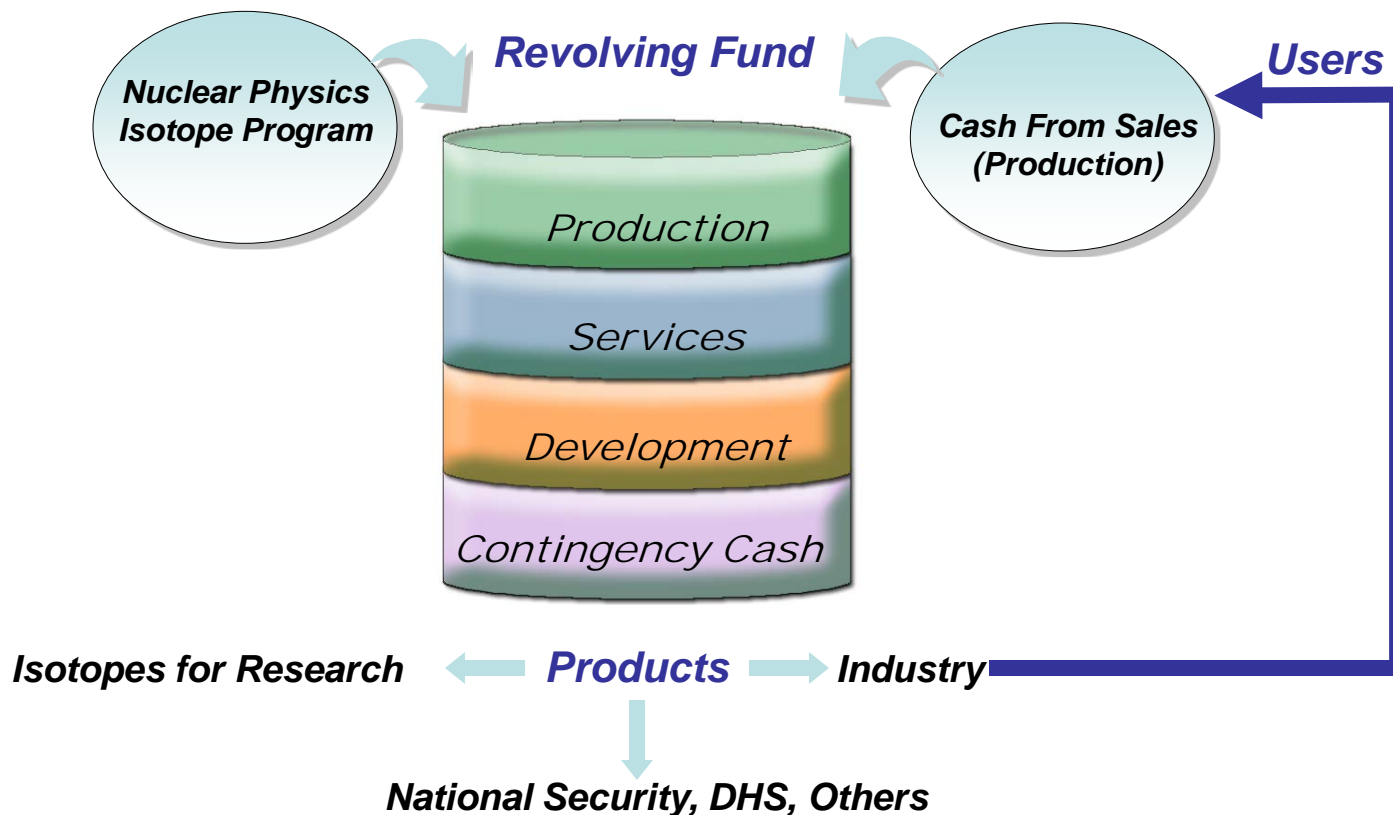




- The Department of Energy National Isotope Development Center (includes the Isotope Business Office located at Oak Ridge National Laboratory) coordinates the distribution of all DOE isotope products and services available from DOE facilities.
- Information and quotations for products and services can be obtained by contacting: National Isotope Development Center, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6158, Phone: (865) 574-6984, Fax: (865) 574-6986, Email: isotopes@ornl.gov



- Isotope Production and Distribution Program Fund (“revolving fund”)
- Prices charged for products and services to be based on costs of production, market value, U.S. research needs and other factors (Consistent with Public Laws 101-101 and 103-316)
- Commercial isotopes are priced at full-cost recovery; research isotopes at reduced prices.
- Program costs are financed by two resources: appropriation and revenue.
- Revolving fund and is audited annually.





Production Sites Integrated into the DOE Isotope Program

Univ. of Washington
Pending supplier of research isotopes (e.g., At-211)

PNNL
Sr-90 Y-90 generator for cancer therapy
Ra-223 Cancer therapy
Np-237 Research

INL (ATR)
Co-60 Gamma knife, sterilization of medical equipment

BNL (BLIP)
Ge-68 Calibration sources for PET equipment, antibody labeling
Sr-82 Rb-82 generator for cardiac imaging
Cu-67 Antibody labeling for targeted cancer therapy

Washington Univ.
Pending supplier of research isotopes (e.g., Cu-64)

ORNL
HFIR:
Se-75 Industrial NDA, protein studies
Cf-252 Industrial sources
W-188 Cancer therapy
Ra-223 Cancer therapy
Np-237 Neutron flux monitors
Stable Isotopes Inventory:
E.g., Ca-48, Ga-69, Rb-87, Cl-37, Pt-195, Nd-146, Sm-149, Ru-99, Zr-96
Radioisotopes Inventory:
Ac-225 Cancer therapy

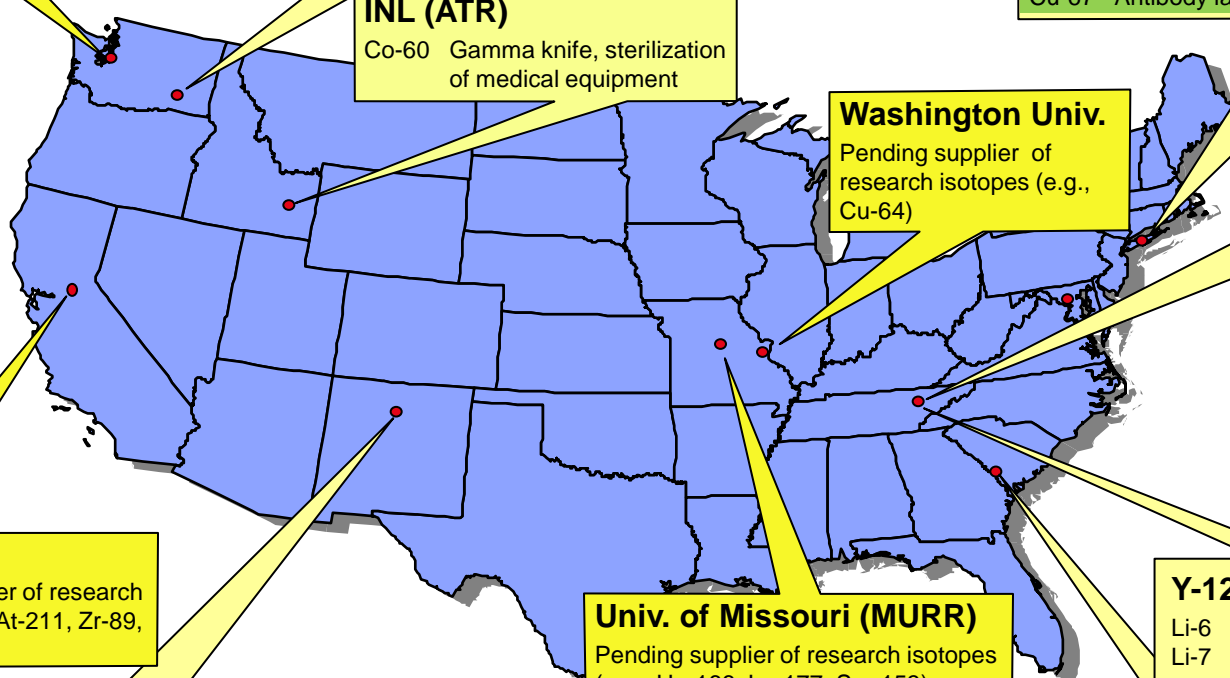
UC Davis
Pending supplier of research isotopes (e.g., At-211, Zr-89, Y-86, Pb-203)

Univ. of Missouri (MURR)
Pending supplier of research isotopes (e.g., Ho-166, Lu-177, Sm-153)

Y-12 (NNSA Facility)
Li-6 Neutron detection
Li-7 Thermoluminescent dosimeters

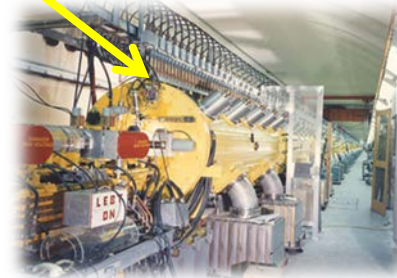
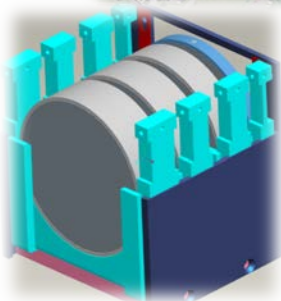
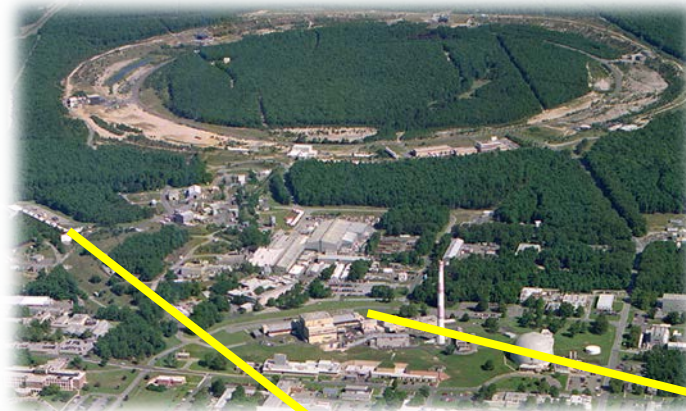
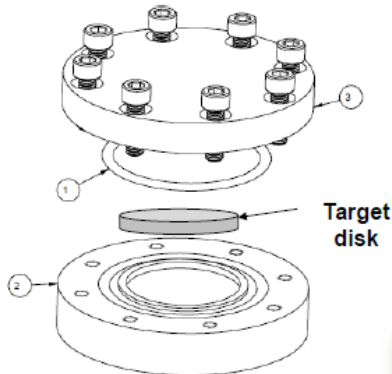
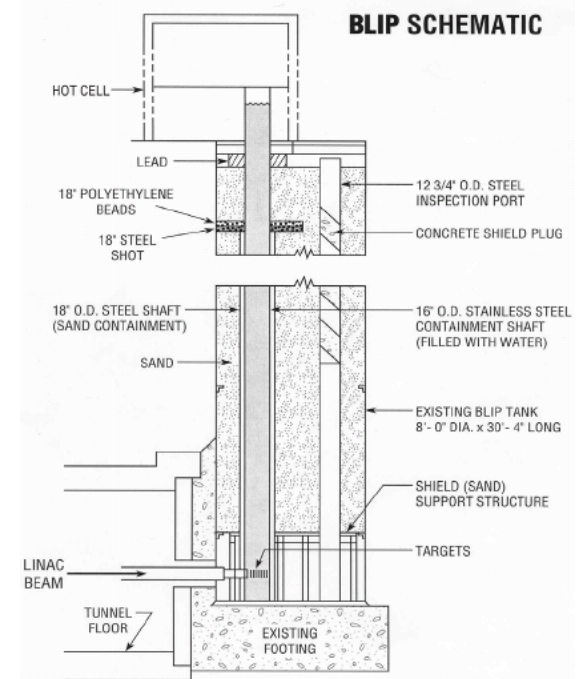
LANL (IPF)
Ge-68 Calibration sources for PET equipment, antibody labeling
Sr-82 Rb-82 generator for cardiac imaging
As-73 Environmental tracer

SRNL (NNSA Tritium Facility)
He-3 Neutron detection
Fuel source for fusion reactors
Lung testing



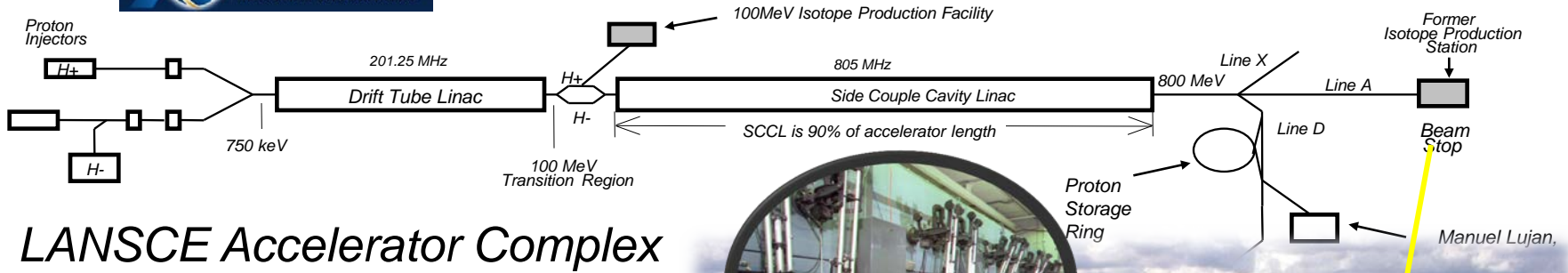
Brookhaven LINAC Isotope Producer (BLIP)

- BLIP utilizes the beam from the proton Linac injector for the Booster, AGS, and RHIC accelerator (nuclear physics)
- Excess pulses (~85%) are diverted to BLIP. Energy is incrementally variable from 66-202 MeV.
- The BLIP beam line directs protons up to $105\mu\text{A}$ intensity to targets; parasitic operation with nuclear physics programs for more cost effective isotope production.**





LANL Isotope Production Facilities



LANSCE Accelerator Complex



High Flux Isotope Reactor (HFIR) at ORNL:

<http://neutrons.ornl.gov/facilities/HFIR/>

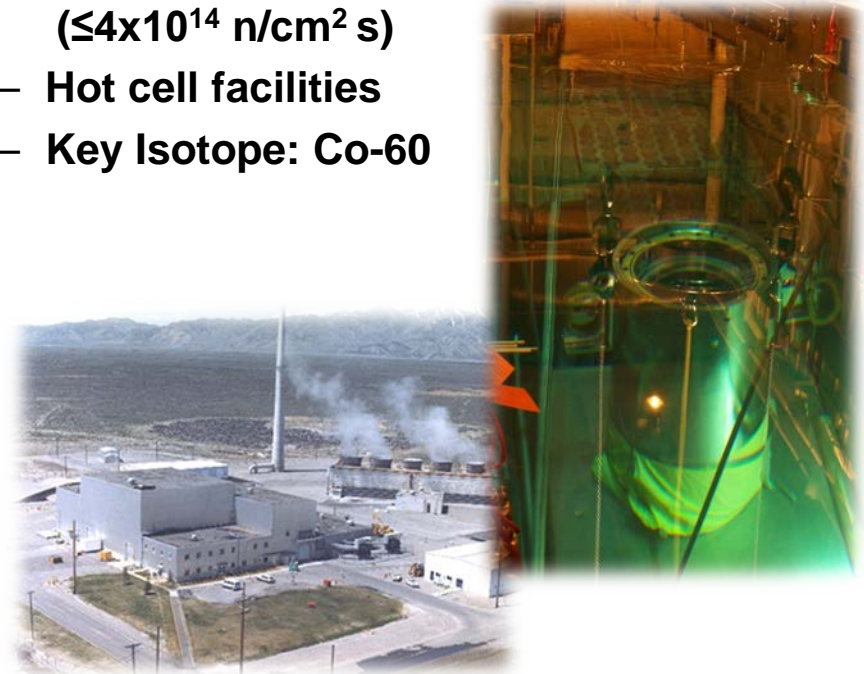
- High neutron flux ($\leq 3 \times 10^{15}$ n/cm² s)
- Multiple hydraulic tubes
- Several hot cell facilities
- Key Isotopes: Cf-252, W-188, Ni-63, Se-75



Advanced Test Reactor (ATR) at INL:

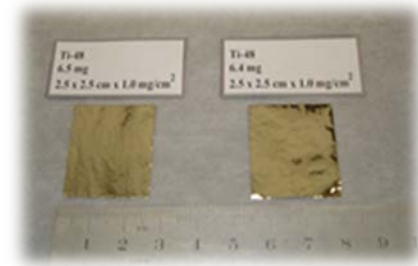
<http://www.inl.gov/research/advanced-test-reactor-research/>

- Moderately high neutron flux ($\leq 4 \times 10^{14}$ n/cm² s)
- Hot cell facilities
- Key Isotope: Co-60



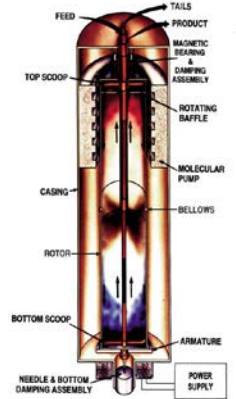


- Laboratories at ORNL are available to provide unique services and dispense over 200 different isotopes in a wide variety of chemical and physical forms:
 - Metallurgical, ceramic, and high vacuum processing methods
 - Pyrochemical Conversion: oxide to high-purity metal
 - Arc-melting and alloying
 - Hot and cold rolling
 - Preparation of cold-rolled foils from air-reactive metals
 - Drop casting
 - Wire rolling/swaging (hot or cold)
 - Target fabrication

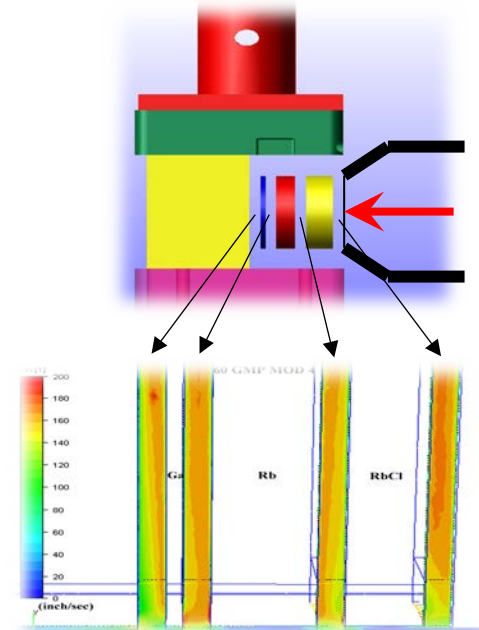
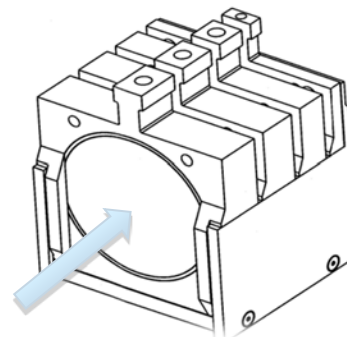
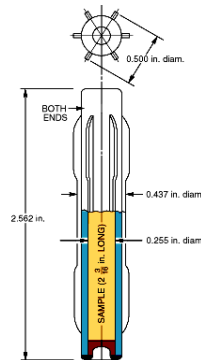


Re-establish Production of Enriched Stable Isotopes in the United States

- Calutrons have not operated for over a decade.
- Isotope Program manages inventory – depleted/short for many isotopes in demand.
- Developing concepts for modern stable isotope separation technology: electromagnetic separation coupled with small configurable gas centrifuges.
- Smaller scale enrichment of specific isotopes for research
- ORNL 10 mA EMIS commissioned December 15, 2011; now developing 100mA ion source
- Successful peer review in August 2013
- Transitioning from R&D to prototype production facility – **September 2013**



- Stable Isotope Enrichment
 - High enrichment
 - High volume
 - Safe, secure operations
- Accelerator and Reactor Radioisotope Production
 - Targetry design and modeling
 - Separations and purification
 - Automation and remote handling
 - Safe compliant transportation of radioactive products
 - Waste management
 - New safe, secure transmutation technologies

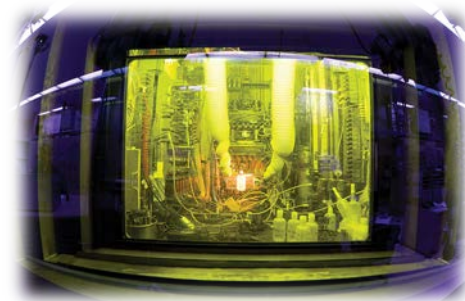
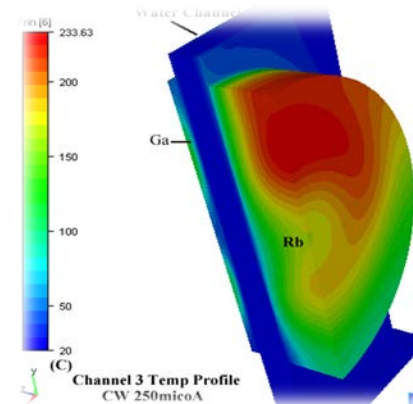


■ SBIR/STTR

- Support R&D toward commercialization of isotope products or services
- Encourage collaboration between Labs and Industrial Partners
- WFO, CRADA, IBO Contract

■ Expectations

- No adverse impacts on programmatic mission (facilities, personnel resources)
- Development to commercialization primarily responsibility of the industrial partner
- Independent commercialization





Thank You