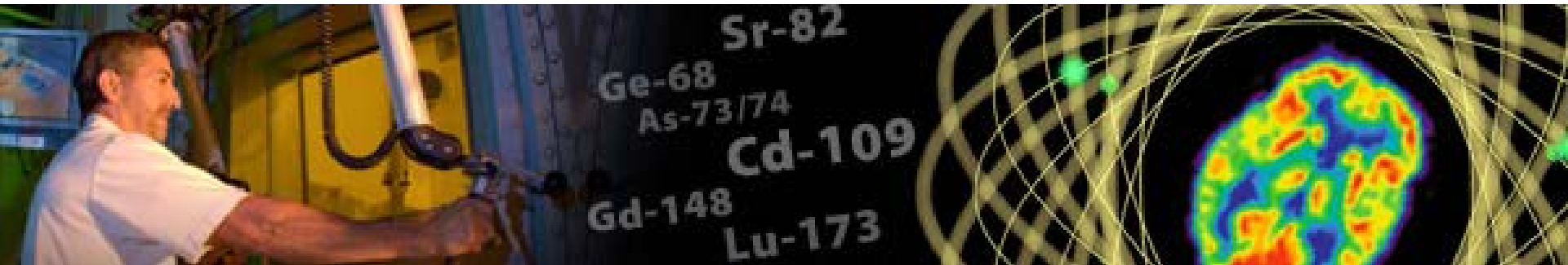


Status of DOE Isotope Program: Supplies, New Isotopes, Response to Prior Workshops



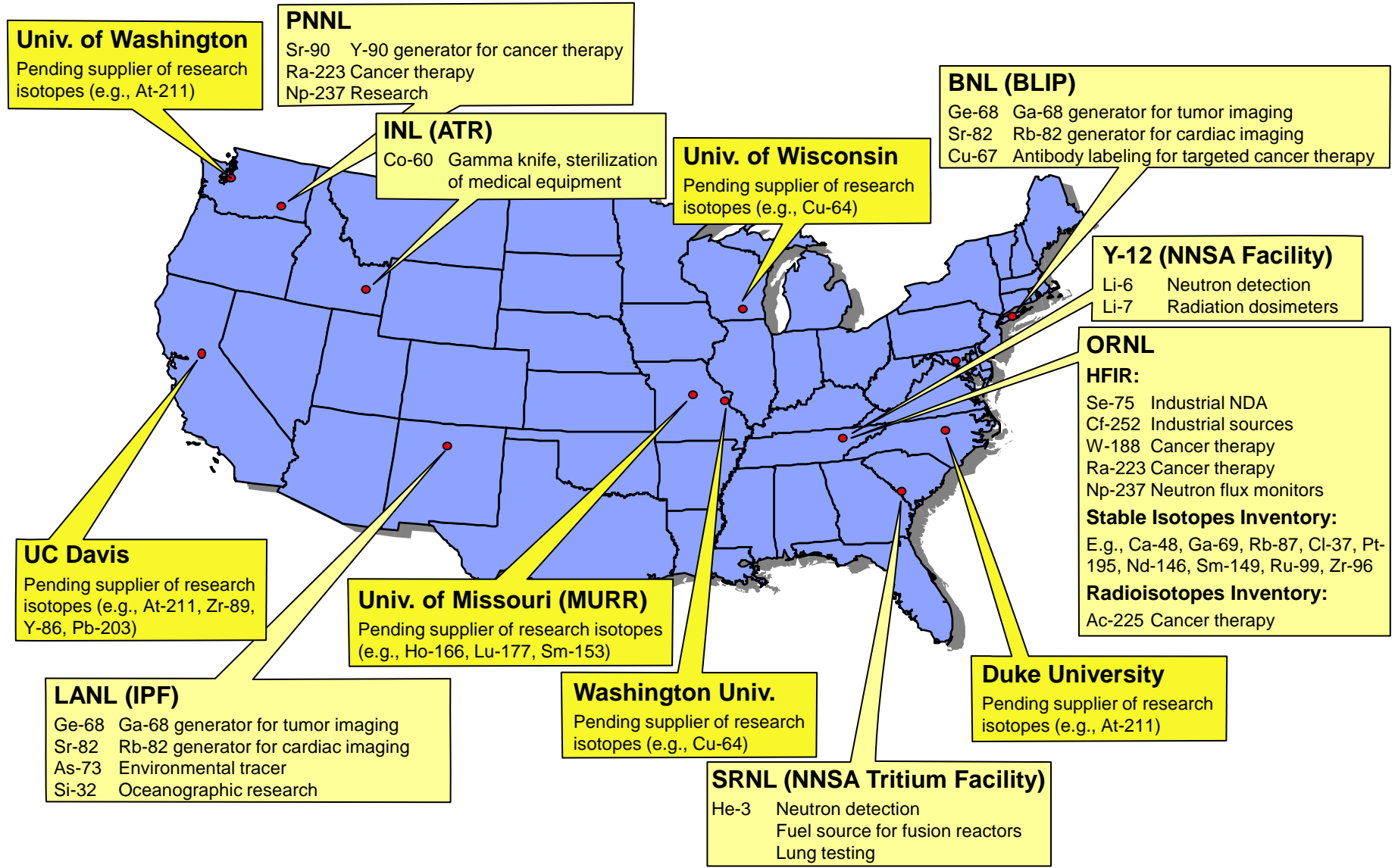
3rd Workshop on Isotope Federal Supply and Demand
November 3, 2014

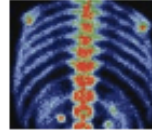
Marc Garland

Program Manager for DOE Isotope Facilities and National Isotope Development Center
DOE Isotope Program
Office of Nuclear Physics, Office of Science, U.S. Department of Energy



Isotope Production Facilities





www.isotopes.gov

PRODUCT CATALOG

Product Catalog - Periodic Table

Please click on a dark gray box to see the products available for that element.

If you would like an isotope product that is not listed,
[you can make a request by clicking here.](#)

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac															
		Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		
		Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		

FY 2014 Statistics

Customer Quotes	1,010
Shipments	
Stable Isotopes	165
Radioisotopes	<u>285</u>
Total	450



PRODUCT CATALOG

Strontium-82

Related Products: [Stable Strontium](#) [Strontium-85](#) [Strontium-90](#)
[Back](#)

<i>ISOTOPE</i> ⁸² Sr	
Request a Quote	Request a Quote for this Sr-82 Product
Half Life / Daughter	25.34 days to rubidium-82
Major Radiation	Positron - 511 keV
Form	Strontium chloride in 0.1-0.5 M HCl
Activity	> 10 mCi/ml (concentration)
Radlopurity	> 99% (excluding strontium-85)
<i>PRODUCTION</i>	
Source	BNL: Spallation using rubidium chloride LANL: Proton reaction on rubidium chloride or rubidium metal
Processing	Dissolution and ion exchange
<i>DISTRIBUTION</i>	
Shipment	Crimp-seal bottle
Availability	Regular production
Unit of Sale	Millicuries
Contact	Oak Ridge National Laboratory National Isotope Development Center Call: (865) 574-6984 Fax: (865) 574-6986 email: isotopes@ornl.gov



NIDOC NATIONAL ISOTOPE DEVELOPMENT CENTER



PRODUCT CATALOG

Strontium

Related Products: [Strontium-82](#) [Strontium-85](#) [Strontium-90](#)
[Back](#)

Isotope	Natural Abundance (atom %)	Isotopic Enrichment (atom %)	Unit of Sale	Request a Quote
Sr-84	0.56	>80	Milligrams of Element	Request a Quote for this Sr-84 Product
Sr-86	9.86	>95	Milligrams of Element	Request a Quote for this Sr-86 Product
Sr-87	7.02	87-93	Milligrams of Element	Request a Quote for this Sr-87 Product
Sr-88	82.56	>99.8	Milligrams of Element	Request a Quote for this Sr-88 Product
PRODUCT FORM				
Inventory Form	carbonate			
Alternate Form	nitrate, metal, chloride, fluoride, oxide			

Targets

Isotopic or Normal
Standard Size: 2.5 cm by 2.5 cm

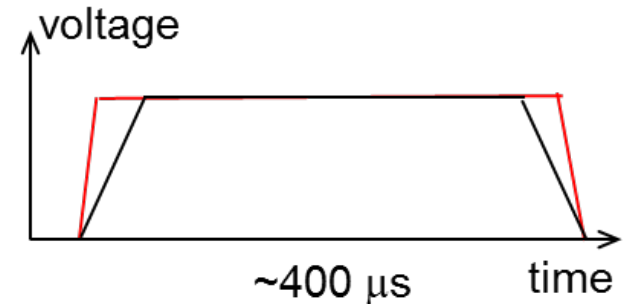
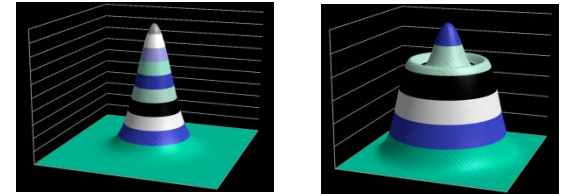
Form	Range of Thickness (milligrams/square cm)	Backing	Method of Preparation
Element	>= 2	Self-supporting	Rolling

Note:

Other isotopic abundances, chemical forms, and/or targets considered on request.

■ Brookhaven Linac Isotope Producer (BLIP)

- Beam raster system development
 - Enables increase in beam current on target (greater isotope yields)
 - Greatly lowers possibility of target failures
- BNL linac intensity upgrade
 - Increases beam current by increasing proton pulse width and doubling pulse rate (greater isotope yields)



■ LANL Isotope Production Facility (IPF)

- High power target development
 - Enables increase in beam current on target (greater isotope yields)



- **IBO administers university contracts to fund production and manages customer sales**
 - Production of research isotopes more cost-effective than DOE facilities
 - Additional capabilities (e.g., alpha-particle beams)
- **Universities being added to DOE IP production network**
 - University of Washington
 - Duke University
 - Washington University
 - University of Wisconsin
 - University of Missouri (MURR)
 - Texas A&M
 - University of California-Davis
- **Isotopes under consideration for additional to portfolio**
 - Coordinated network of regional cyclotron/accelerator production of isotopes
 - At-211, Cu-64, Zr-89, Y-86, Pb-203, Co-55
 - Lower (than DOE) flux reactor isotope production
 - Au-198, Au-199, Cu-64, Re-186, Re-188, Pd-109, Rh-105, radiolanthanides (e.g., Pm-147, Pm-149, Ho-166, Sm-153, Lu-177)

- [Pb-212/Bi-212](#): therapeutic medical applications
- [Actinides](#): production plan being developed to support research applications
- [Zr-89](#): PET imaging
- [Cf-249](#): Provided for actinide borate research
- [Cm-248](#): High purity for research
- [Cf-251](#): for super heavy element research
- [Cf-252](#): Re-established production in FY 2009, new 6 year contract thru 2018; industrial applications
- [Cu-67](#): cancer therapy
- [Cu-64](#): medical applications
- [Li-6](#): Production of metal form for neutron detector isotope sales
- [Np-237](#): Inventory for dispensing bulk quantities and capability to fabricate reactor dosimeters
- [Se-72/As-72](#): Developed production capability for Se-72 for As-72 generator; medical diagnostic
- [Si-32](#): Oceanographic and climate modeling research, replenished depleted inventory
- [Th-227/Ra-223](#): Established Ac-227 cows for the provision of Th-227 and Ra-223 (medical applications)
- [Y-86](#): Established production capability of the positron emitter Y-86; medical diagnostic
- [Cm-243](#): Acquired curium with a high Cm-243 content for research applications

- [Ac-225](#): Developing accelerator production capability
- [At-211](#): Funding production development at four institutions to establish nationwide availability
- [Am-241](#): Initiated project to produce Am-241 in association with an industrial consortium
- [C-14](#): Investigating economic feasibility of reactor production
- [Cd-109](#): Assessing production routes to achieve high specific activity
- [Co-57](#): Evaluating production of Co-57 for commercial source fabricators
- [Cs-137 HSA](#): Pursuing reactor production feasibility for research applications
- [Cu-64](#): Funding production development at multiple institutions
- [Gd-153](#): Pursuing feasibility of reactor production
- [Ho-166](#): Establishing reactor production capability
- [I-124](#): Funding production development at one institution
- [K-40](#): Evaluating possibility of reactor production by irradiating K rather than electromagnetically enriching K-40
- [Li-7](#): Working to establish reserve for nuclear power industry to mitigate potential shortage
- [Np-236](#): Pursuing feasibility of accelerator-based production for security reference materials
- [Pa-231](#): Purifying 100 mg for applications such as fuel cycle research
- [Sr-89](#): Investigating economic feasibility of reactor production
- [U-233](#): Acquisition of mass separated U-233 for research applications
- [U-234](#): Investigating alternatives for provision of U-234 for neutron flux monitors
- [Zn-62/Cu-62](#): Funding production development for Zn-62 for use in a generator to provide the positron emitter Cu-62
- [Zr-89](#): Funding production development at multiple institutions

- DOE sends questionnaires to federal agencies
- Federal agencies return completed questionnaires to DOE
- DOE compiles consolidated spreadsheet of all federal agency responses
- DOE schedules teleconferences with agencies to review their input
- DOE takes action to make needed isotopes available
 - Schedule production
 - Evaluate availability of stable and long-lived isotopes
 - Evaluate production of unavailable isotopes
 - Request federal agencies to inform their grantees to place orders for isotopes that are available

Agency	Isotope Needs	DOE IP Action Item	Status
National Technical Nuclear Forensics Center (NTNFC)	Pa-231 (High Priority isotope for Nuclear Forensics; needed through 2018)	Add isotope to website catalog.	Material delivered to user in 2013. Unpurified material available for future supply; evaluate 2014 demand to make determination on processing unpurified material and placing in inventory.
	Sr-84	Provide assay info.	99.64% purity available at ORNL. Provided assay and quotation to NNSA.
	Looking for future home for some isotopes currently stored at New Brunswick Laboratory	Looking for future home for some material.	NTNFC and/or NBL to provide list of isotopes that need to be transferred.
DOE NP (Texas A&M University)	Th-228 (needed 34 uCi as soon as available)	Provide quote.	ORNL has material set aside; quote was initiated. Order was received. Material was prepared to specs and shipped to customer on 9/11/14.
DOE BER	Cu-64	N/A	BER to review applications to the recent call for proposals on medical isotopes.
	Cf-252 (4 mg/y)	N/A	BER to follow up on determining accuracy of provided information. ORISE will contact IP if/when they need new source.
	Br-76/77	N/A	BER needs to check about amount needed. Follow-up discussions determined that BER currently has no need for Br isotopes.

Agency	Isotope Needs	DOE IP Action Item	Status
DOD	U, Pu, Am, Cm-isotopes	N/A	DoD to determine quantities needed for NTF.
	Li-6 (FY14-18 <10 kg/yr; for FY16 maybe >10 kg needed)		DoD to update IP on a refined forecast.
	U-233	DOE IP to assess current availability of U-233.	High purity (mass separated) U-233 in process of being placed in inventory at ORNL.
DOE NE	Isotopes stored in Building 3047 at ORNL	DOE IP to send inventory to DOE ORO to determine ownership of isotopes.	
DOE New Brunswick Laboratory	U-234 (>0.5 g ~99%)		Available inventory at ORNL: gram quantities for 95% enrichment; <1g for 99+% enrichment. NBL to contact IBO (probably in FY15).
	Th-230 (>0.1 g ~99%)	DOE IP to determine quantity and enrichment in ORNL inventory.	ORNL identifying inventory(ies) of Th-230.

Agency	Isotope Needs	DOE IP Action Item	Status
DOE BES	Various Isotopes	N/A	Many isotopes listed by BES offices are in inventory or commercially available. BES researchers to place orders with the DOE IP.
	Gd-158, 160 (g quantities for neutron scattering at SNS, possibly kg quantities for detectors)	N/A	170 g Gd-158, <5 g Gd-160 in inventory at ORNL.
	Pu-242	N/A	BES to refine amount needed.
	Cm-248, Bk-249, Am-243	Need to assess SHE utilization.	Several hundreds of mg requested, which may be problem for IP to supply. ORNL is developing a strategy for providing these isotopes.
	Pu-244	Need to determine current availability.	NNSA Lead Material Management Organization is writing a report on Pu-244.
	Ti-44 (10 uCi/y)	Determine feasibility at accelerator at LANL.	R&D irradiations planned for FY 2015.
	U-233	DOE IP to assess current availability of U-233.	High purity (mass separated) U-233 in process of being placed in inventory at ORNL.

Agency	Isotope Needs	DOE IP Action Item	Status
National Institute of Standards and Technology (NIST)	Mo-99	DOE IP to send link to NSAC report.	Commercially available. Link was sent to NIST.
Massachusetts Institute for Technology (MIT)	Rb-83	N/A	DOE IP provides Rb-83 upon customer requests.
	Cr-51/Ar-37 (MCi's)		Project at early stage of development and accurate quantity estimation not available yet.
	H-3	N/A	Project 8's needs for the next few years can be met commercially.

Agency	Isotope Needs	DOE IP Action Item	Status
National Institutes of Health (NIH)	Ac-225	Determine quantity and frequency needed in FY15.	Some material could be provided from ORNL. Accelerator-based production being developed.
	At-211	Determine quantity needed in FY15.	Capability under development at 4 institutions.
	Y-86	Determine quantity and frequency needed in FY15.	Available from BNL. DOE IP is supporting production development at 4 institutions.
	Pb-212	Determine quantity needed in FY15.	Production capability established at ORNL to produce 2 generators/month.
	Br-76	Determine quantity needed in FY15.	First time identified as possibly being in short supply; NIH to provide details in FY15 submittal.
	Zr-89	Determine quantity needed in FY15.	DOE IP is supporting production development at 4 institutions; also commercially available.
	Cu-64	Determine quantity needed in FY15.	Available from Washington University. DOE IP is supporting production development at 6 institutions.
	I-124		Available commercially (reportedly expensive). DOE IP is supporting production development at 2 institutions.
	Th-227		DOE IP established production/distribution at 2 Labs.
	Lu-177	Determine quantity needed in FY15.	Available from MURR and could be produced at ORNL.
	Cu-67	Determine quantity needed in FY15.	Can be produced at BNL; DOE IP is supporting production development at 3 institutions.
	Re-188	Determine quantity needed in FY15.	W-188 production at HFIR being reestablished.