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Title:	Recent Challenges and Accomplishments in Characterizing Sealed Sources for Disposition to the Waste Isolation Pilot Plant
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Recent Challenges and Accomplishments in Characterizing Sealed Sources for Disposition to the Waste Isolation Pilot Plant

By Ioana Witkowski, Alex Feldman, Mike Pearson

For the past ten years, the Offsite Source Recovery Project (OSRP) has been recovering excess and unwanted radioactive sealed sources that pose a potential risk to public health and safety. The OSRP is part of the National Nuclear Security Administration's Global Threat Reduction Initiative (GTRI) and has been able to recover over 25,000 sources from more than 900 US and international sites. The project's original mission included recovering sources, packaging them in shielded containers, and providing interm storage pending approval for disposal at the Waste Isolation Pilot Plant (WIPP). The GTRI/OSRP mission has since expanded and evolved from recovering ^{239}Pu, ^{238}Pu and ^{241} Am sources to include high activity ^{60}Co, ^{137}Cs, and ^{90}Sr sources. OSRP continues to search for new disposal avenues for other radioisotopes, such as ^{237}Np, ^{244}Cm, and ^{252}Cf. This paper focuses on the details of the WIPP compliant characterization process for disposal of transuranic (TRU) sealed sources. This process provides an isotopic distribution and activity analysis for all ten WIPP tracked radioisotopes. To meet characterization requirements, each source is characterized using acceptable knowledge "AK" of the available radiological information, in lieu of non-destructive assay testing. Challenges include: identifying source data, such as activity and date of manufacture; obtaining historical process documentation from source manufacturers; correcting for the presence of multiple isotopes; and disposing of radioactive materials that contain a mixture of TRU radionuclides with target elements, such as Lithium. We are now developing characterization methodologies for ^{244}Cm and ^{252}Cf, which have half-lives less than 20 years, but contain long lived impurities and in-growth daughters. . We discuss the challenges in disposition of all of these isotopes at WIPP and discuss our approach to meet characterization requirements.

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NNSA

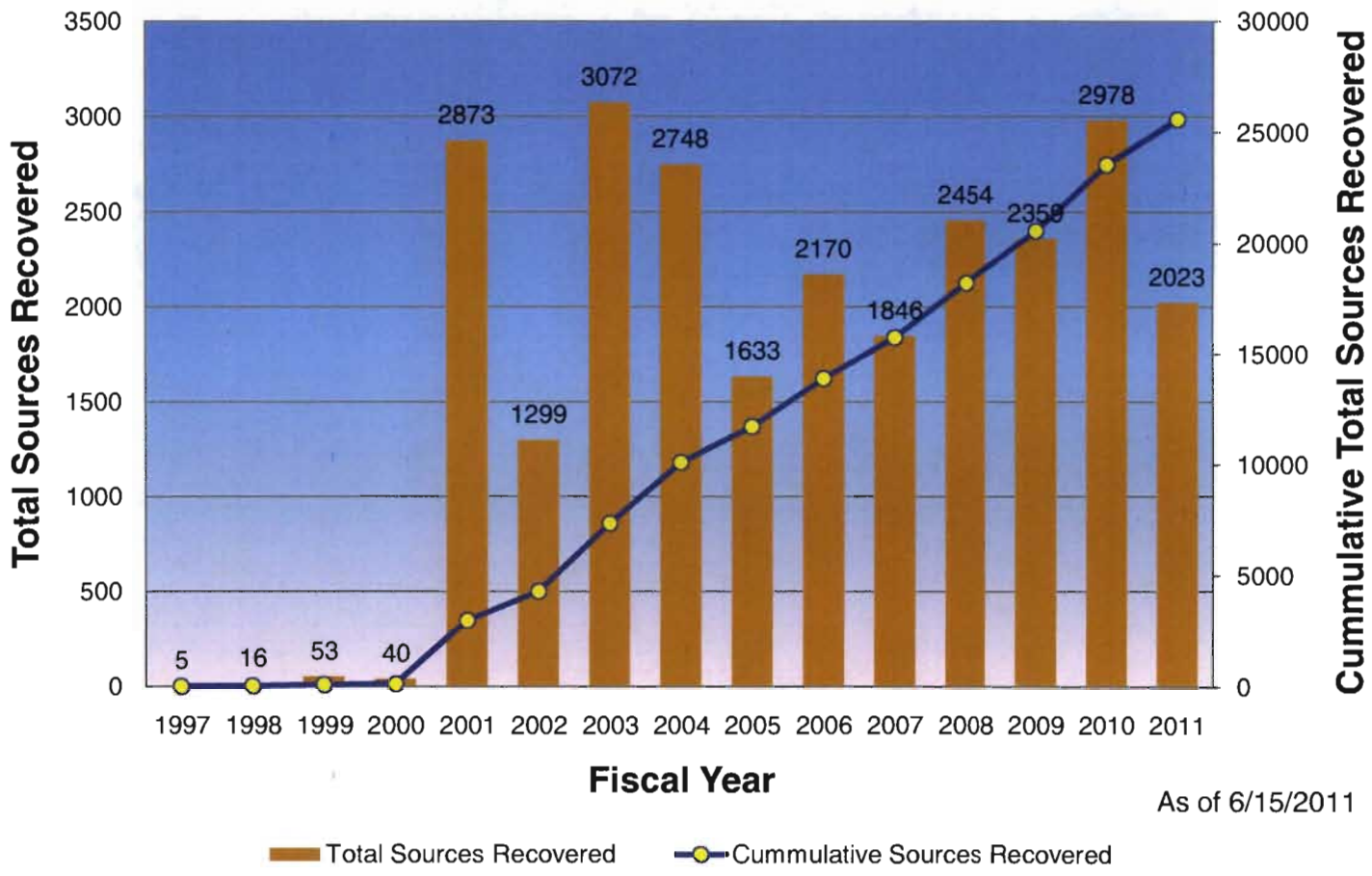
Off-Site Source Recovery Project (OSRP)

- **OSRP's Mission – Eliminate excess, unwanted, abandoned, or orphan radioactive sealed sources that pose a potential risk to public health, national security, and safety.**
- **OSRP is part of the National Nuclear Security Administration (NNSA) Office of Global Threat Reduction.**
- **OSRP addresses radiological threat reduction for NNSA by aggressively removing radioactive materials (in the form of sealed sources) from the public sector that could pose a terrorist threat if acquired.**

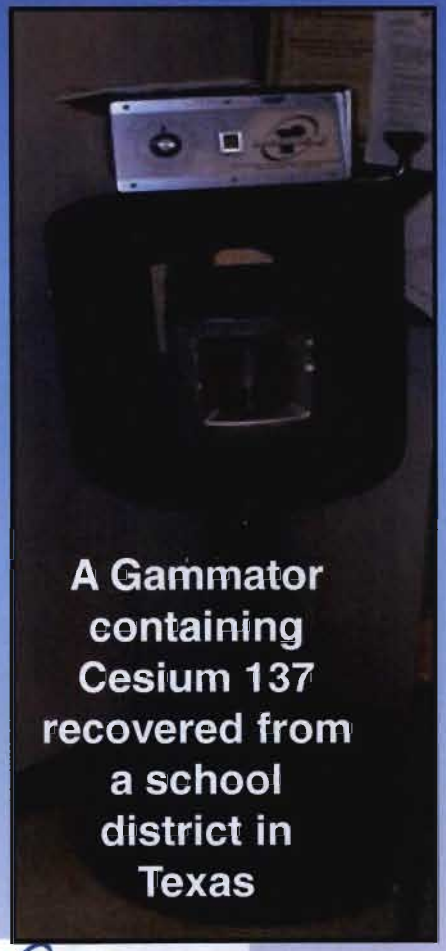
Project Accomplishments

- Project started in 1999 at LANL and since OSRP recovered over:
  - 25,000 sources present in US at more than 900 sites
  - 1000 sources internationally
- A DOE/NNSA Defense Determination in 2003, allowed OSRP to begin final disposition of all ^{239}Pu sources at WIPP. Similar Defense Determinations were obtained in 2006 for ^{238}Pu and ^{241}Am.
- First NTS disposal of ^{60}Co occurred in 2008.
- OSRP's mission expanded in training international community in source management, support to and joint missions with IAEA, and in GTRI tasks related to Search and Secure

Total Sources Recovered by OSRP per Fiscal Year



Isotopes Managed



A Gammator containing Cesium 137 recovered from a school district in Texas

Nuclides Originally Managed
^{241}Am
^{239}Pu
^{238}Pu
^{252}Cf

Additional Nuclides Currently Managed
^{244}Cm
^{226}Ra
^{90}Sr
^{60}Co
^{137}Cs
^{192}Ir

All nuclides currently found in IAEA sealed sources of concern list

Who Uses Radioactive Sealed Sources?

50+ Years of Isotope Distribution in the U.S.

- Oil and Gas Service Companies
- Colleges and Universities
- Manufacturing
- Medical Facilities
- Military Installations
- Construction Industry
- DOE and Government Sites

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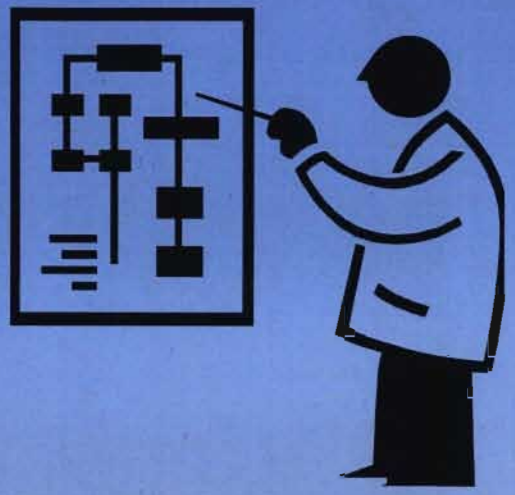
OSRP Operation Processing Steps

1. Licensees Register Sources
2. Sources Entered into OSRP Database
3. OSRP Organizes Source Recovery or Self-Ships
4. Sources Consolidated in Interim Storage
5. Sources Shipped to Long-Term Storage
6. Characterization of Sealed Sources for WIPP
7. Final Disposal Approval by CCP/WRS
8. Transportation for Disposal to WIPP



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OSRP Operation Process Flow Diagram

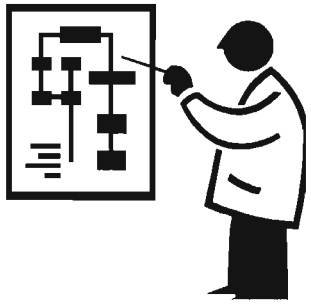
Licensees Register Sources

Sources entered into OSRP SSDB

Source Recovery

Sources Consolidated in Interim Storage

Sources Shipped to Long Term Storage, TA-54 LANL



Characterization of Sealed Sources

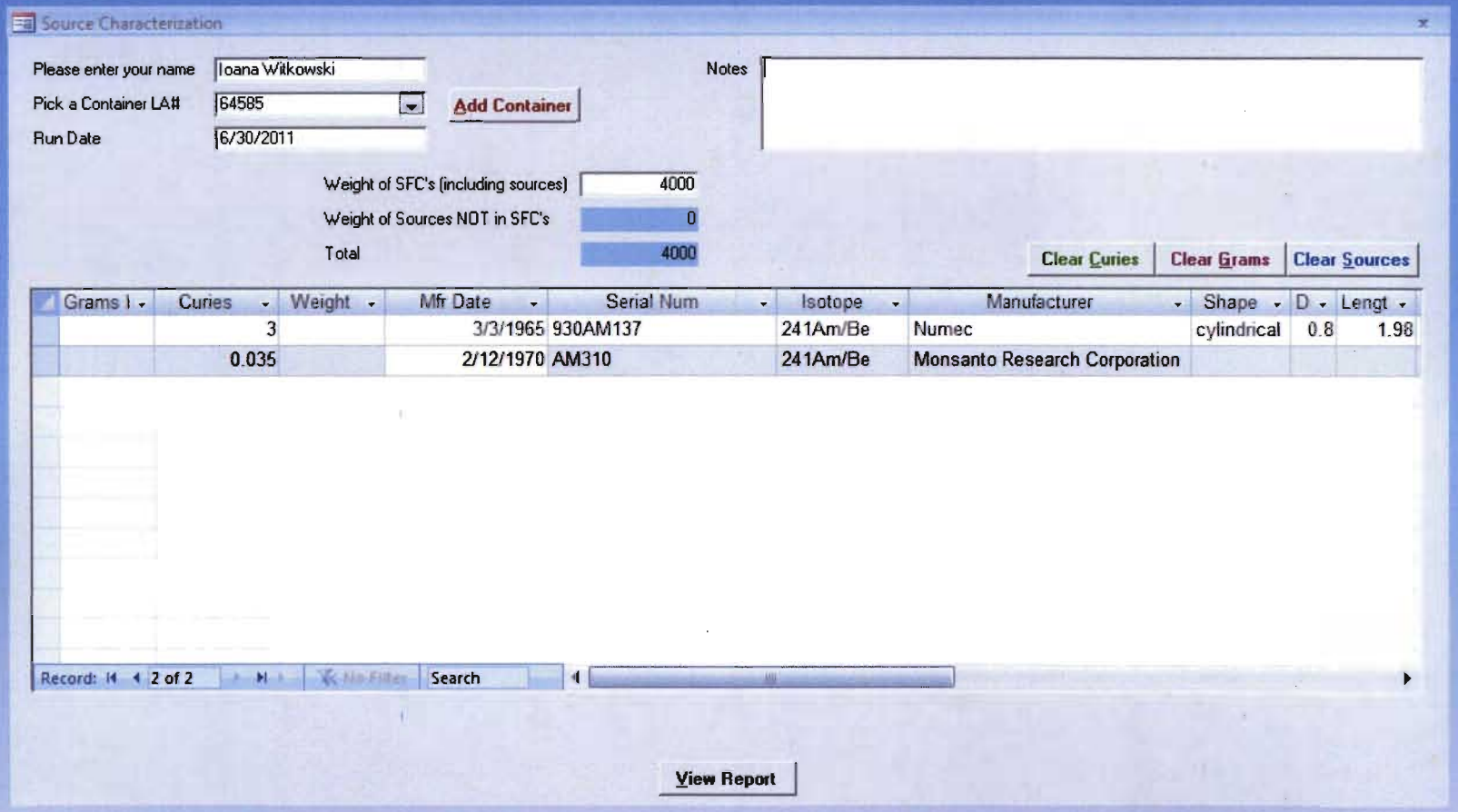
Final Disposal Approval by CCP/WRS

Transportation for WIPP Disposal

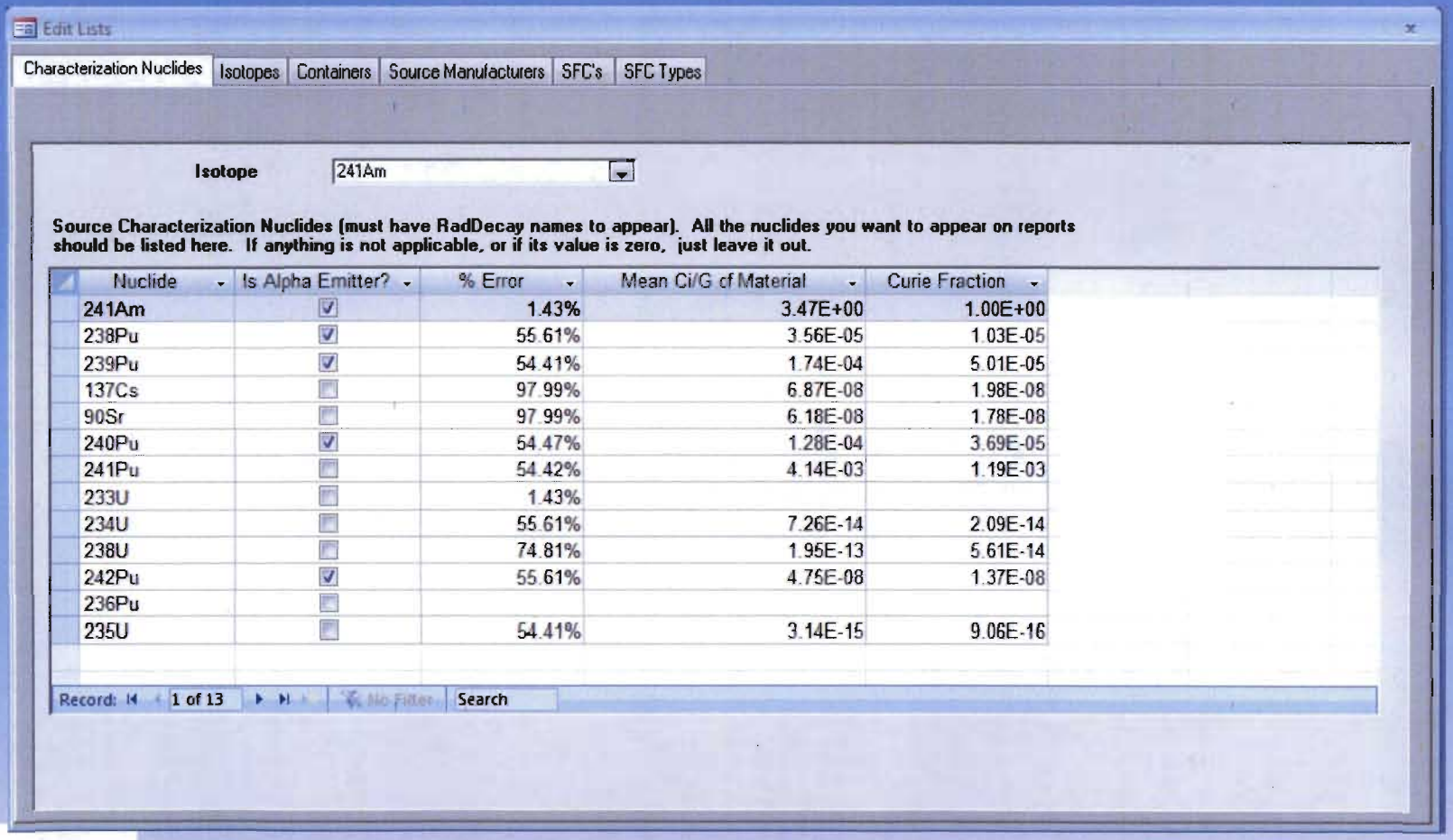
Characterization of Transuranic Sealed Sources

- Acceptable Knowledge in lieu of NDA information required: **isotope**, **activity**, **date of manufacture.**
- Characterization software decays the isotopes for all existing sources in a drum providing a report for the ten WIPP tracked isotopes (^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, ^{137}Cs).
- Calculations ensure the sources meet the transuranic waste WIPP criteria and provide input for TRUPACT II transportation.

Input to the OSR Characterization Database Software version 1.0



Isotope Distributions and Uncertainties Associated with Activity Calculations



Output from the OSR Characterization Database Software

NDA / Radiological Characterization BDR# LA11-OSR-CH-006

Container: LA00000064585 Waste Weight (kg) 4.000

Run Date: 6/30/2011

Decay Corrected Data

Nuclide	Mass (grams)	Mass 1.00 Sigma Error (grams)	Activity (Ci)	Activity 1.00 Sigma Error (Ci)	FGE	PE-Ci	Decay Heat (W)	% Type A Limit	TRU Alpha Activity (Ci)
Cs-137	2.36E-10	2.28E-10	2.08E-08	2.01E-08	0.00E+00	0.00E+00	2.30E-11	3.84E-10	0.00E+00
U-233	4.56E-07	6.46E-09	4.45E-09	6.30E-11	4.10E-07	1.39E-09	1.29E-10	4.05E-12	0.00E+00
U-234	5.43E-07	2.99E-07	3.43E-09	1.89E-09	0.00E+00	0.00E+00	9.89E-11	3.12E-12	0.00E+00
U-235	3.16E-06	1.70E-06	6.93E-12	3.73E-12	2.03E-06	0.00E+00	1.91E-13	0.00E+00	0.00E+00
Pu-238	1.25E-06	6.89E-07	2.17E-05	1.19E-05	1.42E-07	1.97E-05	7.18E-07	8.03E-08	2.17E-05
U-238	5.02E-07	3.71E-07	1.71E-13	1.26E-13	0.00E+00	0.00E+00	4.32E-15	0.00E+00	0.00E+00
Pu-239	2.41E-03	1.30E-03	1.52E-04	8.17E-05	2.41E-03	1.52E-04	4.71E-06	5.62E-07	1.52E-04
Pu-240	4.85E-04	2.61E-04	1.11E-04	6.00E-05	1.09E-05	1.11E-04	3.47E-06	4.13E-07	1.11E-04
Am-241	8.12E-01	1.15E-02	2.82E+00	3.98E-02	1.52E-02	2.82E+00	9.42E-02	1.04E-02	2.82E+00
Pu-241	3.75E-06	2.01E-06	3.90E-04	2.09E-04	8.43E-06	7.64E-06	1.24E-08	3.54E-07	0.00E+00
Pu-242	1.05E-05	5.76E-06	4.16E-08	2.29E-08	7.85E-08	3.78E-08	1.23E-09	1.54E-10	4.16E-08
Sr-90	1.28E-10	1.23E-10	1.76E-08	1.70E-08	0.00E+00	0.00E+00	2.04E-11	2.17E-09	0.00E+00
Other Isotopes	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total*	8.15E-01	1.16E-02	2.82E+00	3.98E-02	1.76E-02	2.82E+00	9.42E-02	1.04E-02	2.82E+00

*RMS for errors

		(1.00 Sigma Error)	
Tru Alpha Activity Concentration	7.05E+05	9.96E+03	nCi/g
Tru Alpha Activity	2.82E+00	3.98E-02	Ci
Total Pu-239 Equiv Activity	2.82E+00	3.98E-02	Ci
Total Pu-239 Fissle Gram Equiv	1.76E-02	1.32E-03	g
Total Decay Heat	9.42E-02	1.33E-03	W

	Printed Name	Signature	Date
RC Operator Review			
2nd RC Operator Review			

Identification: Source/Device Information

- Acceptable Source Information for radiological characterization
  - Source certificate
  - Source markings
  - Source listed in DOE-NMMSS database
  - Shipping records
  - Fabrication documents
  - Source manufacturer
  - Model type or number/serial number
  - Sales catalogue
  - Physical shape and dimensions
  - NRC Sealed Source Device Registry

Identification: Source Self-Identification

Challenges Encountered

- Poor management of source information at the licensee sites
- Most commercial source manufacturers went out of business - lack of historical process documentation and source information
- Source information collected before WIPP requirements were defined - does not satisfy all of the current stringent criteria for disposal
- Sources in interim storage for long time - loss of valuable information with time
- Older sources become non-special form with time before recovery - non-compliance with WIPP requirements, special form packaging considerations

Challenges Encountered (cont'd)

- Recovering sources containing new isotopes ^{244}Cm and ^{252}Cf and qualifying them for WIPP disposal:
  - ^{244}Cm based on in-growth of ^{240}Pu and impurities in original material
  - ^{252}Cf based on impurities in original material and some in-growth of TRU isotopes.
- Adding ^{237}Np sources to the list of WIPP disposable sources

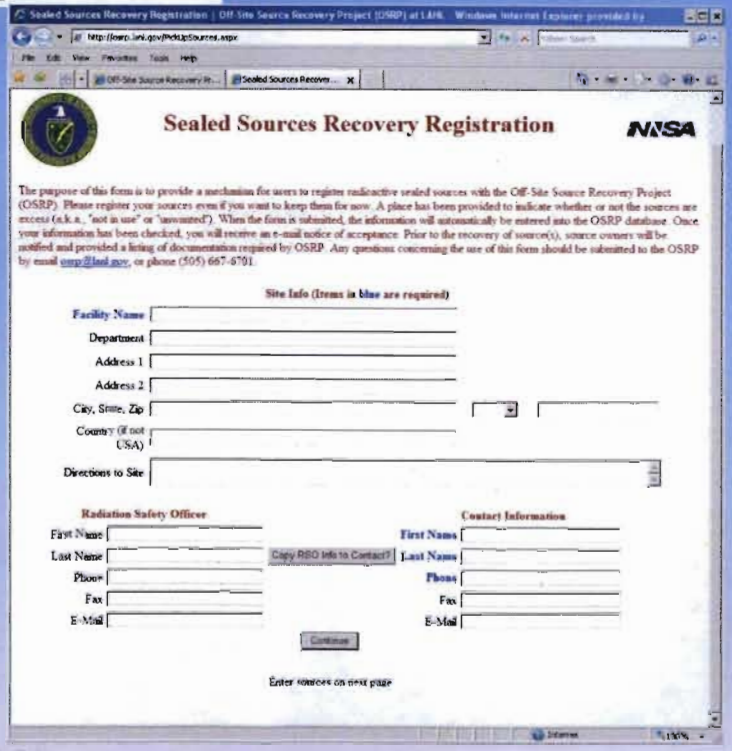
Accomplishments

- Accommodating new characterization methods for combination sources - neutron/gamma sources 241AmBe/137Cs used in moisture/density probes.
- Qualifying for disposal non-hazardous neutron type sources containing a mixture of radioisotope with a light element such as Li.
- Disposal of sealed sources containing RCRA metals such as Cd, based on approval of LANL permit by NMED, opening new avenues for more diverse source recoveries.
- During FY10 the inventory of our TRU drums in storage at LANL was decreased by 50% by characterizing for WIPP disposal about 300 drums.
- OSRP developed and maintains a unique set of comprehensive databases in the US with information about sealed source.

DO YOU HAVE UNWANTED SOURCES?

Register them at osrp.lanl.gov

- Register unwanted transuranic and selected beta, gamma sources with OSRP for recovery consideration.
- OSRP source recovery operations are generally prioritized on the basis of activity and level of security.
- Where numerous sources of lower activity are present at a single location, consideration is given to the total activity from a security perspective.



Contact OSRP:

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