Class 2 Permit Modification Request

LANL Sealed Sources Waste Streams
Headspace Gas Sampling and Analysis Requirements

Waste Isolation Pilot Plant
Carlsbad, New Mexico

WIPP HWFP #NM4890139088-TSDF

Table of Contents

Acronyms and Abbreviations

AK	Acceptable Knowledge
CFR	Code of Federal Regulations
DOE	U. S. Department of Energy
DOT	U. S. Department of Transportation
HWDU	Hazardous Waste Disposal Unit
HWFP	Hazardous Waste Facility Permit
LANL	Los Alamos National Laboratory
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
OSRP	Off-Site Source Recovery Project
PMR	Permit Modification Request
VE	Visual Examination
VOC	Volatile Organic Compound
WIPP	Waste Isolation Pilot Plant

Overview of the Permit Modification Request

This document contains a Class 2 Permit Modification Request (**PMR**) for the Hazardous Waste Facility Permit (**HWFP**) at the Waste Isolation Pilot Plant (**WIPP**), Number NM4890139088-TSDF hereinafter referred to as the WIPP HWFP.

This PMR is being submitted by the U.S. Department of Energy (**DOE**), Carlsbad Field Office and Washington TRU Solutions LLC, collectively referred to as the Permittees, in accordance with the WIPP HWFP, Condition I.B.1 (20.4.1.900 New Mexico Administrative Code (**NMAC**) incorporating Title 40, Code of Federal Regulations (**CFR**), §270.42(b)). The modification will establish specific criteria for the assignment of headspace gas volatile organic compound (**VOC**) concentration values in lieu of headspace gas sampling and analysis for the characterization of waste containers belonging to Los Alamos National Laboratory (**LANL**) sealed sources waste streams. These changes do not reduce the ability of the Permittees to provide continued protection to human health and the environment.

The requested modification to the WIPP HWFP and related supporting documents are provided in this PMR. The proposed modification to the text of the WIPP HWFP has been identified using a double underline and a revision bar in the right hand margin for added information, and a ~~strikeout~~ font for deleted information. All direct quotations are indicated by italicized text. The following information specifically addresses how compliance has been achieved with the WIPP HWFP requirement, Permit Condition I.B.1 for submission of this Class 2 PMR.

1. 20.4.1.900 NMAC (incorporating 40 CFR §270.42(b)(1)(i)), requires the applicant to describe the exact change to be made to the permit conditions and supporting documents referenced by the permit.

The LANL sealed sources waste streams are generated by the activities of the DOE Off-Site Source Recovery Project (**OSRP**) managed by LANL. The mission of the OSRP is defined by the U.S. Congress in Conference Report 107-593, to accompany House Resolution 4775, *Making Supplemental Appropriations for Further Recovery from and Response to Terrorist Attacks on the United States For the Fiscal Year Ending September 30, 2002, and for Other Purposes,* http://www.cfo.doe.gov/budget/billrept/fy02/02supp_conf_hrpt_107-593.pdf. House Resolution 4775 subsequently became Public Law 107-206. The OSRP mission is funded by Public Law 107-206, *Making Supplemental Appropriations for Further Recovery from and Response to Terrorist Attacks on the United States For the Fiscal Year Ending September 30, 2002*, *and for Other Purposes*, http://www.cfo.doe.gov/budget/billrept/fy02/02supp_PL_107-206.pdf. Conference Report 107-593 (page 142) shows $10,000,000 for the “Return of Domestic Sealed Sources” under the heading of “Defense Nuclear Nonproliferation”. Public Law 107-206 shows $100,000,000 for “Defense Nuclear Nonproliferation” (page 32) of which $10,000,000 is designated by Conference Report 107-593 for the “Return of Domestic Sealed Sources”. The scope of the OSRP is to recover, transport, and store at LANL radioactive sealed sources that are not currently being used. A sealed source is defined by 10 CFR §30.4 and 10 CFR §70.4 as any special nuclear material or byproduct material that is encased in a capsule designed to prevent leakage or escape of the special nuclear material or byproduct material.

For many years, radioactive sealed sources have served a number of unique technical functions in commercial, academic, medical, and government applications. However, many sealed sources have become excess and unwanted. Thousands that are Greater Than Class C (GTCC) have no disposition path, and their owners face the dilemma of providing safe storage while they no longer have a useful purpose. Increasing numbers are orphaned, abandoned, or stored with inadequate safety and security measures. The DOE estimates that more than 14,000 excess and unwanted sealed sources will require OSRP management through FY 2010, including sealed sources already recovered by DOE of which approximately 500 drums of these sources will be destined for WIPP.

The long-lived nature of the radionuclides involved requires planning for long-term management. Highly radioactive sources can present public health and safety hazards, including severe and fatal injuries if improperly handled. Recently, radioactive sealed sources have gained additional national attention because of security threats posed by terrorist use for radiological dispersal devices, or "dirty bombs." Because of the nuclear weapons implication, sealed sources containing Pu-239 are considered to be of "High Attractiveness" by DOE Nuclear Material Management Orders and subject to strict security measures during storage. Storage space for High Attractiveness material is severely limited at LANL requiring that a shipment of Pu-239 sources, packaged as waste, must leave the site and be placed in disposal at WIPP before another shipment of sources could be received at LANL.

High Attractiveness materials which must be sampled for VOCs in the headspace gas must be taken to the waste characterization area and must wait the required time for the drum age criteria to be met (152 days). During this time they must remain under guard in accordance with DOE Orders. This provides an undue burden upon LANL security forces and an additional expense that is not warranted.

Under the existing WIPP HWFP these sources would be required to undergo the same characterization activities as contact handled transuranic mixed waste. Specifically of importance to this PMR are the headspace gas requirements. These requirements dictate that every mixed waste container or statistically selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Section B-3 will be sampled and analyzed to determine the concentrations of VOCs in headspace gases.

This PMR proposes to assign headspace gas VOC concentration values which are attributable to the packaging material, in lieu of headspace gas sampling and analysis, to radioactive sources that are sealed, certified as U.S. Department of Transportation (**DOT**) special form radioactive material, and do not contain VOCs in the source material. The PMR delineates criteria for the assignment of headspace gas VOC concentration values in lieu of headspace gas sampling and analysis for the characterization of qualifying containers of sealed sources. Compliance with the defined criteria must be determined and documented as part of the LANL acceptable knowledge (**AK**) record and the LANL visual examination (**VE**) technique.

The assignment of packaging specific headspace gas VOC concentration values in lieu of headspace gas sampling and analysis is proposed for LANL sealed sources containers based primarily on the following key criteria:

- The LANL inventory under consideration consists only of sealed sources that are certified as DOT special form Class 7 (radioactive) material, or equivalent, which is defined by 49 CFR §173.403 as Class 7 (radioactive) material which satisfies the following conditions: (1) It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule; (2) The piece or capsule has at least one dimension not less than 5 millimeters (0.2 inch); and (3) It satisfies the test requirements of 49 CFR §173.469. Among other test requirements, 49 CFR §173.469 specifies that the special form radioactive material may not break or shatter when subjected to the impact, percussion, or bending test, may not melt or disperse when subjected to the heat test, and after each test, leaktightness or indispersibility of the specimen must be determined.

- The sealed sources do not include VOCs or VOC-bearing materials and the outermost casings of the sealed sources are metal or similar non-VOC bearing material. The sealed sources are subject to the same hazardous waste determinations and associated hazardous waste number assignments as other waste characterized under the HWFP.

- The determination of the impact of packaging materials on the VOCs in the headspace gas from containers of sealed sources is detailed in Attachment D entitled: "*Headspace Gas Sampling and Analysis Evaluation for LANL Sealed Sources*".

The addition of a new Section B-3a(1)(iii) is proposed to specify the criteria for assignment of headspace gas VOC concentration values in lieu of headspace gas sampling and analysis for the characterization of containers belonging to LANL sealed sources waste streams. These criteria require that compliance be determined and documented as part of the LANL AK record and the LANL VE technique. The use of the LANL VE technique at the time of packaging is proposed for the verification and documentation that sealed sources are the only non-packaging items in the container, each sealed source is no greater than four liters in size, and the outer casing of each sealed source is of a non-VOC bearing material. The use of the LANL AK record is proposed for the evaluation and documentation that the contents of each container meet the definition of sealed sources, each sealed source is certified as DOT special form radioactive material, the integrity of each sealed source has been validated by contamination survey results, and no VOCs or VOC bearing materials are constituents of the sealed sources. Such information is easily known for sealed sources, which were manufactured according to a strict set of procedures. Attachment C of this PMR describes the types of AK documentation available for use in demonstrating compliance with the proposed criteria for LANL sealed sources containers.

Because no VOCs are present in the sealed sources, a headspace gas sample of a container with sealed sources would represent only the VOCs resulting from the packaging materials. These VOCs are not related to the sealed sources in the container, however, they could potentially contribute to VOC emissions from the disposal unit. To identify and quantify these VOCs, headspace gas samples were collected from ten empty 55-gallon drums containing only the materials used to package the sealed sources. These drums contained no sealed sources. The evaluation of the headspace gas sampling and analysis results is provided in a report entitled *Headspace Gas Sampling and Analysis Evaluation for LANL Sealed Sources*, a copy of which is provided as Attachment D of this PMR. This report also presents data on other potential sources of VOCs from the packaging materials including radiolysis. The report documents the determination of VOC concentration values for assignment to the LANL sealed sources containers for reporting target analytes as required by WIPP HWFP Module II, Section II.C.3.i and for tracking compliance with the room-based VOC emissions limits established in WIPP HWFP Module IV, Table IV.D.1 for protection of human health and the environment.

A new Section B-3a(1)(iii) has been added to specify criteria for the contents of a container belonging to a LANL sealed sources waste stream that must be met for assignment of headspace gas VOC concentration values in lieu of headspace gas sampling and analysis for characterization of that container. Section B-3a(1)(iii) also specifies requirements for the determination of the VOC source term to be assigned to qualifying containers. For consistency, the addition of Section B-3a(1)(iii) requires the revision of the Attachment B Table of Contents; revision of text in Sections B-3a(1), B-3d, B-3d(1), B-3d(2), B1-1a(1), B1-1a(2), B3-2, and B4-3d; and revision of Tables B-6, B3-12, and B3-13. In addition, Sections B3-10b(1) and B3-10b(2) have been revised to require the Site Project Quality Assurance Officer and the Site Project Manager to ensure that the VOC source term is properly developed and/or used in accordance with Section B-3a(1)(iii) for LANL sealed sources waste streams. Text has been added to Section B3-12b(2) to require the inclusion in the Characterization Information Summary of the VOC source term determination data for LANL sealed sources waste streams. Section B4-2c has been revised to specify the additional AK documentation requirements for LANL sealed sources containers meeting the criteria of Section B-3a(1)(iii). Attachment B6 has been revised to reflect revisions to these sections, as appropriate. Details of these revisions are summarized in Attachment A of this PMR.

The NMED has suggested that a container holding sealed sources be randomly selected by NMED and the information showing the AK information documenting the criteria proposed for B-3(a)(1)(iii) has been met and be submitted with this revised PMR. This information serves as a sample of the waste characterization information that the NMED commented was absent from the previous submittal of this PMR. Those data are included in Attachment E fo this PMR. A listing of all changes to this revised PMR are included as an attachment to the Table of Changes.

The proposed changes to the WIPP HWFP text are presented in Attachment B of this PMR.

2. 20.4.1.900 NMAC (incorporating 40 CFR §270.42(b)(1)(ii)), requires the applicant to identify that the modification is a Class 2 modification.

The proposed modification is classified as a Class 2 permit modification because it is considered an *other change* to waste sampling and analysis methods in accordance with 20.4.1.900 NMAC incorporating 40 CFR §270.42 Appendix I, Item B.1.d. This classification is consistent with a similar PMR submitted to the New Mexico Environment Department (**NMED**) in April 2000, and approved in August 2000, concerning reduced headspace gas sampling for waste streams that meet criteria now established in Sections B-3a(1)(i) and B-3a(1)(ii).

4. 20.4.1.900 NMAC (incorporating 40 CFR §270.42(b)(1)(iii)), requires the applicant to explain why the modification is needed.

The proposed modification is needed to obtain relief from characterization requirements that should not be applied to the LANL sealed sources waste streams. These changes to the headspace gas characterization requirements are requested because these are non-VOC bearing waste streams and it is therefore, unnecessary to perform this characterization technique.

The WIPP HWFP issued by the NMED in October 1999 required headspace gas sampling and analysis of 100 percent of mixed contact-handled transuranic waste containers (WIPP HWFP Module II, Section II.C.3.i) and that non-mixed TRU waste will be characterized to the same degree as mixed TRU waste (WIPP HWFP Module IV, Section IV.B.2.b). The WIPP HWFP was modified via Class 2 Modifications on August 8, 2000, to allow reduced headspace gas sampling for waste streams that do not contain VOC's. The HWFP currently allows for the application of statistical headspace gas sampling and analysis requirements when characterizing waste streams that have no VOC-related hazardous waste numbers assigned or which have undergone thermal processing. Sections B-3a(1)(i) and B-3a(1)(ii) establish criteria for qualifying such waste streams for statistical sampling and analysis.

This PMR proposes a headspace gas characterization process for a specific debris waste stream (sealed sources) that is very similar to those allowances previously approved. This PMR establishes specific criteria for the assignment of headspace gas VOC concentration values in lieu of headspace gas sampling and analysis for the characterization of containers belonging to LANL sealed sources waste streams. In addition, the PMR establishes additional AK and VE technique requirements that must be met by LANL for qualifying sealed sources containers under these criteria.

An urgency based on issues of homeland security is associated with the characterization and permanent disposal of the LANL sealed sources waste streams. Subsequent to the events of September 11, 2001, and based on homeland security concerns the DOE and the U.S. Congress have identified significant risk associated with the large number of excess and unsecured sealed sources remaining in the environment and have directed the DOE to accelerate recovery and disposition of the known backlog of sealed sources (Conference Report 107-593 to accompany House Resolution 4775,*Making Supplemental Appropriations for Further Recovery from and Response to Terrorist Attacks on the United States For the Fiscal Year Ending September 30, 2002*, *and for Other Purposes*,). This recovery is to be completed by the OSRP in an 18-month period that began in October 2002. Disposition of these recovered sources in a timely manner is essential to national security. It is estimated that the OSRP activities could result in approximately 500 containers being shipped from LANL to WIPP for disposal.

4. 20.4.1.900 NMAC (incorporating 40 CFR §270.42 (b)(1)(iv)), requires the applicant to provide the applicable information required by 40 CFR §§270.13 through 270.21, 270.62 and 270.63.

The regulatory crosswalk describes those portions of the WIPP HWFP that are affected by this PMR. Where applicable, regulatory citations in this modification reference Title 20, Chapter 4, Part 1, NMAC, revised June 14, 2000, (incorporating 40 CFR Parts 264 and 270). 40 CFR §§270.16 through 270.21, 270.62 and 270.63 are not applicable at WIPP. Consequently, they are not listed in the regulatory crosswalk table. 40 CFR §270.23 is applicable to the WIPP Hazardous Waste Disposal Units (**HWDUs**). This modification does not impact the conditions associated with the HWDUs.

5. 20.4.1.900 NMAC (incorporating 40 CFR §270.11(d)(1) and 40 CFR §270.30(k)), requires any person signing under paragraph a and b must certify the document in accordance with 20.4.1.900 NMAC.

The transmittal letter for this PMR contains the signed certification statement in accordance with Module I.F of the WIPP HWFP.

Regulatory Crosswalk

Regulatory Citation(s) 20.4.1.900 NMAC (incorporating 40 CFR Part 270)	Regulatory Citation(s) 20.4.1.500 NMAC (incorporating 40 CFR Part 264)	Description of Requirement	Added or Clarified Information		
			Section of the HWFP	Yes	No
§270.13		Contents of Part A permit application	Attachment O, Part A		✓
§270.14(b)(1)		General facility description	Attachment A		✓
§270.14(b)(2)	§264.13(a)	Chemical and physical analyses	Attachment B	✓	
§270.14(b)(3)	§264.13(b)	Development and implementation of waste analysis plan	Attachment B	✓	
	§264.13(c)	Off-site waste analysis requirements	Attachment B	✓	
§270.14(b)(4)	§264.14(a-c)	Security procedures and equipment	Attachment C		✓
§270.14(b)(5)	§264.15(a-d)	General inspection requirements	Attachment D		✓
	§264.174	Container inspections	Attachment D		✓
§270.23(a)(2)	§264.602	Miscellaneous units inspections	Attachment D		✓
§270.14(b)(6)		Request for waiver from preparedness and prevention requirements of Part 264 Subpart C	NA		
§270.14(b)(7)	264 Subpart D	Contingency plan requirements	Attachment F		✓
	§264.51	Contingency plan design and implementation	Attachment F		✓
	§264.52 (a) & (c-f)	Contingency plan content	Attachment F		✓
	§264.53	Contingency plan copies	Attachment F		✓
	§264.54	Contingency plan amendment	Attachment F		✓
	§264.55	Emergency coordinator	Attachment F		✓
	§264.56	Emergency procedures	Attachment F		✓
§270.14(b)(8)		Description of procedures, structures or equipment for:	Attachment E		✓
§270.14(b)(8)(i)		Prevention of hazards in unloading operations (e.g., ramps and special forklifts)	Attachment E		✓
§270.14(b)(8)(ii)		Runoff or flood prevention (e.g., berms, trenches, and dikes)	Attachment E		✓
§270.14(b)(8)(iii)		Prevention of contamination of water supplies	Attachment E		✓
§270.14(b)(8)(iv)		Mitigation of effects of equipment failure and power outages	Attachment E		✓
§270.14(b)(8)(v)		Prevention of undue exposure of personnel (e.g., personal protective equipment)	Attachment E		✓
§270.14(b)(8)(vi) §270.23(a)(2)	§264.601	Prevention of releases to the atmosphere	Module II Module IV Attachment M2 Attachment N		✓
	264 Subpart C	Preparedness and prevention	Attachment E		✓
	§264.31	Design and operation of facility	Attachment E		✓
	§264.32	Required equipment	Attachment E Attachment F		✓
	§264.33	Testing and maintenance of equipment	Attachment D		✓
	§264.34	Access to communication/alarm system	Attachment E		✓
	§264.35	Required aisle space	Attachment E		✓

Regulatory Citation(s) 20.4.1.900 NMAC (incorporating 40 CFR Part 270)	Regulatory Citation(s) 20.4.1.500 NMAC (incorporating 40 CFR Part 264)	Description of Requirement	Added or Clarified Information		
			Section of the HWFP	Yes	No
	§264.37	Arrangements with local authorities	Attachment F		✓
§270.14(b)(9)	§264.17(a-c)	Prevention of accidental ignition or reaction of ignitable, reactive, or incompatible wastes	Attachment E		✓
§270.14(b)(10)		Traffic pattern, volume, and controls, for example: Identification of turn lanes Identification of traffic/stacking lanes, if appropriate Description of access road surface Description of access road load-bearing capacity Identification of traffic controls	Attachment G		✓
§270.14(b)(11)(i) and (ii)	§264.18(a)	Seismic standard applicability and requirements	Part B, Rev. 6 Chapter B		✓
§270.14(b)(11)(iii-v)	§264.18(b)	100-year floodplain standard	Part B, Rev. 6 Chapter B		✓
	§264.18(c)	Other location standards	Part B, Rev. 6 Chapter B		✓
§270.14(b)(12)	§264.16(a-e)	Personnel training program	Permit Module II Attachment H		✓
§270.14(b)(13)	264 Subpart G	Closure and post-closure plans	Attachment I & J		✓
§270.14(b)(13)	§264.111	Closure performance standard	Attachment I		✓
§270.14(b)(13)	§264.112(a), (b)	Written content of closure plan	Attachment I		✓
§270.14(b)(13)	§264.112(c)	Amendment of closure plan	Attachment I		✓
§270.14(b)(13)	§264.112(d)	Notification of partial and final closure	Attachment I		✓
§270.14(b)(13)	§264.112(e)	Removal of wastes and decontamination/dismantling of equipment	Attachment I		✓
§270.14(b)(13)	§264.113	Time allowed for closure	Attachment I		✓
§270.14(b)(13)	§264.114	Disposal/decontamination	Attachment I		✓
§270.14(b)(13)	§264.115	Certification of closure	Attachment I		✓
§270.14(b)(13)	§264.116	Survey plat	Attachment I		✓
§270.14(b)(13)	§264.117	Post-closure care and use of property	Attachment J		✓
§270.14(b)(13)	§264.118	Post-closure plan; amendment of plan	Attachment J		✓
§270.14(b)(13)	§264.178	Closure/containers	Attachment I		✓
§270.14(b)(13)	§264.601	Environmental performance standards-Miscellaneous units	Attachment I		✓
§270.14(b)(13)	§264.603	Post-closure care	Attachment I		✓
§270.14(b)(14)	§264.119	Post-closure notices	Attachment J		✓
§270.14(b)(15)	§264.142	Closure cost estimate	NA		✓
	§264.143	Financial assurance	NA		✓
§270.14(b)(16)	§264.144	Post-closure cost estimate	NA		✓
	§264.145	Post-closure care financial assurance	NA		✓
§270.14(b)(17)	§264.147	Liability insurance	NA		✓
§270.14(b)(18)	§264.149-150	Proof of financial coverage	NA		✓

Regulatory Citation(s) 20.4.1.900 NMAC (incorporating 40 CFR Part 270)	Regulatory Citation(s) 20.4.1.500 NMAC (incorporating 40 CFR Part 264)	Description of Requirement	Added or Clarified Information		
			Section of the HWFP	Yes	No
§270.14(b)(19)(i), (vi), (vii), and (x)		Topographic map requirements Map scale and date Map orientation Legal boundaries Buildings Treatment, storage, and disposal operations Run-on/run-off control systems Fire control facilities	Attachment O Part A Part B, Rev. 6 Chapter B, E		✓
§270.14(b)(19)(ii)	§264.18(b)	100-year floodplain	Attachment O Part A Part B, Rev. 6 Chapter B, E		✓
§270.14(b)(19)(iii)		Surface waters	Attachment O Part A Part B, Rev. 6 Chapter B, E		✓
§270.14(b)(19)(iv)		Surrounding Land use	Attachment O Part A Part B, Rev. 6 Chapter B, E		✓
§270.14(b)(19)(v)		Wind rose	Attachment O Part A Part B, Rev. 6 Chapter B, E		✓
§270.14(b)(19)(viii)	§264.14(b)	Access controls	Attachment O Part A Part B, Rev. 6 Chapter B, E, F		✓
§270.14(b)(19)(ix)		Injection and withdrawal wells	Attachment O Part A Part B, Rev. 6 Chapter B, E, F		✓
§270.14(b)(19)(xi)		Drainage on flood control barriers	Part B, Rev. 6 Chapter B, E, F		✓
§270.14(b)(19)(xii)		Location of operational units	Part B, Rev. 6 Chapter B		✓
§270.14(b)(20)		Other federal laws Wild and Scenic Rivers Act National Historic Preservation Act Endangered Species Act Coastal Zone Management Act Fish and Wildlife Coordination Act Executive Orders	Part B, Rev. 6 Chapter K		✓
§270.15	§264 Subpart I	Containers	Attachment M1		✓
	§264.171	Condition of containers	Attachment M1		✓
	§264.172	Compatibility of waste with containers	Attachment M1		✓
	§264.173	Management of containers	Attachment M1		✓
	§264.174	Inspections	Attachment D Attachment M1		✓
§270.15(a)	§264.175	Containment systems	Attachment M1		✓
§270.15(c)	§264.176	Special requirements for ignitable or reactive waste	Attachment E Permit Module II		✓
§270.15(d)	§264.177	Special requirements for	Attachment E		✓

Regulatory Citation(s) 20.4.1.900 NMAC (incorporating 40 CFR Part 270)	Regulatory Citation(s) 20.4.1.500 NMAC (incorporating 40 CFR Part 264)	Description of Requirement	Added or Clarified Information		
			Section of the HWFP	Yes	No
		incompatible wastes	Permit Module II		

Regulatory Citation(s) 20.4.1.900 NMAC (incorporating 40 CFR Part 270)	Regulatory Citation(s) 20.4.1.500 NMAC (incorporating 40 CFR Part 264)	Description of Requirement	Added or Clarified Information		
			Section of the HWFP	Yes	No
	§264.178	Closure	Attachment I		✓
§270.15(e)	§264.179	Air emission standards	Attachment E Attachment N		✓
§270.23	264 Subpart X	Miscellaneous units	Attachment M2		✓
§270.23(a)	§264.601	Detailed unit description	Attachment M2		✓
§270.23(b)	§264.601	Hydrologic, geologic, and meteorologic assessments	Permit Module IV Attachment M2		✓
§270.23(c)	§264.601	Potential exposure pathways	Permit Module IV Attachment M2 Attachment N		✓
§270.23(d)		Demonstration of treatment effectiveness	Permit Module IV Attachment M2 Attachment N		✓
	§264.602	Monitoring, analysis, inspection, response, reporting, and corrective action	Permit Module IV Attachment M2 Attachment N		✓
	§264.603	Post-closure care	Attachment J Attachment J1		✓
	264 Subpart E	Manifest system, record keeping, and reporting	Permit Module I Permit Module II Permit Module IV Attachment B		✓

Attachment A

Table of Changes

Table of Changes

Affected Permit Section	Explanation for Change
a.1. Attachment B, Table of Contents	The Table of Contents has been revised to reflect the addition of the new Section B-3a(1)(iii), Sampling Requirements for Waste Containers of LANL Sealed Sources Waste Streams.
a.2. Attachment B, Section B-3a(1)	Text has been added to require that LANL sealed sources waste containers that meet specified conditions must be assigned headspace gas VOC concentration values in accordance with Section B-3a(1)(iii) in lieu of headspace gas sampling and analysis.
a.3. Attachment B, Section B-3a(1)(iii)	Section B-3a(1)(iii) has been added to specify the following: • Criteria for the contents of a container belonging to a LANL sealed sources waste stream that must be met for assignment of headspace gas VOC concentration values in lieu of headspace gas sampling and analysis for characterization of that container. Compliance with each criterion must be determined and documented as part of the LANL AK record and the LANL VE technique as specified by the criteria. • Determination of a packaging VOC source term for containers meeting the criteria.
a.4. Attachment B, Section B-3d	Text has been added to Sections B-3d, B-3d(1), and B-3d(2) to require that LANL sealed sources waste containers that meet specified conditions must be assigned headspace gas VOC concentration values in accordance with Section B-3a(1)(iii) in lieu of headspace gas sampling and analysis.
a.5. Attachment B, Section B-3d(1)	
a.6. Attachment B, Section B-3d(2)	
a.7. Attachment B, Table B-6	Table B-6 has been revised to add references to sampling requirements for LANL sealed sources waste containers described in Section B-3a(1)(iii) using the existing Footnote "a," which refers to Section B-3a(1).
b.1. Attachment B1, Section B1-1a(1)	Text has been added to Sections B1-1a(1) and B3-2 to require that LANL sealed sources waste containers that meet specified conditions must be assigned headspace gas VOC concentration values in accordance with Section B-3a(1)(iii) in lieu of headspace gas sampling and analysis.
c.1. Attachment B3, Section B3-2	
c.2. Attachment B3, Section B3-10b(1)	Text has been added to require the Site Project Quality Assurance Officer to ensure by signature release that for LANL sealed sources waste streams the quality control provisions for VOC source term development were properly implemented in accordance with Section B-3a(1)(iii).
c.3. Attachment B3, Section B3-10b(2)	Text has been added to require the Site Project Manager to ensure by signature release that for LANL sealed sources waste streams the VOC source term was properly developed and used in accordance with Section B-3a(1)(iii).
c.4. Attachment B3, Section B3-12b(2)	Text has been added to require the inclusion of VOC source term determination data for LANL sealed sources waste streams in the Characterization Information Summary that accompanies the Waste Stream Profile Form.
c.5. Attachment B3, Table B3-12	Table B3-12 has been revised to add a new Footnote “a” to indicate that the headspace gas sampling batch data report is not required for LANL sealed sources waste containers that meet specific conditions and are assigned headspace gas VOC concentration values in accordance with Section B-3a(1)(iii).
c.6. Attachment B3, Table B3-13	Table B3-13 has been revised to add a new Footnote “a” to indicate that the headspace gas analytical batch data report is not required for LANL sealed sources waste containers that meet specific conditions and are assigned headspace gas VOC concentration values in accordance with Section B-3a(1)(iii).

Affected Permit Section	**Explanation for Change**
d.1. Attachment B4, Section B4-2c	Text has been added to specify additional AK documentation requirements for LANL sealed sources waste containers meeting the criteria established in Section B-3a(1)(iii).
d.2. Attachment B4, Section B4-3d	Text has been added to require that LANL sealed sources waste containers that meet specified conditions must be assigned headspace gas VOC concentration values in accordance with Section B-3a(1)(iii) in lieu of headspace gas sampling and analysis.
e.1. Attachment B6, Table B6-1	• Items 27, 28, and 29 have been revised to reflect revisions to Sections B-3a(1), B-3d, B-3d(1), and B-3d(2) to clarify that the LANL sealed sources waste containers that meet specified conditions must be assigned VOC concentration values in accordance with Section B-3a(1)(iii) in lieu of headspace gas sampling and analysis. • Items 40 and 41 have been revised to reflect revisions to Sections B3-10b(1) and B3-10b(2) to require that the Site Project Manager and the Site Project Quality Assurance Officer ensure that for LANL sealed sources waste streams the VOC source term was properly developed and/or used in accordance with Section B-3a(1)(iii). • Item 56a has been revised to reflect the revision to Section B3-12b(2) to require the inclusion of VOC source term determination data for LANL sealed sources waste streams in the Characterization Information Summary that accompanies the Waste Stream Profile Form.
e.2. Attachment B6, Table B6-3	New Item 145a has been added to reflect the revision to Section B4-2c to require the verification that procedures are in place to assure the collection of supplemental AK as defined in Section B4-2c for containers that belong to LANL sealed sources waste streams and meet the criteria specified in Section B-3a(1)(iii).
e.3. Attachment B6, Table B6-4	• Items 182 and 183 have been revised to reflect the revision to Section B1-1a(1) to indicate that headspace gas sampling and analysis is not required for waste containers that belong to LANL sealed sources waste streams and meet the criteria specified in Section B-3a(1)(iii). • New Item 182a has been added to require the verification that the LANL Quality Assurance Project Plan directs the assignment of VOC concentration values to waste containers that belong to LANL sealed sources waste streams and meet the criteria specified in Section B-3a(1)(iii). • Item 223 has been revised to reflect the revision to Section B3-2 to indicate that headspace gas sampling and analysis is not required for waste containers that belong to LANL sealed sources waste streams and meet the criteria specified in Section B-3a(1)(iii).

Changes in the Sealed Sources PMR Resubmittal

The following changes have been made to the revised Sealed Sources PMR:

- The approximate number of containers in the sealed sources waste stream has been provided in the preamble.

- Additional information regarding the national security issues surrounding sealed sources and the difficulty in storing them at LANL has been discussed in the overview.

- Various sections of the HWFP have been revised to reflect comments received by stakeholders. This includes Section B-3a(1)(iii) which has been revised to include the following "The integrity of each sealed source must be validated by documented contamination survey results to meet the requirements of 10 CFR 34.27, which must be assembled as part of the AK documentation".

- Section B-3a(1)(iii) has further been revised to read: "Headspace gas sampling and analysis of a waste container **containing a pipe overpack** component belonging to the LANL sealed sources waste stream....."

- Section B-3a(1)(iii) has further been revised to read: "All LANL sealed sources will be characterized as newly generated waste."

- Section B-3a(1)(iii) has further been revised to read: "The VOC source term also must be re-evaluated if any significant **(e.g., change in material or change in manufacturer)** is made to the packaging materials...."

- Section B-3a(1) has been revised to read "LANL waste containers that meet the conditions specified in Section B-3a(1)(iii) for sealed source containers are to be assigned VOC concentration values as directed in Section B-3a(1)(iii)."

- Attachment E has been added to the PMR which describes the AK available to verify that no hazardous waste constituents nor VOCs are present in the LANL sealed source waste stream and to satisfy other relevant data quality objectives.

Attachment B

Proposed Revised Permit Text

Proposed Revised Permit Text:

a.1. Attachment B , Table of Contents

a.2. Attachment B, Section B-3a(1)

B-3a(1) Headspace Gas Sampling and Analysis

Headspace-gas samples are used to determine the types and concentrations of VOCs in the void volume of waste containers. Measured headspace VOC concentrations in waste containers received at the WIPP facility will be compared routinely and in accordance with requirements of Permit Attachment N to ensure that, on an annual basis, there are no associated adverse worker or public-health impacts. In addition, VOC constituents will be compared to those assigned by acceptable knowledge, and the Permittees will assign hazardous waste codes, as warranted. This comparison may include an analysis of radiolytically derived VOCs. The Permittees may also consider radiolysis when assessing the presence of listed waste, and whether radiolysis would generate wastes which exhibit the toxicity characteristic. Refer to Permit Attachment B4 for additional clarification regarding hazardous waste code assignment and headspace gas results.

With the exception of qualifying LANL sealed sources waste containers, eEvery TRU mixed waste container or statistically selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in this section will be sampled and analyzed to determine the concentrations of VOCs (presented in Table B-3) in headspace gases. Los Alamos National Laboratory (**LANL**) sealed sources waste containers that meet the conditions specified in B-3a(1)(iii) must be assigned VOC concentration values in accordance with Section B-3a(1)(iii). If composite samples are used, containers used in the composite sample must be from the same waste stream with no more than 20 containers being included in a single composite sample. Sampling protocols, equipment, and QA/QC methods for headspace-gas sampling are provided in Permit Attachment B1. In accordance with EPA convention, identification of hazardous constituents detected by gas chromatography/mass spectrometry methods that are not on the list of target analytes shall be reported. These compounds are reported as tentatively identified compounds (**TICs**) in the analytical batch data report and shall be added to the target analyte list if detected in a given waste stream, if they appear in the 20.4.1.200 NMAC (incorporating 40 CFR §261) Appendix VIII, and if they are reported in 25% of the waste containers sampled from a given waste stream. The headspace gas analysis method Quality Assurance Objectives (**QAOs**) are specified in Permit Attachment B3.

a.3. Attachment B, Section B-3a(1)(iii)

Section B-3a(1)(iii) Sampling Requirements for Waste Containers of LANL Sealed Sources Waste Streams

Headspace gas sampling and analysis of a waste container containing a pipe overpack component belonging to a LANL sealed sources waste stream is not required if compliance with the following criteria has been determined and documented by LANL for its individual contents:

- All LANL sealed sources will be characterized as newly generated waste.

- The waste container contents meet the definition of sealed sources per 10 CFR §30.4 or 10 CFR §70.4, evidence of which must be assembled as part of the AK documentation.

- Sealed sources must be the only non-packaging items in the waste container, which must be verified using the VE technique at the time of packaging.

- The sealed sources must be U.S. Department of Transportation Special Form Class 7 (Radioactive) Material, or equivalent, per 49 CFR §173.403, the certification of which must be assembled as part of the AK documentation.

- The integrity of each sealed source must be validated by documented contamination survey results, to meet the requirements of 10 CFR 34.27 which must be assembled as part of the AK documentation.

- Each sealed source must be, or be contained in, a rigid sealed container less than or equal to 4 liters in size, which must be verified using the VE technique at the time of packaging.

- AK documentation does not indicate the use of VOCs or VOC-bearing materials as constituents of the sealed sources.

- The outer casing of each sealed source must be of a non-VOC bearing material, which must be verified using the VE technique at the time of packaging.

A packaging VOC source term for waste containers meeting these criteria must be established on a waste-stream basis for each headspace target analyte listed in Table B-3 as follows:

- Samples must be collected from the headspace of a minimum of five containers, each containing only packaging materials typical and representative of the packaging materials used in containers belonging to the LANL sealed sources waste stream under consideration. In no case is this sampling required to occur on containers that hold sealed sources. Each headspace gas sample must be analyzed for the target analytes listed in Table B-3. Using the statistical approach in Permit Attachment B2, Section B2-3b, VOC concentration values shall be calculated. For each result that is nondetectable, the value calculated as one-half the method detection limit shall be used. For all detectable results, the mean values shall be used. The calculated VOC concentration values shall be assigned to each waste container meeting the criteria of this section.

- Sampling and analysis must be managed in accordance with this Permit using an approved LANL headspace gas sampling and analysis program.

- The VOC source term also must be re-evaluated if any significant (e.g., change in material or change in manufacturer) is made to the packaging materials used in the sealed sources waste stream.

If a waste container meets these criteria, concentrations for the headspace gas target analytes (Table B-3) must be assigned based on the VOC source term developed as described above. The assignment of VOC concentration values for qualifying waste containers belonging to LANL sealed sources waste streams must be managed as documented and approved in the LANL QAPjP.

a.4. Attachment B, Section B-3d

B-3d Characterization Techniques and Frequency for Newly Generated and Retrievably Stored Waste

With the exception of qualifying LANL sealed sources waste containers, aAll waste containers (retrievably stored and newly generated) or randomly selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Section B-3a(1) are sampled and analyzed for VOCs in the headspace gas. The LANL sealed sources waste containers that meet specified conditions must be assigned VOC concentration values in accordance with Section B-3a(1)(iii). A statistically selected portion of each homogeneous solids and soil/gravel waste stream is sampled and analyzed for RCRA-regulated total VOCs, SVOCs, and metals (see Permit Attachment B2). Sampling and analysis methods used for waste characterization are discussed in Section B-3a. In the process of performing organic headspace and solid sample analyses, nontarget compounds may be identified. These compounds will be reported as TICs. TICs reported in 25% of the samples and listed in 20.4.1.200 NMAC (incorporating 40 CFR §261) Appendix VIII, will be compared with acceptable knowledge data to determine if the TIC is in a listed hazardous waste in the waste stream. TICs identified through headspace gas analyses that meet the Appendix VIII list criteria and the 25 percent reporting criteria for a waste stream will be added to the headspace gas waste stream target list, regardless of the hazardous waste listing associated with the waste stream. TICs subject to inclusion on the target analyte list that are toxicity characteristic parameters shall be added to the target analyte list regardless of origin because the hazardous waste designation for these codes is not based on source. However, for toxicity characteristic and non-toxic F003 constituents, the site may take concentration into account when assessing whether to add a hazardous waste code. TICs reported from the Totals VOC or SVOC analyses may be excluded from the target analyte list for a waste stream if the TIC is a constituent in an F-listed waste whose presence is attributable to waste packaging materials or radiolytic degradation from acceptable knowledge documentation. If the TIC associated with a total VOC or SVOC analysis cannot be identified as a component of waste packaging materials or as a product of radiolysis, the Permittees will add these TICs to the list of hazardous constituents for the waste stream (and assign additional EPA listed hazardous waste codes, if appropriate). A permit modification will be submitted to NMED for their approval to add these constituents (and waste codes), if necessary. For toxicity characteristic compounds and non-toxic F003 constituents, the Permittees may consider waste concentration when determining whether to change a hazardous waste code. Refer to Permit Attachment B3 for additional information on TIC identification.

a.5. Attachment B, Section B-3d(1)

B-3d(1) Newly Generated Waste

With the exception of qualifying LANL sealed sources waste containers, a~~A~~ll containers of newly generated waste or newly generated waste containers randomly selected from waste streams that meet the conditions for reduced headspace gas sampling listed in Section B-3a(1) will undergo headspace-gas analysis for VOC concentrations prior to shipment. The LANL sealed sources waste containers that meet specified conditions must be assigned VOC concentration values in accordance with Section B-3a(1)(iii). If the Permittees believe the frequency can be reduced in the future based on trends in analytical results, they may provide technical arguments for such a reduction and request a permit modification from NMED. The headspace-gas sampling method is provided in Permit Attachment B1. Headspace gas data will be used to confirm acceptable knowledge waste characterization, as specified in Permit Attachment B4.

a.6. Attachment B, Section B-3d(2)

B-3d(2) Retrievably Stored Waste

With the exception of qualifying LANL sealed sources waste containers, a~~A~~ll retrievably stored containers or retrievably stored containers randomly selected from waste streams that meet the conditions for reduced headspace gas sampling listed in Section B-3a(1) will undergo headspace gas analysis for VOC concentrations. The LANL sealed sources waste containers that meet specified conditions must be assigned VOC concentration values in accordance with Section B-3a(1)(iii). Retrievably stored waste that is repackaged will be subject to the DAC determination specified in Section B-3d(1). The headspace gas sampling method is provided in Permit Attachment B1. All headspace gas data will be used to confirm acceptable knowledge waste characterization, as specified in Permit Attachment B4.

A statistically selected portion of retrievably stored homogeneous solids and soil/gravel wastes will be sampled and analyzed for total VOCs, SVOCs, and metals. The approach used to statistically select drums for homogeneous solids and soil/gravel wastes is different than the method used to select waste containers for visual examination. This method is also included in Permit Attachment B2. The sampling methods for these wastes are provided in Permit Attachment B1.

a.7. Attachment B, Table B-6

TABLE B-6
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE
FOR CH TRANSURANIC MIXED WASTE (STORED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S3000-Homogeneous Solids S4000-Soil/Gravel	• Solidified inorganics • Salt waste • Solidified organics • Contaminated soil/debris	Physical waste form	100% radiography or visual examination	• Verify waste matrix • Demonstrate compliance with waste acceptance criteria (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas volatile organic compounds (VOC)	100% gas sampling and analysis or statistical sampling[a, b] (see Table B-3)	• Quantify concentration of flammable VOCs • Determine potential flammability of transuranic (TRU) mixed waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Ensure that environmental performance standards are not exceeded

		Hazardous constituents • TCLP/total metals • TCLP/total VOCs • TCLP/total semi-VOCs	Statistical sampling[a] (see Tables B-4 and B-5)	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE B-6 (CONTINUED)
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE
FOR CH TRANSURANIC MIXED WASTE (STORED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S5000–Debris Waste	• Uncategorized metal (metal waste other than lead/ cadmium) • Lead/cadmium waste • Inorganic nonmetal waste • Combustible waste • Graphite waste • Heterogeneous waste • Composite filter waste	Physical waste form	100% Radiography Visual examination (statistical sample)[a] or visual examination	• Verify waste matrix • Demonstrate compliance with waste acceptance (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas VOCs	100% gas sampling and analysis, statistical sampling or assignment of VOC concentrations[a] (see Table B-3)	• Quantify concentration of flammable VOCs • Determine potential flammability of TRU mixed waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Ensure that environmental performance standards are not exceeded • Verify acceptable knowledge

		Hazardous constituents • TCLP/total metals • TCLP/total VOCs • TCLP/total semi-VOCs	Acceptable knowledge	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE B-6 (CONTINUED)
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE
FOR CH TRANSURANIC MIXED WASTE (NEWLY GENERATED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S3000-Homogeneous Solids S4000-Soil/Gravel	• Solidified inorganics • Salt waste • Solidified organics • Contaminated soil/debris	Physical waste form	Documentation and verification[b] or radiography. Applies to 100% of containers	• Verify waste matrix • Demonstrate compliance with waste acceptance criteria (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas VOCs (VOCs)	100% gas sampling and analysis or statistical sampling[a, b] (see Table B-3)	• Quantify concentration of flammable VOCs • Determine potential flammability of TRU mixed waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Ensure that environmental performance standards are not exceeded
		Hazardous constituents • TCLP/total metals • TCLP/total VOCs • TCLP/total semi-VOCs	Statistical sampling[a] (see Tables B-4 and B-5)	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE B-6 (CONTINUED)
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE
FOR CH TRANSURANIC MIXED WASTE (NEWLY GENERATED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S5000–Debris Waste	• Uncategorized metal (metal waste other than lead/ cadmium) • Lead/cadmium waste • Inorganic nonmetal waste • Combustible waste • Graphite waste • Heterogeneous waste • Composite filter waste	Physical waste form	Documentation and verification[b] or radiography. Applies to 100% of containers	• Verify waste matrix • Demonstrate compliance with waste acceptance (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas VOCs	100% gas sampling and analysis, statistical sampling or assignment of VOC concentrations[a] (see Table B-3)	• Quantify concentration of flammable VOCs • Determine potential flammability of TRU mixed waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Ensure that environmental performance standards are not exceeded • Verify acceptable knowledge
		Hazardous constituents • TCLP/total metals • TCLP/total VOCs • TCLP/total semi-VOCs	Acceptable knowledge	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

[a] Applies to certain waste streams that meet the conditions in Section B-3a(1).
[b] Number determined as specified in Permit Attachment B2.
[c] See discussion in Permit Attachment B4.

b.1. Attachment B1, Section B1-1a(1)

B1-1a(1) Summary Category S5000 Requirements

With the exception of qualifying LANL sealed sources waste containers, aAll waste containers or randomly selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Permit Attachment B, Section B-3a(1), designated as summary category S5000 (Debris waste) shall be categorized under one of the sampling scenarios shown in Table B1-5 and depicted in Figure B1-1. The LANL sealed sources waste containers that meet specified conditions must be assigned VOC concentration values in accordance with Section B-3a(1)(iii). If the container is categorized under Scenario 1, the applicable drum age criteria (**DAC**) from Table B1-6 must be met prior to headspace gas sampling. If the container is categorized under Scenario 2, the applicable Scenario 1 DAC from Table B1-6 must be met prior to venting the container and then the applicable Scenario 2 DAC from Table B1-7 must be met after venting the container. The DAC for Scenario 2 containers that contain filters or rigid liner vent holes other than those listed in Table B1-7 shall be determined using footnotes “a” and “b” in Table B1-7. Containers that have not met the Scenario 1 DAC at the time of venting must be categorized under Scenario 3. Containers categorized under Scenario 3 must be placed into one of the Packaging Configuration Groups listed in Table B1-8. If a specific packaging configuration cannot be determined based on the data collected during packaging and/or repackaging (Attachment B, Section B-3(d)1), a conservative default Packaging Configuration Group of 3 for drums and 6 for Standard Waste Boxes (**SWBs**) must be assigned, provided the drums do not contain pipe component packaging. If a container is designated as Packaging Configuration Group 4 (i.e., a pipe component), the headspace gas sample must be taken from the pipe component headspace. The DAC for Scenario 3 containers that contain rigid liner vent holes that are undocumented during packaging (Attachment B, Section B-3(d)1), repackaging (Attachment B, Section B-3(d)1), and/or venting (Section B1-1a[6][ii]) shall be determined using the default conditions in footnote “b” in Table B1-9.The DAC for Scenario 3 containers that contain filters that are either undocumented or are other than those listed in Table B1-9 shall be determined using footnote ‘a’ in Table B1-9. Each of the Scenario 3 containers shall be sampled for headspace gas after waiting the DAC in Table B1-9 based on its packaging configuration (note: Packaging Configuration Groups 4, 5, and 6 are not summary category group dependent, and SWB requirements apply when the SWB itself is used for the direct loading of waste).

c.1. Attachment B3, Section B3-2

B3-2 Headspace-Gas Sampling

Quality Assurance Objectives

With the exception of qualifying LANL sealed sources waste containers, hHeadspace-gas sampling will occur from the headspace within each drum of transuranic (**TRU**) mixed waste or randomly selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Attachment B, Section B-3a(1). The LANL sealed sources waste containers that meet specified conditions must be assigned VOC concentration values in accordance with Section B-3a(1)(iii).

The precision and accuracy of the drum headspace-gas sampling operations must be assessed by analyzing field QC headspace-gas samples. These samples must include equipment blanks, field reference standards, field blanks, and field duplicates. If the QAOs described below are not met, a nonconformance report must be prepared, submitted, and resolved (Section B3-13).

c.2. Attachment B3, Section B3-10b(1)

B3-10b(1) Site Project QA Officer

The Site Project QA Officer review ensures that the Batch Data Reports received from the data generation level is complete, validates and verifies that the QC checks were done properly and meet program criteria, and ensures that the QAOs have been met.

One hundred percent of the Batch Data Reports must receive Site Project QA Officer signature release. The Site Project QA Officer signature release must occur as soon as practicably possible in order to determine and correct negative quality trends in the sampling or analytical process. However at a minimum, the Site Project QA Officer signature release must be performed before any waste associated with the data reviewed is managed, stored, or disposed at WIPP. This signature release must ensure the following:

- Batch Data Reports are complete and data are properly reported (i.e., data are reported in correct units, with correct significant figures, and with correct qualifying flags).

- Sampling batch QC checks (e.g., equipment blanks, field duplicates, field reference standards) were properly performed, and meet the established QAOs and are within established data useability criteria.

- Testing batch QC checks (e.g., replicate scans, measurement system checks) were properly performed. Radiography data are complete and acceptable based on evidence of videotape review of one waste container per day or once per testing batch, whichever is less frequent, as specified in B1-3b(2).

- Analytical batch QC checks (e.g., laboratory duplicates, laboratory blanks, matrix spikes, matrix spike duplicates, laboratory control samples) were properly performed and meet the established QAOs and are within established data useability criteria.

- On-line batch QC checks (e.g., field blanks, on-line blanks, on-line duplicates, on-line control samples) were properly performed and meet the established QAOs and are within established data useability criteria.

- Proper procedures were followed to ensure representative samples of headspace gas and homogenous solids and soil/gravel were taken.

- For LANL sealed sources waste streams, the quality control provisions for VOC source term development were properly implemented in accordance with Permit Attachment B, Section B-3a(1)(iii).

c.3. Attachment B3, Section B3-10b(2)

B3-10b(2) Site Project Manager

The Site Project Manager Review is the final validation that all of the data contained in Batch Data Reports have been properly reviewed as evidenced by signature release and completed checklists.

One hundred percent of the Batch Data Reports must have Site Project Manager signature release. The Site Project Manager signature release must occur as soon as practicably possible after the Site Project QA officer signature release in order to determine and correct negative quality trends in the sampling or analytical process. However at a minimum, the Site Project Manager signature release must be performed before any waste associated with the data reviewed is managed, stored, or disposed at WIPP. This signature release must ensure the following:

- The Site Project Manager or designee shall determine the validity of the drum age criteria (**DAC**) assignment made at the data generation level based upon an assessment of the data collection and evaluation necessary to make the assignment.

- For LANL sealed sources waste streams, the VOC source term was properly developed and used in accordance with Permit Attachment B, Section B-3a(1)(iii).

- Data generation level independent technical, technical supervisory, and QA officer (or designee) review, validation, and verification have been performed as evidenced by the completed review checklists and appropriate signature releases.

- Batch data review checklists are complete.

- Batch Data Reports are complete and data are properly reported (e.g., data are reported in the correct units, with the correct number of significant figures, and with qualifying flags).

- Verify that data are within established data assessment criteria and meet all applicable QAOs (Section B3-11).

c.4. Attachment B3, Section B3-12b(2)

B3-12b(2) Characterization Information Summary

The Characterization Information Summary shall include the following elements:

- Data reconciliation with DQOs

- Headspace gas summary data listing the identification numbers of samples used in the statistical reduction, the maximum, mean, standard deviation, UCL_{90}, RTL, and associated EPA hazardous waste codes that must be applied to the waste stream.

- For LANL sealed sources waste streams, the VOC source term determination data (as defined by Attachment B, Section B-3a(1)(iii)) listing one-half the method detection limit and mean when used to assign concentrations for the headspace gas target analytes.

- Total metal, VOC, and SVOC analytical results for homogeneous solids and soil/gravel (if applicable), and demonstration that control charting cannot be applied effectively, if this option is implemented.

- TIC listing and evaluation, and verification that acceptable knowledge (**AK**) was confirmed.

- Radiography and visual examination summary to document that all prohibited items are absent in the waste and to confirm AK, and documentation and justification for the use of radiography in lieu of or in combination with visual examination/visual examination technique for newly generated waste.

- A complete listing of all container identification numbers used to generate the WSPF, cross-referenced to each Batch Data Report

- Complete AK summary, including stream name and number, point of generation, waste stream volume (current and projected), generation dates, TRUCON codes, Summary Category Group, Waste Matrix Code(s) and Waste Matrix Code Group, other TWBIR information, waste stream description, areas of operation, generating processes, RCRA determinations, radionuclide information, all references used to generate the AK summary, and any other information required by Permit Attachment B4, Section B4-2b.

- Certification through acceptable knowledge or testing and/or analysis that any waste assigned the hazardous waste number of U134 (hydrofluoric acid) no longer exhibits the characteristic of corrosivity. This is confirmed by assuring that no liquid is present in U134 waste.

c.5. Attachment B3, Table B3-12

TABLE B3-12
SAMPLING BATCH DATA REPORT CONTENTS

Required Information	Headspace Gas[a]	Solid Sampling	Comment
Batch Data Report Date	X	X	
Batch number	X	X	
Waste stream name and/or number	O	O	
Waste Matrix Code		X	Summary Category Group included in Waste Matrix Code
Procedure (specific version used)	X	X	If procedure cited contains more than one method, the method used must also be cited. Can use revision number, date, or other means to track specific version used.
Container number	X	X	
Container type	O	O	Drums, Standard Waste Box, Ten Drum Overpack, etc.
Sample matrix and type	X	X	
Analyses requested and laboratory	X	X	
Point of origin for sampling	X	X	Location where sample was taken (e.g., building number, room)
Sample number	X	X	
Sample size	X	X	
Sample location	X	X	Location within container where sample is taken. (For HSG, specify what layer of confinement was sampled. For solids, physical location within container.)
Sample preservation	X	X	
Person collecting sample	X	X	
Person attaching custody seal	O	O	May or may not be the same as the person collecting the sample

Required Information	Headspace Gas[a]	Solid Sampling	Comment
Chain of custody record	X	X	Original or copy is allowed
Sampling equipment numbers	X	X	For disposable equipment, a reference to the lot
Drum age	X		Must include all supporting determinative information, including but not limited to packaging date, equilibrium start time, storage temperature, and sampling date/time. If Scenario 3 is used, the packaging configuration, filter diffusivity, liner presence/absence, and rigid liner vent hole diameter used in determining the DAC must be documented. If Scenario 1 and 2 are used together, the filter diffusivity and rigid liner vent hole diameter used in determining the DAC must be documented. If default values are used for retrievably stored waste, these values must clearly be identified as such.
Cross-reference of sampling equipment numbers with associated cleaning batch numbers	O	X	As applicable to the equipment used for the sampling. For disposable equipment, a reference to the lot and procurement records to support cleanliness is sufficient
Drum age	X		
Equilibration time	X		
Verification of rigid liner venting	X		Only applicable to containers with rigid liners
Verification that sample volume taken is small in comparison to the available volume	X		Must include headspace gas volume when it can be estimated
Scale Calibration		O	
Depth of waste		X	For newly generated waste, if a sampling method other than coring is used, this is replaced by documentation that a representative sample has been taken.
Calculation of core recovery		X	For newly generated waste, if a sampling method other than coring is used, this is replaced by documentation that a representative sample has been taken.
Co-located core description		X	For newly generated waste, if a sampling method other than coring is used, this is replaced by documentation that a QC sample has been taken.
Time between coring and subsampling		X	Only applicable to coring.
OVA calibration and reading	O		Only applicable to manifold systems. Must be done in accordance with manufacturer's specifications

Required Information	Headspace Gas[a]	Solid Sampling	Comment
Field Records	X	X	Must contain the following as applicable to the sampling method used: Collection problems, Sequence of sampling collection, Inspection of the solids sampling area, Inspection of the solids sampling equipment, Coring tool test, random location of sub-sample, canister pressure, and ambient temperature and pressure.
Reference to or copy of associated NCRs, if any	X	X	Copies of associated NCRs must be available.
Operator Signature and date and time of sampling	X	X	
Data review checklists	X	X	All data review checklists will be identified

[a] The headspace gas sampling batch data report is not required for the LANL sealed sources waste containers that meet specified conditions and are assigned VOC concentration values in accordance with Section B-3a(1)(iii).

LEGEND:

X - Required in batch data report.
O - Information must be documented and traceable; inclusion in batch data report is optional.

c.6. Attachment B3, Table B3-13

TABLE B3-13
ANALYTICAL BATCH DATA REPORT CONTENTS

Required Information	Headspace Gas[a]	Solid Sampling	Comment
Batch Data Report Date	X	X	
Batch number	X	X	
Sample numbers	X	X	
QC designation for sample	X	X	
Implementing procedure (specific version used)	X	X	If procedure cited contains more than one method, the method used must also be cited. Can use revision number, date, or other means to track specific version used.
QC sample results	X	X	
Sample data forms	X	X	Form should contain reduced data for target analytes and TICs
Chain of custody	X	X	Original or copy
Gas canister tags	X		Original or copy
Sample preservation	X	X	
Holding time		X	
Cross-reference of field numbers to laboratory sample numbers	X	X	
Date and time analyzed	X	X	
Confirmation of spectra used for results	O	O	Analyst must qualitatively evaluate the validity of the results based on the spectra, can be implemented as a check box for each sample
TIC evaluation	X	X	
Reporting flags, if any	X	X	Table B3-14 lists applicable flags
Case narrative	X	X	
Reference to or copy of associated NCRs, if any	X	X	Copies of associated NCRs must be available.
Operator signature and analysis date	X	X	
Data review checklists	X	X	All data review checklists will be identified

[a] The headspace gas analytical batch data report is not required for the LANL sealed sources waste containers that meet specified conditions and are assigned VOC concentration values in accordance with Section B-3a(1)(iii).

LEGEND:

X - Required in batch data report.

O - Information must be documented and traceable; inclusion in batch data report is optional.

d.1. Attachment B4, Section B4-2c

B4-2c Supplemental Acceptable Knowledge Information

The generator/storage sites shall obtain supplemental acceptable knowledge information. The amount and type of supplemental information is site-specific and cannot be mandated, but sites shall collect information as appropriate to support required information. Adequacy of supplemental information shall be assessed by the Permittees during audits (Section B4-3f). Sites will use this information to compile the acceptable knowledge written record. Supplemental acceptable knowledge documentation that may be used (if available) in addition to the required information specified above include, but are not limited to, the following information:

- Process design documents (e.g., Title II Design)
- Standard operating procedures that may include a list of raw materials or reagents, a description of the process or experiment generating the waste, and a description of wastes generated and how the wastes are managed at the point of generation
- Preliminary and final safety analysis reports and technical safety requirements
- Waste packaging logs
- Test plans or research project reports that describe reagents and other raw materials used in experiments
- Site databases (e.g., chemical inventory database for Superfund Amendments and Reauthorization Act Title III requirements)
- Information from site personnel (e.g., documented interviews)
- Standard industry documents (e.g., vendor information)
- Analytical data relevant to the waste stream, including results from fingerprint analyses, spot checks, or routine verification sampling. This may also include new information acquired apart from the confirmatory process which supplements required information (e.g., visual examination not performed in compliance with the WAP)
- Material Safety Data Sheets, product labels, or other product package information

- Sampling and analysis data from comparable or surrogate waste streams (e.g., equivalent nonradioactive materials)

- Laboratory notebooks that detail the research processes and raw materials used in an experiment

For waste containers that belong to LANL sealed sources waste streams and meet the criteria of Permit Attachment B, Section B-3a(1)(iii), the following information is required as part of the AK documentation:

- Documentation that the waste container contents meet the definition of sealed sources per 10 CFR §30.4 or 10 CFR §70.4.

- Documentation of the certification of the sealed sources as U.S. Department of Transportation Special Form Class 7 (Radioactive) Material or equivalent per 49 CFR §173.403,.

- Documentation of contamination survey results that validate the integrity of each sealed source.

- AK documentation does not indicate the use of VOCs or VOC-bearing materials as constituents of the sealed sources.

- The outer casing of each sealed source must be of a non-VOC bearing material, which must be verified using the VE technique at the time of packaging.

All specific, relevant supplemental acceptable knowledge documentation assembled and used in the acceptable knowledge process, whether it supports or contradicts any required acceptable knowledge documentation, shall be identified and an explanation provided for its use (e.g., identification of a toxicity characteristic). Supplemental documentation may be used to further document the rationale for the hazardous characterization results. The collection and use of supplemental information shall be assessed by the Permittees during site audits to ensure that hazardous waste characterization is supported, as necessary, by supplemental information. Similar to required information, if discrepancies exist between supplemental information and the required information, then sites shall apply all hazardous waste codes indicated by the supplemental information to the subject waste stream unless the sites choose to justify an alternative assignment and document the justification in the auditable record.

d.2. Attachment B4, Section B4-3d

B4-3d Requirements for Confirmation of Acceptable Knowledge Information

With the exception of qualifying LANL sealed sources waste containers, hHeadspace-gas sampling and analysis shall be conducted on all TRU mixed waste or randomly selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Permit Attachment B, Section B-3a(1), to be sent to the WIPP facility. (The LANL sealed sources waste containers that meet specified conditions must be assigned VOC concentration values in accordance with Section B-3a(1)(iii).) Headspace-gas data will be used to confirm the presence or absence of volatile organic compounds (**VOCs**) identified using acceptable knowledge.

e.1. Attachment B6, Table B6-1

27	Are procedures in place to ensure that the following characterization activities shall occur for newly generated wastes: • Acceptable Knowledge for all wastes, with confirmatory: - Either visual examination during packaging or radiography (or VE in lieu of radiography) after packaging for all waste containers, ensuring this occurs prior to any treatment designed to supercompact waste - Headspace gas analysis for all waste containers or randomly selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Section B-3a(1), except for qualifying waste containers belonging to LANL sealed sources waste streams as specified in Section B-3a(1)(iii) - Total VOC, SVOC, and Metals analyses for a selected number of homogeneous solids and soil/gravel waste containers for control charting purposes (annually thereafter), as specified in Attachment B2 - Evaluation of any TICs found in headspace gas and totals analyses (Section B-3d(1))

28	Are procedures in place to ensure that the following characterization activities shall occur for retrievably stored wastes: • Acceptable Knowledge for all wastes, with confirmatory: - Visual examination or radiography for all waste containers - Confirmatory visual examination of a statistically determined number of waste containers as specified in Attachment B2 (when radiography is performed) - Headspace gas analysis for all waste containers or randomly selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Section B-3a(1), except for qualifying waste containers belonging to LANL sealed sources waste streams as specified in Section B-3a(1)(iii) - Total VOC, SVOC, and Metals analyses for a statistically selected number of homogeneous solids and soil/gravel waste containers as specified in Attachment B2 (containers opened for sampling may be used to fulfill the visual examination requirements) - Evaluation of any TICs found in headspace gas and totals analyses (Section B-3d(2))

29	Are procedures in place to ensure that the following characterization activities shall occur for repackaged waste: • Acceptable Knowledge, with confirmatory: - Either visual examination during repackaging or radiography (or VE in lieu of radiography) after repackaging for all waste containers, ensuring this occurs prior to any treatment designed to supercompact waste - Headspace gas analysis for all waste containers or randomly selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Section B-3a(1), except for qualifying waste containers belonging to LANL sealed sources waste streams as specified in Section B-3a(1)(iii) - Total VOC, SVOC, and Metals analyses following either the retrievably stored or newly generated waste characterization process, whichever results in greater sampling requirements, unless it is demonstrated that control charting cannot be applied effectively. - Evaluation of any TICs found in headspace gas and totals analyses (Section B-3d, B-3d(1))

40	Are procedures in place to ensure that 100 percent of all batch data reports receive a Site Project Manager signature release with an associated review checklist prior to characterization of the associated waste and shipment to the WIPP. This release shall ensure the following: • The Site Project Manager or designee shall determine the validity of the drum age criteria (**DAC**) assignment made at the data generation level based upon an assessment of the data collection and evaluation necessary to make the assignment. • For LANL sealed sources waste streams, the VOC source term was properly developed and used in accordance with Permit Attachment B, Section B-3a(1)(iii). • Non-programmatic technical reviews, technical supervisory reviews, and QA Officer reviews have been performed and documented through signature • Data have been verified to be within established data assessment criteria and meet all applicable QAOs • Sampling, testing, and analytical batches are complete and data are reported to the correct units, qualifier flags, and significant figures. • The testing, sampling, and QA data review checklists are complete (Section B3-10b(2))

41	At the project level, are procedures in place to ensure that 100 percent of all batch data reports shall have a Site Project QA Officer signature release with an associated review checklist prior to characterization of the associated waste and shipment to the WIPP. This release shall ensure the following: • Sampling batch field QC checks were properly performed and meet established QAOs and data usability criteria • Testing batch QC checks were properly performed • Analytical batch and on-line QC Checks were properly performed and meet established QAOs and data usability criteria • Radiography data are complete and acceptable • Data are properly reported (i.e., correct units, correct significant figures, and appropriate qualifier flags) • Proper procedures were used to ensure that representative headspace gas and core samples were collected • For LANL sealed sources waste streams, the provisions for VOC source term development were properly implemented in accordance with Permit Attachment B, Section B-3a(1)(iii). (Section B3-10b(1))

56a	Are procedures in place to ensure that hard copy or electronic Characterization Information Summary will include the following: • Data reconciliation with DQOs • Headspace gas summary data listing the identification numbers of samples used in the statistical reduction, the maximum, mean, standard deviation, UCL_{90}, RTL, and associated EPA hazardous waste codes that must be applied to the waste stream. • For LANL sealed sources waste streams, the VOC source term determination data must comply with Attachment B, Section B-3a(1)(iii). • Total metal, VOC, and SVOC analytical results for homogeneous solids and soil/gravel (if applicable), and demonstration that control charting cannot be applied effectively, if this option is implemented. • TIC listing and evaluation, and verification that acceptable knowledge (**AK**) was confirmed. • Radiography and visual examination summary to document that all prohibited items are absent in the waste and to confirm AK, and documentation and justification for the use of radiography in lieu of or in combination with visual examination/visual examination technique for newly generated waste. • A complete listing of all container identification numbers used to generate the Waste Stream Profile Form, cross-referenced to each Batch Data Report • Complete AK summary, including stream name and number, point of generation, waste stream volume (current and projected), generation dates, TRUCON codes, Summary Category Group, Waste Matrix Code(s) and Waste Matrix Code Group, other TWBIR information, waste stream description, areas of operation, generating processes, RCRA determinations, radionuclide information, all references used to generate the AK summary, and any other information required by Permit Attachment B4, Section B4-2b. • Certification through acceptable knowledge or testing and/or analysis that any waste assigned the hazardous waste number of U134 (hydrofluoric acid) no longer exhibits the characteristic of corrosivity. This is confirmed by assuring that no liquid is present in U134 waste. (Section B3-12b(2))

e.2. Attachment B6, Table B6-3

145	Does the generator provide procedures or written commitment to collect supplemental acceptable knowledge information, as available and as necessary to supplement mandatory information? (Section B4-2c)
145a	For waste containers that belong to LANL sealed sources waste streams and meet the criteria of Section B-3a(1)(iii) are there procedures in place to assure the collection of the following supplemental AK: • Documentation that the waste container contents meet the definition of sealed sources per 10 CFR §30.4 or 10 CFR §70.4, • Documentation of the certification of the sealed sources as U.S. Department of Transportation Special Form Class 7 (Radioactive) Material per 49 CFR §173.403, or equivalent. • Documentation of contamination survey results that validate the integrity of each sealed source. • AK documentation does not indicate the use of VOCs or VOC-bearing materials as constituents of the sealed sources. • The outer casing of each sealed source must be of a non-VOC bearing material, which must be verified using the VE technique at the time of packaging. (Section B4-2c)

e.3. Attachment B6, Table B6-4

182	Are procedures in place to ensure that every retrievably stored and newly generated waste containers or randomly selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Section B-3a(1), except for waste containers belonging to LANL sealed sources waste streams as specified in Section B-3a(1)(iii), will undergo headspace gas sampling and analysis? (Section B-3a, -3b)
182a	Are procedures in place or is a program described in the LANL QAPjP to assure that VOC concentrations are determined and assigned in accordance with Permit Attachment B, Section B-3a(1)(iii) for waste containers that belong to LANL sealed sources waste streams and meet the criteria specified in Section B-3a(1)(iii)? (Section B-3a(1)(iii))
183	Are procedures in place to ensure that all waste containers or randomly selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Section B-3a(1) (except for qualifying waste containers belonging to LANL sealed sources waste streams as specified in Section B-3a(1)(iii)) will be allowed to equilibrate to sampling room temperature for 72 hours prior to sampling (18º C or higher) and that the drum ages specified in accordance with Section B1-1a(1) and B1-1a(2) are met? All information necessary to determine drum age criteria must be determined, including but not limited to: • Scenario Determination • Packaging Configuration • Filter Diffusivity • Liner/Lid Opening Diameter Are procedures in place to ensure that equilibrium time and drum ages are documented for each container from which a headspace gas sample is collected as specified in Section B1-1a(3)? (Section B1-1a)

223	Are procedures in place to ensure that headspace gas sampling will occur from the drum headspace for all drums or randomly selected containers from waste streams that meet the conditions for reduced headspace gas sampling listed in Section B-3a(1) (except for qualifying waste containers belonging to LANL sealed sources waste streams as specified in Section B-3a(1)(iii))? (Section B3-2)

Attachment C

Example - LANL Sealed Sources Waste Streams Acceptable Knowledge Documentation

Example - LANL Sealed Sources Waste Streams Acceptable Knowledge Documentation

This permit modification request proposes criteria for the assignment of headspace gas volatile organic compound (**VOC**) concentration values in lieu of headspace gas sampling and analysis for the characterization of specific waste containers belonging to the Los Alamos National Laboratory (**LANL**) sealed sources waste streams. In order the meet these criteria, the following information must be part of the LANL acceptable knowledge (**AK**) record:

- Documentation that the waste container contents meet the definition of sealed sources per Title 10, Code of Federal Regulations (**CFR**), Section 30.4 (10 CFR §30.4) or 10 CFR §70.4
- Documentation of the certification of the sealed sources as U.S. Department of Transportation (**DOT**) Special Form Class 7 (Radioactive) Material or equivalent per 49 CFR §173.403.
- Documentation of contamination survey results that validate the integrity of each sealed source.
- Documentation indicates that no VOCs or VOC-bearing materials are constituents of the sealed sources.
- Documentation that the outer casing of each sealed source is of a non-VOC bearing material, which must be verified using the VE technique at the time of packaging.

Such information exists for the sealed sources because they are manufactured as precision tools with a well-defined pedigree. They have a design history and have been manufactured to a rigid set of specifications. There are only a finite number of sealed sources manufacturers, models, and sizes. Commonly, an individual serial number uniquely defines each sealed source. Often only the specific source serial number differentiates it from other identical sealed sources of a particular model or series. The sealed source containment materials are well defined, and the sealing procedures used are a matter of documented record. LANL compiles all such records as part of the AK documentation for sealed sources.

For a specific sealed source, documentation is compiled on the content and design/construction from the U.S. Nuclear Regulatory Commission (**NRC**) registry of sealed sources, the manufacturer, the original shipping paper and specification sheet, and data from the NRC/ U.S. Department of Energy (**DOE**) Nuclear Material Management and Safeguards System (**NMMSS**), as well as other physical information about the sealed source. Records are accumulated for the individual sealed sources, typically identified by unique serial number, and tracked over the years in organizational records starting with manufacturers' records, records associated with the control of special nuclear materials, or NRC licensing and device registries. Such records provide a complete history of the sealed source from the cradle to its acquisition and management at LANL.

The following list provides examples of the types of AK documentation (followed by the current LANL Transuranic Waste Characterization/Certification Program [TWCP] AK record identification number) that exist for the LANL sealed sources waste streams:

- Source manufacturers' sales catalogues identify sealed source models, isotopes, activity, neutron/gamma emission rates, and dimensional drawings (TWCP-03759, TWCP-09462).

- Original purchase records identify design information for a specific source (identified by a unique serial number). This information may include encapsulation requirements; source loading information, source model used, American National Standards Institute test conducted, and DOT Special Form Class 7 (Radioactive) Material qualifications (TWCP-06723).

- Source manufacturers' fabrication documents identify activity, neutron/gamma emission rates, radioactive source materials, source configuration, source loading, and source testing (TWCP-05462).

- Source manufacturers' drawings provide dimensional information, containment materials, and shape of sources (TWCP-10565).

- Source manufacturers' fuel capsule assembly reports identify material batch number, weight percent of the isotope, isotope powder weight, welding documentation, leak test information, and neutron emission rates (TWCP-05611).

- Source manufacturers' operational procedures identify cleanliness requirements, testing methods, and acceptance criteria (TWCP-06723).

- Source manufacturers' shipping documents identify by unique serial number the isotope, activity, loading, containment material, dimensions, method of sealing, neutron/gamma emission, and special form qualification for a specific sealed source (TWCP-05760).

- Source manufacturers' welding records provide information regarding cleaning agents and welding procedures (TWCP-09293, TWCP-09299).

- Transuranic batch material records trace the radioactive material from the originator (Atomic Energy Commission/DOE) to the source manufacture and, in some cases, to source owners (TWCP-09268, TWCP-09269, TWCP-09267, TWCP-09356).

- National database, NMMSS, identifies the source owner, material type, date of manufacture, and isotopic grams of the nuclide by unique serial number for a specific sealed source. The database provides a listing of sealed sources manufactured containing Pu^{238} and Pu^{239} special nuclear material. The last report issued was in 1985. Additions to the database are now made using NRC/DOE Form 741 (e.g., Am^{241} is treated as special nuclear material by the DOE and is being added to this database) (TWCP-05463).

- NRC/DOE Form 741 defines where radioactive material originated, material type, and batch material information (TWCP-05602, TWCP-05752, TWCP-05630, TWCP-05445, TWCP-05662).

- National database, NRC Registry of Radioactive Sealed Sources and Device Registry, identifies source device, isotope, activity, source marking, source or device diagram, and testing conducted on the source (TWCP-03758).

- DOT Special Form Class 7 (Radioactive) Material documentation identifies if the source has a special form certificate and if the certificate is current (TWCP-05465).

Attachment D

Headspace Gas Sampling and Analysis Evaluation for LANL Sealed Sources

HEADSPACE GAS SAMPLING AND ANALYSIS EVALUATION FOR LANL SEALED SOURCES LAUR-03-0917

INTRODUCTION

Since 1999, the Los Alamos National Laboratory (LANL), Off-Site Source Recovery (OSR) Project has been identifying and collecting radioactive sealed sources that are no longer needed. There is an existing backlog of sealed sources in known locations that are not secure. The OSR Project's mission is to secure and safely dispose of these sealed sources. The basis for this action is to eliminate the homeland security issues associated with this excess material while it remains unsecured. The vast majority of these sources contain transuranic (TRU) isotopes. Most of the TRU sealed sources are beyond the activity limits for acceptance at low-level waste disposal facilities. However, these sealed sources are candidates for disposal at the Waste Isolation Pilot Plant (WIPP). Many of these sources are the result of "atomic energy defense activity." Many more may be determined to meet this WIPP eligibility requirement at some time in the future.

In all cases, the excess unwanted TRU materials are considered to be of high attractiveness, which presents a homeland security risk if not appropriately secured and safeguarded. The Department of Energy (DOE) and the National Nuclear Security Administration have determined that the maximum level of risk reduction will occur only when the recovered sealed sources are dispositioned as TRU waste by permanent isolation. The objective, therefore, is to recover, package as waste, and transfer all eligible-sealed sources to WIPP as expeditiously as possible. To achieve this objective it is necessary to characterize the sealed source waste stream to WIPP requirements resulting in WIPP-certifiable waste.

Among other requirements, the characterization requirements of the Waste Analysis Plan (WAP) of the WIPP Hazardous Waste Facility Permit (HWFP; No. NM4890139088-TSDF) (Ref. 1) must be met in order to certify TRU waste for disposal at WIPP. Of particular interest for sealed sources is the WAP requirement for headspace gas sampling and analysis. The data quality objectives (DQOs) established by the WAP for headspace gas sampling and analysis are as follows:

- To confirm hazardous waste identification by acceptable knowledge (AK)
- To identify volatile organic compounds (VOCs) and quantify the concentrations of VOC constituents in the total waste inventory to ensure compliance with the performance standards of 20.4.1.500 NMAC (New Mexico Administrative Code; incorporating Title 40, Code of Federal Regulations, §264.601(c)) (Ref. 1).

Based on *Acceptable Knowledge Summary Report for Off-Site Source Recovery Sealed Sources* (OSR-MISC-03) (Ref. 2), the LANL sealed sources do not contain VOCs. However, packaging materials are a potential source for VOCs. The WAP does not require the assignment of hazardous waste codes for organic constituents associated with packaging materials. As such, no hazardous waste codes are assigned to the LANL sealed sources waste stream. Therefore, with respect to the first DQO, because AK assigns no hazardous waste codes and demonstrates that the sealed sources meet the stringent criteria for qualification as U.S. Department of Transportation (DOT) *special form* and comply with the associated leak test requirement, headspace gas sampling and analysis confirmation is not necessary.

The objective of this report is to demonstrate that the second DQO can be fulfilled without headspace gas sampling and analysis of the waste containers comprising the LANL sealed sources waste stream.

Because the TRU sealed sources do not contain VOCs, a headspace gas sample collected from a waste container packaged with the sealed sources would only represent the characterization of the packaging materials. The bounding quantification of potential VOCs from materials to be used for packaging the LANL sealed sources is the subject of this report.

PURPOSE

Headspace gas sampling and analysis was performed for the purpose of quantifying VOCs, hydrogen, and methane present in the headspace of waste containers packaging LANL sealed sources. The purpose of this report is as follows:

- To summarize the results obtained from the analysis of headspace gas samples collected from waste containers including only the materials used to package LANL sealed sources

- To present a justification for assigning VOC concentration values for each waste container of LANL sealed sources in lieu of performing headspace gas sampling and analysis

- To determine the VOC concentrations of the target analytes that will be used to satisfy the reporting requirement of the WIPP HWFP (Module II.C.3.i): "Any waste container that does not have VOC concentration values reported for the headspace is not acceptable at WIPP" (Ref. 1).

QUANTIFICATION OF POTENTIAL VOCs FROM PACKAGING MATERIALS

Drum Preparation

In accordance with *OSR Project Drum Test-VOC Evolutions From Packaging Material* (Ref. 3) the LANL OSR Project prepared ten (10) standard pipe overpack containers. As directed by the procedure, each drum was prepared with an identical configuration. These drums contained only the packaging materials that are used in OSR Project drums. No sealed sources were present in any of the drums.

Each empty standard pipe overpack container was initially inspected by performing the following steps:

- Open 55-gallon drum and inspect lid, locking ring, and gasket
- Remove rigid liner lid and fiberboard disk shim. Inspect rigid liner lid to ensure vent hole is open.
- Remove fiberboard packing top and fiberboard flange shims
- Loosen all bolts in pipe component cap and hoist lid vertically off of the pipe component
- Inspect pipe component O-ring for damage
- Verify serial numbers on pipe component lid matches pipe component body.

Each container was prepared for evaluation as follows:

- Place the poly shield insert into the payload cavity of the pipe component.
- The flanged lid of the pipe component was not installed to allow equilibration of VOCs throughout the pipe overpack container.
- Replace cane fiberboard flange shims, matching flange areas with cutouts in fiberboard
- Replace cane fiberboard packing top
- Install spacer(s) on top of cane fiberboard liner top
- Install rigid liner lid, verifying vent hole with a minimum 0.3 in. diameter

- Measure vertical distance between the bottom of the rigid liner lid and the upper surface of the top fiberboard shim. Verify distance is less than or equal to 0.5 in.
- Install drum lid (with filter previously installed) and closure ring, orient bolt closure ends downward and over the drum seam
- Ensure ring is properly seated on drum, thread drum closure bolt through the threaded drum closure ring lug and lightly tighten drum closure bolt. Torque to 40 ft-lb using calibrated torque wrench.
- Tighten lock nut against unthreaded drum closure ring lug
- Apply Tamper Indication Device (TID) to drum.

Table 1 presents the materials included in each standard pipe overpack container.

Table 1 Packaging Materials *

Packaging Components	Material of Construction	Weight (kg)
Poly Shield Insert	High density polyethylene	29.5
12” Pipe Component, without lid	Stainless Steel, 12-7/8 in. bolts	82.6
Dunnage	Cane Fiberboard	28.6
Rigid Liner and Liner Lid	High density polyethylene	7.7
DOT Type 7A 55 Gallon Drum, including lid and bolt ring	Steel	27.2
Drum gasket	Type I—tubular styrene-butadiene Type II—foam styrene-butadiene	
Drum Filter (NucFil-013)	Carbon composite 3.70E-6 mol/s/mol fraction	

* The packaging components used in this evaluation are compliant with the transportation specifications of the TRUPACT-II Authorized Methods for Payload Control (TRAMPAC), Revision 19a.

As required by *OSR Project Drum Test-VOC Evolutions From Packaging Material,* (Ref. 3) a LANL Record of Drum Closure was completed for each drum. Table 2 summarizes the information recorded on the LANL Record of Drum Closure Forms.

Table 2 Drum Information

Drum Serial #	Drum Vent Type	Drum Vent Serial #	TID #	Date Closed
DB4342	NucFil-013	RFP-6798	0000019	11/21/01
DB4340	NucFil-013	RFP-6782	0000063	11/21/01
DB4339	NucFil-013	RFP-6781	0000043	11/21/01
DB3724	NucFil-013	RFP-6779	0000037	11/21/01
DB4345	NucFil-013	RFP-6796	0000001	11/21/01
DB3725	NucFil-013	RFP-6784	0000024	11/21/01
DB3726	NucFil-013	RFP-6800	0000066	11/21/01
DB3723	NucFil-013	RFP-6795	0000071	11/21/01
DB3721	NucFil-013	RFP-6777	0000039	11/21/01
DB3720	NucFil-013	RFP-6778	0000202	11/21/01

The packaged drums were placed in a secure storage location at LANL.

Headspace Gas Sampling and Analysis

The drums were removed and transported to the LANL Headspace Gas sampling area. Sampling was conducted on September 9, 2002, in accordance with *Manual Headspace Gas Sampling for Analysis by INEEL* (TWCP-DTP-1.2-074*)* (Ref. 4). A 250-milliliter sample was collected in a SUMMA® canister from each drum and transported to the Idaho National Engineering and Environmental Laboratory (INEEL) for analysis for VOCs, hydrogen and methane with chain-of-custody (COC) forms. None of the samples were composited before analysis.

In accordance with *Manual Headspace Gas Sampling for Analysis by INEEL* (TWCP-DTP-1.2-074) (Ref. 4) a field blank, field duplicate, and field reference standard were collected during sampling and were included in the sampling batch sent to INEEL for analysis. The analysis was conducted in accordance with *Analysis of Gas Samples for VOCs by GC/MS* (ACMM-9930) (Ref. 5) and *Analysis of Gas Samples for VOCs by GC/FID* (ACMM-9910) (Ref. 6). The analytical batch data report (BDR) LA02-HGAS/IA-006 was subject to INEEL data generation verification and validation in accordance with *RWMC Data Generation Level Data Validation* (MCP-1850) (Ref. 7). The sampling BDR LA02-HGAS/IS-006 and the analytical BDR were validated and verified by LANL in accordance with *Project Level Data Validation and Verification* (TWCP-QP-1.1-010) (Ref. 8). The sampling and analytical quality control samples met acceptance criteria and the headspace gas sampling and analysis quality assurance objectives specified by the WAP were met.

Analytical Results

The analytical results for the headspace gas samples collected from the 10 standard pipe overpack containers are tabulated in Table 3. The program required quantitation limit (PRQL) for the alcohols and ketones is 100 parts per million by volume (ppmv) and 10 ppmv for the remaining VOCs. With the exception of three out of 32 analytes measured, the concentrations are reported at the method detection limit (MDL). For acetone, cyclohexane, and toluene, the results are just slightly above detectable. The analytical results identified no tentatively identified compounds (TICs) as determined in accordance with *Analysis of Gas Samples for VOCs by GC/MS* (ACMM-9930) (Ref. 5). As shown in Table 3, the results are clearly orders of magnitude below the PRQL for the regulated VOCs. The concentrations of regulated and flammable VOCs and hydrogen and methane are very small and, in most cases, not detectable. Therefore, VOC contributions from packaging materials are insignificant for the sealed sources waste stream.

Table 3 Analyte Concentrations Resulting from Packaging Materials

DRUM		DB4345	DB4340	DB3721	DB4339	DB3726	DB3723	DB3724	DB3725	DB3720	DB4342
Lab sample ID (INEEL)		02262002	02262005	02262006	02262007	02262008	02262009	02262010	02262011	02262012	02262013
Acetone	ppmv	1.1 J	1.5 J	1.7 J	1.2 J	1.2 J	1.5 J	1.7 J	0.80 J	1.6 J	0.86 J
Benzene	ppmv	0.055 U	0.056 U	0.055 U	0.054 U	0.056 U	0.054 U	0.056 U	0.057 U	0.055 U	0.058 U
Bromoform	ppmv	0.018 U	0.018 U	0.018 U	0.017 U	0.018 U	0.017 U	0.018 U	0.018 U	0.018 U	0.019 U
Butanol	ppmv	0.059 U	0.060 U	0.060 U	0.058 U	0.060 U	0.058 U	0.060 U	0.062 U	0.060 U	0.062 U
Carbon tetrachloride	ppmv	0.033 U	0.034 U	0.034 U	0.033 U	0.034 U	0.033 U	0.034 U	0.035 U	0.034 U	0.035 U
Chlorobenzene	ppmv	0.031 U	0.032 U	0.032 U	0.031 U	0.032 U	0.031 U	0.032 U	0.033 U	0.032 U	0.033 U
Chloroform	ppmv	0.030 U	0.031 U	0.031 U	0.030 U	0.031 U	0.030 U	0.031 U	0.032 U	0.031 U	0.032 U
Cyclohexane	ppmv	1.9 J	2.1 J	2.6 J	2.2 J	1.8 J	2.4 J	2.2 J	1.7 J	1.9 J	1.0 J
1,1-Dichloroethane	ppmv	0.047 U	0.048 U	0.048 U	0.047 U	0.048 U	0.047 U	0.048 U	0.049 U	0.048 U	0.050 U
1,2-Dichloroethane	ppmv	0.052 U	0.053 U	0.052 U	0.051 U	0.053 U	0.051 U	0.052 U	0.054 U	0.052 U	0.054 U
1,1-Dichloroethylene	ppmv	0.074 U	0.075 U	0.075 U	0.073 U	0.076 U	0.073 U	0.075 U	0.077 U	0.075 U	0.078 U
cis-1,2-Dichloroethylene	ppmv	0.038 U	0.039 U	0.039 U	0.038 U	0.039 U	0.038 U	0.039 U	0.040 U	0.039 U	0.040 U
trans-1,2-Dichloroethylene	ppmv	0.052 U	0.053 U	0.052 U	0.051 U	0.053 U	0.051 U	0.053 U	0.054 U	0.052 U	0.055 U
Ethyl benzene	ppmv	0.045 U	0.046 U	0.046 U	0.045 U	0.047 U	0.045 U	0.046 U	0.048 U	0.046 U	0.048 U
Ethyl ether	ppmv	0.079 U	0.080 U	0.080 U	0.078 U	0.081 U	0.078 U	0.080 U	0.083 U	0.080 U	0.083 U
Methyl ethyl ketone	ppmv	0.098 U	0.10 U	0.099 U	0.097 U	0.10 U	0.097 U	0.099 U	0.10 U	0.099 U	0.10 U
Methyl isobutyl ketone	ppmv	0.040 U	0.041 U	0.040 U	0.040 U	0.041 U	0.040 U	0.040 U	0.042 U	0.040 U	0.042 U
Methylene chloride	ppmv	0.082 U	0.084 U	0.083 U	0.081 U	0.084 U	0.081 U	0.083 U	0.086 U	0.083 U	0.087 U
1,1,2,2-Tetrachloroethane	ppmv	0.030 U	0.031 U	0.031 U	0.030 U	0.031 U	0.030 U	0.031 U	0.032 U	0.031 U	0.032 U
Tetrachloroethylene	ppmv	0.028 U	0.029 U	0.028 U	0.028 U	0.029 U	0.028 U	0.028 U	0.029 U	0.028 U	0.030 U
Toluene	ppmv	0.052 J	0.062 J	0.054 J	0.061 J	0.062 J	0.047 J	0.092 J	0.075 J	0.063 J	0.038 J
1,1,1-Trichloroethane	ppmv	0.032U	0.033 U	0.032 U	0.032 U	0.033 U	0.032 U	0.033 U	0.034 U	0.032 U	0.034 U
Trichloroethylene	ppmv	0.028 U	0.029 U	0.029 U	0.028 U	0.029 U	0.028 U	0.029 U	0.030 U	0.029 U	0.030 U
1,1,2-Trichloro-1,2,2-trifluoroethane	ppmv	0.021 U	0.022 U	0.022 U	0.021 U	0.022 U	0.021 U	0.022 U	0.022 U	0.022 U	0.022 U
1,3,5-Trimethylbenzene	ppmv	0.032 U	0.032 U	0.032 U	0.031 U	0.032 U	0.031 U	0.032 U	0.033 U	0.032 U	0.033 U
1,2,4-Trimethylbenzene	ppmv	0.036 U	0.036 U	0.036 U	0.035 U	0.036 U	0.035 U	0.036 U	0.037 U	0.036 U	0.038 U
p/m-Xylene	ppmv	0.045 U	0.046 U	0.046 U	0.045 U	0.047 U	0.045 U	0.046 U	0.048 U	0.046 U	0.048 U
o-Xylene	ppmv	0.033 U	0.034 U	0.034 U	0.033 U	0.034 U	0.033 U	0.034 U	0.035 U	0.034 U	0.035 U
Hydrogen	Vol%	0.011 U	0.012 U	0.012 U	0.011 U	0.012 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U
Methane	Vol%	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Methanol	ppmv	2.6 U	2.7 U	2.7 U	2.5 U	2.7 U	2.6 U	2.7 U	2.7 U	2.6 U	2.8 U

POTENTIAL VOCs FROM RADIOLYSIS

Sealed radioactive sources, as packaged by the OSR Project, are not capable of significant hydrogen or VOC generation from radiolytic interaction. The AK documentation available demonstrates that sources meet DOT *special form*, and comply with the requirement for a leak test (Ref. 2). In addition, physical inspection during the visual examination assures that no VOC-bearing materials are associated with the TRU sealed source waste. Thus the *sealed* barrier prevents any possible interaction between alpha radiation and the compounds present in the packaging. By definition, no radiolytic gas generation is possible from the alpha and beta energy contained by the sealed sources.

The release of VOCs and hydrogen from the interactions of gamma radiation or neutron particles is zero or nearly zero as shown by the following analysis. Six hydrogen generation test vessels, or canisters, were loaded with a variety of materials, including the high density polyethylene used for packaging sealed sources, and were exposed to a neutron source loaded in each canister in the center of the material. The headspace gas in the canisters was sampled and subjected to gas chromatography measurements. With the exception of some residual hydrogen being released from packaging materials observed during curing, there was no hydrogen detected from radiolysis. The results from the tests are given in Table 4.

Table 4 Empirical Measurement Results of H_2 Released From Irradiated Packaging Materials

Canister #	Material	H_2 Concentration After 114 Days	Effective "G" Value*
1	Concrete and Polybeads	<1.29 ppmv**	<0.012
2	High Density Polyethylene	<1.29 ppmv**	<0.045
3	Borated Polyethylene	<1.29 ppmv**	<0.017
4	Water-Extended Polyethylene	<1.29 ppmv** (H_2 evolution from residual curing = 35 ppmv)	<0.026
5	Poly Cast	<1.29 ppmv** (H_2 evolution from residual curing = 41 ppmv)	<0.024

* The units for the effective "G" value are molecules of H_2 released per 100 electron volts of energy absorbed.
** 1.29 ppm is the lower limit of detection for the gas chromatograph.

As shown in Table 4, the effective G values (gas generation release potential) measured in this test are insignificant for all tested materials. A low G value indicates low gas generation release and is associated with low hydrogen concentration also presented in Table 4. Low hydrogen generation has been correlated to low VOC generation. The G values for VOCs observed in previous studies (Ref. 9) were consistently more than a factor of 200 below those observed for hydrogen generation. Therefore, the generation of VOCs from non-alpha radiolysis is inconsequential for these packaging materials.

CONCLUSIONS

The analytical results listed in Table 3 for the packaging materials alone demonstrate that VOC, hydrogen, and methane concentrations are well below the PRQLs for those compounds. The headspace gas analysis taken from the combination of packaging materials and neutron sources provide confirmation that radiolytic generation of headspace gas from alpha, beta, gamma, and neutron emissions is inconsequential. Therefore, the WAP DQO for identifying VOCs and quantifying the concentrations of VOC constituents can be fulfilled without headspace gas sampling and analysis of the waste containers comprising the LANL sealed source waste stream.

For the purpose of assigning headspace gas VOC concentration values to the OSR Project sealed source waste stream, UCL_{90} calculations were performed in accordance with *Calculation of UCL_{90} Values* (TWCP-DTP-1.2-006) (Ref. 10) using the results listed in Table 3. The resulting concentrations are presented in Table 5.

Table 5 Proposed LANL Sealed Sources Waste Container Headspace Gas VOC Concentration Values

Compound	Concentration (ppmv)
Acetone	1.46
Benzene	0.03
Bromoform	0.01
Butanol	0.03
Carbon Tetrachloride	0.02
Chlorobenzene	0.02
Chloroform	0.02
Cyclohexane	2.17
1,1-Dichloroethane	0.02
1,2-Dichloroethane	0.03
1,1-Dichloroethylene	0.04
cis-1,2-Dichloroethylene	0.02
trans-1,2-Dichloroethylene	0.03
Ethyl Benzene	0.02
Ethyl Ether	0.04
Methanol	1.35
Methyl ethyl ketone	0.05
Methyl isobutyl ketone	0.02
Methylene Chloride	0.04
1,1,2,2-Tetrachloroethane	0.02
Tetrachloroethylene	0.01
Toluene	0.07
1,1,1-Trichloroethane	0.02
Trichloroethylene	0.02
1,1,2-Trichloro-1,2,2-trifluoroethane	0.01
1,3,5-Trimethylbenzene	0.02
1,2,4-Trimethylbenzene	0.02
p/m-Xylene	0.02
o-Xylene	0.02
Hydrogen	0.01 (vol %)
Methane	0.002 (vol %)

REFERENCES

1. Waste Isolation Pilot Plant Hazardous Waste Facility Permit, NM 4890139088-TSDF

2. *Acceptable Knowledge Summary Report for Off-Site Source Recovery Sealed Sources* (OSR-MISC-03)

3. *OSR Project Drum Test-VOC Evolutions From Packaging Material*

4. *Manual Headspace Gas Sampling for Analysis by INEEL* (TWCP-DTP-1.2-074)

5. *Analysis of Gas Samples for VOCs by GC/MS* (ACMM-9930)

6. *Analysis of Gas Samples for VOCs by GC/FID* (ACMM-9910)

7. *RWMC Data Generation Level Data Validation* (MCP-1850)

8. *Project Level Data Validation and Verification* (TWCP-QP-1.1-010)

9. *Calculations by S.T. Kosiewicz*, June 1998

10. *Calculation of UCL_{90} Values* (TWCP-DTP-1.2-006)

Attachment E

Verification of the AK for Container LA00000061414

Attachment E

Verification That Container LA00000061414 Has No Hazardous Constituents Nor Any Volatile Organic Compounds

On September 30, 2003 the Permittees received a letter from NMED regarding additional information requested by the agency for the permit modification entitled LANL Sealed Sources Wastes Streams Headspace Gas Sampling and Analysis Requirements.

The NMED requested a listing of all drums at LANL which currently contained sealed sources. From that list NMED indicated that they would randomly "*select at least one specific source/container from that list for which the required information would be provided in a revised PMR*."

NMED subsequently selected container LA00000061414.

The information requested by the NMED is as follows:

- Defense determination for individual sources
- Container packaging material examinations/considerations
- Transuranic status of sources
- Process information on how the sealed sources were generated, especially the contents of the sealed sources with respect to hazardous constituents
- Information pertaining to the outer casing not being of VOC bearing materials
- Estimated volume of the waste stream
- Technical difficulties associated with sampling sealed sources
- Clarify the national security issues of the PMR

It is the belief of the Permittees that bullets 1 through 5 are the crux of the issue however each of these requests have been addressed.

Container LA00000061414 is packaged with two sealed sources manufactured by the Monsanto Research Laboratory and have been identified with the serial numbers M364 and M561.

Both sources are plutonium 239/beryllium sources.

Appendix 1 of this Attachment is a letter from Ms. Jesse Hill Roberson, Assistant Secretary for Environmental Management to Dr. Ines Triay, Manager of the Carlsbad Field Office dated July 8, 2003. This letters states in part the following: "*The Pu-239 in these sources is weapons-grade plutonium manufactured at either the Savannah River Site or Hanford*." It further states "*The Pu-239 sources, as a group, are waste from defense activities as defined in the Nuclear Waste Policy Act...*" Therefore, the Pu-239 sources are defense related material and allowable for disposal at WIPP.

The container packaging material is described in detail in Attachment D entitled Headspace Gas Sampling and Analysis Evaluation for LANL Sealed Sources. Page 2 of 8 describes the drum

preparation and Table 1 lists the specific packaging materials.
In response to stakeholder comments which were submitted to the NMED on July 28, 2003 the Permittees responded to a comment regarding packaging (Comment 37).
Both Attachment D and Comment 37 are included as Appendix 2 of this Attachment

Since this is a Pu-239 source it definitely qualifies as transuranic and acceptable at the WIPP facility.

Appendix 3 of this Attachment is the Nuclear Materials Management and Safeguards System Report SS-1 indicating that sources M-364 and M-561 are Pu-239 sources manufactured by Monsanto.

Appendix 4 of this Attachment are shipping information for sources M-364 and M-561. Both documents indicate these are plutonium neutron sources. The container material is identified as tantalum and stainless steel and the method of sealing is “welded”. Finally in the lower right hand area of the page the sources have been identified as “recanned”. This means the sources were physically removed from there original cannister and placed in a new cannister as will be discussed later.

Appendix 5 of this Attachment is a report from the Monsanto Research Corporation entitled “Inspection and Recanning Program of PuBe Neutron Sources”, dated January 7, 1964.

Page three of the Introduction describes the Monsanto fabrication process for these sealed sources including M-364 and M-561. The process involves placing the Pu pellet into a beryllium cup which was then placed in a tantalum case and sealed with a tantalum plug. This was sealed by tungsten-inert gas welding. The Pu and Be were then heated to about 2000 degrees centigrade and then allowed to cool. The potential for any hazardous constituent or volatile organic compound to be present in the tantalum sealed case is impossible.

This recanning process was required due to a single sealed source exploding. It was found that water had entered the source during leak testing which caused gas to be produced and the internal pressure rose to over 2000 psi which caused a failure of the cannister. The leak test procedure has been revised and immersion in water or solvent is no longer performed.

It is impossible that any VOCs would remain after heating to 2000 degrees centigrade; no other materials other than Pu, Be, Ta, Ti and stainless steel are present in the sources (see page 3 of the report) and any contaminant in the source would create off-gassing and the source cannister would be deformed from the internal pressure.

On page 11 of the report are the group serial numbers of the sources to be recanned and on page 14 of the report are the sources that were NOT recanned. Neither M-364 nor M-561 are on this list.

Included as Appendix 6 of this Attachment is the information on the reference standard and the swipes from M-364 and M-561 which indicate the sources are not leaking and there is no potential of contamination.

Appendix 7 of this Attachment includes the VE report for container LA00000061414 which indicates the type of container configuration (page 1, item 2), that the outer casing is made of non-VOC bearing material (page 1, item 5), that the drums contains Pu239Be sources identified as M364 and M561 (page 2, item 1) and that the drums contains no prohibited items (page 3).

The estimated quantity of containers within the sealed sources waste stream, the national security issues and the lack of storage for “attractive materials” has been addressed in the preamble to this PMR..

APPENDIX 1

DEFENSE DETERMINATION

DOE F 1325.8
(8-89)
EFG (07-90)

United States Government | Department of Energy

Memorandum

DATE: July 8, 2003

REPLY TO ATTN OF: EM-22 (Robert Campbell, 678-567-0336)

SUBJECT: Plutonium-239 Sealed Sources

TO: Dr. Inés Triay, Manager, Carlsbad Field Office

The Albuquerque Operations Office requested that the Office of Environmental Management (EM) review and make a determination regarding the eligibility for disposal at the Waste Isolation Pilot Plant (WIPP) of plutonium-239 (Pu-239) sources. The history of the production and use of these sources and other information has been reviewed by the Office of General Counsel (GC) pursuant to the guidance concerning atomic energy defense activities and the requirements of the Waste Isolation Pilot Plant Land Withdrawal Act. This review was undertaken in order to support the accelerated recovery of Pu-239 sources by the Off-Site Source Recovery Program at the Los Alamos National Laboratory.

This review revealed the following about these sealed sources:

- All Pu-239 sources were provided to lessees under loan-lease agreements. The Atomic Energy Commission and its successor, the Department of Energy (DOE), retained title to these sources, and the loan-lease agreements prohibited the user from altering the form of the material, specifically so this material could be recalled for use in weapons programs.
- Pu-239 has never been sold under the DOE's Isotope Sales Program.
- The Pu-239 in these sources is weapons-grade plutonium manufactured at either the Savannah River Site or Hanford. All of the Pu-239 was manufactured for weapons production.
- Of the 2,400 Pu-239 sources manufactured, about 1,320 were returned to the DOE and the plutonium was recovered and returned to plutonium stockpiles.
  The Pu-239 sources, as a group, are waste from defense activities as defined in the Nuclear Waste Policy Act (NWPA) because they were the result of defense nuclear materials production, defense nuclear waste and materials by-product management, and defense nuclear materials security and safeguards and security investigations.

The result of this review is that EM and GC have concluded plutonium-239 sealed sources meet the definition of defense waste as defined in the NWPA and described in the September 9, 1996, memorandum by Robert R. Nordhaus, *Interpretation of the Term 'Atomic Energy Defense Activities' As Used In the Waste Isolation Pilot Plant Land Withdrawal Act*. This determination is limited to Pu-239 sealed sources.

If you have any questions about this determination, please contact Ms. Patrice M. Bubar, Associate Deputy Assistant Secretary, Office of Integration and Dispost on at (202) 586-5151, or Mr. Paul Detwiler, Office of General Counsel at (202) 586-1371.

Jessie Hill Roberson
Assistant Secretary for
Environmental Management

cc: Jack Tillman, DOE-AL
Ralph Erickson, DOE-OLASO

APPENDIX 2

PACKAGING MATERIAL FOR SEALED SOURCES

HEADSPACE GAS SAMPLING AND ANALYSIS EVALUATION FOR LANL SEALED SOURCES LAUR-03-0917

L. Leonard
Los Alamos National Laboratory

INTRODUCTION

Since 1999, the Los Alamos National Laboratory (LANL), Off-Site Source Recovery (OSR) Project has been identifying and collecting radioactive sealed sources that are no longer needed. There is an existing backlog of sealed sources in known locations that are not secure. The OSR Project's mission is to secure and safely dispose of these sealed sources. The basis for this action is to eliminate the homeland security issues associated with this excess material while it remains unsecured. The vast majority of these sources contain transuranic (TRU) isotopes. Most of the TRU sealed sources are beyond the activity limits for acceptance at low-level waste disposal facilities. However, these sealed sources are candidates for disposal at the Waste Isolation Pilot Plant (WIPP). Many of these sources are the result of "atomic energy defense activity." Many more may be determined to meet this WIPP eligibility requirement at some time in the future.

In all cases, the excess unwanted TRU materials are considered to be of high attractiveness, which presents a homeland security risk if not appropriately secured and safeguarded. The Department of Energy (DOE) and the National Nuclear Security Administration have determined that the maximum level of risk reduction will occur only when the recovered sealed sources are dispositioned as TRU waste by permanent isolation. The objective, therefore, is to recover, package as waste, and transfer all eligible-sealed sources to WIPP as expeditiously as possible. To achieve this objective it is necessary to characterize the sealed source waste stream to WIPP requirements resulting in WIPP-certifiable waste.

Among other requirements, the characterization requirements of the Waste Analysis Plan (WAP) of the WIPP Hazardous Waste Facility Permit (HWFP; No. NM4890139088-TSDF) (Ref. 1) must be met in order to certify TRU waste for disposal at WIPP. Of particular interest for sealed sources is the WAP requirement for headspace gas sampling and analysis. The data quality objectives (DQOs) established by the WAP for headspace gas sampling and analysis are as follows:

> To confirm hazardous waste identification by acceptable knowledge (AK)
>
> To identify volatile organic compounds (VOCs) and quantify the concentrations of VOC constituents in the total waste inventory to ensure compliance with the performance standards of 20.4.1.500 NMAC (New Mexico Administrative Code; incorporating Title 40, Code of Federal Regulations, §264.601(c)) (Ref. 1).

Based on *Acceptable Knowledge Summary Report for Off-Site Source Recovery Sealed Sources* (OSR-MISC-03) (Ref. 2), the LANL sealed sources do not contain VOCs. However, packaging materials are a potential source for VOCs. The WAP does not require the assignment of hazardous waste codes for organic constituents associated with packaging materials. As such, no hazardous waste codes are assigned to the LANL sealed sources waste stream. Therefore, with respect to the first DQO, because AK assigns no hazardous waste codes and demonstrates that the sealed sources meet the stringent criteria for qualification as U.S. Department of Transportation (DOT) *special form* and comply with the associated leak test requirement, headspace gas sampling and analysis confirmation is not necessary.

The objective of this report is to demonstrate that the second DQO can be fulfilled without headspace gas sampling and analysis of the waste containers comprising the LANL sealed sources waste stream. Because the TRU sealed sources do not contain VOCs, a headspace gas sample collected from a waste container packaged with the sealed sources would only represent the characterization of the packaging materials. The bounding quantification of potential VOCs from materials to be used for packaging the LANL sealed sources is the subject of this report.

PURPOSE

Headspace gas sampling and analysis was performed for the purpose of quantifying VOCs, hydrogen, and methane present in the headspace of waste containers packaging LANL sealed sources. The purpose of this report is as follows:

To summarize the results obtained from the analysis of headspace gas samples collected from waste containers including only the materials used to package LANL sealed sources

To present a justification for assigning VOC concentration values for each waste container of LANL sealed sources in lieu of performing headspace gas sampling and analysis

To determine the VOC concentrations of the target analytes that will be used to satisfy the reporting requirement of the WIPP HWFP (Module II.C.3.i): "Any waste container that does not have VOC concentration values reported for the headspace is not acceptable at WIPP" (Ref. 1).

QUANTIFICATION OF POTENTIAL VOCs FROM PACKAGING MATERIALS

Drum Preparation

In accordance with *OSR Project Drum Test-VOC Evolutions From Packaging Material* (Ref. 3) the LANL OSR Project prepared ten (10) standard pipe overpack containers. As directed by the procedure, each drum was prepared with an identical configuration. These drums contained only the packaging materials that are used in OSR Project drums. No sealed sources were present in any of the drums.

Each empty standard pipe overpack container was initially inspected by performing the following steps:

Open 55-gallon drum and inspect lid, locking ring, and gasket
Remove rigid liner lid and fiberboard disk shim. Inspect rigid liner lid to ensure vent hole is open.
Remove fiberboard packing top and fiberboard flange shims
Loosen all bolts in pipe component cap and hoist lid vertically off of the pipe component
Inspect pipe component O-ring for damage
Verify serial numbers on pipe component lid matches pipe component body.

Each container was prepared for evaluation as follows:

Place the poly shield insert into the payload cavity of the pipe component.
The flanged lid of the pipe component was not installed to allow equilibration of VOCs throughout the pipe overpack container.

Replace cane fiberboard flange shims, matching flange areas with cutouts in fiberboard
Replace cane fiberboard packing top
Install spacer(s) on top of cane fiberboard liner top
Install rigid liner lid, verifying vent hole with a minimum 0.3 in. diameter
Measure vertical distance between the bottom of the rigid liner lid and the upper surface of the top fiberboard shim. Verify distance is less than or equal to 0.5 in.
Install drum lid (with filter previously installed) and closure ring, orient bolt closure ends downward and over the drum seam
Ensure ring is properly seated on drum, thread drum closure bolt through the threaded drum closure ring lug and lightly tighten drum closure bolt. Torque to 40 ft-lb using calibrated torque wrench.
Tighten lock nut against unthreaded drum closure ring lug
Apply Tamper Indication Device (TID) to drum.

Table 1 presents the materials included in each standard pipe overpack container.

Table 1 Packaging Materials *

Packaging Components	Material of Construction	Weight (kg)
Poly Shield Insert	High density polyethylene	29.5
12" Pipe Component, without lid	Stainless Steel, 12-7/8 in. bolts	82.6
Dunnage	Cane Fiberboard	28.6
Rigid Liner and Liner Lid	High density polyethylene	7.7
DOT Type 7A 55 Gallon Drum, including lid and bolt ring	Steel	27.2
Drum gasket	Type I—tubular styrene-butadiene Type II—foam styrene-butadiene	
Drum Filter (NucFil-013)	Carbon composite 3.70E-6 mol/s/mol fraction	

*The packaging components used in this evaluation are compliant with the transportation specifications of the TRUPACT-II Authorized Methods for Payload Control (TRAMPAC), Revision 19a.

As required by *OSR Project Drum Test-VOC Evolutions From Packaging Material,* (Ref. 3) a LANL Record of Drum Closure was completed for each drum. Table 2 summarizes the information recorded on the LANL Record of Drum Closure Forms.

Table 2 Drum Information

Drum Serial #	Drum Vent Type	Drum Vent Serial #	TID #	Date Closed
DB4342	NucFil-013	RFP-6798	0000019	11/21/01
DB4340	NucFil-013	RFP-6782	0000063	11/21/01
DB4339	NucFil-013	RFP-6781	0000043	11/21/01
DB3724	NucFil-013	RFP-6779	0000037	11/21/01
DB4345	NucFil-013	RFP-6796	0000001	11/21/01
DB3725	NucFil-013	RFP-6784	0000024	11/21/01
DB3726	NucFil-013	RFP-6800	0000066	11/21/01
DB3723	NucFil-013	RFP-6795	0000071	11/21/01
DB3721	NucFil-013	RFP-6777	0000039	11/21/01
DB3720	NucFil-013	RFP-6778	0000202	11/21/01

The packaged drums were placed in a secure storage location at LANL.

Headspace Gas Sampling and Analysis

The drums were removed and transported to the LANL Headspace Gas sampling area. Sampling was conducted on September 9, 2002, in accordance with *Manual Headspace Gas Sampling for Analysis by INEEL* (TWCP-DTP-1.2-074) (Ref. 4). A 250-milliliter sample was collected in a SUMMA® canister from each drum and transported to the Idaho National Engineering and Environmental Laboratory (INEEL) for analysis for VOCs, hydrogen and methane with chain-of-custody (COC) forms. None of the samples were composited before analysis.

In accordance with *Manual Headspace Gas Sampling for Analysis by INEEL* (TWCP-DTP-1.2-074) (Ref. 4) a field blank, field duplicate, and field reference standard were collected during sampling and were included in the sampling batch sent to INEEL for analysis. The analysis was conducted in accordance with *Analysis of Gas Samples for VOCs by GC/MS* (ACMM-9930) (Ref. 5) and *Analysis of Gas Samples for VOCs by GC/FID* (ACMM-9910) (Ref. 6). The analytical batch data report (BDR) LA02-HGAS/IA-006 was subject to INEEL data generation verification and validation in accordance with *RWMC Data Generation Level Data Validation* (MCP-1850) (Ref. 7). The sampling BDR LA02-HGAS/IS-006 and the analytical BDR were validated and verified by LANL in accordance with *Project Level Data Validation and Verification* (TWCP-QP-1.1-010) (Ref. 8). The sampling and analytical quality control samples met acceptance criteria and the headspace gas sampling and analysis quality assurance objectives specified by the WAP were met.

Analytical Results

The analytical results for the headspace gas samples collected from the 10 standard pipe overpack containers are tabulated in Table 3. The program required quantitation limit (PRQL) for the alcohols and ketones is 100 parts per million by volume (ppmv) and 10 ppmv for the remaining VOCs. With the exception of three out of 32 analytes measured, the concentrations are reported at the method detection limit (MDL). For acetone, cyclohexane, and toluene, the results are just slightly above detectable. The analytical results identified no tentatively identified compounds (TICs) as determined in accordance with *Analysis of Gas Samples for VOCs by GC/MS* (ACMM-9930) (Ref. 5). As shown in Table 3, the results are clearly orders of magnitude below the PRQL for the regulated VOCs. The concentrations of regulated and flammable VOCs and hydrogen and methane are very small and, in most cases, not detectable. Therefore, VOC contributions from packaging materials are insignificant for the sealed sources waste stream.

Table 3 Analyte Concentrations Resulting from Packaging Materials

DRUM		DB4345	DB4340	DB3721	DB4339	DB3726	DB3723	DB3724	DB3725	DB3720	DB4342
Lab sample ID (INEEL)		02262002	02262005	02262006	02262007	02262008	02262009	02262010	02262011	02262012	02262013
Acetone	ppmv	1.1 J	1.5 J	1.7 J	1.2 J	1.2 J	1.5 J	1.7 J	0.80 J	1.6 J	0.86 J
Benzene	ppmv	0.055 U	0.056 U	0.055 U	0.054 U	0.056 U	0.054 U	0.056 U	0.057 U	0.055 U	0.058 U
Bromoform	ppmv	0.018 U	0.018 U	0.018 U	0.017 U	0.018 U	0.017 U	0.018 U	0.018 U	0.018 U	0.019 U
	ppmv	0.059 U	0.060 U	0.060 U	0.058 U	0.060 U	0.058 U	0.060 U	0.062 U	0.060 U	0.062 U
	ppmv	0.033 U	0.034 U	0.034 U	0.033 U	0.034 U	0.033 U	0.034 U	0.035 U	0.034 U	0.035 U
Chlorobenzene	ppmv	0.031 U	0.032 U	0.032 U	0.031 U	0.032 U	0.031 U	0.032 U	0.033 U	0.032 U	0.033 U
Chloroform	ppmv	0.030 U	0.031 U	0.031 U	0.030 U	0.031 U	0.030 U	0.031 U	0.032 U	0.031 U	0.032 U
Cyclohexane	ppmv	1.9 J	2.1 J	2.6 J	2.2 J	1.8 J	2.4 J	2.2 J	1.7 J	1.9 J	1.0 J
1,1-Dichloroethane	ppmv	0.047 U	0.048 U	0.048 U	0.047 U	0.048 U	0.047 U	0.048 U	0.049 U	0.048 U	0.050 U
1,2-Dichloroethane	ppmv	0.052 U	0.053 U	0.052 U	0.051 U	0.053 U	0.051 U	0.052 U	0.054 U	0.052 U	0.054 U
1,1-Dichloroethylene	ppmv	0.074 U	0.075 U	0.075 U	0.073 U	0.076 U	0.073 U	0.075 U	0.077 U	0.075 U	0.078 U
cis-1,2-Dichloroethylene	ppmv	0.038 U	0.039 U	0.039 U	0.038 U	0.039 U	0.038 U	0.039 U	0.040 U	0.039 U	0.040 U
trans-1,2-Dichloroethylene	ppmv	0.052 U	0.053 U	0.052 U	0.051 U	0.053 U	0.051 U	0.053 U	0.054 U	0.052 U	0.055 U
Ethyl benzene	ppmv	0.045 U	0.046 U	0.046 U	0.045 U	0.047 U	0.045 U	0.046 U	0.048 U	0.046 U	0.048 U
Ethyl ether	ppmv	0.079 U	0.080 U	0.080 U	0.078 U	0.081 U	0.078 U	0.080 U	0.083 U	0.080 U	0.083 U
	ppmv	0.098 U	0.10 U	0.099 U	0.097 U	0.10 U	0.097 U	0.099 U	0.10 U	0.099 U	0.10 U
	ppmv	0.040 U	0.041 U	0.040 U	0.040 U	0.041 U	0.040 U	0.040 U	0.042 U	0.040 U	0.042 U
Methylene chloride	ppmv	0.082 U	0.084 U	0.083 U	0.081 U	0.084 U	0.081 U	0.083 U	0.086 U	0.083 U	0.087 U
1,1,2,2-Tetrachloroethane	ppmv	0.030 U	0.031 U	0.031 U	0.030 U	0.031 U	0.030 U	0.031 U	0.032 U	0.031 U	0.032 U
Tetrachloroethylene	ppmv	0.028 U	0.029 U	0.028 U	0.028 U	0.029 U	0.028 U	0.028 U	0.029 U	0.028 U	0.030 U
Toluene	ppmv	0.052 J	0.062 J	0.054 J	0.061 J	0.062 J	0.047 J	0.092 J	0.075 J	0.063 J	0.038 J
1,1,1-Trichloroethane	ppmv	0.032U	0.033 U	0.032 U	0.032 U	0.033 U	0.032 U	0.033 U	0.034 U	0.032 U	0.034 U
Trichloroethylene	ppmv	0.028 U	0.029 U	0.029 U	0.028 U	0.029 U	0.028 U	0.029 U	0.030 U	0.029 U	0.030 U
1,1,2-Trichloro-1,2,2-trifluoroethane	ppmv	0.021 U	0.022 U	0.022 U	0.021 U	0.022 U	0.021 U	0.022 U	0.022 U	0.022 U	0.022 U
1,3,5-Trimethylbenzene	ppmv	0.032 U	0.032 U	0.032 U	0.031 U	0.032 U	0.031 U	0.032 U	0.033 U	0.032 U	0.033 U
1,2,4-Trimethylbenzene	ppmv	0.036 U	0.036 U	0.036 U	0.035 U	0.036 U	0.035 U	0.036 U	0.037 U	0.036 U	0.038 U
p/m-Xylene	ppmv	0.045 U	0.046 U	0.046 U	0.045 U	0.047 U	0.045 U	0.046 U	0.048 U	0.046 U	0.048 U
o-Xylene	ppmv	0.033 U	0.034 U	0.034 U	0.033 U	0.034 U	0.033 U	0.034 U	0.035 U	0.034 U	0.035 U
Hydrogen	Vol%	0.011 U	0.012 U	0.012 U	0.011 U	0.012 U	0.011 U	0.012 U	0.012 U	0.012 U	0.012 U
Methane	Vol%	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Methanol	ppmv	2.6 U	2.7 U	2.7 U	2.5 U	2.7 U	2.6 U	2.7 U	2.7 U	2.6 U	2.8 U

POTENTIAL VOCs FROM RADIOLYSIS

Sealed radioactive sources, as packaged by the OSR Project, are not capable of significant hydrogen or VOC generation from radiolytic interaction. The AK documentation available demonstrates that sources meet DOT *special form*, and comply with the requirement for a leak test (Ref. 2). In addition, physical inspection during the visual examination assures that no VOC-bearing materials are associated with the TRU sealed source waste. Thus the *sealed* barrier prevents any possible interaction between alpha radiation and the compounds present in the packaging. By definition, no radiolytic gas generation is possible from the alpha and beta energy contained by the sealed sources.

The release of VOCs and hydrogen from the interactions of gamma radiation or neutron particles is zero or nearly zero as shown by the following analysis. Six hydrogen generation test vessels, or canisters, were loaded with a variety of materials, including the high density polyethylene used for packaging sealed sources, and were exposed to a neutron source loaded in each canister in the center of the material. The headspace gas in the canisters was sampled and subjected to gas chromatography measurements. With the exception of some residual hydrogen being released from packaging materials observed during curing, there was no hydrogen detected from radiolysis. The results from the tests are given in Table 4.

Table 4 Empirical Measurement Results of H_2 Released From Irradiated Packaging Materials

Canister #	Material	H_2 Concentration After 114 Days	Effective "G" Value*
1	Concrete and Polybeads	<1.29 ppmv**	<0.012
2	High Density Polyethylene	<1.29 ppmv**	<0.045
3	Borated Polyethylene	<1.29 ppmv**	<0.017
4	Water-Extended Polyethylene	<1.29 ppmv** (H_2 evolution from residual curing = 35 ppmv)	<0.026
5	Poly Cast	<1.29 ppmv** (H_2 evolution from residual curing = 41 ppmv)	<0.024

* The units for the effective "G" value are molecules of H_2 released per 100 electron volts of energy absorbed.

** 1.29 ppm is the lower limit of detection for the gas chromatograph.

As shown in Table 4, the effective G values (gas generation release potential) measured in this test are insignificant for all tested materials. A low G value indicates low gas generation release and is associated with low hydrogen concentration also presented in Table 4. Low hydrogen generation has been correlated to low VOC generation. The G values for VOCs observed in previous studies (Ref. 9) were consistently more than a factor of 200 below those observed for hydrogen generation. Therefore, the generation of VOCs from non-alpha radiolysis is inconsequential for these packaging materials.

CONCLUSIONS

The analytical results listed in Table 3 for the packaging materials alone demonstrate that VOC, hydrogen, and methane concentrations are well below the PRQLs for those compounds. The headspace gas analysis taken from the combination of packaging materials and neutron sources provide confirmation that radiolytic generation of headspace gas from alpha, beta, gamma, and neutron emissions is inconsequential.

Therefore, the WAP DQO for identifying VOCs and quantifying the concentrations of VOC constituents can be fulfilled without headspace gas sampling and analysis of the waste containers comprising the LANL sealed source waste stream.

For the purpose of assigning headspace gas VOC concentration values to the OSR Project sealed source waste stream, UCL_{90} calculations were performed in accordance with *Calculation of UCL_{90} Values* (TWCP-DTP-1.2-006) (Ref. 10) using the results listed in Table 3. The resulting concentrations are presented in Table 5.

Table 5 Proposed LANL Sealed Sources Waste Container Headspace Gas VOC Concentration Values

Compound	Concentration (ppmv)
Acetone	1.46
Benzene	0.03
	0.01
	0.03
Carbon Tetrachloride	0.02
Chlorobenzene	0.02
Chloroform	0.02
Cyclohexane	2.17
1,1-Dichloroethane	0.02
1,2-Dichloroethane	0.03
1,1-Dichloroethylene	0.04
cis-1,2-Dichloroethylene	0.02
trans-1,2-Dichloroethylene	0.03
Ethyl Benzene	0.02
	0.04
Methanol	1.35
Methyl ethyl ketone	0.05
Methyl isobutyl ketone	0.02
Methylene Chloride	0.04
1,1,2,2-Tetrachloroethane	0.02
Tetrachloroethylene	0.01
Toluene	0.07
1,1,1-Trichloroethane	0.02
Trichloroethylene	0.02
1,1,2-Trichloro-1,2,2-trifluoroethane	0.01
1,3,5-Trimethylbenzene	0.02
1,2,4-Trimethylbenzene	0.02
p/m-Xylene	0.02
o-Xylene	0.02
Hydrogen	0.01 (vol %)
Methane	0.002 (vol %)

meet all of the characterization requirements of newly generated waste. This means that as they are packaged the AK is verified visually using the VE technique and no subsequent AK verification is required (i.e., subsequent radiography is not needed).

Comment 36: It is not clear how visual examination will determine that the outer casing is of non-VOC bearing material. (B-22). This should be made specific.

Response: The containers for sealed sources are metallic. As such they are not VOC bearing material.

Comment 37: The proposal states that a waste stream VOC source term for packaging is to be established based on sampling of five or more containers holding packaging materials "typical and representative" of such materials in the waste stream. (at B-4). It is not stated whether all sealed sources in the waste stream in question will be repackaged using substantially similar methods and materials, although that is the implication. This should be made explicit.

Response: All LANL OSR Program TRU sealed sources are packaged in a Pipe Overpack Component assembly payload container. Four variations currently approved and used are:

The standard 12" Pipe Component is used for sealed sources containing pure isotopes of Pu-239, Pu-238, or Am-241. These sources do not require shielding beyond that afforded by the steel in the 12" pipe.

APPENDIX 3

NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS SYSTEM REPORT

MARTIN MARIETTA

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS SYSTEM

NMMSS Report SS-1

Listing of Sealed Sources by Manufacturer as of 12-31-85

MOUND LABORATORIES,
PLUTONIUM BERYLLIUM SEALED SOURCES

RIAL #	RIS		ELEMENT WEIGHT	ISOTOPE WEIGHT	DATE OF MANUFACTURE	CONT TYPE IC	OC	POSSESSED BY	OWNERSHIP
50	ZCP	CALIFORNIA INSTITUTE OF TECHNOLO	15.9900	14.9900	062761	TA	SS	A/S LIC	P/O
51	ZCP	CALIFORNIA INSTITUTE OF TECHNOLO	15.9200	14.9200	062761	TA	SS	A/S LIC	P/O
52	ZCP	CALIFORNIA INSTITUTE OF TECHNOLO	16.0600	15.0600	062761	TA	SS	A/S LIC	P/O
M353	DZA	E I DUPONT DE NEMOURS & CO, AIKEN	15.8400	14.8300	093072			DOE CONT	DOE OWNED
M354	DZA	E I DUPONT DE NEMOURS & CO, AIKEN	15.9900	14.9700	093072			DOE CONT	DOE OWNED
M355	DZA	E I DUPONT DE NEMOURS & CO, AIKEN	15.9600	14.9400	093072			DOE CONT	DOE OWNED
M356	DZA	E I DUPONT DE NEMOURS & CO, AIKEN	15.9600	14.9400	093072			DOE CONT	DOE OWNED
M357	AUA	LOS ALAMOS NATIONAL LABORATORY	31.0000	29.0000	093072			DOE CONT	DOE OWNED
M358	CZA	ARGONNE NATIONAL LABORATORY,ILLINOI	15.6900	14.5900	021962	TA	SS	DOE CONT	DOE OWNED
M359	ZHC	GETTYSBURG COLLEGE	15.6400	14.5500	062961	TA	SS	NRC LIC	P/O
M360	AUA	LOS ALAMOS NATIONAL LABORATORY	79.9800	74.0000	081161	TA	SS	DOE CONT	DOE OWNED
M361	QZB	ARMY	2.0000	1.9000	080160	TA	SS		GOVT AGCY
M362	AUA	LOS ALAMOS NATIONAL LABORATORY	79.5700	74.0000	031962	TA	SS	DOE CONT	DOE OWNED
M363	ZMH	MANHATTAN COLLEGE,NUCLAR REACTOR LA	15.9600	14.8400	090161	TA	SS	NRC LIC	DOE LOAN
M364	YNG	TRENTON STATE COLLEGE	31.6500	29.2000	112961	TA	SS	NRC LIC	P/O
M365	ZKL	KANSAS STATE UNIVERSITY	15.9900	14.8800	090561	TA	SS	NRC LIC	P/O
M366	ZKL	KANSAS STATE UNIVERSITY	16.0100	14.8900	090561	TA	SS	NRC LIC	P/O
M367	ZKL	KANSAS STATE UNIVERSITY	15.9800	14.8600	090561	TA	SS	NRC LIC	P/O
M368	ZKL	KANSAS STATE UNIVERSITY	15.8800	14.7600	090561	TA	SS	NRC LIC	P/O
M369	ZKL	KANSAS STATE UNIVERSITY	16.0900	14.9800	090561	TA	SS	NRC LIC	P/O
M370	ZTP	SAN DIEGO STATE UNIVERSITY	15.7800	14.6800	041662	TA	SS	NRC LIC	DOE LOAN
M371	ZTP	SAN DIEGO STATE UNIVERSITY	15.9900	14.8900	041662	TA	SS	NRC LIC	DOE LOAN
M372	ZLV	LOWELL TECHNOLOGICAL INSTITUTE	15.9500	14.8600	071251	TA	SS	NRC LIC	P/O
M373	ZLV	LOWELL TECHNOLOGICAL INSTITUTE	15.9800	14.9800	071251	TA	SS	NRC LIC	P/O
M374	ZLV	LOWELL TECHNOLOGICAL INSTITUTE	15.9900	14.9900	071261	TA	SS	NRC LIC	P/O
M375	ZLV	LOWELL TECHNOLOGICAL INSTITUTE	15.9900	14.9900	071261	TA	SS	NRC LIC	P/O
M376	ZLV	LOWELL TECHNOLOGICAL INSTITUTE	15.9900	14.9900	071261	TA	SS	NRC LIC	P/O
M377	HRA	ROCKWELL INTERNATIONAL CORP, HANFORD	15.8000	14.7000	071261	TA	SS	DOE CONT	DOE OWNED
M378	HRA	ROCKWELL INTERNATIONAL CORP, HANFORD	15.6500	14.5600	071261	TA	SS	DOE CONT	DOE OWNED
M379	HRA	ROCKWELL INTERNATIONAL CORP, HANFORD	15.7700	14.6700	071261	TA	SS	DOE CONT	DOE OWNED
M380	HRA	ROCKWELL INTERNATIONAL CORP, HANFORD	16.0400	14.9300	071261	TA	SS	DOE CONT	DOE OWNED
M381	HRA	ROCKWELL INTERNATIONAL CORP, HANFORD	16.1300	15.0100	071261	TA	SS	DOE CONT	DOE OWNED
M382	AUA	LOS ALAMOS NATIONAL LABORATORY	15.9900	14.8700	112861	TA	SS	DOE CONT	DOE OWNED
M383	AUA	LOS ALAMOS NATIONAL LABORATORY	79.9500	74.4000	112861	TA	SS	DOE CONT	DOE OWNED
M384	ZSK	PRINCETON UNIV, OCCUPA HEALTH&SAFETY	1.0000	1.0000	093072			NRC LIC	P/O
M385	FZC	UNION CARBIDE CORP, ORNL, OAK RIDGE	80.0000	79.0000	101361	TA	SS	DOE CONT	DOE OWNED
M386	ZPL	UNIVERSITY OF NEW MEXICO	15.9100	14.8000	101961	TA	SS	NRC LIC	DOE LOAN
M387	ZPL	UNIVERSITY OF NEW MEXICO	15.9800	14.8600	101961	TA	SS	NRC LIC	DOE LOAN
M388	ZPL	UNIVERSITY OF NEW MEXICO	15.9600	14.8500	101961	TA	SS	NRC LIC	DOE LOAN
M389	ZPL	UNIVERSITY OF NEW MEXICO	15.9800	14.8600	101961	TA	SS	NRC LIC	DOE LOAN
M390	ZPL	UNIVERSITY OF NEW MEXICO	15.9900	14.8700	101961	TA	SS	NRC LIC	DOE LOAN
M391	HRA	ROCKWELL INTERNATIONAL CORP, HANFORD	15.9900	14.8700	080461	TA	SS	DOE CONT	DOE OWNED

BEST AVAILABLE COPY

(IES)
PLUTONIUM BERYLLIUM SEALED SOURCES

	RIS	NAME	ELEMENT WEIGHT	ISOTOPE WEIGHT	DATE OF MANUFACTURE	CONT TYPE TC	OC	POSSESSED BY	OWNERSHIP
M521	DZA	E I DUPONT DE NEMOURS & CO, AIKEN	31.2300	29.0000	101862	TA	SS	DOE CONT	DOE OWNED
M522	DZA	E I DUPONT DE NEMOURS & CO, AIKEN	32.1800	30.0000	071163	TA	SS	DOE CONT	DOE OWNED
M523	DZA	E I DUPONT DE NEMOURS & CO, AIKEN	31.2900	29.2000	101962	TA	SS	DOE CONT	DOE OWNED
M524	DZA	E I DUPONT DE NEMOURS & CO, AIKEN	32.1700	30.0000	071163	TA	SS	DOE CONT	DOE OWNED
M525	FZC	UNION CARBIDE CORP, ORNL, OAK RIDGE	128.0000	119.0698	092959			DOE CONT	DOE OWNED
M526	VZD	E I DUPONT DE NEMOURS (SOLIDS) AGRND	6.0000	5.0000	010159	TA	SS	DOE CONT	DOE OWNED
M527	YCP	COLLEGE OF ST THOMAS	15.8200	14.7200	101562	TA	SS	NRC LIC	P/O
M528	AUA	LOS ALAMOS NATIONAL LABORATORY	79.0000	74.0000	093072	TA	SS	DOE CONT	DOE OWNED
M529	QZD	NAVY	79.5700	74.0000	070259	TA	SS		GOVT AGCY
M530	YMV	UNIVERSITY OF WISCONSIN, MILWAUKEE	47.9000	44.5600	092261	TA	SS	NRC LIC	P/O
M531	RCI	TAIWAN	79.5600	73.9600	070259	TA	SS	DOE CONT	P/O
M532	RCI	TAIWAN	15.8500	14.8900	070259	TA	SS	DOE CONT	P/O
M534	AUA	LOS ALAMOS NATIONAL LABORATORY	79.9200	74.5000	080159	TA	SS	DOE CONT	DOE OWNED
M535	AUA	LOS ALAMOS NATIONAL LABORATORY	80.0000	74.0000	093072			DOE CONT	DOE OWNED
M536	ZJP	ILLINOIS INSTITUTE OF TECHNOLOGY	15.8800	14.7800	061961	TA	SS	NRC LIC	P/O
M537	ZJP	ILLINOIS INSTITUTE OF TECHNOLOGY	15.9600	14.8000	061961	TA	SS	NRC LIC	P/O
M538	ALA	SANDIA NATIONAL LABS, ALBUQUERQUE	105.7500	100.0000	092161	TA	SS	DOE CONT	DOE OWNED
M539	KZA	GENERAL ELECTRIC COMPANY, KNOLLS LAB	159.9100	148.7600	060662	TA	SS	DOE CONT	DOE OWNED
M540	RSD	SWITZERLAND	79.9700	74.4000	070959	TA	SS		P/O
M541	ZQK	SIEMENS GAMMASONICS, DES PLAINS, IL	79.7200	74.1570	012263	TA	SS	NRC LIC	P/O
M542	YBK	NAVAL UNDERSEA MEDICAL INST. GROTON	31.4900	29.0000	112563	TA	SS	NRC LIC	DOE LEASE
M543	YND	NORTHERN STATES POWER CO, MONTICELLO	31.5600	29.3200	121963	TA	SS	A/S LIC	P/O
M544	ZRA	UNIVERSITY OF OKLAHOMA, NORMAN	16.0000	15.0000	102268	TA	SS	A/S LIC	P/O
M545	ZRA	UNIVERSITY OF OKLAHOMA, NORMAN	15.9700	15.0000	102268	TA	SS	A/S LIC	P/O
M546	ZRA	UNIVERSITY OF OKLAHOMA, NORMAN	15.9700	15.0000	102268	TA	SS	A/S LIC	P/O
M547	ZRA	UNIVERSITY OF OKLAHOMA, NORMAN	15.9900	15.0000	102269	TA	SS	A/S LIC	P/O
M548	ZRA	UNIVERSITY OF OKLAHOMA, NORMAN	15.9500	15.0000	102258	TA	SS	A/S LIC	P/O
M549	JSG	E G & G IDAHO-TRA, ARA, LOFT, PBF,	79.6100	78.3000	082659			DOE CONT	DOE OWNE
M550	ZMK	MARQUETTE UNIVERSITY	15.9900	14.8800	062861	TA	SS	NRC LIC	DOE LOAN
M551	ZMK	MARQUETTE UNIVERSITY	15.9800	14.8600	062861	TA	SS	NRC LIC	DOE LOAN
M552	ZMK	MARQUETTE UNIVERSITY	15.9600	14.8400	062861	TA	SS	NRC LIC	DOE LOAN
M553	ZMK	MARQUETTE UNIVERSITY	16.0000	14.8800	062861	TA	SS	NRC LIC	DOE LOAN
M554	ZMK	MARQUETTE UNIVERSITY	15.9700	14.8500	062861	TA	SS	NRC LIC	DOE LOAN
M555	FZC	UNION CARBIDE CORP, ORNL, OAK RIDGE	0.4300	0.4000	112261	TA	SS	DOE CONT	DOE OWNED
M556	HXA	UNC NUCLEAR INDUSTRIES, RICHLAND	79.2300	75.0000	020562	TA	SS	DOE CONT	DOE OWNED
M557	LZB	LAWRENCE LIVERMORE NATIONAL LAB	79.6800	74.0000	010154	TA	SS	DOE CONT	DOE OWNED
M558	4RA	ROCKWELL INTERNATIONAL CORP, HANFORD	80.0200	76.0000	092959	TA	SS	DOE CONT	DOE OWNED
M559	AUA	LOS ALAMOS NATIONAL LABORATORY	79.2300	75.0000	092959	TA	SS	DOE CONT	DOE OWNED
M560	AUA	LOS ALAMOS NATIONAL LABORATORY	79.8100	76.0000	092959	TA	SS	DOE CONT	DOE OWNED
M561	ZTM	RUTGERS UNIVERSITY, BUSH CAMPUS	75.6300	70.3300	052361	TA	SS	NRC LIC	P/O
M562	ZJH	UNIVERSITY OF HOUSTON	159.7700	149.0000	071461	TA	SS	A/S LIC	DOE LOAN
M563	ZVT	TEXAS A&M UNIVERSITY	159.6700	149.0000	083061	TA	SS	NRC LIC	DOE LOAN

APPENDIX 4

SHIPPING DOCUMENTS OF SOURCES M-364 AND M-561

-582
REV 1-29-59

SHIPPING DATA
PLUTONIUM NEUTRON SOURCE
MONSANTO CHEMICAL COMPANY

BEST COPY AVAILABLE

Work Order #6711-5
MOUND LABORATORY
MIAMISBURG, OHIO

TO: Rutgers University
Chemistry Area X
University Heights Campus
New Brunswick, New Jersey

Attn: Mr. Cunningham

May 23, 1961
DATE OF SHIPMENT & CALIBRATION

VIA Railway Express

YOUR P.O. No. 30358

LICENSE No. SNM-314

SS ALLOTMENT QUOTA No. 7000/SNM-31A

NEUTRON SOURCE No. M-561

WITHDRAWN FROM SNM-3101

1. TYPE OF SOURCE - PuBe
2. GRAMS OF BE - ~~30.59~~ 39.28
3. GRAMS OF PU - ~~79.94~~ 75.63
4. CONTAINER MATERIAL - Tantalum and Stainless Steel
5. DIMENSIONS OF CONTAINER - INSIDE - 1.36" ID x 1.34" H
   OUTSIDE - 1.55" OD x 2.05" H
6. METHOD OF SEALING - WELDED
7. NEUTRON EMISSION - 8.81×10^6 N/SEC
8. TOLERANCE DISTANCE IN AIR FOR 8 HOURS - 48" INCHES
   (BASED ON ~~30~~ 55 N/SEC/CM^2)

SHIPPING CONTAINER IS A PARAFFIN-FILLED 15 GALLON DRUM

SOURCE(S) IS IN A SLOT AT THE BOTTOM OF A PARAFFIN-FILLED TUBE WHICH MAY BE LIFTED AFTER REMOVING THE SEALED CLOSURE OF THE DRUM.

PRICE OF SOURCE .... Recommend

PLUS COST OF SHIPPING CONTAINER .... No

TOTAL .... Charge

REMARKS:
THE TITLE TO THE PLUTONIUM USED IN THIS SOURCE REMAINS WITH THE ATOMIC ENERGY COMMISSION.

CC: H. K. Wood

CEW:lg

J. L. Richmond
GROUP LEADER, SOURCES

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

O-582,

SHIPPING DATA
PLUTONIUM NEUTRON SOURCE

MONSANTO RESEARCH CORPORATION
MOUND LABORATORY
MIAMISBURG, OHIO

TO: Mr. Robert J. Kinsey
Central Foundry Division
General Motors Corporation
Danville, Illinois

Work Order 36901-119
November 29, 1961
DATE OF SHIPMENT & CALIBRATION

VIA: REA

YOUR P.O. No.: R-9014

LICENSE No.: SNM-277

SS ALLOTMENT QUOTA No.: 7000/SNM-240

NEUTRON SOURCE No.: M-364

WITHDRAWN FROM: SBX-3101

---

1. TYPE OF SOURCE - PuBe
2. GRAMS OF BE - 15.88
3. GRAMS OF PU - 31.65
4. CONTAINER MATERIAL Tantalum and stainless steel
5. DIMENSIONS OF CONTAINER - INSIDE - w/10-32 thread OUTSIDE - 1.06" O. D. x 2.50" high
6. METHOD OF SEALING - WELDED
7. NEUTRON EMISSION - 3.50×10^6 N/SEC
8. TOLERANCE DISTANCE IN AIR FOR 8 HOURS - 28 INCHES (BASED ON ~~50~~ 55 N/SEC/CM^2)

SHIPPING CONTAINER IS A PARAFFIN-FILLED 30 GALLON DRUM

SOURCE(S) IS IN A SLOT AT THE BOTTOM OF A PARAFFIN-FILLED TUBE WHICH MAY BE LIFTED AFTER REMOVING THE SEALED CLOSURE OF THE DRUM.

PRICE OF SOURCE .... Recanned -

PLUS COST OF SHIPPING CONTAINER .... No

TOTAL .... Charge

REMARKS: NON-PROJECT

THE TITLE TO THE PLUTONIUM USED IN THIS SOURCE REMAINS WITH THE ATOMIC ENERGY COMMISSION.

CC: Robert J. Kinsey

/ss

M. R. Hertz
GROUP LEADER, SOURCES

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

APPENDIX 5

MONSANTO REPORT ON RECANNING SEALED SOURCES

MONSANTO RESEARCH CORPORATION

MOUND LABORATORY MIAMISBURG, OHIO

U. S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

AREA CODE 513
866-3311

November 25, 1963

Commander
New York Naval Shipyard
Naval Base
Brooklyn 1, New York

Dear Commander:

Return of PuBe Neutron Sources for Inspection and Recanning

The Recanning Program was initiated because of the discovery, in August 1960, of one source which had developed sufficient internal pressure to cause a visually detectable swelling of the outer stainless steel container. While the cause of the abnormality was determined and source fabrication procedures were immediately modified to prevent any possibility of pressure development in newly fabricated sources, there was some question as to the condition of the 740 sources previously fabricated and in the hands of users. A program of recall of all previously fabricated sources was therefore initiated. During the past three years, therefore, you have received several letters requesting return of your sources for inspection and recanning. The serial numbers of the sources you are now holding which have not been returned are listed as follows:

M-1

At the present stage of completion 650 of the 740 sources in question have been recanned. There has been no indication of internal pressure or potentially hazardous condition in any source, except for the single source which resulted in initiation of the program. Because of the favorable results the program is, therefore, being closed out effective January 1, 1964.

To permit orderly close-out of the program, shipment of sources to be recanned must be made to permit receipt at Mound Laboratory on or before December 15, 1963. We will not accept collect shipments after that date.

A dimensional check requirement will be placed on sources, formerly subject to recanning, which are not received prior to the cut-off date. This can be performed concurrently with the six-month alpha wipe test now required of licensees.

A comprehensive report of the investigation of the original abbormal source and of the results of the recanning program will be forwarded to all holders of PuBe sources in early 1964, together with instructions for performing the dimensional checks.

Thank you for your cooperation in this matter.

Very truly yours,

M. R. Hertz
Group Leader, Sources

MRH:lg

TWCP-QP-1.1-004,R.8/IC1
Effective Date: 12/20/01

TWCP-07664

RECORDS SUBMITTAL

INSTRUCTIONS: This form is prepared by the record source when submitting individual records, batch data reports, or a records package to the RMDC Center. For records packages, a Table of Contents (TOC) must also be submitted. Each record submitted requires a complete form.

MANDATORY: ☒ To the best of my knowledge, the record(s) have no radioactive contamination.

Signature: [signature]

RECORD TYPE:

☐ TWCP ☐ Facility (C-FM) ☐ E-ET Group (including Programmatic Facility)

☒ Other: OSR ☐ UCNI ☐ Proprietary

RECORD SOURCE:

Submittal Date: 01/29/2002 Z No.: 147549 Name/Org: Jerry McAlpin / E/EM/OSR

Originator: Jerry McAlpin Organization: E/EM/OSR

TYPE OF RECORD/ACTION TO BE TAKEN

☒ Individual Record ☐ Batch Data Report ☒ Records Package (+ TOC)

☐ New ☐ Revision* ☒ Addition* ☐ Supersedes*

*Record Barcode Number: TWCP - 05659 *Review Cycle (if applicable): ☐ Yes ☒ No ☐ NA

RECORD ID NUMBER: (e.g., memo symbol number, procedure (include revision), deficiency number, batch data report number, unique record identifier if applicable):

Record Date: 01/29/2002 Physical Page Count: 2 ☒ Single Sided ☐ Double Sided

Category Number: (from page two): 38

RECORD TITLE, SUBJECT, AND/OR KEYWORDS:

OSR - Manufacturers Data - Pkg-002
Monsanto- MLM-1188; Inspection and Recanning program of PuBe Neutron Sources; M.R. Hertz

RECORD CENTER USE ONLY

☑ Accepted Date: 2/8/02 ☐ Return Date:

Signature: [signature] Resubmitted:

RIDs Type: NP

Scan Date: By: QC Date: By:

(Subject to change prior to scheduled review cycle).

BEST AVAILABLE COPY

MLM-1188
TID-4500 (27th Ed.)
UC-23 Isotopes -
Industrial Technology

INSPECTION AND RECANNING PROGRAM OF PuBe NEUTRON SOURCES

M. R. Hertz

Date: January 7, 1964

Issued: May 1, 1964

MONSANTO RESEARCH CORPORATION

A SUBSIDIARY OF MONSANTO COMPANY

MOUND LABORATORY

MIAMISBURG, OHIO

OPERATED FOR

UNITED STATES ATOMIC ENERGY COMMISSION

U.S. GOVERNMENT CONTRACT NO. AT-33-1-GEN-53

TABLE OF CONTENTS

INTRODUCTION

Prior to 1956 a number of PuBe sources were fabricated at Los Alamos Scientific Laboratory. The method, as described by Tate and Coffinberry[1], was not economically adaptable to the routine production fabrication of neutron sources. Stoichiometric amounts of plutonium and beryllium were placed into a beryllium oxide crucible which was then heated in a vacuum furnace to initiate the reaction to form the intermetallic compound, $PuBe_{13}$. The furnace heat, plus the exothermic heat of reaction, carried the temperature above the melting point of the alloy (1750°C), resulting in a cast slug of $PuBe_{13}$. The crucible was then broken from the slug and the $PuBe_{13}$ was encapsulated in double-sealed containers.

The fabrication method, developed at Mound Laboratory[2] and used until September, 1960, is illustrated in Figure 1. A weighed pellet of plutonium, (*c*), was placed in the beryllium cup, (*a*), which was in turn placed in the tantalum case (*b*). The tapered tantalum plug, (*d*), was driven in flush with the top of the case, which was then sealed by tungsten-inert gas welding.

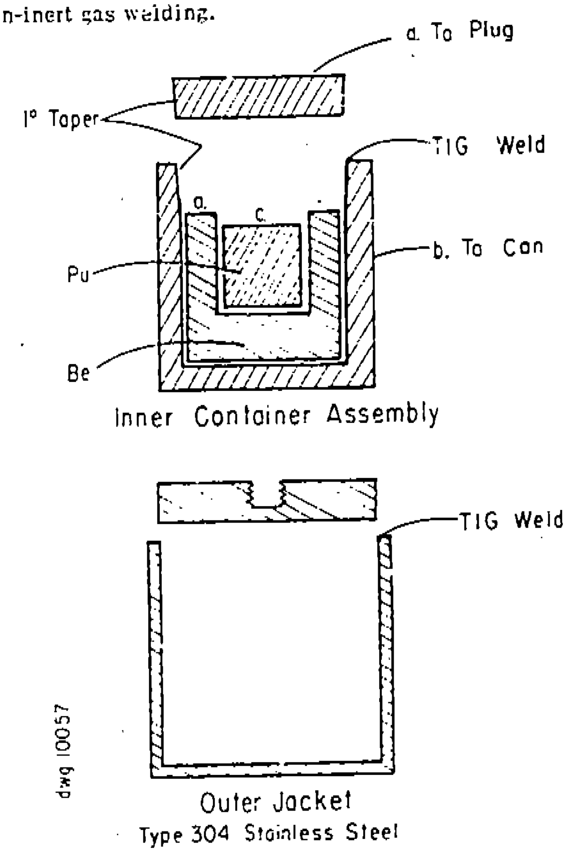


Figure 1 *PuBe Source Assembly*

The assembly was then placed on an alumina support in a Vicor vacuum chamber and heated in a 15KW electronic heater to initiate the reaction. Although plutonium melts below 650°C, the reaction did not start until the temperature approaches the melting point of beryllium, 1278°C. The heat of reaction carried the temperature to about 2000°C.

[1] R. E. Tate and A. S. Coffinberry "Plutonium-Beryllium Neutron Sources, Their Fabrication and Neutron Yield", *Proceedings of Second United Nations International Conference on Peaceful Uses of Atomic Energy*, XIV, 427 (1958).

[2] J. L. Richmond and C. E. Wells, US Patent 3,073,768 (January 15, 1963).

When the source was cool, it was removed from the chamber, and checked for wipable contamination. Although the sources usually had a wipe count of less than 500 counts per minute (cpm), the inner containers were contaminated occasionally by their surroundings in the glove box during removal. In this case the sources were decontaminated using various techniques until a surface wipe count was less than 500 cpm. The source was then pressed into a 304 stainless steel outer jacket. The thick end plug, normally containing a 10-32 threaded hole for handling, was welded in place. After final neutron calibration the source was ready for use.

In August, 1960, as a result of an increase in internal pressure, a PuBe neutron source came apart violently as the outer case was being removed on a lathe. As a result of this incident, all users of Mound Laboratory sources which were fabricated prior to August 31, 1960, were requested to measure the dimensions of their sources to determine if any deformation of the container was evident. This request in October, 1960, was followed by a request in May, 1961, to return all of these neutron sources to Mound Laboratory for inspection, testing, and recanning.

This report describes the incident which resulted in the initiation of the Recanning Program, and the results of the investigation into the cause of the incident.

DESCRIPTION OF THE INCIDENT INVOLVING A SOURCE

Occasionally, sources were returned to Mound Laboratory by the users because of mechanical damage, usually to the handling threads. In these cases the outer jacket was removed in a lathe, and replaced with a new one. In August, 1960, two sources were returned from the same user; the first source was returned because of a damaged handling thread; and the second, Source No. M-218, was returned because the source could no longer be inserted in the 1.38-inch diameter hole in an oil well logging tool.

Laboratory personnel, intending to replace the jacket on the source with the damaged thread, mistakenly removed M-218 from the shipping container and, without close examination, placed it in the lathe chuck to remove the outer jacket. When the cut had been made more than four-fifths of the way through, the case ruptured with a sharp report.

The portion of the outer case outboard from the cut, including the heavy end cap, ricocheted from the lathe tail stock into the room. The remaining portion of the outer jacket was driven back through the chuck and partially into the hollow lathe spindle. The inner container weld was broken and both parts dropped to the lathe bed along with several grams of loose black powder from the interior of the source. The room was contaminated by flying powder. Figures 2 through 5 show the source parts after the incident.

PERSONNEL CONTAMINATION

The individual performing the operation suffered no physical damage but was contaminated externally and had apparently inhaled some of the contents of the source. Alpha wipe counts from the nostrils were more than 10^5 cpm. In the next few days alpha counts greater than 10^5 cpm were obtained from the feces. Counts decreased to background within two months. No count above background was obtained from the urine. The fact that urine counts did not appear and that feces counts rapidly returned to zero indicated that there was no permanent body burden and that all the inhaled plutonium was rapidly rejected from the lungs, passing out through the digestive tract. It also indicates that $PuBe_{13}$ is biologically inert.

BEST AVAILABLE COPY

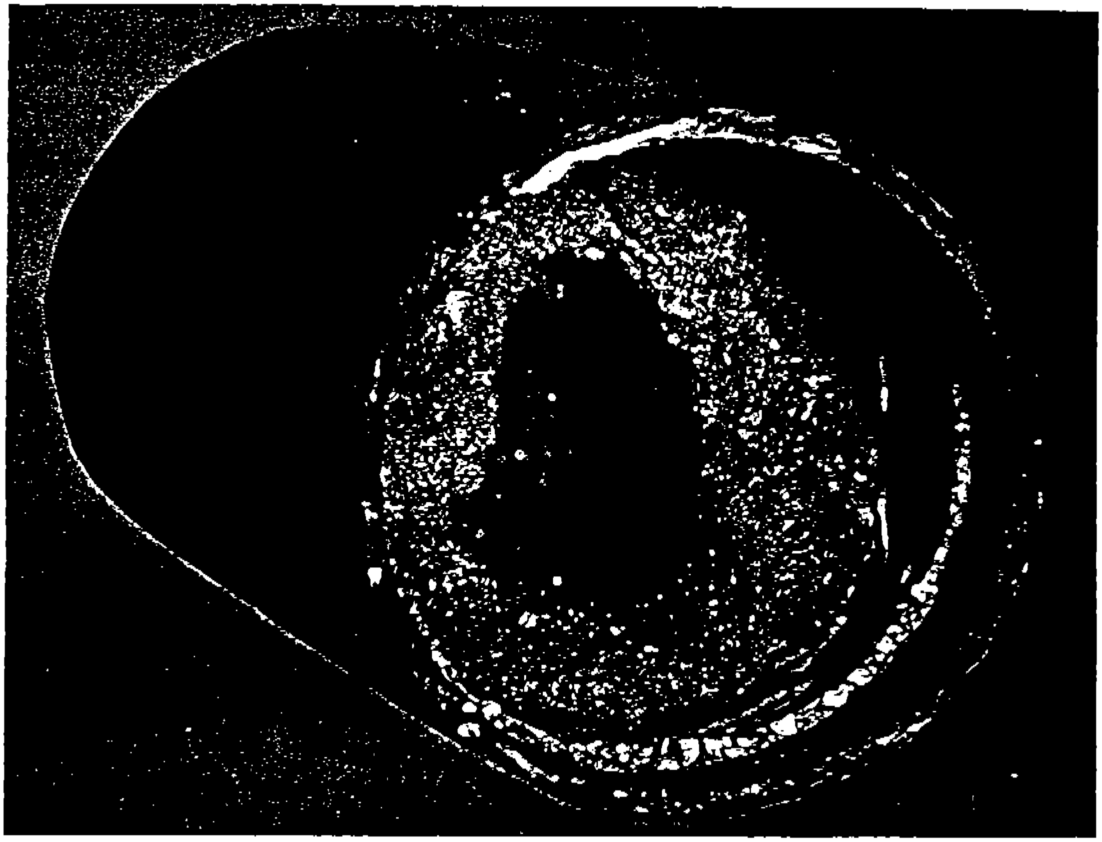


Figure 2 $PuBe_{13}$ *Alloy Remaining in the Tantalum Inner Container*

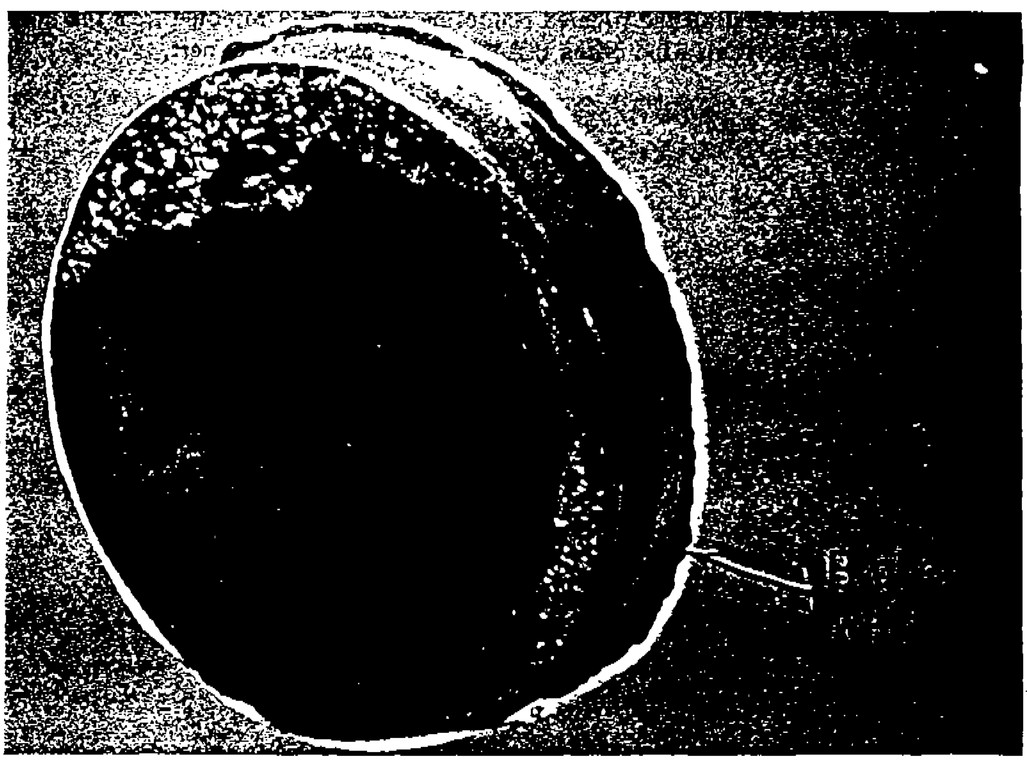


Figure 3 *Tantalum Inner Container End Plug Showing Broken Weld*

BEST AVAILABLE COPY

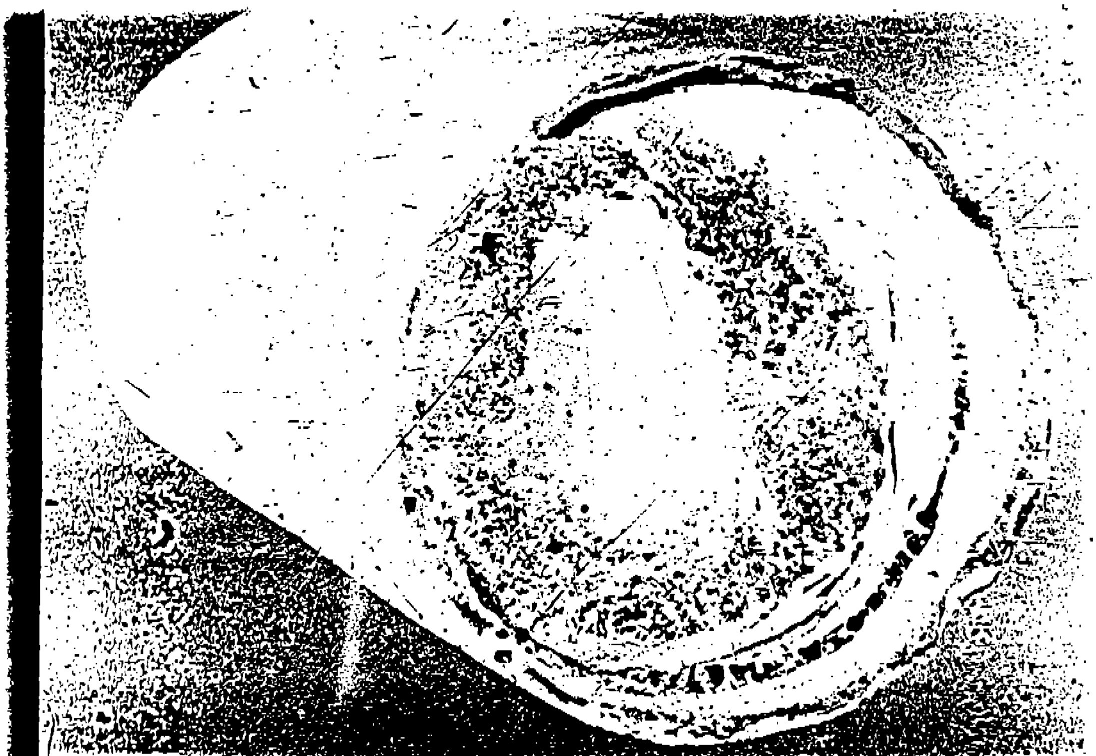
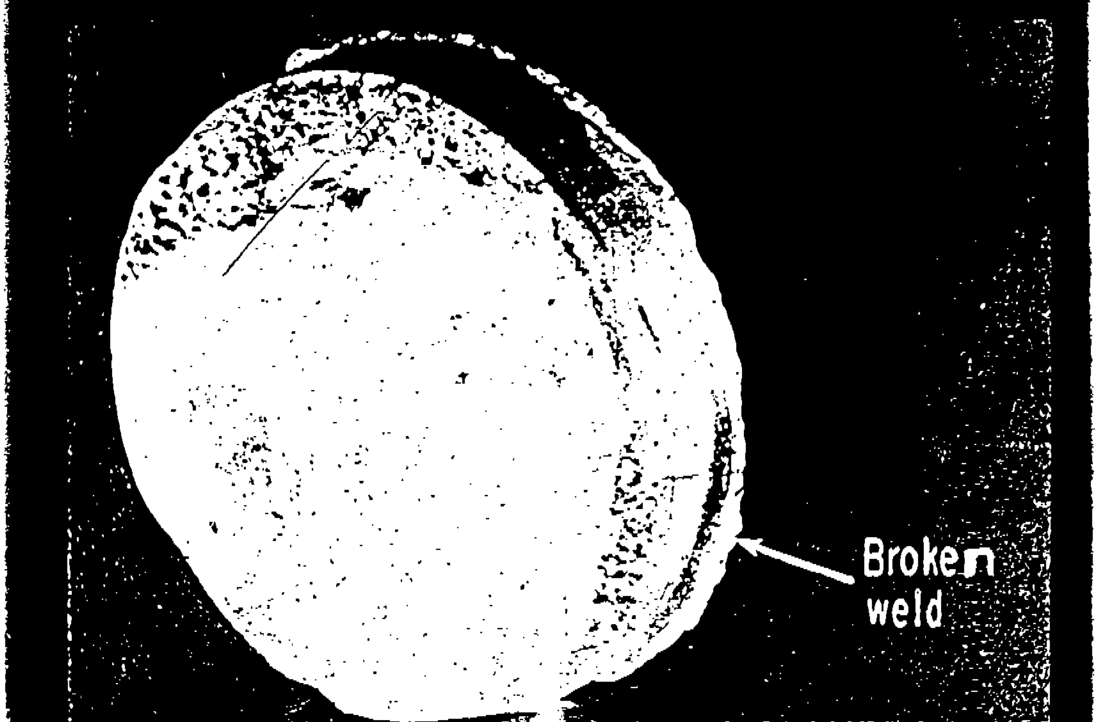


Figure 2 $PuBe_{11}$ Alloy Remaining in the Tantalum Inner Container



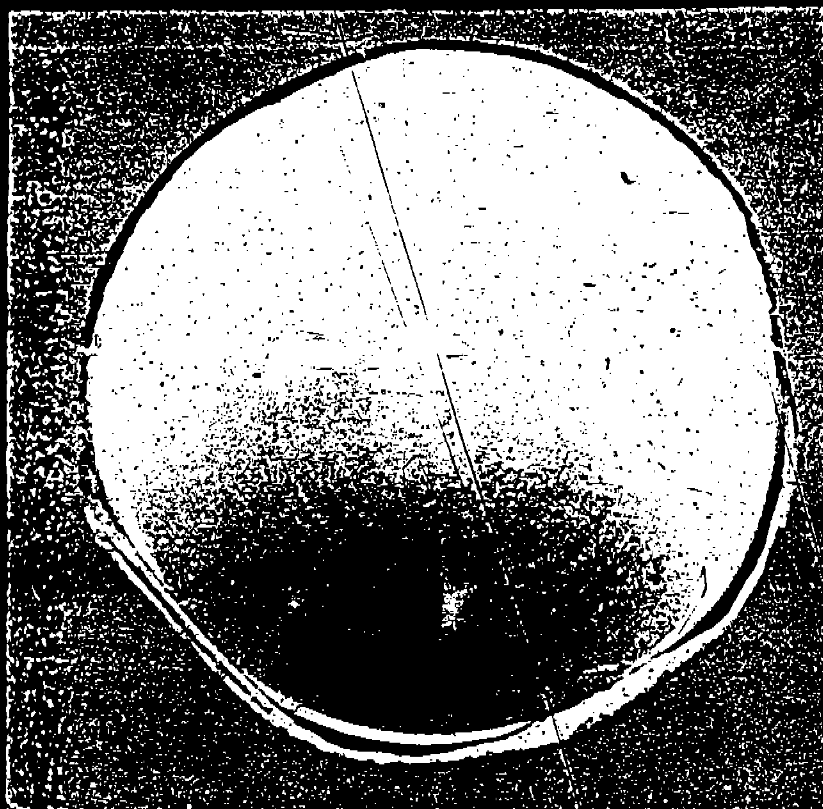
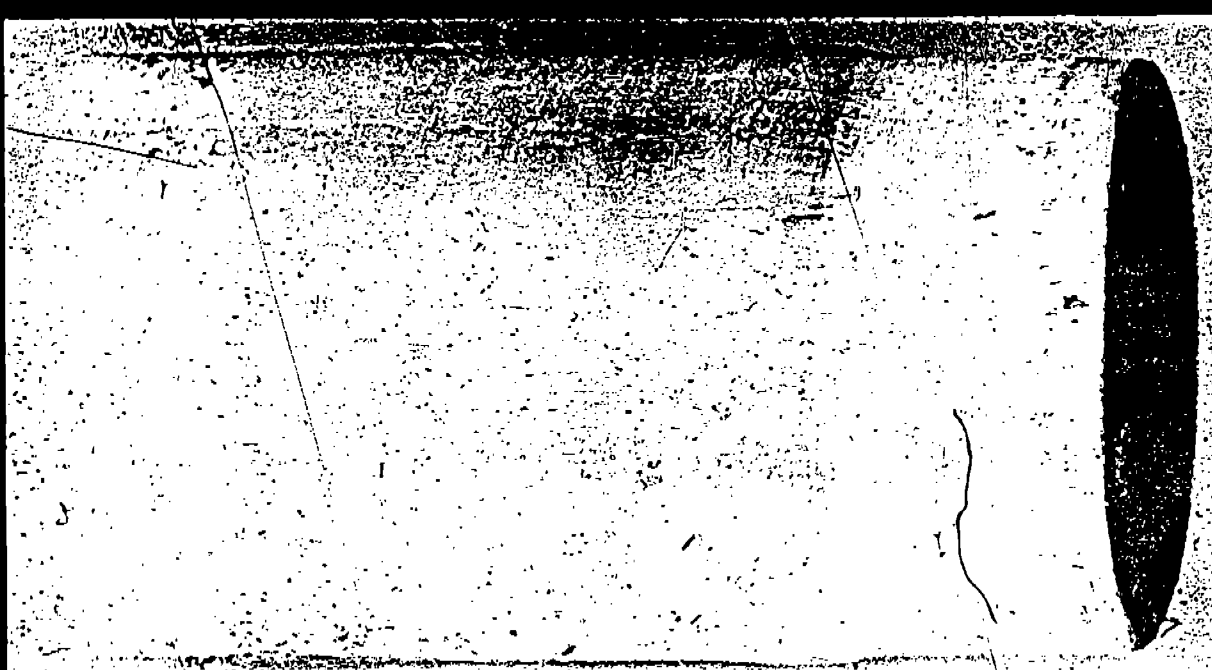


Figure 4 Stainless Steel Outer Container End Cap (interior).



BEST AVAILABLE COPY

CAUSE OF INTERNAL PRESSURE

Immediately after the incident all users of PuBe sources which were manufactured prior to August 31, 1960, were asked to measure the dimensions of their sources to determine whether or not other sources existed with internal pressure. Since the 304 stainless steel used in the outer containers has more than 40% elongation, swelling of a source would be indicated before rupture. The user of source No. M-218 reported that the source had swelled gradually over a period of several months. Replies to the questionnaire were obtained for about three-fourths of the outstanding sources with no dimensional changes reported. Since the swelling of Source M-218 had been gradual, the return of all sources on an emergency program was not requested.

A number of possible causes for the pressure increase were investigated, such as mechanical damage by the user, phase changes in the $PuBe_{13}$ compound, plutonium decay, "trap door" leaks, inward diffusion of gas, and evolved hydrogen from corrosion. The details and results of the experiments to evaluate these mechanisms are presented in the appendix. The mechanism which probably caused the pressure increase is described below.

ENTRAPMENT OF FOREIGN MATTER DURING FABRICATION

The presence of gas-producing impurities in the inner container when originally welded is highly improbable, since it is difficult to conceive of any reaction taking place at low temperature which would not have been rapidly carried to completion at the 2000°C reaction temperature. If gas was produced, it would be immediately evident at 2000°C because of the negligible residual strength of the tantalum.

Although leak checks were not routinely made on the inner containers, they were assumed to be leak-free since the contamination was never higher than the levels which would have been expected from pick-up during removal from the glove box. Previous experience with several thousand polonium sources substantiated this assumption: nonremovable external contamination is a more sensitive leak test than the most sensitive range of a mass spectrometer helium leak tester. The contamination of the PuBe inner containers was routinely removed with an ultrasonic cleaner to a wipe count of less than 500 cpm.

To check the possibility of leaking inner containers, six sources, three recalled sources contemporary with M-218 and three new sources, were leak checked using a simple bubble technique. Each source was placed in a chamber which was pressurized with 200 psi helium for 15 minutes then immediately immersed in a side-lighted beaker of acetone. Three sources were found to be leaking at the weld. One of the new leaking sources was free of contamination after removal from the reaction chamber.

The results immediately suggested a mechanism for the pressurization of M-218. The source, assumed to be leaking, micht have been removed from the reaction chamber before it had completely cooled, and placed in the cold tap water of the ultrasonic cleaner. Upon further cooling, the air in the head space would contract, resulting in the ingestion of water. Discussions with personnel later revealed that, on numerous occasions, sources had indeed been transferred to the cleaning bath while hot enough to sizzle.

If a leaking source at 100°C was placed in 25°C tap water, 20% of the free space in the source would be filled. If the source was at 300°C, 48% of the free space would be filled. Assuming all the water reacted with the source contents to form hydrogen, pressures of 3700 and 8800 psi could be generated in these two cases. It is assumed that the volume between the inner and outer containers is negligible.

An experiment was devised to test the mechanism. Source M-300, one of the original sources recalled from logging operations, was stripped of the outer container and leak checked. It was found to have an obvious leak. This source was heated to about 300°C and immersed in water. No water was drawn into the source, based on weights before and after the procedure. It was evident that the leak would have to be extremely large to allow water to enter in this manner.

The source was immersed in water in the helium leak test chamber which was then pressured with helium to 200 psi. Twelve grams of water were forced in, but in the next few minutes eight grams were forced out by the trapped gas in the source. This water was found to be uncontaminated. The source, with the four remaining grams of water in it, was canned in a standard outer container with a tubulation welded in the cap. This was connected to a gas measuring buret. Over a period of three months 3.5 cc of gas per day was evolved. Projected over a two-year period this would amount to 2600 cc. With a head space of 18.6 cc this gas evolution rate would produce a pressure of about 2050 psi. The outer case of M-218 had been cut more than four-fifths of the way through. Based on the 156,000 psi measured ultimate strength of the steel and one-fifth of the wall remaining, a pressure of 3700 psi would be required to produce endwise rupture.

Several additional variables are involved. Source M-218 may have ingested a larger amount of water; it would have been more uniformly distributed over the surface area of the contents due to the agitation over two years of shipping and handling; and it might have been stored at considerably higher temperatures.

Immediately after these experiments the source fabrication procedure was modified to include a helium leak check of the inner container after reaction, and the sources were not immersed in liquids during decontamination.

THE RECANNING PROGRAM

It was apparent that the sequence of events which probably produced the internal pressure in M-218 were not necessarily unique to this source. A total of 743 sources fabricated prior to the change in procedure was being used. Only three other sources, M-152, M-219 and M-300 had been recalled. The pressure was measured by placing the source in a closed chamber drill jig to which a pressure gage and gas sample bulb were attached, and drilling a small hole in the outer container end plug. These three sources did not have an internal pressure.

In view of the serious nature of a possible rupture in the field, the users of all sources fabricated prior to September 1, 1960 were requested to return their sources. Of the 743 sources , 668 sources were returned for recanning. The categories of users of the sources not returned are presented in Table 1.

The following operations were preformed on the recalled sources.

1. A small hole was drilled through the center of one end of the outer container. This would furnish an indication of possible internal pressure, if it existed, and safely release it.
2. The outer container was machined off in a lathe.
3. The inner source container was helium leak checked. If a leak was found, the source was heated to drive out any possible trapped liquids.
4. If the inner container was leaking, it was rewelded and leak checked again.
5. The source was welded in a new outer container, leak checked, recalibrated and returned to the user. (See Appendix No. 3 for information on neutron recalibration).

Table 1

BREAKDOWN OF SOURCES, SUBJECT TO RECANNING, NOT RETURNED
(By Users, To December 31, 1963)

Atomic Energy Commission Laboratories	18
Special U. S. Navy "Cable" Test Sources[1,2]	15
Other U. S. Government Agencies (Primarily Military)	8
Educational Institutions	7
Oil Well Logging Companies	13
Other Industrial Companies[3]	2
Foreign Countries[2]	12
TOTAL	75

[1]These are special, heavy wall, inspected to Naval reactor specifications.

[2]No attempt was made to have these returned.

[3]One of these was exposed to 5×10^{11} n/cm^2/sec thermal for several years. It will be replaced so that assessment of possible damage can be made.

GENERAL: Return of sources known to have been calibrated by the National Bureau of Standards was made optional pending outcome of the rest of the program.

BEST AVAILABLE COPY

The results of this program to date are given in Table 2. No additional sources with internal pressure were found; however, 142 sources were found with leaking inner containers.

Table 2

RESULTS OF PuBe NEUTRON SOURCE RECANNING PROGRAM

Serial No. Group	No. to Recan	Returned No.	Returned %	Leaking Inner Container No.	Leaking Inner Container %
1 - 100	81	77	95	13	16.9
101 - 200	96	94	98	26	27.0
201 - 300	98	91	93	23	25.0
201 - 400	87	80	92	17	21.3
401 - 500	98	93	94	23	24.7
501 - 600	96	83	87	20	24.2
601 - 700	81	54	67	5	9.3
701 - 800	91	82	88	12	14.6
801 - 840	15	14	93	2	14.3
TOTAL (1 - 840)	743	668	90	142*	21.2

*Of these, six sources were ruined during attempts to reweld inner containers and were replaced.

The probability of a source having an internal pressure in the group of sources not recanned was calculated as follows:

$$P = \frac{a}{a+b} = \frac{667}{667+1} = 0.9985$$

$$Q = 1 - P = 0.00150$$

$$P_R = \frac{N!}{R!\,(N-R)!}\,(P^{N-R}\,Q^R)$$

where

P - Probability that the next source checked does not have internal pressure.

Q - Probability that the next source checked has internal pressure.

a - Number of sources checked and found to have no internal pressure (667 sources).

b - Number of sources checked and found to have internal pressure (one source).

N - Number of sources remaining to be checked (75 sources).

P_R - Probability that R more sources from the group of N sources remaining to be checked have internal pressure.

Of the 743 sources 668 were checked, and only one (M-218) was found to have internal pressures.

For $R=O$ (Probability that none of N remaining sources have internal pressure):

$$P_o = (0.9985)^{75} = 0.894$$

The probability that one or more if the remaining 75 sources has internal pressure is 0.106.

The incidence of leaking inner containers was also examined by blocks of 100 serial numbers. Serial numbers generally correspond to the sequence of source fabrication and establish the approximate date of fabrication. There was no significant difference among the number of leaking inner containers in each block. Results of this tabulation are given in Table 2.

DISCUSSION

Since the dimensions of all other sources were reported to be within specifications, internal pressures which may exist are not sufficiently large to deform the outer container. The yield strength of the drawn seamless stainless steel tubing used for the outer container was measured at approximately two-thirds of the ultimate strength. There is, therefore, a probability of approximately 0.1 that a remaining source has developed internal pressure and may be stressed beyond the ASME pressure vessel code (working pressure = 1/5 rupture pressure).

The only danger is that such a source, if it exists, might rupture if accidentally involved in a fire. A source with no internal pressure is not affected, except for minor surface oxidation, by the Standard Underwriters Laboratory One-Hour Test (1700°F for one hour). Its resistance to mechanical shock or crushing will not be appreciably affected. Puncture of a pressurized outer container will only release the pressure without danger of contamination.

The basic purpose of the recanning program was to eliminate the possibility of rupture of the outer container in the field. Such an occurrence would not be similar to the M-218 incident. A thin wall cylindrical container is twice as strong in longitudinal strength as in hoop strength. A hydrostatically tested dummy container failed by a lengthwise split on one side. Due to its ductility, stainless steel does not produce flying shrapnel when it ruptures. If the test container had been pressurized with gas instead of water, the only difference would have been that the edges at the rupture would have curled outward. The inner source would probably have been contained. Source M-218 failed endwise, resulting in a flying fragment only because the wall had been cut more than 4/5 of the way through around the circumference, thus reducing the longitudinal strength considerably below the hoop strength.

If a source which was not cut on the circumference ruptures, it would split along its side; the inner container would be incarcerated and contamination would not spread. All standard sources have an outer container with a wall thickness of 0.030 inch. Less than five percent of the sources in the group being tested are of special construction with thicker walls.

The increase in hydrogen pressure in a source containing water is proportional to the surface area of the $PuBe_{13}$ alloy exposed to the water, rather than to the total amount of water contained.

Since all sources have approximately the same ratio of free volume to weight of alloy, the rate of pressure increase (in psi/year for a source containing water) is expected to be nearly the same for all sources.

The time after fabrication at which sources containing water would reach the yield point is inversely proportional to the source diameter and directly proportional to the wall thickness. If the data on the hydrogen evolution rate obtained by introducing water into only one source is valid for all sources, any source of standard wall thickness which contained water at fabrication should by this time show dimensional changes.

Of the nonstandard sources, the type with the thinnest walls have been calculated to fail at 18,500 psi internal pressure. If water completely filled the free space and reacted to form free hydrogen, the resultant pressure would be approximately 18,500 psi. The postulated mechanism by which water was introduced into M-218 woul not be expected to fill more than one-third of the free space and result in much lower final gas pressure.

CONCLUSIONS AND RECOMMENDATIONS

The most probable cause for the development of internal pressure in PuBe Source M-218 was ingestion of water by the leaking inner container when the hot source was placed in a decontamination bath. Reaction of the water with the contents evolved hydrogen, and increased the internal pressure in both the inner and outer containers over a period of more than two years. Approximately 90% of the sources of similar fabrication were inspected, and no additional evidence of internal pressure was found.

It is significant that the individual preforming the operation did not retain a permanent body burden, indicating that $PuBe_{13}$ is biologically inert.

Occurrence of internal pressure in any of the sources not inspected is unlikely. Fabrication methods have been revised to eliminate any possibility of internal pressure development in sources other than in the group discussed in this report. If internal pressure should develop in one of the not checked sources, it would be evident from visual inspection at least six months to one year before any danger of rupture.

It is recommended that all users of PuBe sources, listed by serial numbers in the Appendix, measure the source diameters at maximum intervals of six months. Methods of obtaining measurements with minimum exposure to source radiation are given in the Appendix. *Any increase in diameter of more than 0.010 is of possible significance and should be reported to Neutron Source Group, Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio - 45342.*

SOURCES NOT RETURNED FOR RECANNING
(As Of January 1, 1964)

M-1	M-525	M-645*
M-11	M-526	M-646*
M-47	M-529	M-647*
M-75	M-531	M-648*
	M-532	M-651*
M-193	M-540	M-675
M-194	M-542	M-676
	M-558	M-677
M-203	M-559	M-678
M-205	M-560	M-679
M-206	M-570	M-692*
M-235	M-571	M-693*
M-236	M-581*	
M-238		M-719
M-256	M-602	M-730
	M-603	M-732
M-353	M-604	M-733
M-354	M-611	M-744
M-355	M-612	M-751
M-356	M-613	M-771
M-357	M-614	M-772
M-361	M-624	M-775
M-396	M-625	
	M-639*	M-805
M-445	M-640*	
M-446	M-641*	
M-448	M-642*	
M-457	M-643*	
M-465	M-644*	

*Navy Cable Test Sources

MEASUREMENT OF SOURCE DIMENSIONS

The only dimension of value in determining if a source is developing an internal pressure is the outside diameter.

To minimize personnel exposure, the source should be handled by a rod threaded into the hole in the source; 18-inch long laboratory tongs; or handling tools which allow equivalent body-source distance to be maintained. With a body-source distance in air of two feet, a 10-curie (160-gram Pu source can be handled for 30 minutes with an exposure of less than 25 milliroentgens. For smaller sources the exposure is correspondingly less. A measurement by either of the techniques described below should not expose personnel for more than 10 minutes.

Method A: Use of Standard Micrometer Caliper (see Figure 6)

The yoke of the caliper is held in a ring stand clamp which, in turn, is attached to a rod of suitable length.

Another rod is coupled to the micrometer barrel with a piece of rubber tubing. Readings can be obtained to 0.001-inch diameter by handling from the ends of the rods. Several readings should be obtained at different points on the source. Before actual source measurements are attempted, the method should be practiced using a non-radioactive test piece to gain confidence in the accuracy.

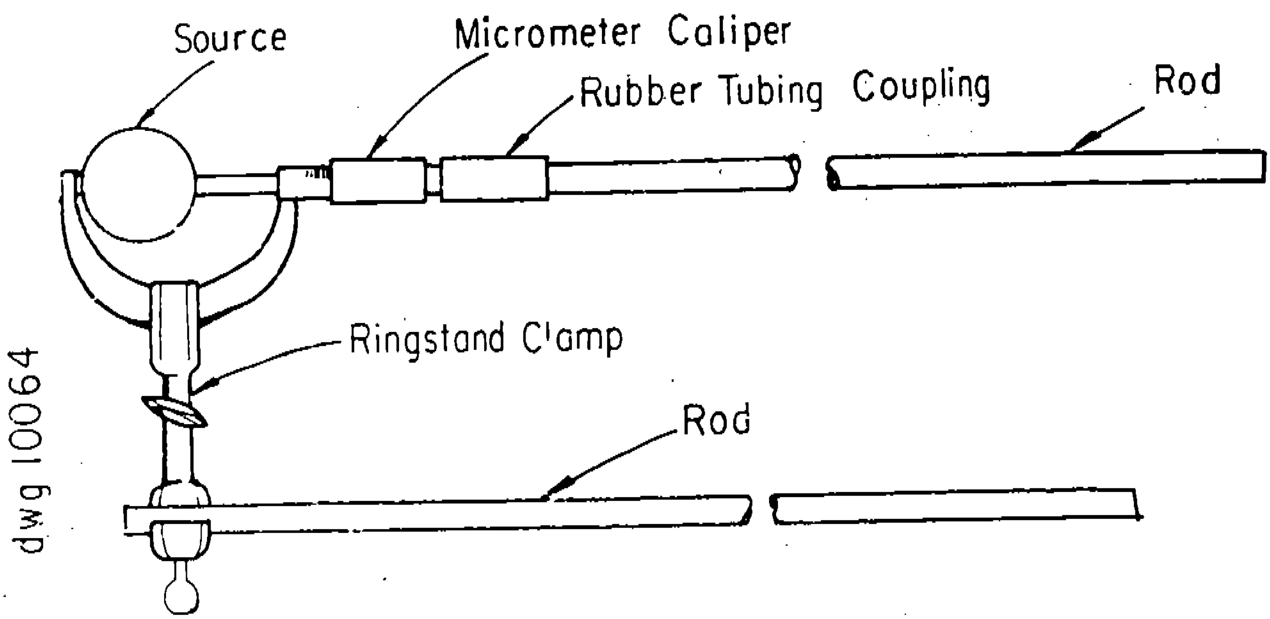


Figure 6 *Micrometer Caliper with Extension Rods*

Method B: Gage Ring (see Figure 7)

Due to the possibility of measurement errors, the gage ring should be made 0.010-inch larger than the largest diameter measured with a micrometer. Laboratory tongs may be used to drop the gage ring over the source or, if desired, a handling rod may be threaded or brazed to the ring.

Any increase in diameter of more than 0.010 is of possible significance and should be reported to Neutron Source Group, Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio - 45342.

RECALIBRATION OF NEUTRON EMISSION

In addition to the testing and recanning discussed in the next section, the neutron emissions of all sources were determined after recanning. This was done using a "Precision Long Counter"[3,4] and neutron source standards calibrated by the National Bureau of Standards. Data on anisotropy of neutron emission were also furnished.

[3] J. DePangher, "A Reproducible Precision Polyethylene Long Counter for Measuring Fast Neutron Flux", *Bull Am Phys Soc*, 6, 252 (1961).

[4] J. DePangher, "A Reproducible Precision Polyethylene Long Counter for Measuring Fast Neutron Flux", *AEC Report No. HW-70050*, pp 51-57 (1961).

BEST AVAILABLE COPY

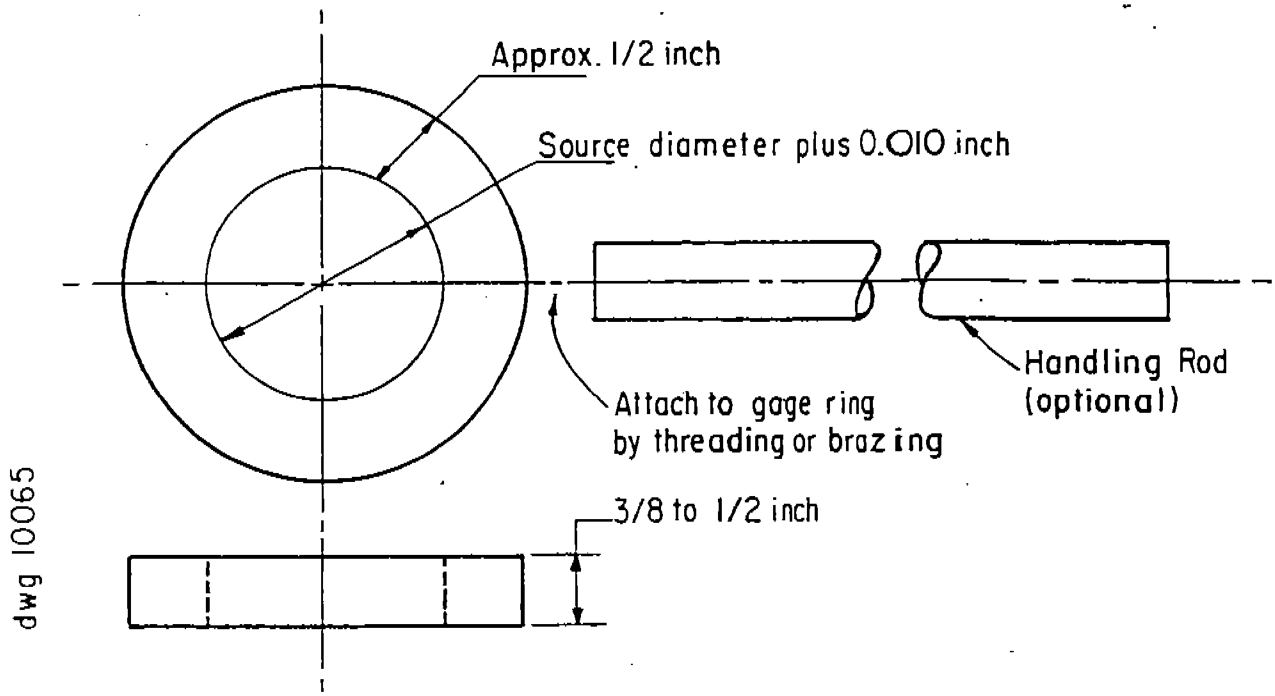


Figure 7 *Ring Gage (Stainless Steel preferable)*

Apparent changes in the values of total emission were from a combination of factors, including correction for anisotropy, better counting statistics, and the ingrowth of americium-241. Americium-241, an alpha emitter, is formed by the beta decay of 13.2 year plutonium-241 which is present in small amounts. The recanning process itself would not produce a detectable change in emission.

While neutron emission values are generally higher than those originally supplied, the change cannot be used to predict the emission growth due to americium-241 ingrowth. Isotopic analyses of the plutonium originally used are unavailable. An analysis is being made of the calibration data obtained during the Recanning Program and it may be possible, at sometime in the future, to furnish expected growth rates by blocks of serial numbers. This information will be furnished to source users when it becomes available.

EVALUATION OF PRESSURE INCREASES

A number of possible causes for the pressure increase were evaluated. The various possibilities and tests are discussed below:

Mechanical Damage   Pressure on the end of the source might have occurred if an attempt had been made to place it in a logging tool designed for another type of source. This could account for the broken weld o the inner container. To store energy, the inner container would have to be stressed and held in a stressed condition by the outer container.

This does not account for the bulging sides of the outer container nor the large energy release at rupture. While the ultimate strengths of tantalum and 304 stainless steel are comparable, the tantalum is much softer. Compression forces as high as 20,000 pounds have been placed at the ends of the sources without causing damage.

Phase Change in the $PuBe_{13}$ Compound Little is known of the metallurgy of this alloy. It is conceivable that changes might occur in the crystal structure of the $PuBe_{13}$ causing pressure on the tantalum container.

No endwise force would be expected as there was an 18.6 cc space above the $PuBe_{13}$. Also, the side walls of the stainless steel outer container had expanded to give at least 0.040-inch radical clearance between the inner and outer containers.

The hardness of $PuBe_{13}$ exceeds Vickers 800. The slug is bonded to the tantalum by diffusion at the interface, and growth of the alloy to cause rupture is unlikely.

Helium Pressure Caused by Plutonium Decay One curie of plutonium-239 produces helium at the rate of 2.22×10^{12} atoms per minute; thus, 0.043 cc of helium per year is produced for each curie of plutonium. Since the free space is 18.6 cc, it would require 86 years to produce one atmosphere of pressure in the source. In addition, a major portion of the helium is trapped in the crystal lattice and does not cause gas pressure.

"Trap Door" Leak Although the possibility appears to be remote, leaks which allow the passage of gas in but not out have been reported.

In this case, the source was placed inside a sealed logging tool and not subjected to down-hole pressure. The source had been used on only 30-40 logging operations and not in any hole more than 5000 feet deep. This would indicate the maximum pressure to which it could have been subjected, even with a leaking logging tool, was about 3000 psi.

A dummy five-curie outer container was welded closed with a tubulation and subjected to a hydrostatic pressure test. Strain, as indicated by diameter change, was measured to 0.0001 inch by means of opposed dial indicators. The elastic limit was reached at 5200 psi internal pressure, corresponding to 108,000 psi tensile stress on the steel. Failure occurred at 7500 psi or 156,000 psi ultimate tensile stress. The stress-strain curve is presented in Figure 8. Even with a "trap door" leak, the outer container could not have been stressed beyond the elastic limit and this mechanism could not account for the swelling of the source.

Inward Diffusion of Gas This was proposed as a mechanism which might produce the same effect as the "trap door" leak, since downhole temperatures as well as pressures are considerable elevated. If the source was exposed to these conditions, gases might have diffused into the outer container and have been trapped as it was withdrawn from the hole. The only gas with an appreciable diffusion rate, however, is hydrogen. Free hydrogen is not normally a major constituent of oil well gases.

The diffusion rate of hydrogen through 304 stainless steel at one atmosphere and 300°C is approximately 5.5×10^{-4} cc (STP)/cm²/hr/mm thickness.[5] Since recorded diffusion rates are variable from sample to sample of steel, the rate of hydrogen diffusion was measured for seamless drawn tubing used for the outer capsule. The apparatus is illustrated in Figure 9.

A five-curie source container, filled with a copper slug to reduce the volume, was welded to a heavy stainless steel plate. A concentric outer container was then welded to the same plate. One-eighth inch copper tubing was silver soldered into holes in the plate to furnish pressure connections to the two chambers. The inner chamber was connected to a pressure gage while the outer container was connected through a 500 psi regulator to a hydrogen cylinder. The unit was leak checked with a mass spectrometer helium leak tester and then placed in a furnace. Both chambers were maintained at 500°C and 450 psi hydrogen pressure for 24 hours to saturate the metal. The diffusion rates were then measured at 450 psi hydrogen pressure and

[5] P. S. Flint, "The Diffusion of Hydrogen Through Materials of Construction", *KAPL 659*, Knolls Atomic Power Laboratory, Schenectady, N. Y. (December 14, 1951).

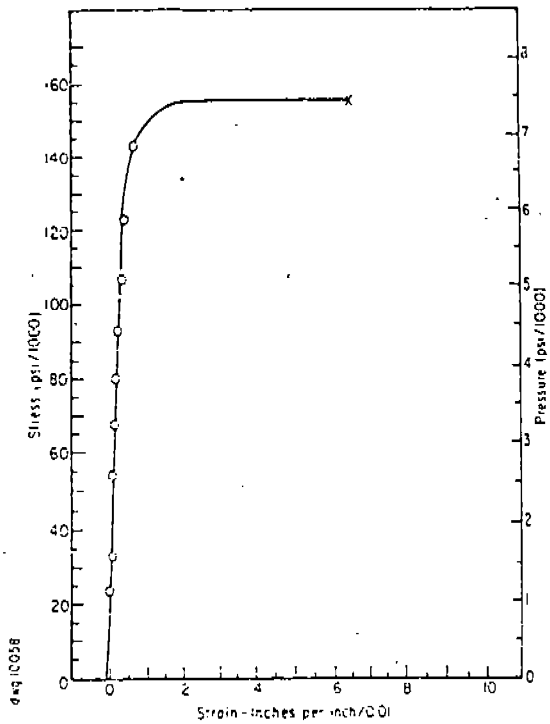


Figure 8 *Pressure Test of 5C Stainless Outer Can*

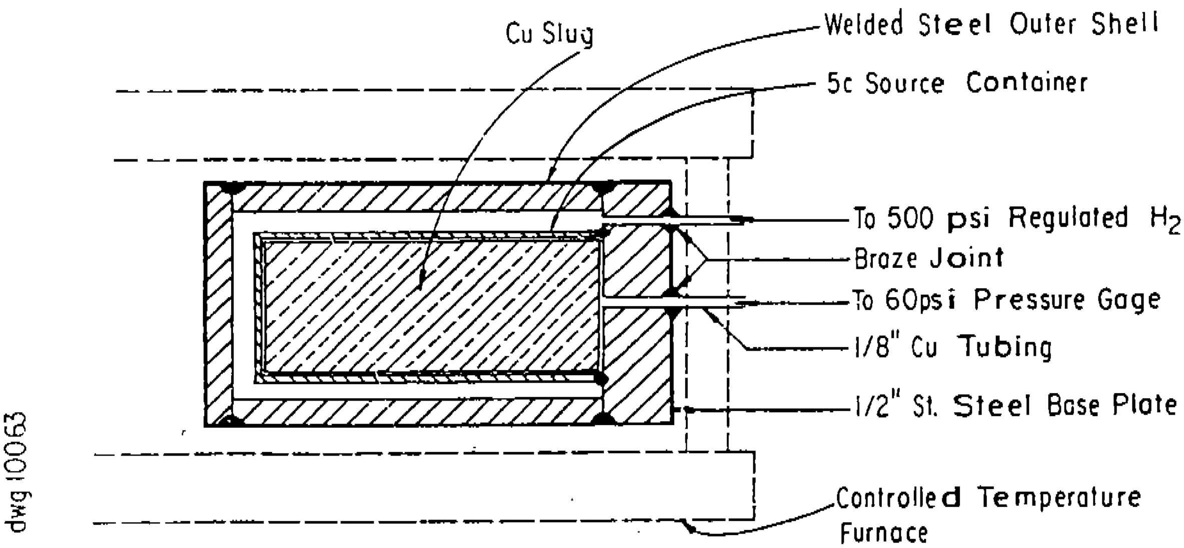


Figure 9 *Hydrogen Diffusion Apparatus*

500°, 400°, 300°, and 250°C. At 300°C the measured rate, calculated to one atmosphere, was 4.75×10^{-4} cm^3/ hr/mm thickness, which checked within five percent of the rates given in the literature. With this rate it would require 45 days at 5000 psi to raise the internal pressure one atmosphere. The rate was not measureable at 250°C.

This explanation does not seem plausible. The electronic circuitry in the logging tool would not operate above 200°C. Again the tool would have had to leak.

Hydrogen Pressurization Due to Corrosion or Electrolysis If hydrogen producéd by acidic corrosion of steel is suppressed by the presence of hydrogen sulfide, the hydrogen is forced into the metal and will diffuse through.* Pressures in hollow rods have risen to 60 atmospheres in nine days. When carbon steel is used as a hollow cathode in electrolysis, pressure of 200 to 300 atmospheres have been measured.

The possibility of this occurring in the type 304 stainless steel container is considered highly improbable since the use of austenitic stainless steel is recommended where hydrogen cracking or blistering of other steels occurs. Stainless steel cathodes are used in commercial electrolytic hydrogen cells.

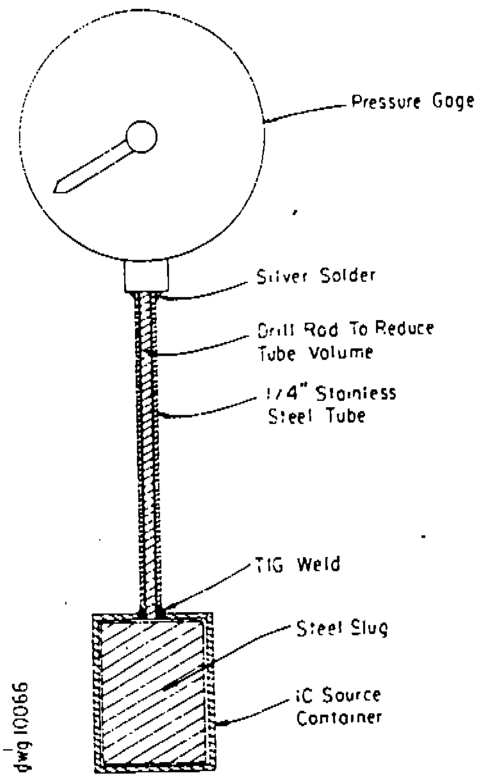


Figure 10 *Hydrogen Corrosion Diffusion Apparatus*

A test was set up to investigate this mechanism. The apparatus is shown in Figure 10. A one-curie size stainless steel outer container was welded closed with the inner volume filled with a steel slug. A 1/4-inch diameter stainless steel tube was welded in place and almost completely filled with a drill rod to reduce the volume. This was connected to a small pressure gage. The source container was immersed in dilute

*U. R. Evans "The Corrosion and Oxidation of Metals", St. Martins Press, Inc. New York (1960).

hydrochloric acid and operated as a cathode at one ampere for one week. This was then repeated with hydrogen sulfide continuously bubbled through the electrolyte, and finally repeated with an electrolyte composed of 10 percent sodium chloride slightly acidified with hydrochloric acid, saturated with hydrogen sulfide. The tests were run at 95°C.

While the surface of the capsule was noticeably corroded, the pressure did not increase in any of the tests. After the tests the tube was cut and both the gage and source portions were helium leak checked. No leaks were found.

APPENDIX 6

SWIPE DATA ON SOURCES

Pu-239 Standard
Mass: 16.29596 g
Source#: 493-19-1
Ref Date: 5-15-95
Amount: 5.09 nCi

M-561

ID: DAILY CHECK

8 AUG 2003 14:34

USER: 1　　COMMENT: 20 ML STD
PRESET TIME : 1.00
DATA CALC : DL DPM　H# : YES　SAMPLE REPEATS: 1　PRINTER : EDIT
COUNT BLANK : YES　IC# : NO　REPLICATES : 1　RS232 : OFF
TWO PHASE : NO　AQC : YES　CYCLE REPEATS : 1　DISK : OFF
SCINTILLATOR: LIQUID　LUMEX: YES　LOW SAMPLE REJ: 0
LOW LEVEL : NO　HALF LIFE CORRECTION DATE: none

ISOTOPE 1: 3H　%ERROR: 0.00　FACTOR: 1.000000　BKG. SUB: 0
ISOTOPE 2: 14C　%ERROR: 0.00　FACTOR: 1.000000　BKG. SUB: 0
WIDE OPEN WINDOW　%ERROR: 0.00　FACTOR: 1.000000　BKG. SUB: 0

BACKGROUND QUENCH CURVE: Off　　COLOR QUENCH CORRECTION: Off

Quench Limits　Low: -3.793　High: 303.49

SAM NO	POS	TIME MIN	H#	ISO	CORRECTED CPM	%ERROR	DPM	EFF-1	EFF-2	RATIO	LUMEX %	ELAPSED TIME
B1	[illegible]	.00	181.5	3H	198.00	14.21	803.57	18.60	0.97	2.602	0.01	1.45
				14C	219.00	13.51	308.82	15.72	68.38			
				WIDE	11539.00	1.86						

Blank Average DPM for 3H : 803.57 COEF. OF VAR: 0.000
Blank Average DPM for 14C : 308.82 COEF. OF VAR: 0.000

239Pu DPM of Std = 11,300

$$\text{eff} = \frac{\text{obs} - \text{bkg}}{\text{Known}} = \frac{11{,}539 - 24}{11{,}300} = 1.02$$

BEST AVAILABLE COPY

PuBe

8-7-03

M-561

ID:LSC LAB

8 AUG 2003 14:36

USER: 8 COMMENT:

PRESET TIME :	1.00					
DATA CALC :	CPM	H# :YES	SAMPLE REPEATS:	1	PRINTER	: STD
COUNT BLANK :	NO	IC# : NO	REPLICATES :	1	RS232	: OFF
TWO PHASE :	NO	ADC : NO	CYCLE REPEATS :	1	DISK	: OFF
SCINTILLATOR:	LIQUID	LUMEX: NO	LOW SAMPLE REJ:	0		
LOW LEVEL :	NO	HALF LIFE CORRECTION DATE:			none	

ISOTOPE 1: 3H	%ERROR: 2.00	FACTOR: 1.000000	BKG. SUB:	0
ISOTOPE 2: 14C	%ERROR: 0.00	FACTOR: 1.000000	BKG. SUB:	0
WIDE OPEN WINDOW	%ERROR: 0.00	FACTOR: 1.000000	BKG. SUB:	0

SAM NO	POS	TIME MIN	H#	3H CPM	3H %ERROR	14C CPM	14C %ERROR		WIDE CPM	WIDE %ERROR	LUMEX %	ELAPSED TIME
1	**-1	1.00	13.5	12.00	57.74	6.00	81.65	BKG	24.00	40.82	2.98	1.52
2	**-2	1.00	123.7	19.00	45.88	4.00	100.00	PuBe	27.00	38.49	10.39	3.44

Net cpm = 27 - 24 = $\frac{3 \text{ cpm}}{1.02}$ = 3 DPM

BEST AVAILABLE COPY

2 Ci PuBe Source Wipe
8-8-03

M-364

ID:LSC LAB

8 AUG 2003 14:30

USER: 8 COMMENT:
PRESET TIME : 1.00
DATA CALC : CPM H# :YES SAMPLE REPEATS: 1 PRINTER : STD
COUNT BLANK : NO IC# : NO REPLICATES : 1 RS232 : OFF
TWO PHASE : NO ADC : NO CYCLE REPEATS : 1 DISK : OFF
SCINTILLATOR: LIQUID LUMEX: NO LOW SAMPLE REJ: 0
LOW LEVEL : NO HALF LIFE CORRECTION DATE: none

ISOTOPE 1: 3H %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0
ISOTOPE 2: 14C %ERROR: 0.00 FACTOR: 1.000000 BKG. SUB: 0
WIDE OPEN WINDOW %ERROR: 0.00 FACTOR: 1.000000 BKG. SUB: 0

SAM NO	POS	TIME MIN	H#	3H CPM	3H %ERROR	14C CPM	14C %ERROR		WIDE CPM	WIDE %ERROR	LUMEX %	ELAPSED TIME
1	**-1	1.00	14.7	13.00	55.47	10.00	63.25	BKG	30.00	36.51	2.66	1.71
2	**-2	1.00	113.0	11.00	60.30	11.00	60.30	PuBe	34.00	34.30	5.83	3.53

Net CPM = 34 - 30 = 4 cPm / 1.03 = **4 DPM**

BEST AVAILABLE COPY

Pu-239 Standard
Mass: 16.29596 g
Source #: 493-19-1
Ref Date: 5-15-95
Amount: 5.09 nCi

M-364

ID:DAILY CHECHK	8 AUG 2003 14:28

SER: 1	COMMENT:20 ML STD
RESET TIME : 1.00
DATA CALC : DL DPM H# :YES SAMPLE REPEATS: 1 PRINTER :EDIT
COUNT BLANK : YES IC# : NO REPLICATES : 1 RS232 : OFF
TWO PHASE : NO AGC :YES CYCLE REPEATS : 1 DISK : OFF
SCINTILLATOR: LIQUID LUMEX:YES LOW SAMPLE REJ: 0
LOW LEVEL : NO HALF LIFE CORRECTION DATE: none

ISOTOPE 1: 3H %ERROR: 0.00 FACTOR: 1.000000 BKG. SUB: 0
ISOTOPE 2: 14C %ERROR: 0.00 FACTOR: 1.000000 BKG. SUB: 0
WIDE OPEN WINDOW %ERROR: 0.00 FACTOR: 1.000000 BKG. SUB: 0

BACKGROUND QUENCH CURVE: Off	COLOR QUENCH CORRECTION: Off

Quench Limits	Low:-3.793	High:303.49

SAM NO	POS	TIME MIN	H#	ISO	CORRECTED CPM	%ERROR	DPM	EFF-1	EFF-2	RATIO	LUMEX %	ELAPSED TIME
31	**-1	1.00	179.0	3H	234.00	13.07	991.42	19.09	0.97	3.514	0.01	1.46
				14C	203.00	14.04	282.12	15.84	68.56			
				WIDE	11725.00	1.85						

Blank Average DPM for 3H : 991.42 COEF. OF VAR: 0.000
Blank Average DPM for 14C : 282.12 COEF. OF VAR: 0.000

^{239}Pu DPM of Std = 11,300

$$\text{eff} = \frac{\text{obs} - \text{bkg}}{\text{known}} = \frac{11,725 - 30}{11,300} = 1.03$$

BEST AVAILABLE COPY

HSR-1 SMEAR SURVEY FORM

SAMPLE DESCRIPTION

Sample Date/Time: 8-19-03 No. Of Samples: 15

TA: 00 Bldg: N/A

RCT: L Mamanares Z Number: 109238

RCT Signature: [signature] MS: K988

Phone/Fax: 5-4926

SAMPLE TRACKING NUMBER

HSR-1 SAMPLE TRACKING

*23019

PURPOSE OF SURVEY

☐

☐

INSTRUMENTATION

TYPE	HSE No.	CAL Due	% EFF	BKG
Alpha 542-10	13656	10/10/03	31.5	0
Beta 543-10	13656	10/10/03	35.2	233

ADDITIONAL INFORMATION

Occurrence No.: N/A

Incident No.:

RWP No.:

ESH-1 REVIEW BY

Larry M Pacheco [signature]

Smear No.	Location	ALPHA*	BETA*	Smear No.	Location	ALPHA*	BETA*
1	pre Job floor & area	NDA	NDA	16			
2	↓	↓	↓	17			
3				18			
4				19			
5				20			
6	lucite Source holder			21			
7	source in SFC 11-1-0080			22			
8	↓			23			
9	exterior SFC 11-1-0080			24			
10	Drum 61414 Top			25			
11	Side			26			
12	Bottom			27			
13	post Job floor & area			28			
14	↓			29			
15	↓	↓	↓	30			

*dpm/100 cm²

of 1

3/11/99

BEST AVAILABLE COPY

HPAL ANALYSIS REPORT FORM

FILE: 23019868

Comments: rutgers university

SAMPLE DESCRIPTION — ANALYSIS REQUESTED — RCT

Berthold 780 at TA-50

Sample Date: 9/3/03 — Nucon — Name: Leonard Manzanares 0

TA: 00 — TA: 52

BLDG: N/A — Analyst: Trujillo Isaac — MS: K988

Sample ID #	Alpha Activity dpm	2*sigma dpm	Alpha MDA dpm	Beta Activity dpm	2*sigma dpm	Beta MDA dpm
1	NDA	NDA	5.0	NDA	NDA	7.7
2	NDA	NDA	5.1	NDA	NDA	7.4
3	NDA	NDA	6.3	NDA	NDA	7.0
4	NDA	NDA	5.0	NDA	NDA	7.5
5	NDA	NDA	6.3	NDA	NDA	9.5
6	NDA	NDA	5.9	NDA	NDA	8.3
7	NDA	NDA	5.0	NDA	NDA	7.0
8	NDA	NDA	4.9	NDA	NDA	7.7
9	NDA	NDA	5.5	NDA	NDA	7.7
10	NDA	NDA	6.6	NDA	NDA	9.0
11	NDA	NDA	5.0	NDA	NDA	7.7
12	NDA	NDA	5.1	NDA	NDA	7.4
13	NDA	NDA	6.3	NDA	NDA	7.0
	NDA	NDA	5.0	NDA	NDA	7.5
15	NDA	NDA	6.3	NDA	NDA	9.5

109238

BEST AVAILABLE COPY

APPENDIX 7

VE REPORT

Container Packaging and VE Data Record

Container Identifier	LA00000061414
Printed name of VE Packager	S. Leonard
Printed name of VE Recorder	J. A. Tompkins

Step	Requirement	Initials and Date of Recorder
1.	Procedure Used OSR-OP-120, R.7/IC2 Effective Date __03/05/03_	[initials] 08/19/03
2.	Indicate the container configuration used (refer to OSR-OP-120, Attachment 2, for configuration types. Attachment 2 is included as part of the batch data report) *(check one)*: _X_ Standard Pipe Overpack (12" pipe component) POC Insert ____ None _X_ Cane ___ Poly _____ Poly/Lead ___ S100 Overpack (6" pipe component) ___ S200-A Overpack (12" pipe component with lead/poly shielding) ___ S200-B Overpack (12" pipe component with lead/poly shielding)	[initials] 08/19/03
3.	Inspect and prepare the container by completing steps 1-5 of the *Container Loading and Closing Instructions*, Attachment 8. If container is found to be acceptable for use, then enter the Container ID at the top of all pages of this form.	[initials] 08/19/03
3a.	• Filter model on drum lid: __NFT-019__ • Filter serial number on drum lid:__BD-76____ • Filter manufacture date: __02/03_____	[initials] 08/19/03
3b.	• Filter model on POC: ___UT9400___ • Filter serial number on POC:___ 025285___ • Filter manufacture date: ____01/03_____	[initials] 08/19/03
4.	Check that OSROC has provided a list of the OSR sealed sources to be loaded into this container.	[initials] 08/19/03
5.	Complete step 6 of the *Container Loading and Closing Instructions*, Attachment 8. Verify the unique identifier, outer casing is made of non-VOC bearing material, and estimated weight of each sealed source on page 2 of this form as the sources are placed in the container.	[initials] 08/19/03
6.	Complete the checklist on page 3 of this form to verify the absence of indicators of prohibited items or conditions.	[initials] 08/19/03
7.	Verify, based on visual examination, that the contents of the container match the waste stream description and Summary Category Group.	[initials] 08/19/03
8.	Enter the Waste Matrix Code for the sealed sources, based on visual examination (typically S5100) : __S5100__	[initials] 08/19/03
9.	Complete steps 7-13 of Attachment 8. Torque the POC bolts in accordance with steps 14-16 of *Container Loading and Closing Instructions*, Attachment 8 and record the following information. • Closure bolts tightened to ___65___ft-lbs • Torque wrench ID # ____027676____ • Calibration due date of torque wrench _____06-08-04______	[initials] 08/19/03
10.	Replace the packing materials in accordance with step 17 of the *Container Loading and Closing Instructions*, Attachment 8.	[initials] 08/19/03
11.	Close the container and torque ring bolt to 40 ft-lb (±4) in accordance with step 18 of the *Container Loading and Closing Instructions*, Attachment 8. Record the torque settings. • Drum ring bolts tightened to ___40___ ft-lbs • Torque wrench ID # ____027676_____ • Calibration due date of torque wrench _____06-08-04_______	[initials] 08/19/03

Comments:

NA

Container Packaging and VE Data Record (continued)

Container Identifier
LA00000061414
NOTE: Puncture protection (from heavy or sharp objects) for the container is ensured by the use of a pipe component for packing sealed sources.

Record or verify the requested information for each OSR sealed source as it is loaded into the container.

Item #	OSR Sealed Source Description and Identifier	WMP*	Estimated Weight (indicate grams)	Verified item information during VE Enter Y (yes) or N (no)	Comments (if any)
1	Pu239Be SFC II-1-0080 containing M364 & M561	OM	7000	Y	NA
2	NA	NA	NA	NA	NA
3	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA
5	NA	NA	NA	NA	NA
6	NA	NA	NA	NA	NA
7	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA
9	NA	NA	NA	NA	NA
10	NA	NA	NA	NA	NA
11	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA
13	NA	NA	NA	NA	NA
14	NA	NA	NA	NA	NA
15	NA	NA	NA	NA	NA

Total estimated weight (kg) for each WMP listed for above items	7.0 kg	
Total estimated weight (kg) for loaded container (using appropriate drum weight from OSR-OP-120, Attachment 2)	182.6 kg	

OSR-028,R.7

If the list of items is continued on additional pages, attach and number added pages (Page ___ of ____).

* WMP categories are listed in Attachment 1 of OSR-OP-120; WMP should be OM for OSR sealed sources. If a source is comprised of mixed WMPs, each WMP will be entered on a separate line.

† Conversion factors: 0.002205 pounds per gram; 453.59 grams per pound

Container Packaging and VE Data Record (continued)

Container Identifier
LA00000061414

NP There are no indicators for the presence of the prohibited item in this container.

P An indicator for the possible presence of the prohibited item has been observed. (If any condition is noted as present (or possibly present), note details in the comments section at the end of this form.)

Enter P or NP	Prohibited Hazardous Items or Conditions
NP	Free liquids in an inner container or in the container
NP	* Incompatible waste (i.e., incompatible with WIPP backfill, seal and panel closure materials, shipping container materials, or other wastes as defined by TRUCON codes)
NP	* Polychlorinated Biphenyl (PCB) compounds
NP	* Explosive items
NP	* Ignitable items
NP	* Reactive items
NP	* Corrosive items
NP	* Hazardous waste not occurring as co-contaminates with TRU mixed wastes
NP	* Potentially pressurized containers (e.g., aerosol can, light bulb, gas cylinder)
NP	* Nonradionuclide pyrophorics greater than or equal to 1% by weight of the waste container.
NP	* Radioactive pyrophorics greater than or equal to 1% by weight of the waste container that have not been rendered nonreactive.
NP	* Chemical incompatibility
NP	* Sealed containers greater than 4 liters

Comments, including the identifiers of any relevant NCRs or PWRs:

NA

I certify that I have visually examined each sealed source loaded into this container, and that the above information is correct. I also verify that no items other than those listed on this form have been placed into this container.

Shelley J. Leonard — 8-19-03

Signature of VE Packager — *Date*

I certify that I examined and witnessed the loading of this container, and that the above information is correct.

[signature] — 8-19-03

Signature of VE Recorder — *Date*

OSR-028,R.7

BEST AVAILABLE COPY

APPENDIX 8

SPECIAL FORM CAPSULE


DANGER - RADIOACTIVE MATERIALS
IF FOUND, NOTIFY CIVIL AUTHORITIES