Attachment 3 - Acceptable Knowledge Source Document Summary

Waste Stream Number(s): LA-OS-00-01	
Site(s): Los Alamos National Laboratory	**Source Document Tracking Number:** D008
Acceptable Knowledge Documentation Type: ☑ TRU Waste Management Program Information ☑ Waste Stream-Specific Information ☐ Supplemental Information	**Category:** ☑ Published Document or Controlled Database ☐ Unpublished Data ☐ Internal Procedure or Note ☐ Correspondence ☐ Discrepancy
Title of Source Document: Sealed Sources Peer Review Report	
Source Document Reference Information (author(s), document and revision number, date, publisher): H. Evans, J. Harvill, T. Sowdon, and J. Booth, TWCP-18562, December 5, 2003, OSRP	

AK # [a]	Source Doc. Page #[b]	AK Information Summary
WS11	1-3, 6, 19	Outlines OSR's proposal to use existing data as the basis for satisfying WIPP's radiological characterization requirements. A peer review panel reviewed "the adequacy of the available data to reasonably support the determination of the radionuclide content for compliance with the WIPP" WAC, including manufacturing records, shipping data sheets, and NMMSS database information. In short, the Panel assessed "the validity of the permits that the currently existing source records are adequate for establishing the radioactive source content at the time of construction." It was conducted under controlled procedures according to guidance in NUREG-1297, Peer Review for High-Level Nuclear Waste Repositories. The Panel concluded that "the various data records collected provide either uniquely, or as the sum of several individual records, adequate documentation for determining the radionuclide type, the radionuclide content/activity and either the date of manufacture or other more conservative date (for purposes of decay correction)," and that the records were adequate for supplying the required information to WIPP. Further, it stated that "AK results far surpass any that could currently be generated using NDA." OSR proposed to use records to determine the as-fabricated radiological content of sources, account for decay and ingrowth, and report the results to WIPP; this approach is being proposed because the packaging of the sources and self-shielding severely attenuate the characteristic low-energy gamma radiations that would normally be used by WIPP-approved NDA systems, making "accurate NDA content estimations unfeasible."
PR2, PR3, WS7	2	OSR Project at LANL was created in 1999 to recover and manage excess/unwanted radioactive sources for which DOE was made responsible in the Low-Level Radioactive Waste Policy Amendments of 1985 (PL 99-240). Among other things, OSR must provide disposition paths for non-reusable sealed sources.
WS8, WS9, O1	2, 5	Sealed sources are basically known quantities of radioactive material encapsulated in containment vessels are have many different uses. They are defined in 10 CFR 30.4 and 10 CFR 70.4. Many sources used as neutron generators comprise a primary nuclide and light element such as Be. "Most of the sources in the OSR Project were manufactured prior to 1985.
	3-4	The OSR approach would rely on use of AK to determination each source's primary radionuclide and quantity (mass or activity) and date of manufacture, as well as an isotopic distribution and associated uncertainties for the radiological material in the sources. OSR developed an isotopic distribution for the ten WIPP-required radionuclides and proposes to apply it to the known quantity of the particular radionuclide in each source. This distribution and uncertainties are based on MC&A records, safeguards documents, and batch analytical data for different radionuclides (Am-241, Pu-238, and Pu-239). "Primary" document sources used to determine

Attachment 3 - Acceptable Knowledge Source Document Summary (continued)

Site(s): Los Alamos National Laboratory		Source Document Tracking Number: D008
AK # [a]	Source Doc. Page #[b]	AK Information Summary
		source contents include the NMMSS database, source certificates, source shipping data sheets, and source fabrication documents. These have sufficient information to determine the primary isotope, its quantity, and the manufacture date. Secondary documents include source and device markings, the National NRC Device Registry, manufacturer catalogs, drawings and dimensions, and NRC licenses. These provide either the isotope and quantity or the manufacture date.
WS11	7-13	The panel found that source certificates "provide the most accurate and detailed information about the source." Documents that were found to provide accurate information include the following: Shipping documents (element and activity); fabrication documents (element and activity), markings, National Sealed Source Design Registry (element, Special form status, construction description), manufacturer catalogs (drawings, physical design and dimensions, element, activity), drawings (element), NMMSS database (element, activity, manufacture date) for al Pu-239 and many Pu-238 sources, and manufacturer databases (element, activity, manufacture date). The type of information available varied for each source type (Pu-238, Pu-239, and Am-241).
WS11	14-15	For Pu-238, MT-83 (80'%) was for general use, but MT-83 (90%) was usually used in pacemakers. The largest fraction in source documents was MT-83 (80%). Information used to develop an isotopic distribution for Pu-238 included NMMSS, material transfers from SRS to ORNL, ORNL analytical data sheets, shipping records, and data sheets on specific devices using the sources. The panel concluded that the "use of this data to estimate the isotopic distribution in Pu-238 sources is appropriate."
WS11	15-17	To determine the isotopic distribution for Pu-239, OSR used NMMSS (which includes data for "100%" of the Pu-239 sources manufactured), a LANL AK report for its Pu-239 manufacturing facility at TA-55, and other sources. The Panel concluded that the data "provide reliable estimates of the distribution of Pu isotopes within Pu-239 sources." For Am-241, supporting records included manufacturing, regulatory, and DOT shipping records, as well as the National Sealed Source Device Registry (M005), and feedstock analytical batch data sheets from LANL and ORNL. The Panel concluded that use of the analytical data sheets to determine the Am-241 isotopic distribution "is appropriate." The Panel also concluded that "estimates of error contributed by individual sources of error ... are appropriate."
O2, O6, O8, O9, O12, O15, O17	Appendix A	Examples of AK documentation

Attachment 3 - Acceptable Knowledge Source Document Summary (continued)

Site(s): Los Alamos National Laboratory	Source Document Tracking Number: D008

Source Document Data Limitations (if any):

1. Panel recommended that sources that were deliberately physically altered, had missing or illegible documentation, were irradiated, or with severely inconsistent documentation should not be characterized by the proposed approach.
2. Panel scope was "limited to assessing the quality of the data and not to assessing the characterization method."
3. Review panel only considered Pu-238, Pu-239, and Am-241 sealed sources.

Acceptable Knowlege Expert:

Julia Whitworth , Julia Whitworth Date: 3/9/05

Print /Sign

[a] Obtain from Acceptable Knowledge Documentation Checklist
[b] For microfilm or microfiche, identify box, tape, reel number and location.

RECORDS SUBMITTAL

P2010 - 0885

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: _____

RECORD TYPE:

☐ Project 2010 ☐ Facility

☒ Other: OSR ☐ UCNI ☐ Proprietary

RECORD SOURCE:

Submittal Date: 12/12/2003 Z No.: 147549 Name: Jerry McAlpin

Originator: Jerry McAlpin Organization: RRES-CH

TYPE OF RECORD/ACTION TO BE TAKEN

☒ Individual Record ☐ Batch Data Report ☐ Records Package

☐ New ☒ Addition* ☐ Supersedes*

*Record Barcode Number: TWCP - 05523

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

Characterization Data – Pkg 06

Record Date: 12/12/2003 Physical Page Count: 92 ☒ Single Sided ☐ Double Sided

Category Number: (from page two): 38

RECORD TITLE, SUBJECT, AND/OR KEYWORDS:

Characterization Data - Pkg-06
Transmittal of The Sealed Source Peer Review Report

MEDIA TYPE:

☐ CD ☐ Diskette ☐ VHS ☐ Zip ☐ Other (specify): _____

RECORD CENTER USE ONLY

☑ Accepted Date: 12-16-03 ☐ Return Date: _____

Signature: Danette Martin Resubmitted: _____

RIDs Type: NP

(Subject to change prior to scheduled review cycle).

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: _____

RECORD TYPE:

☐ Project 2010 ☐ Facility

☒ Other: QSR ☐ UCNI ☐ Proprietary

RECORD SOURCE:

Submittal Date: 12/12/2003 Z No.: 147549 Name: Jerry McAlpin

Originator: Jerry McAlpin Organization: RRES-CH

TYPE OF RECORD/ACTION TO BE TAKEN

☒ Individual Record ☐ Batch Data Report ☐ Records Package

☐ New ☒ Addition* ☐ Supersedes*

*Record Barcode Number: TWCP - 05523

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

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Transmittal of The Sealed Source Peer Review Report

MEDIA TYPE:

☐ CD ☐ Diskette ☐ VHS ☐ Zip ☐ Other (specify): _____

RECORD CENTER USE ONLY

☑ Accepted Date: 12-16-03 ☐ Return Date: _____

Signature: Danette Martin Resubmitted: _____

RIDs Type: NP

(Subject to change prior to scheduled review cycle).

Washington Group International
Integrated Engineering, Construction, and Management Solutions

December 5, 2003 WSMS-LOS-03-0065

Mr. Lee Leonard
Offsite Source Recovery Project
Los Alamos National Laboratory
Bikini Atoll Road
Mail Stop J-552
P.O. Box 1663
Los Alamos, NM 87545

Dear Mr. Leonard:

SUBJECT: TRANSMITTAL OF THE SEALED SOURCE PEER REVIEW REPORT (U)

Enclosed is the final report (one copy) for the Sealed Sources Peer Review conducted in accordance with NUREG 1297, *Peer Review for High-Level Nuclear Waste Repositories*, from October 27, 2003 through October 31, 2003. The report documents the proceedings and findings of the peer review established to determine the adequacy of using existing data gathered by the Offsite Source Recovery Project for radiological characterization of transuranic sealed sources intended for disposal at the Waste Isolation Pilot Plant.

The Sealed Sources Peer Review Report:

- Describes the work and issues that were reviewed;
- Describes the conclusions reached by the Sealed Sources Peer Review Panel;
- Provides individual statements by the Sealed Sources Peer Review Panel members reflecting additional comments, as appropriate;
- Provides the Sealed Sources Peer Review Panel members acceptability information (i.e., technical qualifications and independence); and is
- Signed by each Sealed Sources Peer Review Panel member

Please contact Jim Booth, the Sealed Sources Peer Review Chairman, at (937) 426-7204 or me at (803) 507-1180 [cell] if you have any questions.

Sincerely,

Ron Burns
Washington Safety Management Solutions
Sealed Sources Peer Review Manager

106 Newberry Street, SW • Aiken, South Carolina USA 29801 • Phone: (803) 502-9936 • Fax: (803) 502-9795
www.wgint.com

Washington Group International
Integrated Engineering, Construction, and Management Solutions

December 5, 2003

WSMS-LOS-03-0065

cc: w/ attachments
Jerry Mc Alpin, LANL
Mike Pearson, LANL
Jim Booth
Joe Harvill
Hugh Evans
Tom Sowdon
WSMS Records Mgmt, CCC-3

cc: w/o attachments
Paul Bell, WGI

106 Newberry Street, SW • Aiken, South Carolina 29801 • Phone: (803) 502-9936 • Fax: (803) 502-9795
www.wgint.com

Final Report

Sealed Sources
Peer Review Report

A Peer Review Conducted by

Hugh Evans
Joe Harvill
Thomas Sowdon
James Booth

for

Off-Site Source Recovery Project
Los Alamos National Laboratory
Los Alamos, New Mexico

December 5, 2003

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ACRONYMS

AK	Acceptable Knowledge
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ISO	International Standards Organization
CFR	Code of Federal Regulations
CH-TRU	Contact Handled Transuranic
CBFO	Carlsbad Field Office
DOE	Department of Energy
DOT	Department of Transportation
EPA	U.S. Environmental Protection Agency
LANL	Los Alamos National Laboratory
MT	Material Type
NMMSS	Nuclear Materials Management and Safeguards System
NSSDR	National Sealed Source and Device Registry
NDA	Non-destructive Assay
NQA	Nuclear Quality Assurance
NRC	Nuclear Regulatory Commission
NSSDR	National Sealed Source and Device Registry
ORNL	Oak Ridge National Laboratory
OSR	Offsite Source Recovery
QA	Quality Assurance
SNM	Special Nuclear Material
TI	Transport Index
SSPRP	Sealed-Source Peer Review Panel
TRU	transuranic
WAC	Waste Acceptance Criteria
WIPP	Waste Isolation Pilot Plant

EXECUTIVE SUMMARY

Actinide-containing sealed sources (those containing Pu-238, Pu-239, and Am-241) have been generated for the past 60 years for applications ranging from use of micro-curie amounts of Am-241 in smoke detectors to Curie amounts of Pu-238, Pu-239, and Am-241 in neutron generating devices. Due to radiological risks posed by these materials when they are no longer needed by their original user, the Off-Site Source Recovery (OSR) Project at the Los Alamos National Laboratory (LANL) has been tasked with gathering these sources for proper control and disposal. To support disposal of these sources at the Waste Isolation Pilot Plant (WIPP), the OSR Project proposes to use existing data from original production, transportation, or source control documents as the basis for determining radiological information required by WIPP's U.S. Environmental Protection Agency (EPA) Compliance Certification.

This peer review panel was convened to review the adequacy of the available data to reasonably support the determination of the radionuclide content for compliance with the WIPP Contact-Handled Transuranic (TRU) Waste Acceptance Criteria (WAC). These records include original manufacturing records, shipping data sheets, and source control information such as the Nuclear Materials Management and Safeguards System (NMMSS). In addition, other corroborating sources of information, such as sealed source engraved markings, Nuclear Regulatory Commission (NRC)/Agreement State regulatory approval data and US Department of Transportation (DOT) records have been collected to support the assignment of radiological properties.

Based on the peer review panel's expertise and experience, the historical documents gathered by the OSR Project are known to have been originally prepared in a controlled manner. Strict adherence to procedures under the oversight of quality assurance programs of the day assured that these sources and their associated production documents were prepared with a high degree of care and certainty. The nature of the source production work itself and the historically successful performance of these sources as fit for their intended purposes support this observation. In addition, the feed material batches for the production of these sources were generated with close tolerances. These narrow tolerances were necessary to satisfy Material Type (MT) requirements in the production of defense materials as well as in the manufacture of sources to defined specifications.

From these considerations, the Peer Review Panel believes that the various data records collected provide either uniquely, or as the sum of several individual records, adequate documentation for determining the radionuclide type, the radionuclide content/activity and either the date of manufacture or other more conservative date (for purposes of decay correction). The Peer Review Panel believes these data are adequate for assigning, with a high degree of certainty, the radiological information required for the disposal of this material at WIPP.

1.0 INTRODUCTION

The Off-Site Source Recovery (OSR) Project at Los Alamos National Laboratory (LANL) was created in 1999, under the direction of the Waste Management Division of the U.S. Department of Energy (DOE) Albuquerque. The OSR Project has been assigned the responsibility to recover and manage excess and unwanted radioactive sources. These sources in their current locations present a risk to the public health and safety and homeland security. *Title I – Low-Level Radioactive Waste Policy Amendments Act of 1985* (Public Law 99-240) transferred responsibility for disposition of these sources to the DOE. The OSR Project has been tasked to provide disposition paths for those sealed sources for which recycling or reuse are not viable options, and which the DOE has declared to be waste.

Sealed radiation sources represent prescribed, known quantities of radioactive material that are encapsulated in containment vessels that are fit for the intended application of supplying a prescribed radiation output. These sealed radiation sources have a myriad of uses in industrial nucleonic measurements, nuclear instrumentation calibration, nuclear medicine, and radiation cancer treatment. The radioactivity contained within a sealed radiation source can be naturally occurring or cyclotron produced (which is controlled by State authorities), or byproduct material or special nuclear material (which is controlled by the NRC and Agreement States). Sealed sources under NRC and Agreement State control are defined in 10 CFR § 30.4 and 10 CFR § 70.4. Of particular interest in this review are sources containing the transuranic (TRU) isotopes Pu-238, Pu-239 and Am-241 as the primary nuclides.

Many of the sources were constructed to generate neutron output by the containment of a controlled mixture of the primary nuclide and a light element, such as beryllium (Be). The concentrations of radioactive TRU materials in such sources usually exceeds NRC Class C concentration limits; therefore, near-surface disposal is prohibited (10 CFR 61.55(a)(2)). The only disposal option for greater than Class C waste available within the United States is the WIPP, provided the waste meets the Contact-Handled (CH) WAC.

These sealed radiation sources were fabricated under highly controlled production and distribution requirements, which has resulted in a detailed pedigree of historical records. LANL proposes to use these records to characterize the radiological content of these sources at the time of their fabrication and then apply the principles of radioactive decay and ingrowth to calculate the change in radioactive content of these sources since their fabrication. The qualified data generated in this manner will be recognized as Acceptable Knowledge (AK) and used for the radiological characterization of these sources for disposal at the WIPP. Such characterization is proposed in lieu of direct measurement by standard non-destructive assay (NDA) techniques due to the technical difficulty of accurately assaying the contained radioactivity. In most cases, the sources represent differing construction geometries, active dimensions and encapsulation material wall thicknesses; therefore, the characteristic low-energy gamma radiations usually used for isotope identification and even quantification are severely attenuated. The degree of the attenuation is so severe that the NDA systems qualified for estimating TRU content in WIPP drums – containing uniformly distributed waste TRU material in a fairly low density matrix - makes accurate NDA content estimations unfeasible. In addition, self-shielding of the radionuclides is another important component of attenuation since these are very dense materials when compressed for sealed sources. Performing NDA on unshielded sources outside the waste container would expose workers to large doses of radiaiton.

LANL proposes to use data generated from existing records documenting the fabrication of the sources to provide all of the necessary radionuclides activities for disposal at WIPP. The ten radionuclides required to be tracked upon disposal at WIPP are U-233, U-234, U-238, Pu-238, Pu-239, Pu-240, Am-241, Pu-242, Cs-137, and Sr-90.

To support the calculation of these radionuclides and their activities at the time of disposal, this Peer Review Panel was convened to assess the validity of the premise that the currently existing source records are adequate for establishing the radioactive source content at the time of construction.

The use of qualified existing data is allowed by the EPA under 40 CFR 194.22 as long as the data were collected under a Nuclear Quality Assurance (NQA) program (40 CFR § 194.22(a)) or the data are qualified using one or more of the following alternative methods (40 CFR § 194.22 (b)):

- Determination that the data were collected under a QA program that is equivalent in effect to American Society of Mechanical Engineers (ASME) NQA-1-1989 edition; ASME NQA-2a-1990 addenda, Part 2.7, to ASME NQA-2-1989 edition; and NQA-3-1989
- The use of corroborating data, with the data relationships and inferences clearly identified and justified
- Confirmatory testing that is performed and documented
- Peer review conducted in a manner that is compatible with NUREG 1297, *Peer Review for High Level Nuclear Waste Repositories.*

Based on the viability of each alternative for qualifying existing data, performing a peer review is the most suitable. The use of a peer review is appropriate under NUREG 1297 guidelines because the adequacy of radiological information cannot otherwise be established through testing, alternative calculations or reference to previously established standards and practices.

2.0 BACKGROUND

LANL intends to ship drums containing qualified sealed sources to WIPP for disposal. Prior to shipping, the contents in the drums must be characterized with respect to radiological isotopic distribution and total activity; as well as other parameters. The method historically preferred by the EPA and Carlsbad Field Office (CBFO) approved TRU waste programs is NDA in accordance with Appendix A of the *Contact-Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE, 2002).

The proposed radiological characterization method relies on the use of AK records to determine the following specific pieces of information to be used in the characterization process:

- The identification of the primary nuclide in the source;
- The quantity of the primary nuclide in the source (in activity or mass);
- The isotopic distribution;
- The associated uncertainties in the quantities and distributions; and
- The date of manufacture of the source.

The proposed characterization method would determine an isotopic distribution for all ten required radionuclides based on conservative assumptions and additional available AK information and applies it to the known quantities of the major radionuclides in order to quantify the remaining WIPP-tracked radionuclides. The use of AK information is aimed at determining the radionuclide content of the sealed sources at the time of manufacture.

The scope of the Peer Review is limited to assessing the quality of the data and not to assessing the characterization method. That assessment is better handled outside the Peer Review process. However, for the panel's understanding, LANL presented information on the characterization process that included information on how decay, ingrowth and activation would be accounted for in the final waste package. The nuclide content of a source would be predicted based on changes in nuclide distribution as a result of decay, neutron interactions and activation of cladding using industrial standard decay correction and nuclear particle transport computer software, such as RADDECAY and Monte Carlo N-Particle (also known as MCNP) shielding code and calculations.

In the LANL approach, the specific records used to determine nuclide identity and source content for each of the three nuclides have been grouped into primary and secondary document sources. The primary document sources for determining the content of the nuclear sources include the NMMSS database, source certificates, source shipping data sheets and source fabrication documents. The secondary document sources include source and device markings, National NRC Device Registry, source manufacturers' product catalogues, source drawings, source physical dimensions and NRC licenses. The information on each nuclear source will be entered into a database used to determine whether sufficient information exists to accurately determine the isotope and activity of the nuclear source. The primary documents have sufficient information to determine both the isotope and activity and date of manufacture of the source. The secondary documents may provide either the isotope or activity or both and perhaps the date of manufacture. In summary, the proposed characterization method for identified sources includes:

- Assembly and evaluation of documentation
- Identification of source content
- Input of data into a database calculational tool
- Review and approval of data, which provides the quantities of radioactive materials in the sealed source in a waste package.

The remaining data needed in the LANL approach are the isotopic distribution and the uncertainties in the quantities and distributions. The isotopic distribution that is used for the particular source types is determined from a combination of Material Control and Accountability Records, Safeguards documents and analytical results on "batches" of materials furnished for source construction. These records are also used to calculate the uncertainties associated with the AK data. By examining the measurements of mass and nuclide distributions in materials furnished for source production, the total uncertainties can be estimated using standard propagation techniques. The uncertainties for those nuclides originally present in materials were associated with the measurement process employed.

A sealed radiation source represents prescribed, known quantities of radioactive material typically embodied as an unreactive and minimally dispersive chemical form that is encapsulated in a containment vessel that is fit for the intended application of supplying a prescribed radiation

output. The NRC/Agreement State regulatory environment for the manufacturers of sealed radiation sources demands:

- Licensed approval for manufacturing – QA systems conformance and the use of unique serial numbers to identify sealed sources
- Licensed controls on nuclides handled – nuclide and maximum holding/inventory
- Reporting requirements for special nuclear materials (SNM)
- Registration of sealed source designs (Model Number) – specifying the nuclide, maximum contained activity, physical dimensions and conformance to minimum American National Standards Institute/International Standards Organization (ANSI/ISO) sealed source performance standards for fitness for purpose in application

The NRC/Agreement State regulatory environment for the users of sealed radiation sources demands:

- Licensed "ownership" requirements defining the source type (Model Number) and the number permitted to possess via a maximum possession activity

The DOT regulatory environment pertaining to the safe transport of radioactive materials demands:

- Nuclide identity, contained total activity and package radiation exposure measurement requirements for each shipment

The NRC and Agreement States mandate that sealed source and device designs are controlled via a national approval process. Engineering and radiation safety evaluations are conducted on proposed designs to ensure that sealed sources are not only manufactured in a consistent manner but also able to safely contain the defined radioactive contents under the conditions of their possession and use. Approval of the evaluated design results in an entry to the National Sealed Source and Device Registry (NSSDR) database, after which commercial production of the design can commence. The registration documents also dictate how the sealed sources and devices are permitted to be distributed and possessed (specific license, general license, or exempt) as well as defining the design, allowed nuclides and maximum radioactive content, function, radiation safety and limitations of use.

The NMMSS is the US government's information system containing historical data on the possession, use and shipment of nuclear materials. This centralized database contains information collected from government and commercial nuclear facilities and provides output reports to those facilities and other interested parties. Data from commercial and government facilities in the U.S. were collected and maintained in the system up to 1985. In addition, the system maintains accounting data on U.S. peaceful use exports and imports that have occurred since 1950. The last NMMSS report was issued in 1985, but the system has been maintained from that day to the present. After 1985, NMMSS has not been as stringent in assuring that the database was updated when material was transferred. Recently, those maintaining NMMSS have begun sending out questionnaires to licensees to update the information. Most of the sources in the OSR Project were manufactured prior to 1985.

The total documentary record base existing for TRU sealed radiation sources therefore provides a high level of detail and enables many duplicate, traceable and cross-referenceable data records to be used for AK confirmation of the identity of individual sealed sources.

TRU sealed sources have multiple uses and energy ranges, such as < 1μCi alpha emitting smoke detection sources, low-energy gamma-emitting mCi X-ray fluorescence sources, and 20Ci neutron sources used in geological formation evaluation.

3.0 REVIEW PROCESS

The peer review process followed the requirements of the Carlsbad Field Office Management Procedure MP 10.5, *Peer Review*, as restated in the *Sealed Source Peer Review Procedure*, in order to implement the guidance in NUREG-1297, *Peer Review for High-Level Nuclear Waste Repositories*.

Specifically, the peer review panel reviewed the adequacy of existing historical data for sealed sources, the validity of the basic assumptions applied to these data, and the potential impacts of alternative assumptions or interpretations affecting the data. Historical data review encompassed source manufacturing records, nuclear source database records (such as the NMMSS), manifesting records and transportation records. Records for each of the three specific subsets of sources (Pu-238, Pu-239 or Am-241) were evaluated, thereby addressing the original technical objectives from the Peer Review Panel Plan on material source, manufacture, and isotopic distribution.

4.0 EVALUATION – HISTORICAL DOCUMENT REVIEW

4.1 Historical Documentation Review

The Peer Review Panel examined each of the historical documents. In doing so, they reviewed the purpose of the document, who generated it, the type of information typically generated for the report and drew a conclusion as to whether the document would be adequate to determine the pertinent information required by the LANL OSR Project.

The Peer Review Panel reviewed the types of data records available to LANL for the radiological characterization of recovered sources. The type of source and isotope are determined using the following sources of data records:

- Sealed Source Test Report/Certificates
- Shipping Documents
- Source Fabrication Documents
- Source markings
- NRC Sealed Source and Device Registry
- Source manufacturer product catalogues
- Source drawings
- Unique physical descriptions

- The NMMSS database for Pu-239 and Pu-238 (to 1985)
- Source manufacturer's databases

In the following sections, each of these data records is described, with a conclusion as to the quality of the information provided.

4.1.1 Source Certificates

The source certificates (Appendix A, Example A-1) are generated by the manufacturer just prior to the point of shipment, after any radiation output measurements, contamination or other leak tests have been performed and supplied to the customer upon delivery of the sealed radiation source. Before source certificates, manufacturers provided similar information on shipping data sheets (Appendix A, Example A-2) that accompanied the source to the purchaser. In light of the radioactive properties of the product and the fact that the product is usually "handled" remotely and never actually "seen" by the user, the certificate acts as the record of definitive product description and is usually considered a quasi-legal document providing proof of ownership. The certificate provides the customer with a summary of the most important parameters relating to the properties and specification of the source; it also usually contains relevant regulatory information pertaining to ownership, such as:

- a certification to the customer confirmation that the source meets Special Form criteria necessary for DOT compliance
- the ANSI/ISO sealed source performance classification, proving that the source is fit for its intended application
- the relevant NRC/Agreement State Model Number important for correct possession license ownership

The source certificates typically contain the following information as determined by panel experience and record examination conducted during the peer review:

- Source manufacturer
- Purchaser
- NRC Model number
- Serial number
- Active material (Am-241, etc.)
- Curie content or gram content (and may include a range)
- Radiation output and reference date (neutrons/sec, etc.)
- Material construction (stainless steel Type 316L)
- Results and date of surface contamination tests
- Confirmation of Special Form status
- Confirmation of ANSI sealed source performance classification
- Signature of the person certifying the source

This document would provide the most accurate and detailed information about the source. Within the industry the certificate is regarded as a legal record describing the source. It would confirm the type of source, isotope and source serial number. The Peer Review Panel would recommend using this as a primary reference whenever available.

4.1.2 Shipping Documents

The shipping documents are prepared by the manufacturer at the time of shipment and a copy of the document is included with the shipment. The purpose of the shipping document was for the manufacturer to provide to the customer information regarding the radioisotope, and package source radiation emission and radiation exposure rate so that the package could be shipped safely and in compliance with the DOT requirements for the shipment of radioactive materials. In the event of an accident, the shipping document would identify the manufacturer and sufficient information to assist in mitigation of the consequences of the accident.

The shipping documents examined give as a minimum:

- Active material - nuclide
- Curie content
- Surface radiation exposure rate on package
- Transport Index (TI) – mR/h at 1 meter
- Date of shipment or date TI determined
- Signature of the person signing the document

Shipping documents provide some accurate and detailed information about the source. Since this document was a legal (DOT) requirement for shipping the source, it would be considered accurate. It certainly would be sufficient to corroborate the contained element and activity. The Peer Review Panel recommends using this reference for the cited information. There are instances when other data would be needed to provide additional information. The Peer Review Panel evaluated a shipping document that did not specify the isotope of plutonium. Thus additional information from source certificates, source fabrication documents, source markings, NRC National Sealed Source and Device Registry, manufacturer product catalogues or source drawings would be necessary to make the final isotope identification.

4.1.3 Source Fabrication Documents

Source fabrication documents (Appendix A, Examples A-3 through A-6) were generated by the manufacturer in order to design and build the sealed radiation source. The documents would provide sufficient detail to enable the manufacture of the containment capsule components the hardware (primary and secondary containers capsules), identify amount of isotope necessary to achieve the required radiation output, provide details about the welding of the capsules and provide a listing of quality assurance requirements for the source. There is no minimum information associated with the source manufacturing documents. Therefore the determination of whether these documents provide sufficient detail to determine the type of source and isotope would be done on a case-by-case basis. Records from Monsanto Research Corporation, Engineered Products Department, were adequate to determine the type of source and maximum curie content. The records uniquely identified the serial number so that there was a link between the source and the information provided.

The Peer Review Panel recommends using this information because source fabrication documents would provide accurate and detailed information about the source, but such information would need to be evaluated on a case-by-case basis. The information would have to be accurate as the information provided was required for the source manufacture. However, there are instances where the information may be incomplete or may not have a link with the specific source under consideration. If that were the case, additional information would need to be provided. Additional information could be acquired from source certificates, shipping documents, source markings, NRC National Sealed Source and Device Registry, manufacturer product catalogues or source drawings. Although information in the source fabrication documents could provide sufficient information to characterize the source, it needs to be evaluated on a case-by-case basis. The documents do, however, provide a wealth of information that is expected to be very accurate. Therefore this information should be used, when available, as a primary source of information.

4.1.4 Source Markings

Marking requirements for sources may be included in the NRC/Agreement State National Sealed Source and Devise Registry, source drawings, Department of Transportation regulations and manufacturing catalogues (Appendix A, Examples A-7 through A-9). Depending on the source size and shape, the source marking may include:

- Serial number of the source
- Manufacturer identification
- Nuclide
- Model Number
- Manufacturing date
- Maximum or nominal activity

If the source is located inside an instrument or other device, this information may also be found on the outside of the instrument or device. Examples were provided ("Sources of AK Documentation," Jerry McAlpin, October 2003) which did provide information on the type of source and isotope. There were other examples where the source model number was identified and based upon additional information, the type of source and isotope could be determined.

The Peer Review Panel recommends the use of source markings for determining the type of source and isotope because such information would be accurate. However, there may be cases where the information is insufficient to make a determination and therefore additional information (such as manufacturing or regulatory records) would be necessary to determine the type of source and isotope. The source markings are believed to be an accurate indication of isotope and quantity and would make a good secondary source of information. Information supplied on the date would be reliable.

4.1.5 NRC National Sealed Source and Devise Registry

NRC and the Agreement States perform engineering and radiation safety evaluations of the ability of sealed sources and devices to safely contain radioactivity under the conditions of their possession and use. These evaluations are summarized in registrations that NRC/Agreement States maintain in the National Sealed Source and Device Registry (NSSDR) (Appendix A, A-10 and A-11). The registration certificates contain detailed information on the sources and devices,

such as how they are permitted to be distributed and possessed (specific license, general license, or exempt), design and function, radiation safety, and limitations on use.

The NSSDR includes the following information:

- Scaled source model number
- Principal use approved
- Manufacturer
- Isotope
- Maximum activity allowed
- Exposure rates at certain distances from the source
- Description of construction
- Requirement for 6 month leak test

The Peer Review Team examined source listings from the Sealed Source and Device Registry. In one instance the model number was not included in the source listing, but the source was well described (Issuing Agency AEC, 1964). Therefore an unequivocal link could not be made between the source and the information in that case. However, later NRC registrations are significantly more comprehensive and rigorous in their data requirements thereby potentially assuring a link.

The NSSDR can be used to identify the type of source and isotope if the source can be linked to the data in the registry. In order to achieve registration in the NSSDR, the manufacturer had to provide a complete source description, cited maximum activity of contained isotope, evidence that the design met the minimum applicable ANSI performance, evidence of Special Form status (where applicable) and indications of exposures rates from the source at certain distances. Therefore this information is deemed to be accurate and reliable. The Peer Review Team deems it is an excellent secondary source of information.

4.1.6 Source Manufacturer Product Catalogues

Source manufacturer product catalogues (Appendix A, Examples A-12 through A-15) were written for the purpose of enabling the potential customer to choose the optimal source and specification for the intended application. They assisted the customer by identifying the radioisotopes available, outer dimension of the sources, maximum curie content per design and neutron or gamma emission of the source. Typically the catalogues identified a specific NRC/Agreement State model number associated with the source and a brief description of the purpose of the source. The information was usually identical to that provided to the NRC/Agreement State for those sources listed for registration in the NSSDR.

Source manufacturer product catalogues may include the following information:

- Source drawings
- Source types
- Model number
- Activity content associated with model number

- Radiation outputs for different activity contents
- Tolerance information
- Method of closure for inner and outer containers
- Quality control tests
- Typical neutron spectrum
- Neutron and gamma dose rates

The panel reviewed portions of and in one case a complete source manufacturer product catalogue from three source manufacturers. The level of information provided in the source manufacturer product catalogues varied among manufacturers but consistently advised the key parameters of interest in this review. The information presented in the product catalogs could be used by customers to apply for the appropriate possession licenses (NRC/agreement states) and to evaluate the appropriateness for the end use of the specific radioactive source.

Source manufacturer product catalogues provide accurate data about the sources made by the specific manufacturer. This information can be linked to an unknown source particularly on consideration of matching the physical design and dimensions. It could provide the type of source and isotope. The information in the catalog would be accurate in order to satisfy the requirements for product liability. The Peer Review Team concludes that this is an excellent secondary source of radiological information.

4.1.7 Source Drawings

The source drawings (Appendix A, Example A-16) were generated by the manufacturer in order to machine fabricate the inner and outer capsules and to provide additional details about the assembly of the source. Since the drawings were used in the manufacture of the source, they would necessarily be accurate. Inaccurate or misleading drawings would be revised so that the source could be manufactured in a consistent manner. Drawings examined during this Peer Review showed an independent reviewer signing the drawing in addition to the drawer. In many instances there were additional approvals shown.

The source drawings could include the following:

- Physical dimensions of the inner and outer container
- Engineering tolerances
- Material of the inner and outer container
- Type of source (Am-Be)
- Specified activity content range
- Required engraving script

The panel reviewed source drawings from one source manufacturer. The degree of information on source drawings varies among manufacturers. Since source drawings were used as a component of the analysis of source design life, the ability to achieve minimum ANSI/ISO performance tests and as a component in the evaluation of Special Form in addition to the

primary purpose of ensuring the consistent manufacture of the sources, the information presented would necessarily be accurate and complete.

If a link can be established between the source and the source drawings, the information presented should be accurate and may be sufficient to identify the source type and isotope. The Peer Review Team concludes that this is an excellent secondary source of information.

4.1.8 Unique Physical Descriptions

The source's outer capsule design had a unique physical appearance that was a characteristic of the application design. It was recognized that visual examination of an unknown source, under suitable radiation protection, provided valuable first assessment leads. The type of source and the contained isotope could be inferred and later determined via cross-referencing.

This type of information may assist in determining the source type and identifying the isotope. Further corroborating information may be needed in order to determine with sufficient confidence, the source type and identify the isotope. The Peer Review Team concludes that this is an excellent secondary source of information.

4.1.9 The NMMSS Database

When weapons grade Pu-239 material first became available for the dissemination of sealed sources for commercial industrial applications, the government made it clear that the material would be "leased" to users and would require its eventual return. A central database was constructed known as the Nuclear Materials Information System, which later segued to the Nuclear Materials Management and Safeguards System (NMMSS) (Appendix A, Examples A-17 and A-18). This database was also extended to capture Pu-238 sources. The last report issued was in 1985. Recently, the owners of the database have begun sending out questionnaires to licensees to update the database. The sources included in the OSR Project were manufactured prior to 1985. This database records the following information:

- Manufacturer
- Source serial number
- Source owner/user
- Material Type
- Date of Manufacture
- Isotopic grams of nuclide contained
- Whether or not Be was incorporated as a target element

This database is exact and robust for all Pu-239 sources and for the majority of Pu-238 sources, in light of the original efforts to collect the data. The missing information is the result of the introduction of foreign-manufactured sources either using US-origin Pu-238 or Russian material of similar grade. The Peer Review Team recommends the database as an excellent source of secondary information.

4.1.10 Source Manu' cturers Databases

Manufacturers may maintain databases as illustrated in Appendix A, Example A-19 and A-20. The database shown contains the source serial number, customer name, number of curies of isotope, the isotope and the date of manufacture. Other information could be provided, depending upon the manufacturer. This information represents an accurate secondary source that could provide all the necessary information for shipment of the source. The Peer Review Team recommends this source of information as a valuable asset and considers it to be a quality document.

4.1.11 Historical Documentation Conclusion

The Peer Review Panel reviewed Table 2 of LA-UR-03-3557, "Characterization of Actinide Bearing Sealed Sources by Acceptable Knowledge, Justification and Methods" by Pearson, M.W. et al. The panel agreed with the conclusions of the table for determining specific source knowledge (i.e. source serial number, isotope, activity or gram content, and date of activity determination). It is reproduced here (rearranged to match the order above) for clarity of the above comments.

Documents	Source Serial Number	Isotope	Activity or Gram Content	Date of Activity Determination
Source Certifications	yes	yes	yes	yes
Shipping Documents	yes	yes	yes	yes
Source Fabrication Documents	yes	yes	yes	yes
Source Marking	yes	case-by-case	case-by-case	case-by-case
NRC National Sealed Source and Device Registry (NSSDR)	no	yes	case-by-case	no
Source Manufacturer Product Catalogues	no	yes	yes	no
Source Drawings	yes	yes	case-by-case	case-by-case
Unique Physical Description	no	yes	yes	yes
Nuclear Materials Management and Safeguards System (NMMSS)	yes	yes	yes	yes
Source Manufacturer's Database	yes	yes	yes	yes

A "YES" in the intersecting cell of the table indicates that a particular type of document provides the information specified. A "Case-by-Case" indicates that the particular information source may or may not contain the specified information.

4.2 RADIONUCLIDE CONTENT AND DISTRIBUTION INFORMATION

Section 4.1 evaluates the use of AK data to determine the following specific pieces of information to be used in the characterization process:

- The identification of the primary nuclide in the source;

- The quantity of the primary nuclide in the source (in activity or mass);
- The date of manufacture of the source.

This section evaluates the use of AK data to determine:

- The isotopic distributions;
- The associated uncertainties in the isotropic distributions.

Each of the three isotopes (Pu-238, Pu-239, and Am-241) is discussed separately. Provided with each isotope are the information sources, how evaluated, conclusions, and uncertainty associated with the isotopic distributions.

4.2.1 Pu-238 Sources

Documentation records for Pu-238 are well characterized for US manufactured sources up to 1985 in the NMMSS database. MT-83(80%) was typically used for general purpose sealed sources – ref: Vance et al. (whereas MT-83(90%) was a unique requirement for heart pacemakers – presently outside the scope of this study). Foreign manufactured sources are identified that utilize both US and Russian origin Pu-238 for low-energy gamma sources used in X-ray fluorescence applications. Manufacturing specifications and records confirm that, in order to achieve consistent product production, the isotopic distributions were essentially identical for the US and Russian origin feedstocks. The duplicate data reference sources available from both manufacturers' records and regulatory records provide alternative as well as corroborative sources of information. It is concluded that verification by these means is fully acceptable.

4.2.1.1 Information basis

LANL provided information extracted from the NMMSS database that indicates that a large fraction of the sources in the NMMSS database (and therefore most of the Pu-238 presently available for recovery) correspond to material type 83 with an enrichment of 80% Pu-238 and a significantly smaller fraction of material type 83 with 90% Pu-238.

This material was produced at the Savannah River Site and was controlled and distributed through Oak Ridge National Laboratory (ORNL) as special nuclear materials. LANL provided several records of material transfers accompanied by the ORNL analytical data sheets that contain detailed information on the distribution of Pu isotopes in this material.

LANL proposes to use the average isotopic distributions of MT83 (80%) and MT83 (90%) in the ratios indicated by the NMMSS database to provide characterization of the distribution of radionuclides at the time of source manufacture for Pu-238 containing sources. The sources of data provided include data sheets on specific devices incorporating the Pu-238, shipping records and official US Atomic Energy Commission Nuclear Material Transfer Reports. In most cases the data sheets were signed or certified and the originating organization was clearly identified along with the date on which the data sheet was created. The data sheets included information on the isotopic distribution of the primary radionuclide and also information on source impurities such as fission products and uranium.

4.2.1.2 Evaluation

The information provided by LANL from various sources was reviewed, evaluated for reasonableness, reliability and internal consistency. The data appeared to be internally consistent and well organized, and the methods used to obtain the data (such as spectroscopy) were referenced. In some cases there were clear references to quality control activities applied to the source(s). The data also appears to represent a significant proportion of the total quantity of Pu potentially available for retrieval.

The Panel finds this information persuasive in that it appears credible, reliable and consistent. The Panel concludes that these data sources are likely to be sufficiently accurate and reliable to be used for source characterization of the initial isotopic distribution for this material (including impurities) and that use of this data to estimate the isotopic distribution in Pu-238 sources is appropriate.

4.3.2 Pu-239 Sources

Documentation records for the Pu-239 SNM are well characterized as a result of the fissile nature of the material and the strict regulatory controls imposed at the time of dissemination of the material to authorized and licensed sealed source manufacturers and then to end-users. The NMMSS database possessed by LANL is a central record and has achieved 100% capture of the products manufactured. Where duplicate data is available (e.g. manufacturing records), then this may be used as corroborative data. The isotopic distribution analysis records for the various material types are well recorded with the majority of the sources being manufactured from MTs 52 and 53 (Ref: Vance et al). It is concluded that verification by these means is fully acceptable.

4.2.2.1 Information Basis

Data on Pu-239 sources is available from NMMSS. LANL used the NMMSS data to determine the quantity (in grams) of each of seven identified material types and combined this information with the known isotopic distributions for each material type from TWCP-AK-2.1-015,R.2 to determine the average distribution of Pu isotopes in a Pu-239 source. The total quantity of Pu-239 sources is estimated at about 40 kg.

4.2.2.2 Evaluation

The Panel considers NMMSS data to be reliable and use of NMMSS data in this fashion to be appropriate. Samples of NMMSS data sheets were reviewed to ascertain that sufficient data was present to make the above calculation. (An evaluation of the isotopic distribution of Pu-239 sources has already been performed and approved and is documented in TWCP-AK-2.1-015,R.2, Table 11.)

The Panel concludes that use of NMMSS data to determine and classify Pu-239 material types is both reliable and appropriate for the purpose proposed and that combination of this data along with the isotopic distributions from TWCP-AK-2.1-015,R.2, Table 11 provide reliable estimates of the distribution of Pu isotopes within Pu-239 sources.

4.2.3 Am-241 Sources

The diversity of possible sealed source configurations achieved with the use of Am-241 (alpha emitter, low-energy gamma emitter or neutron emitter) provides a significant challenge.

In the case of Am-241Be neutron and low-energy gamma sources, the same degree of verification as for Pu-239 and Pu-238 sources is achieved save for the absence of entries in a NMMSS database. The alternative and duplicative data sources involving manufacturing, regulatory and shipping (DOT) records provide a well qualified and corroborative database.

In the case of alpha sources, particularly those used in smoke detection ionization chamber manufacture, the Am-241 "sources" are characterized by low activity (<1μCi), but in production quantities in excess of 20 million per year. The sources are so small that they bear no identification whatsoever; however, the waste stream is only likely to receive manufacturing rejects. For these sources, available data is totally dependent upon manufacturing records and maximum contained activity being governed by the regulatory database, which is the National Sealed Source and Device Registry (NSSDR).

Documentation records for feedstock batches of US origin are well characterized. It was realized during the review that during periods of feedstock unavailability from the US stockpile that both Russian and French feedstock materials had been accessed and accounted for a significant proportion of the sources in circulation. However, in light of the tight purchasing specifications used by the sealed source manufacturers (in order to ensure batch to batch consistency), there is good evidence to show the equivalency to the historical US feedstock. It was noted that some manufacturers used feedstock Am-241 for alpha, low-energy gamma and neutron sealed source applications. In some instances sealed source manufacturers may have subjected the feedstock to further radiochemistry refining which would have disrupted the accepted feedstock isotope distribution. This was usually only necessary when a given batch contained an interfering impurity that was problematical to the intended application (usually alpha or low-energy gamma sources), the resulting Am-241 feedstock being even purer than originally. If the standard feedstock isotope distribution was used as a standard then this would represent the worst-case isotope distribution. It is concluded that verification by these means is fully acceptable.

4.2.3.1 Information Basis

LANL provided 70 historical analytical data sheets obtained from LANL and ORNL that included estimates of isotopic distribution in Am-241 sources including impurities. These data were used to calculate averages of the relative mass abundance of Am-241 and Pu-238, -239. This data was then used to calculate the fraction of total source activity represented by each isotope for an Am-241 source. LANL estimates that these data sheets are representative of about 7.4 kg of the estimated 10 kg of Am-241 supplied for source manufacture.

4.2.3.2 Evaluation

The Panel reviewed all of the data sheets provided. The data appeared to be carefully prepared, clear, legible and reliable. The data sheets appear to provide the type of data required for the specified analysis.

The Panel concludes that use of historical analytical data sheets to determine the mass fractions and distribution of isotopes in Am-241 sources (including impurities) is both reliable and appropriate for the purpose proposed and that use of this data to estimate the isotopic distribution in Am-241 sources is appropriate.

4.2.4 Uncertainty

4.2.4.1 Information Basis

An assessment of individual types of error that contribute to the total uncertainty in the final estimate of the isotopic distribution in a source was provided by LANL. These types included manufacturing uncertainty, mass spectroscopy uncertainty and random data variability. This information was provided principally by vendors (Monsanto and Oak Ridge) and by straightforward statistical analysis on the available radionuclide mass distribution data sheets.

LANL also proposes the use of "generic" uncertainty information for a variety of different measurement techniques used in measuring the quantities of radionuclide in the source materials that should be addressed. In particular this information may come from the following references or other relevant sources:

- "Handbook of Nuclear Safeguards Measurement Methods", NUREG/CR-2078, September 1983.
- "Calibration Techniques for the Calorimetric Assay of Plutonium Bearing Solids Applied to Nuclear Materials Control", ANSI Standard 1522, 1975.
- "An Evaluation of the Use of Calorimetry for Shipper-Receiver Measurements of Plutonium", NUREG/CR-0014, June 1978.
- Correspondence from Atlantic Richfield Hanford Company to Mound Laboratory, entitled "NDA Isotopic System-Standards Measurement Data", dated February 18, 1977.

4.2.4.2 Evaluation

The Panel reviewed the information provided and determined that the information appears reasonable and consistent with the Panel's own experience. The method of assessing random error in the radionuclide mass distribution data sheets uses proper error propagation methods and appears appropriate; however, is outside the scope of the peer review and will be evaluated by subsequent assessments.

The Panel concludes that the estimates of error contributed by individual sources of error (manufacturing, calorimetry, isotopic determination, material distribution and sample variation) are appropriate.

5.0 CONCLUSIONS

The quality and content of source records varied from one source to another based on the type and age of each record. In many cases information critical to source characterization was clearly and unequivocally identified. The best example of this was a document that made reference to a unique source number that was directly traceable to an actual physical source.

In other cases, source information data sheets required some additional information, interpretation or inference beyond that contained on a single sheet. For example, some records referred to "PuBe" sources with specific activities without identifying which Pu isotope was present. However, through discussion with LANL personnel, it was clear that other reliable information

existed for the specific sources and manufacturer that unequivocally resolved which Pu isotope was present in the source.

The Panel believes that the best way to address the quality of records and to ensure that appropriate records may be relied upon while others should be excluded (i.e. not form the exclusive basis for a source characterization) is to specify as clearly and definitively as possible a set of criteria to be applied that establish whether or not documentation can be relied upon for source characterization.

The Panel proposes the following criteria be used to determine which sources should NOT be considered as candidates for the AK approach to source classification because of the nature or condition of the source or supporting documentation.

- Sources exhibiting any indication of deliberate modification or source marking alteration.
- Sources with equivocal, illegible or ambiguous documentation or source marking.
- Sources that may have undergone significant external neutron irradiation, such as would be encountered in a nuclear reactor.
- Sources that are supported solely by informal or "ad-hoc" documentation (handwritten source information, unsigned or undated, no attributable manufacturer, etc.).
- Sources for which information from multiple data sources is severely inconsistent.

The criteria listed above, although directed at the source itself, are intended to ensure that only reliable documentation is used for source characterization and only sources for which reliable documentation exists are characterized using AK. Note that these criteria are not intended to exclude sources for which adequate documentation exists simply because a single source of data is unreliable or fails any of the above criteria. Conflicting data need to be resolved in a manner that provides assurance and clearly documents that the radionuclide information developed for a source is representative of that source.

The peer review panel has received and reviewed presentations from LANL personnel on the analytical methods used to determine the isotopic distribution of TRU sources destined for disposal at WIPP. The Panel has also reviewed samples of documentation made available by the LANL staff as the type of documents expected to be relied upon in the application of AK to source characterization.

The method proposed consists primarily of 1) identification of the initial quantity and type of TRU from one or more qualified source records and, 2) calculation of changes in source composition resulting from buildup (ingrowth), decay, and, where appropriate, neutron-induced transformations from the time of initial source characterization to the time of disposal.

In summary, the Panel believes that the application of AK to the determination of the distribution of isotopes in TRU sources at the time of disposal provides adequate for source characterization within the limitations and exclusions described in this report. Data are within the accepted range of data developed through the current NDA programs as defined within the NDA Performance

Demonstration Program Quality Assurance Objectives. In fact, the Panel believes that the AK results far surpass any that could currently be generated using NDA.

6.0 RECOMMENDATIONS

The Panel offers the following recommendations for consideration by the LANL staff.

1. The uncertainty analyses appear to contain redundant terms resulting in a greater estimate of total uncertainty than likely exists. For processes that may employ different analytical methods as confirmatory or alternate steps in determination of isotopic inventory, the uncertainties of both methods need not be included. For example, for a case where calorimetry in conjunction with gamma spectroscopy are used to determine the mass of an isotope present in a sample, and uncertainty terms are included for both calorimetry and gamma spectroscopy, it is not necessary to include an additional uncertainty contribution resulting from the estimation of the mass of source material deposited since that parameter is already accounted for by calorimetry and gamma spectroscopy.

2. The criteria for inclusion and exclusion of a source or source documentation from the AK characterization process should be clearly established and documented. Examples of such "exclusion criteria" are included earlier in this report.

3. Information on measurements of impurities (such as Cs, Sr and U) in the initial sample may be available from the same data sheets used to determine source type and quantity. These estimates may be used to establish upper limit estimates of the quantity of source impurities and may be used to specify the contribution of such impurities as "less than" values if enough information is available for a particular isotope. Since these impurities are likely to be insignificant fractions of the total source inventory, even crude estimates of these activities should be sufficient for source characterization.

7.0 REFERENCES

- Carlsbad Field Office Master Procedure MP 10.5, *Peer Review,* Revision 5, February 1, 2003.
- *Contact Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, DOE/WIPP-02-3122.
- Pearson, et al., *Characterization of Actinide Bearing Sealed Sources by Acceptable Knowledge - Justification and Methods*, LAUR-03-3557, May 2003.
- *Peer Review for High-Level Nuclear Waste Repositories*, NUREG 1297, US Nuclear Regulatory Commission, Washington, DC.
- *Sealed Sources Peer Review Plan*, Revision 1, October 29, 2003.
- Sealed Sources Peer Review Procedure, Revision 1, October 29, 2003.
- *Sources of AK Documentation*, Peer Review Orientation Material, Jerry McAlpin, October 2003.

APPENDIX A

EXAMPLES OF DATA RECORDS

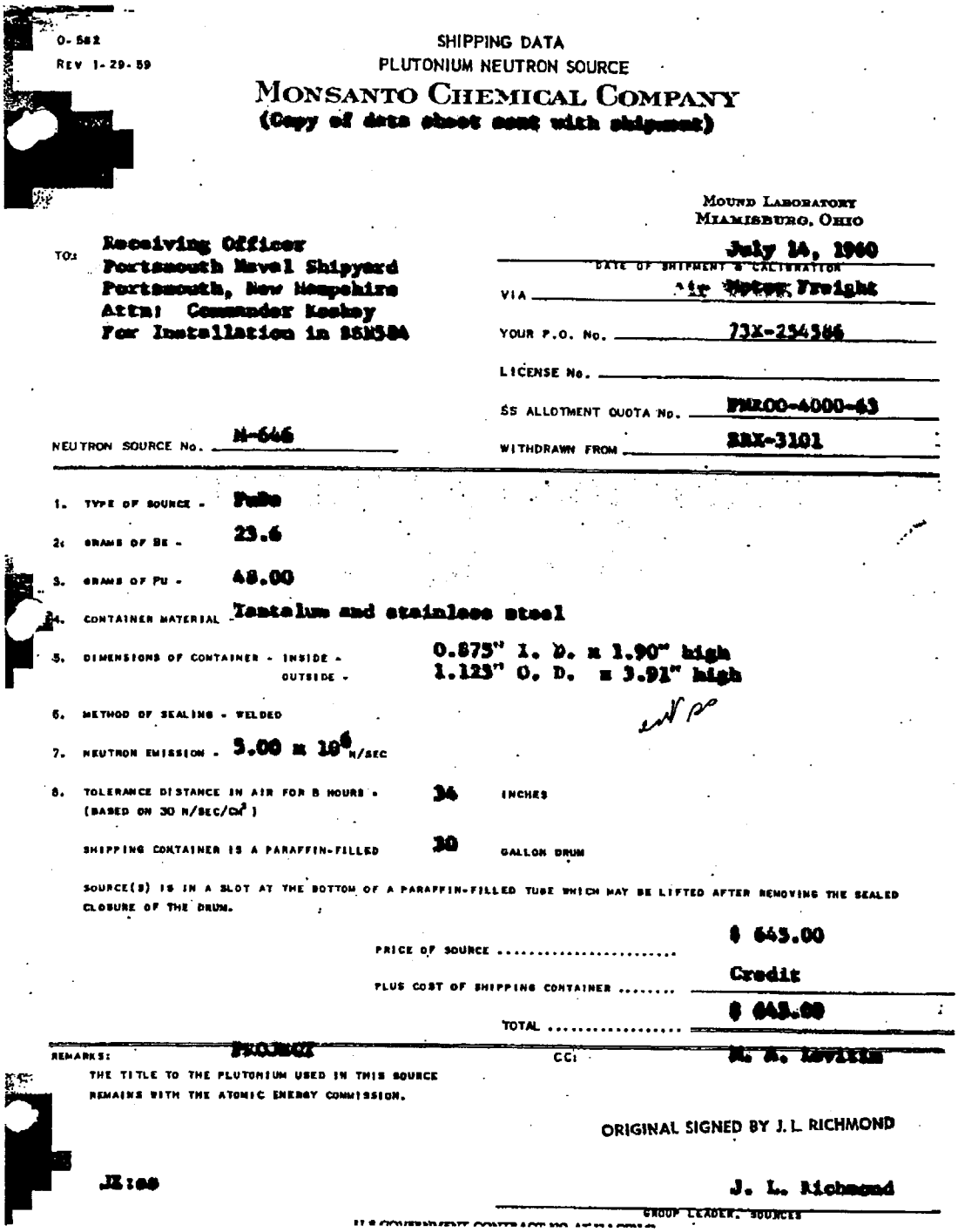
GAMMATRON INC.

GAMMATRON INC.
P.O. BOX 34042 • HOUSTON, TEXAS 77034 • AREA CODE 713/641-0391

SEALED SOURCE CERTIFICATE

1. PURCHASER: CPN COMPANY — P.O. # 13300-1
2. MANUFACTURER: GAMMATRON, INC.
3. MODEL: AN-HP — SERIAL # CPN620
4. ACTIVE MATERIAL: Am-241Be
   55 mCi
   MAXIMUM CONTENT
   45 mCi
   MINIMUM CONTENT
   ACTUAL CONTENT BASED ON WEIGHT INPUT AND CI/GRAM AS SUPPLIED BY ORNL ± 1%: 50 mCi
   YIELD: N/A
   STD: 126 mCi REF NBS
   GAMMATRON STD: CPN-20=1.50 X 10^5 NPS
   SERIAL #
5. THIS IS TO CERTIFY THAT THIS SOURCE MEETS THE REQUIREMENTS FOR SPECIAL FORM AS DEFINED IN DOT TITLE 49 (173.403[Z]) AND THE REQUIREMENTS OF:
   77C55535
   ANSI CLASSIFICATION — SIGNATURE
   TEXAS REGULATIONS PART 36.108 — SIGNATURE
6. MATERIAL OF CONSTRUCTION: 316L SS
7. WIPE TEST:
   INNER CAPSULE: <.005 uCi
   OUTER CAPSULE: <.0005 uCi
   DATE: 07/29/92
   BY
8. HELIUM TEST: NEG — INNER: NEG. — OUTER
9. PRESSURE TEST: N/A — WT. — FINAL OUT
10. CONTAINER WIPE TEST: <.0005 uCi
11. TYPE: 7A — SERIAL #: GT-25
12. SURFACE: 60 mrem/hr — INDEX: 3 — LABEL: YELLOW III

Example A-1 Sealed Source Certificate



O-582
REV 1-29-59

SHIPPING DATA
PLUTONIUM NEUTRON SOURCE

MONSANTO CHEMICAL COMPANY
(Copy of data sheet sent with shipment)

MOUND LABORATORY
MIAMISBURG, OHIO

TO: Receiving Officer
Portsmouth Naval Shipyard
Portsmouth, New Hampshire
Attn: Commander Keeley
For Installation in SSN584

DATE OF SHIPMENT & CALIBRATION: July 14, 1960

VIA: Air Motor Freight

YOUR P.O. No.: 73X-254586

LICENSE No.:

SS ALLOTMENT QUOTA No.: PNROO-4000-63

NEUTRON SOURCE No.: M-646

WITHDRAWN FROM: SRX-3101

1. TYPE OF SOURCE - Pu-Be
2. GRAMS OF Be - 23.6
3. GRAMS OF Pu - 48.00
4. CONTAINER MATERIAL - Tantalum and stainless steel
5. DIMENSIONS OF CONTAINER - INSIDE - 0.875" I. D. x 1.90" high
   OUTSIDE - 1.125" O. D. x 3.91" high
6. METHOD OF SEALING - WELDED
7. NEUTRON EMISSION - 3.00×10^6 N/SEC
8. TOLERANCE DISTANCE IN AIR FOR 8 HOURS - 36 INCHES
   (BASED ON 30 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 ..... $ 645.00
PLUS COST OF SHIPPING CONTAINER ..... Credit
TOTAL ..... $ 645.00

REMARKS: PROJECT

CC: M. A. Levitin

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

ORIGINAL SIGNED BY J. L. RICHMOND

JE:ee

J. L. Richmond
GROUP LEADER, SOURCES

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

Example A-2 Shipping Data Sheet

1-15-73

ENGINEERED PRODUCTS DEPARTMENT

Contract No. 018-4C0 Manufacturing Order No. 1128-C
Quantity 1 Serial Number(s) AmBe-2516

Customer:
LFE CORP.
1601 TRAPELO RD
WALTHAM, MASS 02154

Shipping Address:
SAME

Purchase Order No. 35037
Date Received 1-15-75
SHIP DATE Delivery Required 3-28-75
Spec. Form Cert. Req'd. ☑ Yes ☐ No
License No. ☑ Yes ☐ No

Ship: ☐ Prepaid ☑ Collect ☐ Prepaid & Charge
FOB: ☑ Dayton ☐ Destination
Ship Via METER FREIGHT

Additional Documents Required LICENSE CERTIFICATE WILL BE SENT LATER (OUR CERTIFICATE SENT TO LFE ON 1/16/75)

Manufacturing Instructions:

MANUFACTURE ONE 10 Ci AmBe MODEL 2726-B NEUTRON SOURCE.

NOTE ⇒ THIS IS A 10 Ci MAX SOURCE DUE TO THEIR LICENSE AMENDMENT

Engineering Notice/Release: Meets: ☑ Special Form ☐ Normal Form

Construct the source per M.R.C. Dwg. A2726-BA00. Minimum weld penetration .030". Mark the source per MRC license.

By: W.R. Date 1-21-75

Authorized Time and Material:

Nuclear Mfg. Labor: 8 Isotope (Ci ~~or gms~~): 10 Ci Am241
Nuclear Engrg. Labor: Outside Jobs:
Shop Labor: 6 Material:
Released to: ☐ Engineering ☐ Manufacturing
Issued by: T W Jones Date 1-16-75

ENGINEERED PRODUCTS MANUFACTURING ORDER FORM

Example A-3 Source Fabrication Documents -- Manufacturing Order Form

PROCESS CONTROL DIVISION
1601 Trapelo Road
Waltham, Massachusetts 02154
(617) 890-2000 TWX – 710-324-0681

35037
35037

DATE	BUYER	CONFIRMING	☐ PHONE	☐ WIRE	MASS. SALES TAX REG. >	TERMS	N30
/14/75	AVOLIO	DATE	TO		4-2226247 YES ☐ NO ☐	F.O.B.	SP
	VENDOR NO.		REQUISITION BY W.FREDERGAST			SHIP VIA:	BESTWAY

DOR

MONSANTO RESEARCH CORPORATION
1515 NICHOLAS ROAD
P.O. BOX 8, STATION B
DAYTON, OHIO 45407
ATTN: LES JONES

1) OUR PART NUMBER MUST APPEAR ON ALL INVOICES AND PACKING SLIPS.
2) DUPLICATE INVOICES REQUIRED
3) OUR ORDER NUMBER MUST APPEAR ON ALL PACKAGES, INVOICES AND CORRESPONDENCE

QUANTITY ORDERED	OUR PART NUMBER	DESCRIPTION	RELEASE SCHEDULE QUANTITY	RELEASE SCHEDULE DUE DATE	ACCOUNT NUMBER	UNIT PRICE	TOTAL PRICE
1		MODEL 2726B AMERICIUM NEUTRON SOURCE 10 Curies SHIPPING CONTAINER TO BE SUPPLIED BY LFE. INSTRUCTIONS RE: SOURCE HOLDER TO BE SUPPLIED BY W. FREDERGAST.	1	2/15/75	9124101	1760.00	1,760.00
		Purchase by Les Jones Date 1/14/75					
						TOTAL	1,760.00

THE PRICE FOR THESE PARTS IS NOT IN ACCORDANCE WITH THE PRICE SHOWN ON THE PURCHASE ORDER, NOTIFY US IMMEDIATELY.
E PEVERSE SIDE AND ATTACHMENTS FOR INSTRUCTIONS, TERMS AND CONDITIONS WHICH ARE INCORPORATED HEREIN AS PART OF THIS ORDER.
CKNOWLEDGE ORDER PROMPTLY SHOWING DELIVERY DATE.

LFE - Process Control Division
A. Avolio
PURCHASING AGENT

Example A-4 Source Fabrication Documents – Purchase Order

1-21-75
AVR

L.F.E. Corp.
Waltham, Mass

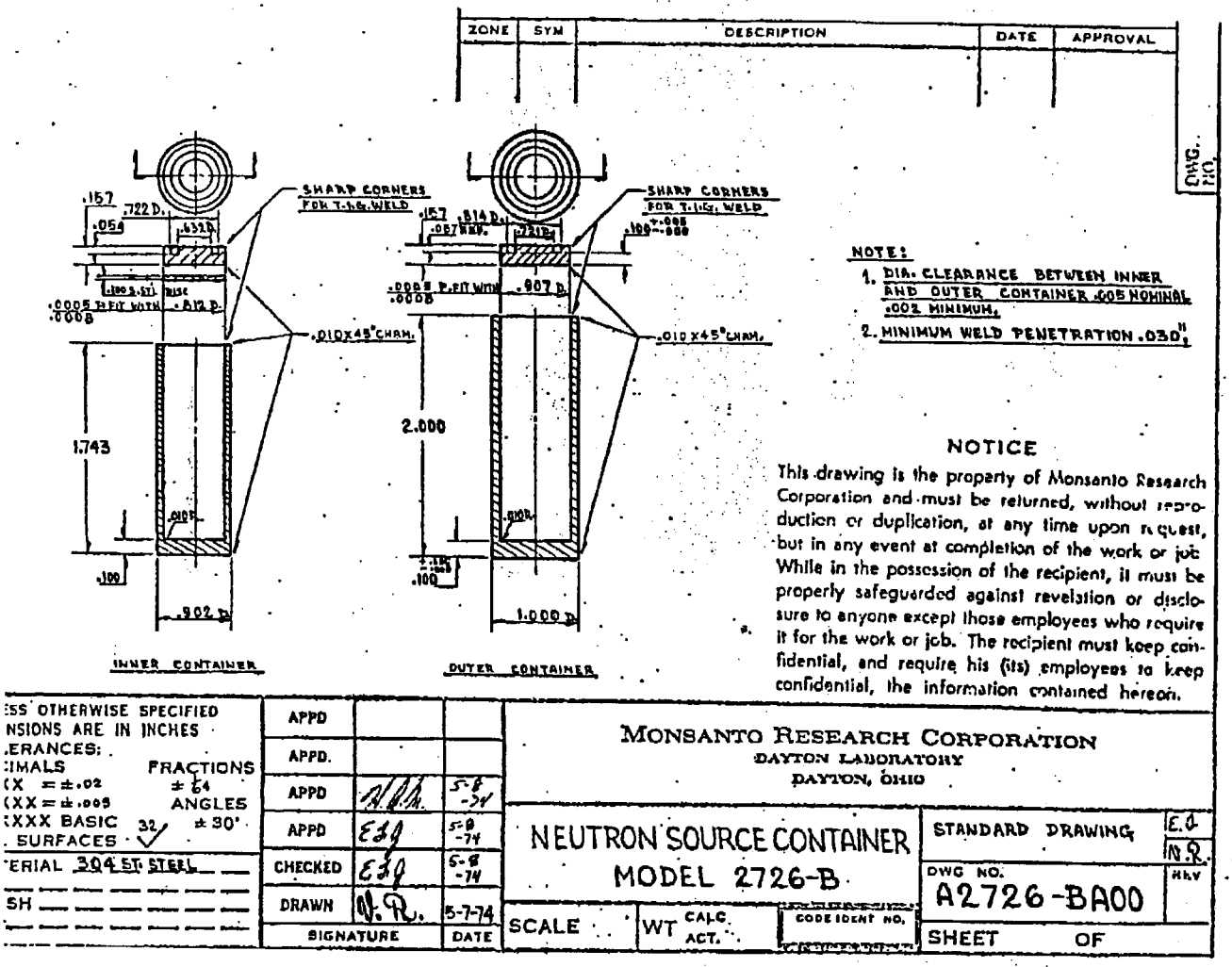
Contr. No. 018-4CO
Mo. No. 1028-6

The Contract calls for AmBe Neutron-source, with 10 ci. max. output; to be fabricated as MRC Model 2726-B, per MRC Dwg. A2726-BA00.

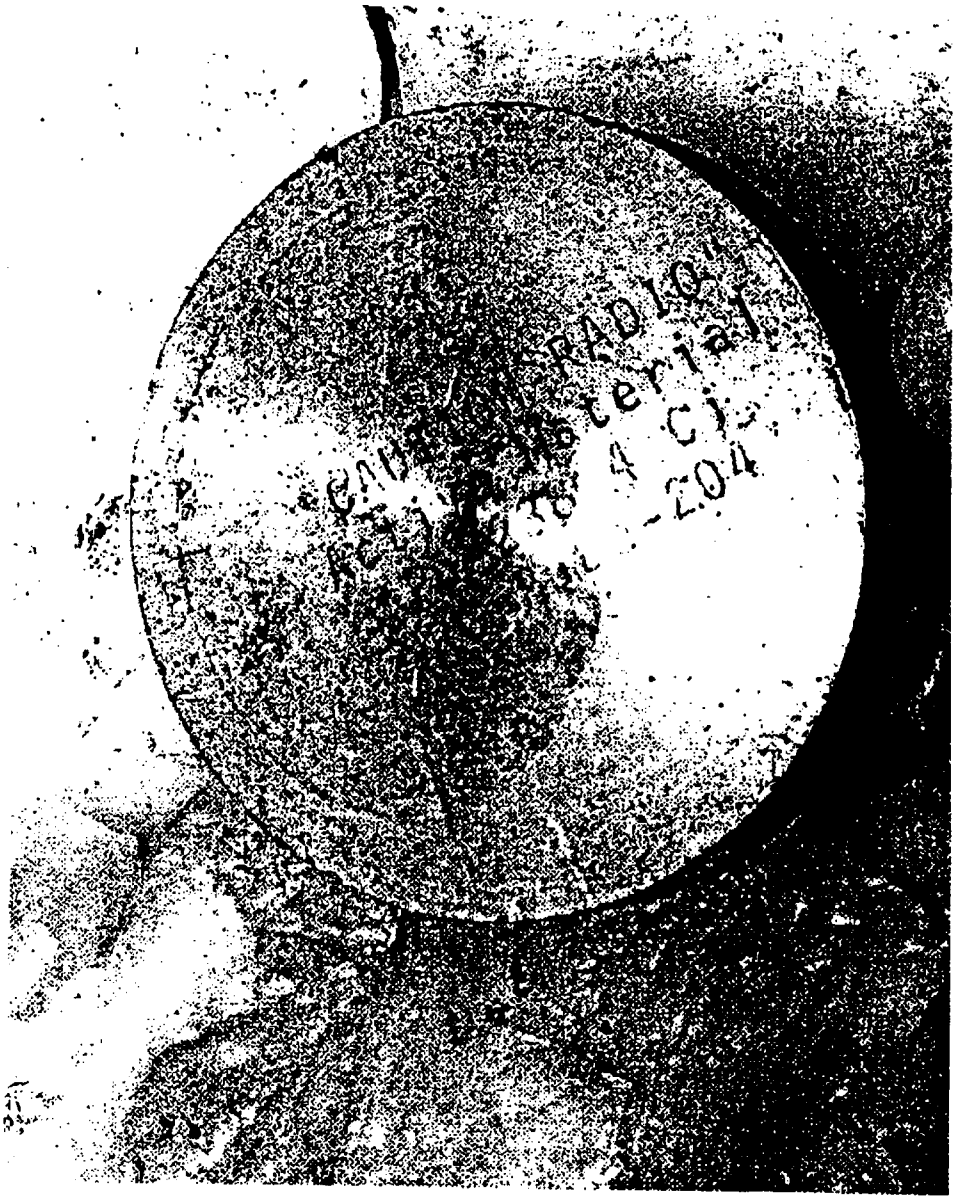
The Engineering file for MRC standard-sources shows that AmBe Neutron-source Model 2726-B Dwg. A2726-BA00 is analysed for 16,6 curies max. and will meet "Special Form" criteria for 10 yrs. life expectancy.

By the comparison to the above, the source design A-2726-BA00 meets customer request and could be fabricated.

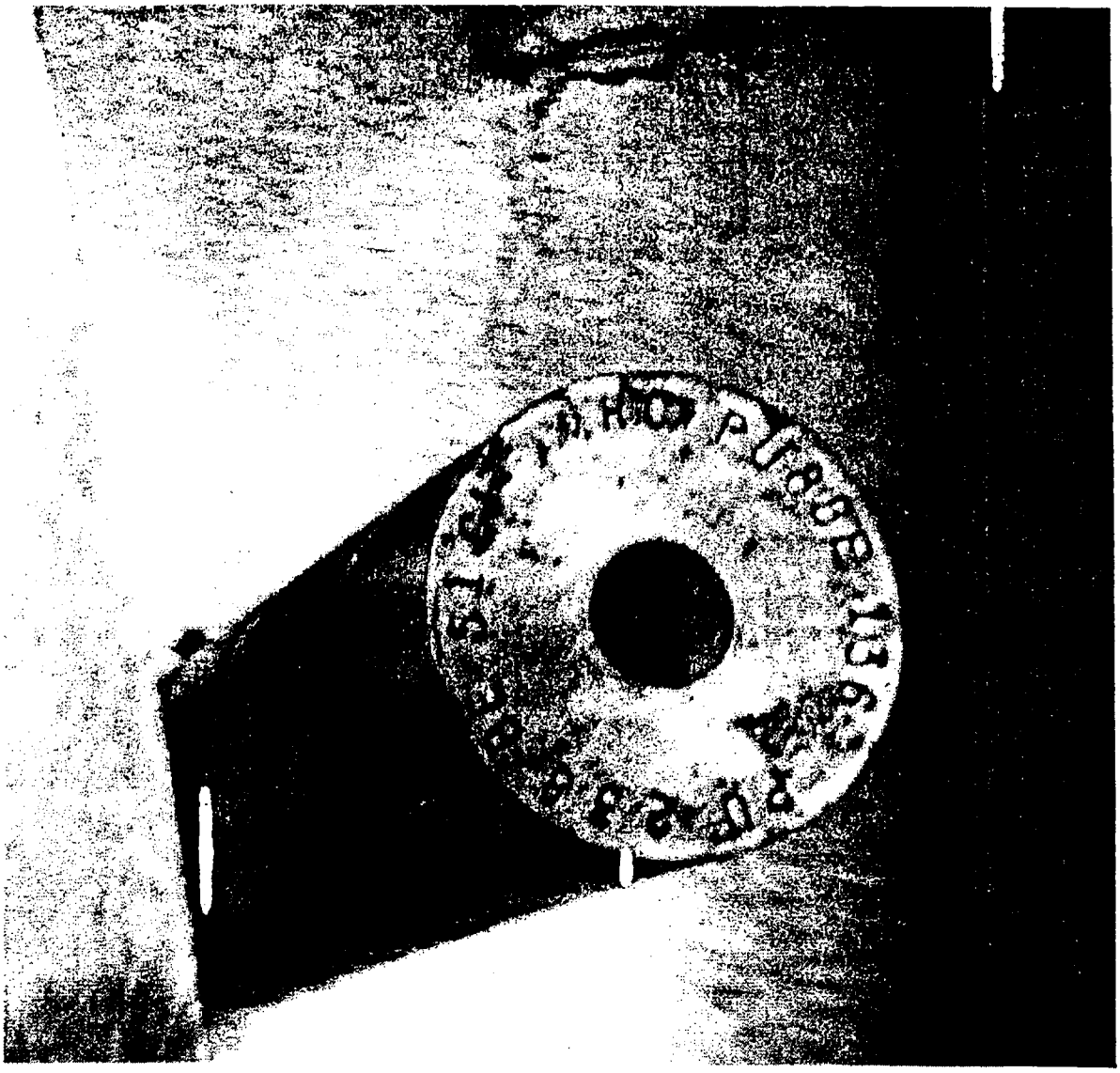
Example A-5 Source Fabrication Documents – Engineering Release



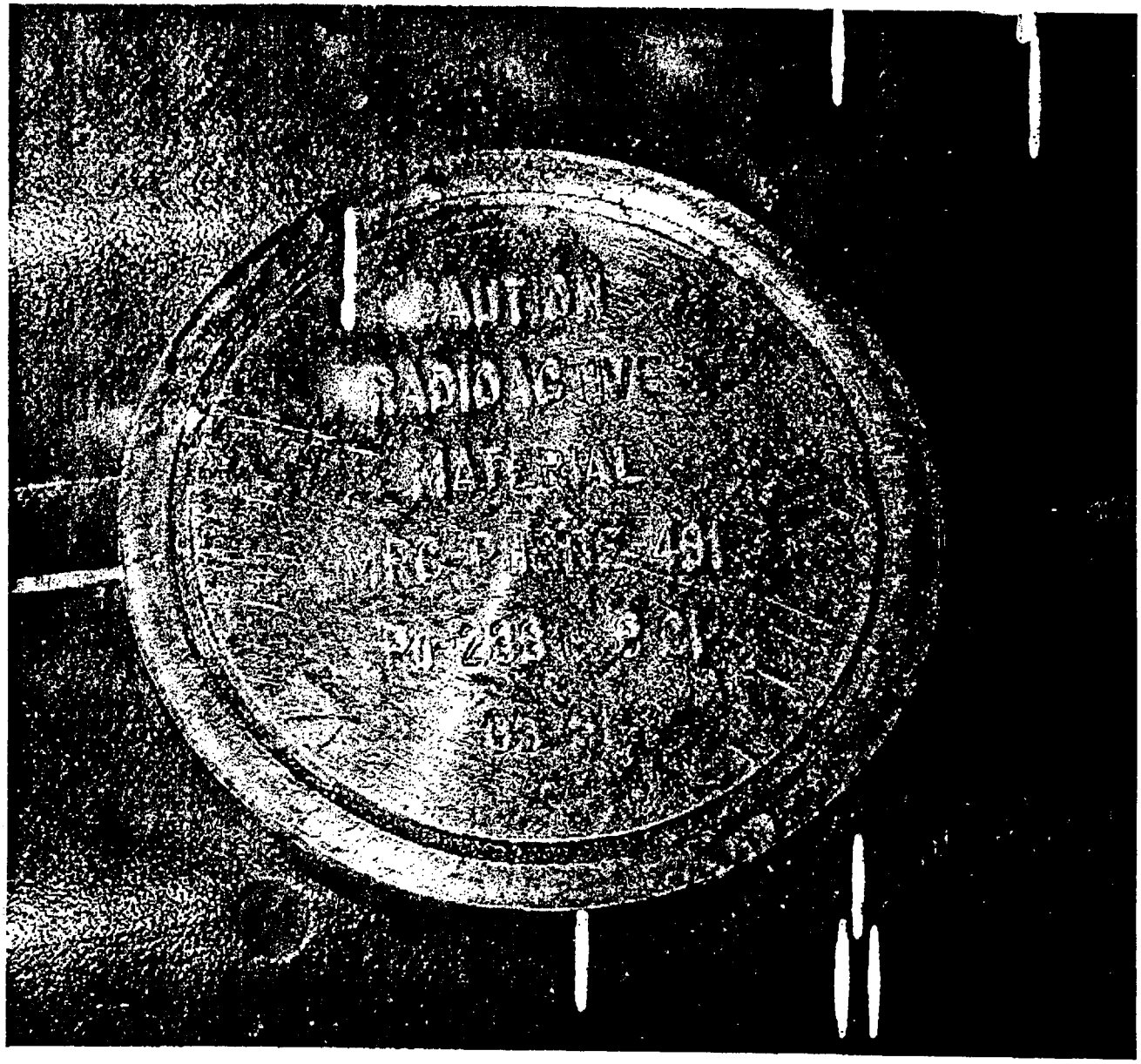
Example A-6 Source Fabrication Documents – Source Drawing



Appendix A-7 Source Markings – "CAUTION – RADIO Active Material Pu-238 4 Ci MRC PuBe-204"



Example A-8 Source Marking – "MRC PU 8 BE PU 238 BE51 CI"



Example A-9 Source Marking – "CAUTION RADIOACTIVE MATERIAL MRC-PU 238 8 CI 05 81"

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE

NO.: NR930S803U DATE: July 06, 1964 PAGE 2 OF 2

SEALED SOURCE TYPE: Neutron Source

DESCRIPTION:

Use	Isotope	Model #	Activity (CURIES)
Neutron Source	Americium 241	NUMEC-AM-31	1
		NUMEC-AM-62	2
		NUMEC-AM-93	3
		NUMEC-AM-100	3.24
		NUMEC-AM-123	4
		NUMEC-AM-154	5
		NUMEC-AM-185	6
		NUMEC-AM-200	6.48
		NUMEC-AM-309	10
		NUMEC-AM-500	16.2
		NUMEC-AM-1000	32.4

The americium is in the form of an oxide and pelletized.

The source contains americium-berylium with the quantity of americium for a particular source listed above. The sources may be used in applications such as neutron activation, well-logging, gauging, etc. The source is doubly encapsulated in 304 stainless steel and each capsule is welded.

EXTERNAL RADIATION LEVELS:

The capsule is decontaminated and contains less than 10 disintegrations per minute. (Outer surface.)

QUALITY ASSURANCE AND CONTROL:

Each source is inspected prior to transfer. The sources have been extensively tested to determine source integrity.

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

The supplier does not routinely furnish a storage container with the source; however, NUMEC will supply a container if requested.

ISSUING AGENCY:

U.S. Atomic Energy Commission

Example A-10 NRC National Sealed Source and Device Registry, Page 1

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE

NO.: NR9305803U DATE: July 06, 1964 PAGE 2 OF 2

SEALED SOURCE TYPE: Neutron Source

DESCRIPTION:

Use	Isotope	Model #	Activity (CURIES)
Neutron Source	Americium 241	NUMEC-AM-31	1
		NUMEC-AM-62	2
		NUMEC-AM-93	3
		NUMEC-AM-100	3.24
		NUMEC-AM-123	4
		NUMEC-AM-154	5
		NUMEC-AM-185	6
		NUMEC-AM-200	6.48
		NUMEC-AM-309	10
		NUMEC-AM-500	16.2
		NUMEC-AM-1000	32.4

The americium is in the form of an oxide and pelletized.

The source contains americium-beryllium with the quantity of americium for a particular source listed above. The sources may be used in applications such as neutron activation, well-logging, gauging, etc. The source is doubly encapsulated in 304 stainless steel and each capsule is welded.

EXTERNAL RADIATION LEVELS:

The capsule is decontaminated and contains less than 10 disintegrations per minute. (Outer surface.)

QUALITY ASSURANCE AND CONTROL:

Each source is inspected prior to transfer. The sources have been extensively tested to determine source integrity.

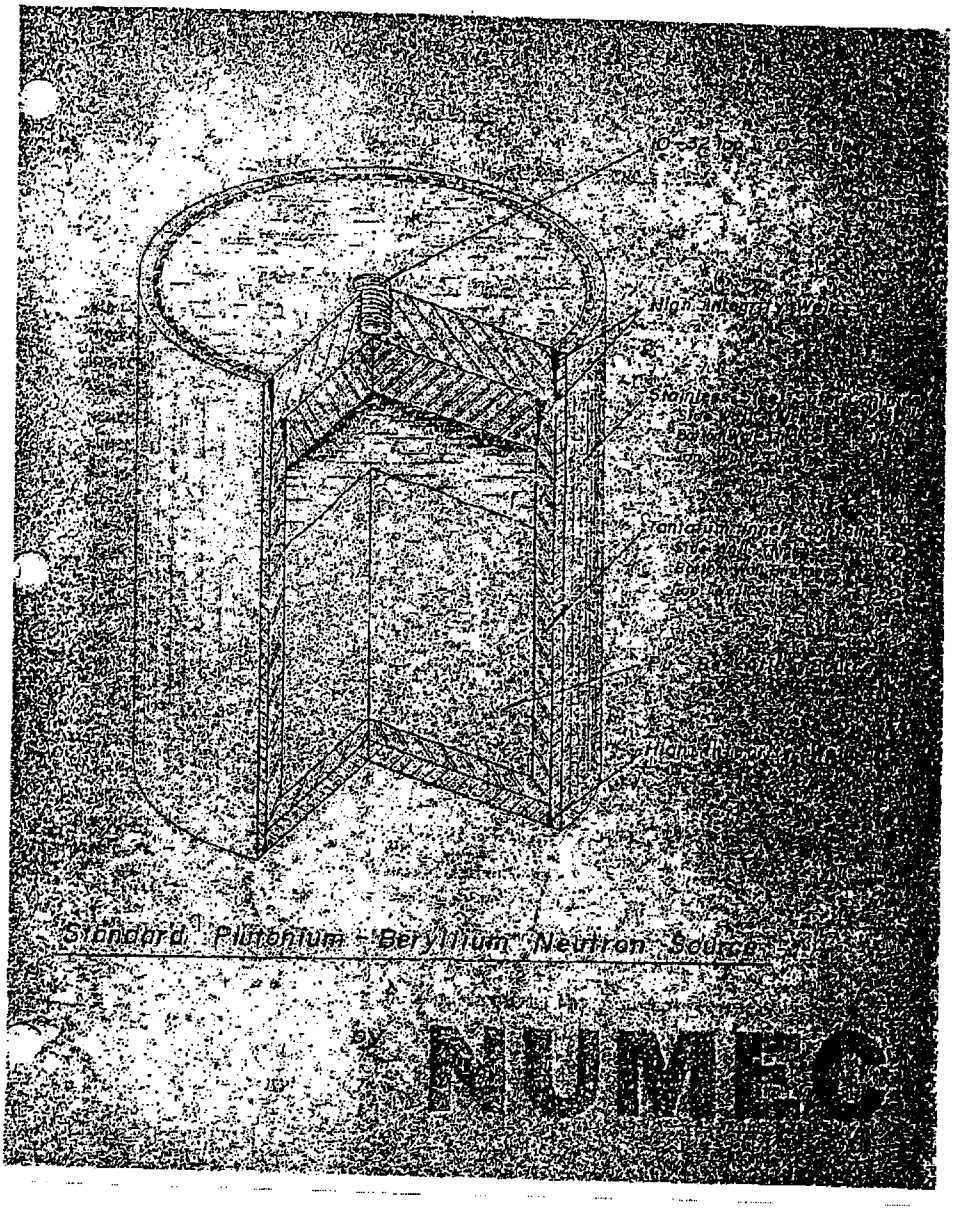
LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

The supplier does not routinely furnish a storage container with the source; however, NUMEC will supply a container if requested.

ISSUING AGENCY:

U.S. Atomic Energy Commission

Example A-11 NRC National Sealed Source and Device Registry, Page 2



Example A-12 Source Manufacturer Sales Catalogue: NUMEC, Page 1

PRICE LIST

Standard NUMEC Plutonium-Beryllium Neutron Sources

Catalog No.	Grams of Pu	Diameter of Cylinder *	Length of Cylinder *	Price
I. Sources whose length includes 0.250" cap and 10/32 tapped hole:				
NUMEC-A	1	1.020	[illegible]	[illegible]
NUMEC-B	2	1.020	2.190	[illegible]
NUMEC-C	2	[illegible]	1.510	$ 775
NUMEC-D	3	[illegible]	[illegible]	[illegible]
NUMEC-E	3	[illegible]	[illegible]	[illegible]
NUMEC-M	3	1.020	[illegible]	[illegible]
NUMEC-F	4	1.310	[illegible]	[illegible]
NUMEC-G	4	[illegible]	1.775	[illegible]
NUMEC-N	4	1.020	3.080	[illegible]
NUMEC-H	5	[illegible]	2.720	$1000
NUMEC-L	5	1.550	[illegible]	$1000
NUMEC-P	[illegible]	[illegible]	[illegible]	$1000
NUMEC-J	7	[illegible]	2.585	$1150
NUMEC-K	10	[illegible]	[illegible]	[illegible]
II. Sources whose length includes 0.100" cap and no tapped hole:				
NUMEC-AT	1	1.020	[illegible]	[illegible]
NUMEC-BT	2	1.020	2.040	[illegible]
NUMEC-CT	3	[illegible]	[illegible]	[illegible]
NUMEC-DT	4	[illegible]	[illegible]	[illegible]
NUMEC-ET	5	[illegible]	[illegible]	[illegible]

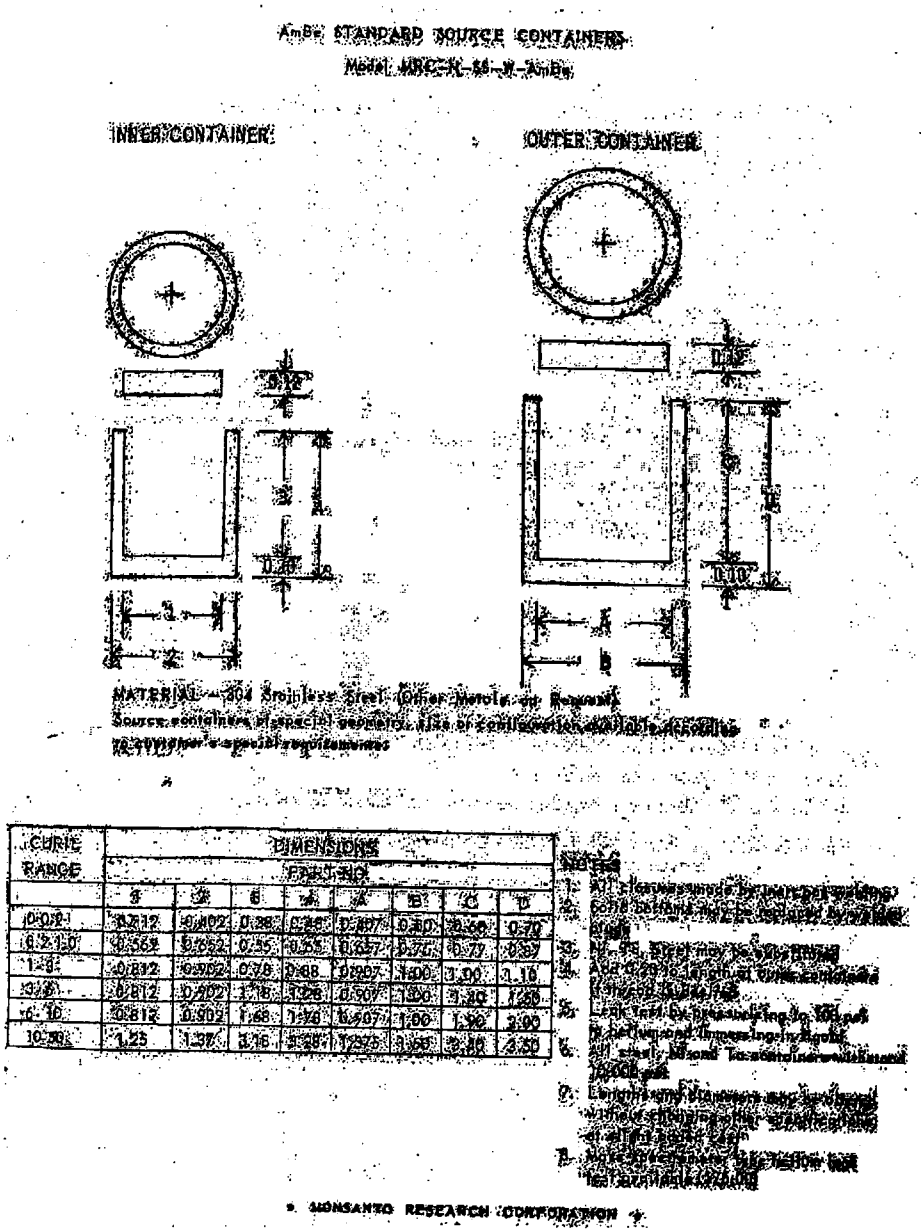
* = All standard dimensions are ± .001 inches

Special neutron sources can also be fabricated on a custom basis. Further information is available upon request [illegible].

NUCLEAR MATERIALS AND EQUIPMENT CORPORATION
[illegible], Pennsylvania

February 1[illegible], [illegible]

Example A-13. Source Manufacturer Price List: NUMEC



Example A-14. Source Manufacturer Sales Catalogue: Monsanto Research Corporation

Sources

Americium-241/Beryllium

Neutron Sources

Source Emission Data

Neutron emission:	~2.2 x 10^6n/sec per Ci ~6 x 10^7n/sec per TBq
γ-exposure rate:	~2.5mR/hr at 1m per Ci ~Air kerma rate at 1m of 22μGy/h per Ci
Neutron dose rate	2.2 mrem/h at 1m per Ci 22μSv/h at 1m per Ci

Note
(α-n) beryllium neutron sources also emit a significant number of low energy neutrons.
(~23% below 1MeV with mean energy 400keV)

Cylinder sources
Compacted mixture of americium oxide with beryllium metal, doubly encapsulated in welded stainless steel.

Nominal content activity GBq	mCi	Emission* n/sec	Capsule type	Code
18.5	0.5	1.1 x 10^6	X.3	AMN.19
37	1	2.2 x 10^6	X.3	AMN.22
111	3	6.6 x 10^6	X.4	AMN.23
185	5	110 x 10^6	X.14	AMN.24
370	10	200 x 10^6	X.14	AMN.25

*Tolerance ±10%

Recommended working life: 15 years

Quality control
Wipe test A
Bubble test D
Immersion test L

Neutron emission measured against standards using BF_3/wax moderator system.
The test report includes a statement of the neutron emission.

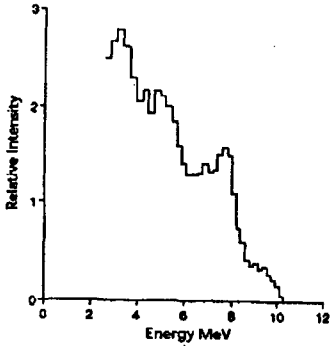
Calibration for Am-241/Be neutron sources
Special calibrations of neutron emissions can be made on these sources and certificates issued by the National Physical Laboratory, Teddington, England.

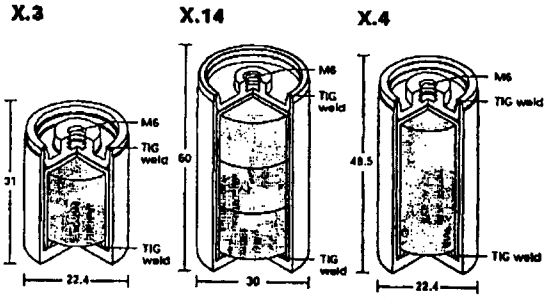
Handling rod available.

Neutron spectrum

Source made and measured at AEA Technology QSA using a stilbene crystal and pulse shape discrimination.

Spectrum reproduced by courtesy of: LORCH, E.A.
Int J. Appl. Radiat. Isotopes, 24, 590, 1973.





Each source type has a 2mm "screwdriver" slot on the end face.

Safety performance testing

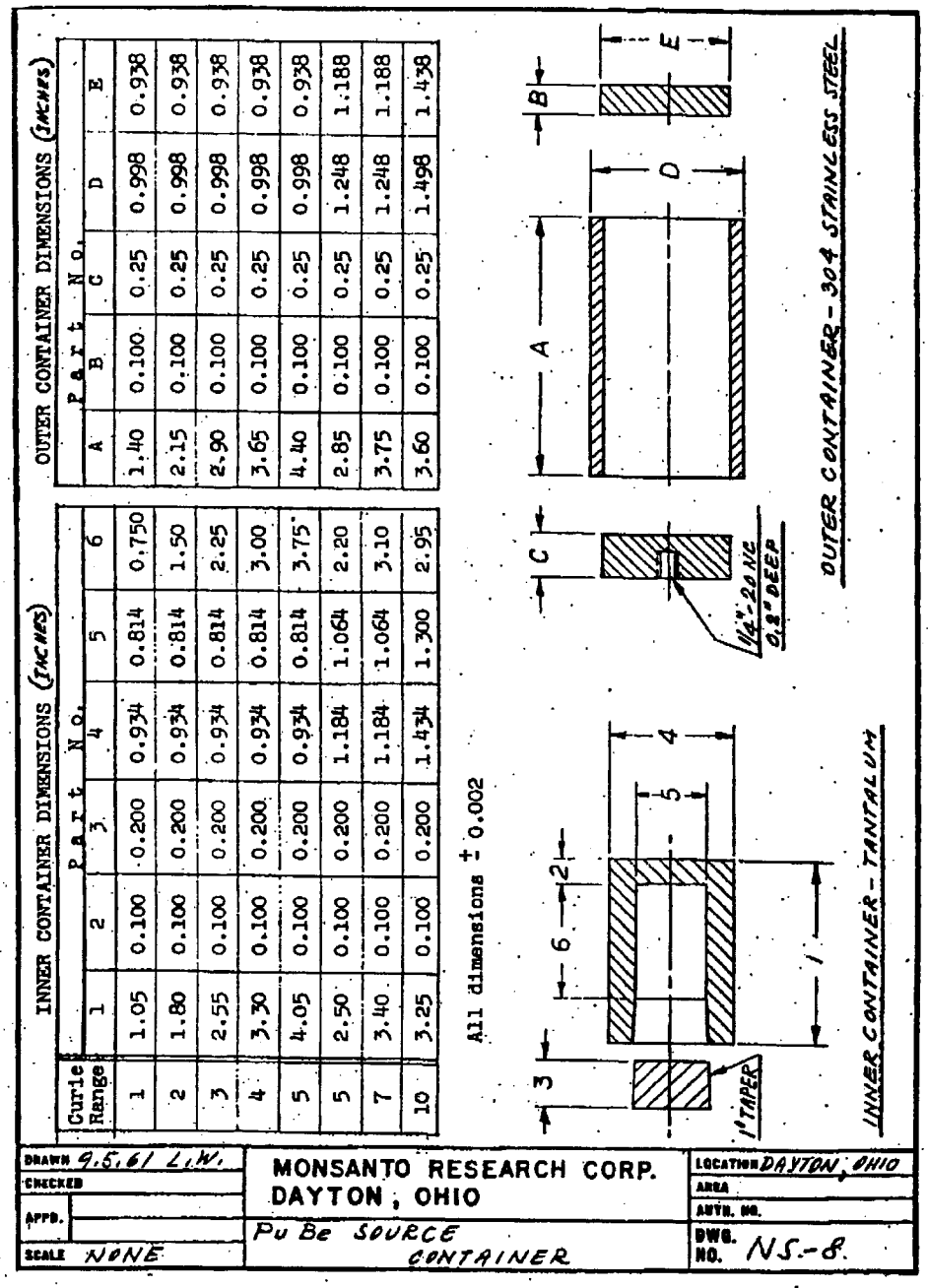
Capsule	IAEA special form	Model no.
X.3	GB/009/S-85	AMN.PE2
X.4	GB/10/S-85	AMN.PE3
X.14	GB/11/S-85	AMN.PE4

B7

United Kingdom
AEA Technology QSA, St. Mary's Court, The Broadway, Old Amersham, Bucks, HP70UT, Tel: +44 1235 43 1267
United States
AEA Technology QSA, 40 North Avenue, Burlington, MA 01803, Tel: 781-272-2000

AEA TECHNOLOGY QSA

Example A-15. Source Manufacturer Sales Catalog: AEA Technology



OUTER CONTAINER DIMENSIONS (INCHES)

Part No.	A	B	C	D	E
1	1.40	0.100	0.25	0.998	0.938
2	2.15	0.100	0.25	0.998	0.938
3	2.90	0.100	0.25	0.998	0.938
4	3.65	0.100	0.25	0.998	0.938
5	4.40	0.100	0.25	0.998	0.938
5	2.85	0.100	0.25	1.248	1.188
7	3.75	0.100	0.25	1.248	1.188
10	3.60	0.100	0.25	1.498	1.438

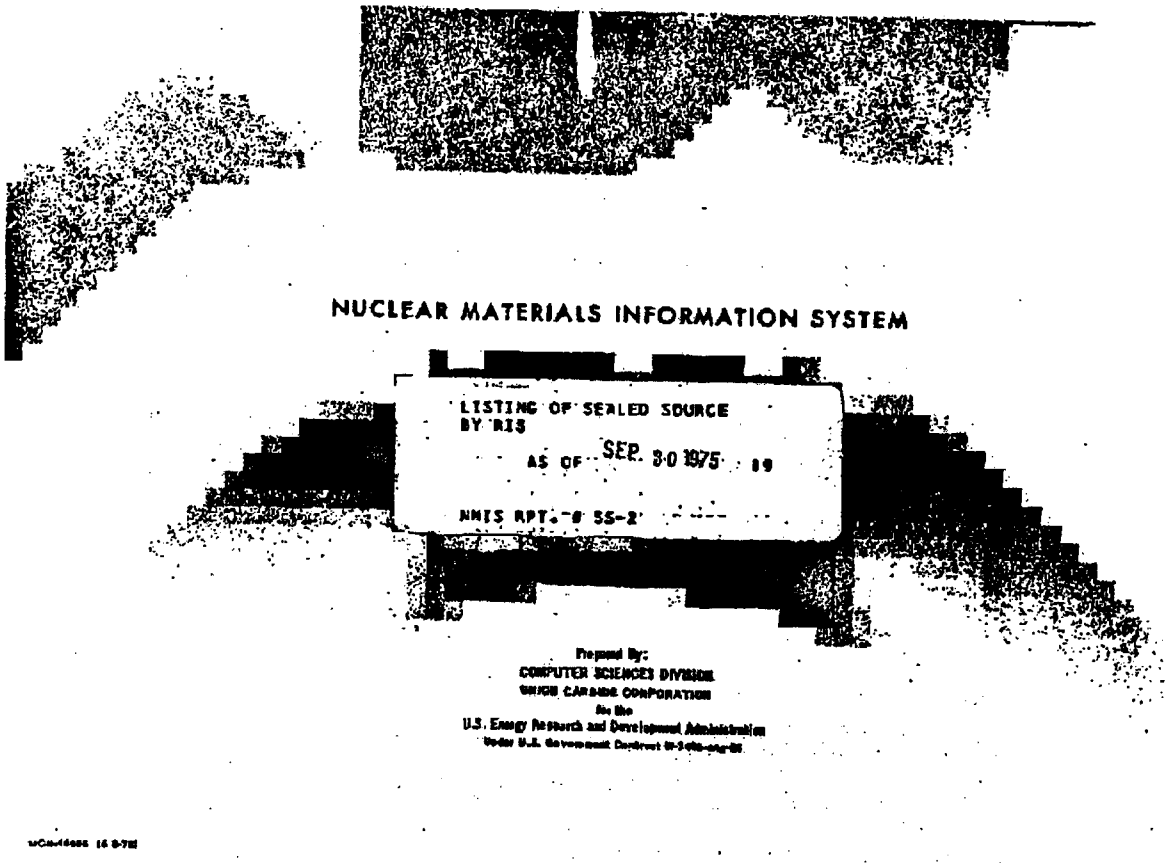
INNER CONTAINER DIMENSIONS (INCHES)

Curie Range	Part No. 1	2	3	4	5	6
1	1.05	0.100	0.200	0.934	0.814	0.750
2	1.80	0.100	0.200	0.934	0.814	1.50
3	2.55	0.100	0.200	0.934	0.814	2.25
4	3.30	0.100	0.200	0.934	0.814	3.00
5	4.05	0.100	0.200	0.934	0.814	3.75
5	2.50	0.100	0.200	1.184	1.064	2.20
7	3.40	0.100	0.200	1.184	1.064	3.10
10	3.25	0.100	0.200	1.434	1.300	2.95

All dimensions ± 0.002

DRAWN 9.5.61 L.W.	MONSANTO RESEARCH CORP. DAYTON, OHIO	LOCATION DAYTON, OHIO
CHECKED		AREA
APPD.		AUTH. NO.
SCALE NONE	Pu Be SOURCE CONTAINER	DWG. NO. NS-8.

Example A-16. Source Drawing: Monsanto Research Corporation



Example A-17. The NMMSS Database, Sheet 1

The GNI Group

September 23, 1996

Mr. Robert Free
Bureau of Radiation Control
Texas Department of Health
1100 West 49th Street
Austin, TX 78756

Dear Mr. Free:

Per your meeting with Mr. Carl Rush, I am enclosing is the Gulf Nuclear Sealed Source Log as requested.

I trust you will let me know if you have any questions.

Sincerely,
THE GNI GROUP, INC.

Cathy Hill
Administrative Assistant

/ch

Enclosure

RECEIVED
96 SEP 24 PM 3 04
TEXAS DEPT. OF HEALTH
BUREAU OF RADIATION CONTROL

The GNI Group • 2525 Battleground Road • P.O. Box 220 • Deer Park, Texas 77536-0220
(713) 930-0350 • FAX: (713) 930-0355

Example A-19 Source Manufacturer's Database, Sheet 1

AmBe 8-1-76 to 4-9-81

S/N	CUSTOMER	CURIES	ISOTOPE	DATE
71-1- 220	Basin Surveys	3 Ci.	AmBe	07/30/76
71-1- 221	Camco	5 Ci.	AmBe	09/14/76
71-1- 222	McCullough	5 Ci.	AmBe	09/28/76
71-1- 223	Centry Geo.	1 Ci.	AmBe	10/07/76
71-1- 224	Trainer	3 Ci.	AmBe	10/19/76
71-1- 225	Century Geo.	120 mCi.	AmBe	10/25/76
71-1- 226	Century Geo.	120 mCi.	AmBe	10/25/76
71-1- 227	Western Co.	150 mCi.	AmBe	11/09/76
71-1- 228	Century Geo.	1 Ci.	AmBe	11/18/76
71-1- 229	Century Geo.	1 Ci.	AmBe	11/18/76
71-1- 230	Century Geo.	1 Ci.	AmBe	11/18/76
71-1- 231	Century Geo.	1 Ci.	AmBe	11/18/76
71-1- 232	Century Geo.	1 Ci.	AmBe	11/18/76
71-1- 233	Southern Well Survey	3 Ci.	AmBe	12/17/76
71-1- 234	Western Co.	300 mCi.	AmBe	01/03/77
71-1- 235	Bravo Wireline	3 Ci.	AmBe	01/07/77
71-1- 236	Victoria Perferators	3 Ci.	AmBe	01/13/77
71-1- 237	Geartex	5 Ci.	AmBe	
71-1- 238	Century Geo.	120 mCi.	AmBe	02/02/77
71-1- 239	Century Geo.	120 mCi.	AmBe	02/02/77
71-1- 240	Century Geo.	120 mCi.	AmBe	02/02/77
71-1- 241	Jetco	5 Ci.	AmBe	02/02/77
71-1- 242	K&N Perforators	3 Ci.	AmBe	02/21/77
71-1- 243	Century Geo.	1 Ci.	AmBe	02/22/77
71-1- 244	Century Geo.	1 Ci.	AmBe	02/22/77
71-1- 245	Century Geo.	1 Ci.	AmBe	02/22/77
71-1- 246	Century Geo.	1 Ci.	AmBe	02/22/77
71-1- 247	Century Geo.	1 Ci.	AmBe	02/22/77
71-1- 248	Century Geo.	1 Ci.	AmBe	02/22/77
71-1- 249	Century Geo.	1 Ci.	AmBe	02/22/77
71-1- 250	Century Geo.	1 Ci.	AmBe	02/22/77
71-1- 251	Century Geo.	1 Ci.	AmBe	02/22/77
71-1- 252	Century Geo.	1 Ci.	AmBe	02/22/77
71-1- 253	Trainer Surveys	3 Ci.	AmBe	03/16/77
71-1- 254	Western Co.	3 Ci.	AmBe	03/21/77
71-1- 255	Logmaster	3 Ci.	AmBe	03/21/77
71-1- 256	Western Co.	300 mCi.	AmBe	05/10/77
71-1- 257	Western Co.	300 mCi.	AmBe	06/17/77
71-1- 258	Western Co.	300 mCi.	AmBe	06/17/77
71-1- 259	Western Co.	300 mCi.	AmBe	06/17/77
71-1- 260	Western Co.	300 mCi.	AmBe	06/17/77
71-1- 261	Accr.	3 Ci.	AmBe	06/27/77
71-1- 262	McCullough	5 Ci.	AmBe	06/28/77

1

Example A-20 Source Manufacturer's Database, Sheet 2

APPENDIX B

PEER REVIEW PANEL MEMBER COMMENTS

Peer Review Panel Member Comments

This appendix provides individual statements by peer review panel members reflecting dissenting views or additional comments, as appropriate.

Comment by James Booth

The importance of the Offsite Source Recovery Project (OSR) at LANL cannot be overemphasized. The approach they have taken with regards to sending the sealed sources to WIPP is not only technically sound, but also minimizes worker exposures which would happen if the sources had to be characterized using NDA techniques. As a generator of some of the original AK data, I can state that the quality systems in place during its generation were robust and had extensive internal and external oversight.

Comments by Hugh Evans

No comments or statements.

Comments by Joe Harvill

No comments or statements.

Comments by Tom Sowdon

No comments or statements.

Attachment 2 - CCP Records Transmittal/Receiving Form

Page 1 of 1

CCP Central Records / Records Custodian, 4021 National Parks Highway - MS: GSA 203, Carlsbad, New Mexico 88220

Telephone Number: 505-234-7523, 505-234-7233, 505-234-7617

Fax Number: 505-234-7014

- [X] Original Record
- [ ] Fax Record
- [ ] E-mail Record

Attn:	SHEILA PEARCY	From:	JUILA WHITWORTH
Ship to:	RECORDS CENTER	Site:	LANL OSR
	4021 NATIONAL PARKS HWY	Company:	UC/LANL
	CARLSBAD,NM 88220	Telephone Number:	(505) 699-3915
		Date Sent:	03/11/05
Telephone Number:	(505) 234-7523		

Document Number	Title / Description	Record Date	Total Pages
D008	AK SOURCE DOCUMENT SUMMARY WASTE STREAM LA-OS-00-01 SEALED SOURCE PEER REVIEW REPORT	03/09/05	51
	N/A		

Comments

N/A

CCP Records Center Acceptance/Rejection Signature and Date

Records Accepted [X] — Signature: Lynda Strode — Printed Name: Lynda Strode — Date: 3/21/05

Records Rejected [ ] — Signature: _____ — Printed Name: _____ — Date: _____

Reason for Rejection:

Re-submittal: Signature: _____ — Printed Name: _____ — Date: _____