LA-UR-14-23918

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| Title: | Shipping Plan for the "Establish Americium-Oxide Production Capability Project |
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| Intended for: | Report |
| Issued: | 2014-06-02 |

LA-UR XX-xxxxx

# SHIPPING PLAN

For the

# Establish Americium-Oxide Production Capability Project

at the

## Los Alamos National Laboratory

Version 1.20

# SHIPPING PLAN

## Establish $^{241}AmO_2$ Production Capability Project

Los Alamos National Laboratory

**Approval:**

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Reference


1. Shipping/Packaging Requirements and Methods for Americium-241 Oxide Production Operations; LA-UR-12-25118; Schulte, et al.

REVISION Log

| Date | Revision # | Change Description |
|---|---|---|
| Oct/13 | 1.0 | Early Rev. |
| May/14 | 1.2 | Mods from Team review |
| | | |
| | | |

# 1.0 Introduction

**1.1.1 Overview**

The “Establish Americium-Oxide Production Capability” Project will produce purified $^{241}AmO_2$ powder for the DOE-SC (Department of Energy - Office of Science) to be used in industrial applications.

When production operations begin, the $^{241}AmO_2$ Program at LANL will receive funding/guidance from the DOE Office of Science – Office of Nuclear Physics (DOE-SC), conduct operations in a NNSA Defense Programs (NNSA-DP) Facility with material owned by the NNSA-DP, receiving oversight/authorization by the Los Alamos Field Office (NA-LO), and produce product for the National Isotope Distribution Center (NIDC) for sale to Industry. There are a number of interfaces and requirements for safety, security, product acceptance, and MC&A (Material Control & Accountability) which must be met in order to move this material from the NNSA to Industry. Material will be administratively transferred from NNSA-DP to DOE-SC, and then administratively/physically provided to customers designated by the DOE-SC/NIDC.

The goal is to establish a shipping function capable of supporting more than the minimum goal of a 200g/yr. production capability of $^{241}AmO_2$ (americium-oxide)[1]. It is the intent of the project to increase production capacity to a nominal 500g/yr., with “stretch” goal of 750g/yr. and up to 25 shipments per year will be targeted.

This plan, the Shipping Plan, is intended to provide a high-level discussion on how the requirements from the various organizations will be met as the material moves from the TA-55/PF-4 Vault through processing to shipment and transfer from the NNSA to Industry.

[1] “PROJECT EXECUTION PLAN for the Establish $^{241}AmO_2$ Production Capability Project”, Toby J. Vigil, Louis D. Schulte, LA-UR-11-03312.

### 1.1.2 Purpose

The purpose of this document is to provide a high-level discussion on how the various requirements, from the organizations providing oversight/guidance, will be met – from the perspective of Shipping. Because Shipping represents a major set of interfaces across LANL, Los Alamos Field Office, NIDC, DOE-SC, and NNSA-DP there are a number of topics to address. The key topics are Technical (i.e., Drawings, Containers, Shipping Configurations, dose, etc.), QA (i.e., Production Flowsheet, QAP, Customer Specs, etc.), Transfer Methods (i.e., Ownership transfer, Authorizations, MC&A, Liability, etc.), and Financial (i.e., Cost Accounting, decay, etc.) The material specifications, as noted in the Project Execution Plan, are shown below in Table 1.

| Quantity | Specification |
|---|---|
| $^{241}$Am isotopic purity | $^{241}$Am > 99% of all Am by weight |
| $^{241}AmO_2$ chemical purity | > 95% by weight from NDA methods |
| Pu content | < 1.0% by weight from NDA methods |
| Any other individual impurity measured | < 0.5% by weight of any other individual inert impurity measured, including – Al, B, Be, Bi, Ca, Cd, Co, Cr, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Si, Sn, Zn, Zr, Np, and U by ICP-ACE and ICP-MS |

Table 1- Material Specifications

The Key Performance Parameters, also taken from the Project Execution Plan, are listed below in Table 2.

| Performance Parameter | Specification |
|---|---|
| Product Specification | See Table 1 (Material Specifications) |
| Yield | At least 90% extraction of americium-oxide from feedstream |
| Capacity | 30 grams, reserved for NDA Standards, produced upon project completion<br>Operations- at least 200 g/yr. production capability |

Table 2 - Key Performance Parameters

While 200 g/yr. is the minimum production capability, the program will strive for a 500 g/yr. “nominal” capacity and a potential 750 g/yr. “stretch” goal capacity. Other key functional objectives include the following.

- Cost - full cost recovery model
- Shipping - approved procedures, approved containers, no material repackaging from innermost $^{241}AmO_2$ container
- Gloveboxes – safe/secure with adequate shielding
- Compliance – MC&A

**1.1.3 Scope** This plan applies to all activities pertaining to the $^{241}AmO_2$ Project and Programmatic Operations, with a detailed focus on Shipping and the respective interfaces where there is a transfer of ownership.

# 2.0 Technical

The technical requirements for shipping are focused on the delivery of qualified SNM and containers for use by the program. These qualified containers have been validated as acceptable to the industry consortium customer, via the National Isotope Distribution Center (NIDC). The intent of the design of the $^{241}AmO_2$ containers is optimization effort to meet the identified requirements, meet the needs of the customers, minimize exposure dose to workers, and to minimize the probability/severity of contamination of customers/workers/equipment. While focused on a (targeted) 30g batch size, the Program would like to maintain the flexibility for larger payloads (e.g., up to two batches in one container).

An additional design requirement is that the assembled shipping package/configuration meets the requirements for radiation exposure limits at the surface of the shipping container (i.e., 200 mrem/hour at surface). From a cost and dose perspective, it is important that repackaging of qualified/packaged lots of $^{241}AmO_2$ – solely to achieve custom or specific batch sizes - be avoided. In special cases however, coordinated through the NIDC, it is possible to look to honor requests for specific quantities less than 30 grams.

A meeting was held in September/2011 between the NIDC, Los Alamos Field Office, and LANL. At this meeting there was a discussion of requirements and capabilities, including the LANL Baseline Proposal to use a Type B Container. The feedback from this meeting was a request for a conceptual design for containers that would be compatible with an existing Type A Special Form Capsule (SFC) such as the LANL Model II Source Capsule.

Based on the feedback from industry representatives and NIDC, the LANL Team has modified the Baseline to incorporate a Type A Special Form Capsule (SFC) shipping strategy. With this feedback, LANL has since gone forward with the development of containers. The designs have been vetted by representatives of Industry and/through the NIDC. The designs and configurations shown below are the result of this collaborative effort. A more thorough discussion of the development of the technical requirements for transport and containers is contained in a LANL publication[2].

### 2.1.1 Drawings

The designs of new SNM containers meet the specific requirements identified for $^{241}AmO_2$ to allow integration into existing approved storage and shipping containers. The requirements considered include: required payload capacity, measurement/qualification of payload, diameter,

[2] "Shipping/Packaging Requirements and Methods for Americium-241 Oxide Production Operations; Louise D. Schulte, Sheldon K. Apgar, Mike L. Caviness, Toby J. Vigil, Lorenzo E. Viramontes, LA-UR-12-25118; September 28, 2012.

height, weight, sealing of closure, materials of construction, waste minimization, labeling, and exposure limits.

The current drawings for LANL "inner" and "middle" containers are attached in Appendix A. These drawings are the final, signed revisions of the design for the *"SNM Inner Container 12-MET1-S267 R2"* and *"SNM Middle Container 12-MET1-S268 R2"*. These drawings include laser etch labeling instructions for the "inner" and "middle" containers. No substantive design changes to dimensions have been made to these drawings were made between revisions 1 & 2. Specific direction of the surface finish, label etching instructions, and cleaning instructions has been added to the drawings.

The labels will include the CAGE (Commercial & Government Entity) code for the design of the components and the revision controlled/approved drawing number. The labels will also include the CAGE code for subcontractors that manufacture the components. The initial batch of containers will list the LANL CAGE code of 41SP7 as the design/fabricator. A serial number (S/N) will be etched on the walls of the individual containers and this unique number will be referenced in documentation tracking the container and providing a description of the material contents.

| | |
|---|---|
| Example: Laser Etch Labels | Laser Etch Labels – Inner Container |
| Part Description | SNM Inner Container |
| CAGE Code: Designer Drawing Number – Rev | 41SP7 LANL 14-MET1-S267 R2 |
| Manufacturer: CAGE Code | MFR: 41SP7 |
| S/N: 000x (if utilized) | S/N: 0001 |

**2.1.2 Containers**

A nested configuration of containers will be used to transport the $^{241}AmO_2$ product. The qualified Type A shipping package will consist of a LANL Model II Source Capsule as the "Special Form Capsule", nested inside a 10 gallon Type A-7A Drum or similar Type A Overpack. Although Type B shipping containers are typically reusable and Type A containers are not reusable, there is a potential for a future capability to perform an evaluation for the return of some containers.

For the handling/packaging of $^{241}AmO_2$ inside PF-4, two containers are used. Both of these containers are specially designed and the result of discussions with the NIDC and Industry Representatives at the September/2011 meeting and follow-up correspondence. Designs presented to the customer through the NIDC have received positive feedback. The "middle" container *(12-MET1-S268 R2)* is designed to receive a closed "inner" container *(12-MET1-S267 R2)* as it is removed from the glovebox. The designs for these LANL containers, including the laser-etch labeling information on the containers, is included in the attachments. The middle container provides a critical contamination control barrier to protect workers from contamination resident on the "inner" container.


Figure 1. Photos of LANL prototype “middle” and “inner” containers with lids removed.

**2.1.3 Dimensions of Containers**

LANL Model II Source Capsule

Considerable effort has been expended to develop container designs that meet the customer’s expectations for the dimensional requirements for the LANL Model II Source Capsule, utilized for shipment, working with the LANL internal-use transfer/storage container (SAVY-400 Overpack Container). The design requirement to meet the diameter limit of the LANL Model II Source Capsule along with subsequent limits for nested containers, plus adequate tolerances and gamma shielding for the $^{241}AmO_2$ payload, represents one of the more difficult design constraints.

The LANL Model II Source Capsule lists an internal diameter of 2.06 (+0.012, -0.003)[3]. The outer diameter of 1.95” for the LANL “middle” container will fit within the diameter constraint of the LANL Model II Source Capsule. The outer dimension height of 4.056” for the LANL “middle” container will easily fit within the height constraint LANL Model II Source Capsule (inner dimension height of ~8.5”) and, in fact, it is possible to stack two LANL containers. This stacking can be done with the understanding the total amount of material does not exceed the limits for the container.

[3] Dimensions of existing LANL Model II Source Capsule are taken from LANL Drawing #90Y-219998, “Source Containment Capsule, Module II Detail/Assembly”.

10 gallon Drum

The selection of an approved Type A overpack drum is less prescriptive than the selection of the LANL Model II Source Capsule along with the "inner" and "middle" containers nested within. Overpack drums with other (internal) advantages not discussed her, might be selected. The 17" height of the 10 gallon/38L Drum (Note: The Team will initially be using the Skolnik Item # CQ1002 Drum). The Type A-7A Drum is one of the smaller drums that will adequately contain the 12" tall LANL Model II Source Capsule.

LANL Internal Storage/Transfer Container

Packaged items of $^{241}AmO_2$ removed from the LANL glovebox environment in an "inner" container are placed into a "middle" container are "over-packed" into a required LANL SAVY-4000 container while subjected to measurements for qualification and MC&A purposes. The current design for the containers utilizes the 4.38" height constraint originating from the 1 quart SAVY-4000 storage container. The outer dimension height of 4.056" for the LANL "middle" container will fit within the height constraint of the 1 quart SAVY overpack container and includes an allowance for a plastic bag (if required and for LANL use only).

Middle Container

The "middle" container is designed to receive a closed "inner" container as it is removed from the glovebox. This container provides a critical contamination control barrier to protect workers from contamination resident on the "inner" container. The outer diameter of 1.95" for the LANL "middle" container will fit within the diameter constraint of the LANL Model II Source Capsule (inner diameter of 2.06").

The outer dimension height of 4.056" for the LANL "middle" container will fit within the height constraint LANL Model II Source Capsule (inner dimension height of ~8.5"). The height of the LANL "middle" container (4.056" height) is such that two of these containers could be stacked inside. In the normal package configuration of a single LANL "inner/middle" container assembly, it may be desirable to include a simple "blank" segment of stainless pipe of a length to minimize load shifting/impact if the package is inverted. The outer dimension height of 4.056" for the LANL "middle" container will fit within the height constraint of the 1 quart LANL (i.e., SAVY) overpack container (inner dimension height of 4.38").

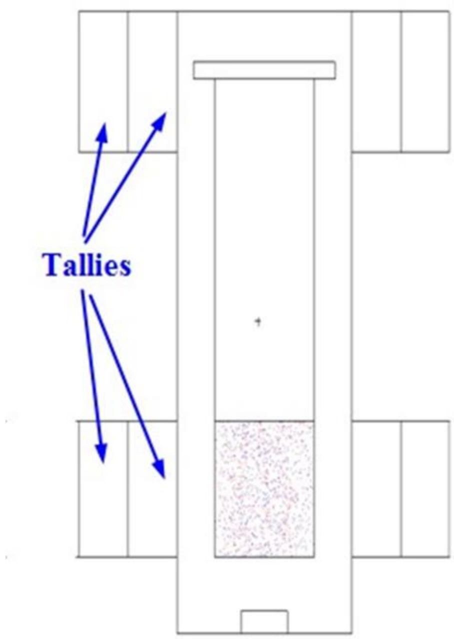
Inner Container

The outer diameter of 1.400" for the LANL "inner" container will fit within the diameter constraint of the LANL "middle" container (inner diameter of 1.550"). The outer dimension height of 3.480" for the LANL "inner" container will fit within the height constraint of the LANL "middle" container (inner dimension height of 3.538"). The volume of the "inner" container easily allows the current normal planned standard payload of ~34 g net weight of $^{241}AmO_2$, (~30 g of 241Am isotope) and some room for growth to maximum payload capability.

### 2.1.4 Shipping Configurations

The $^{241}AmO_2$ material is packaged in a nested configuration for transportation. From innermost container to outermost container, the nesting is as follows.

- Inner Container – The container in direct contact with the $^{241}AmO_2$. Some dose protection, designed to enable protection while handling, but not extensive. Contaminated surfaces on inside & outside. This container is robust but not qualified to any transportation standards.
- Middle Container – Holds the inner container and the next layer of protection with material packaging. Designed to enable a relatively clean (i.e., less than 20 dpm) outer surface to enable handling outside a glovebox environment. This container is robust but not qualified to any transportation standards.
- LANL Model II Source Capsule – Holds the middle container and designed to provide the additional dose protection to guarantee transport and tamper-proof protection. This capsule also provides the capability to ship two middle containers or "center" a single middle container, with nominal batch size amounts, to provide a more balance dose at the boundaries. The LANL Model II Source Capsule is a qualified SFC for use as part of a Type A Package. The use of the SFC allows and A1 quantity of 241Am to be shipped per 49 CFR 173.435.
- 10 gallon Drum – The combination of an approved Type A overpack drum and the LANL Model II Source Capsule provides a qualified Type A package, available for transport to either the NIDC or directly to the domestic industry customer. Other approved Type A drums could be used with the LANL Model II Source Capsule.



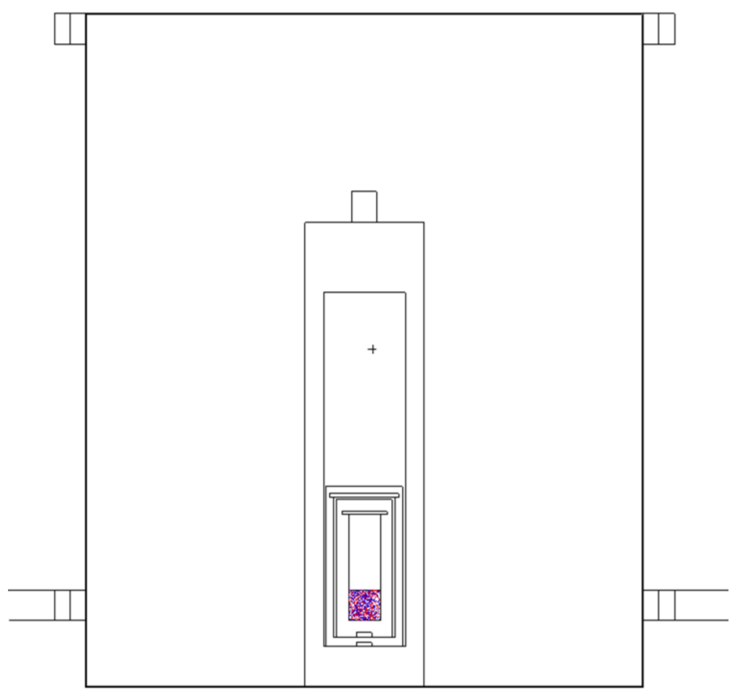



Figure 2. Shipping configuration with inner & middle containers, source capsule, and drum.

The height of the LANL "middle" container is such that two of these nominal batch-sized containers could be stacked inside a LANL Model II Source Capsule. The weight of two nested LANL "inner/middle" container assemblies (~2.6 lb each) would remain within the payload limit (5.5 lb) of the LANL Model II Source Capsule. Or, in the normal package configuration of a single LANL "inner/middle" container assembly, it may be desirable to include a simple "blank" segment of stainless pipe of a length to minimize load shifting/impact if the package is inverted.

Designs of the "inner" and "middle" containers include a method of compressing a sealing disk without the use of conflat bolts to create a robust seal. It is anticipated that the robust nature of the seals of the "inner" and "middle" containers will minimize the probability/severity of contamination of customers, workers, and equipment. The design of the "middle" container is concentrically smooth both inside and out to optimize efficiency in nesting of containers.

### 2.1.5 Alpha Activity Limits

The LANL Model II Source Capsule currently approved for shipment allows a maximum $^{241}AmO_2$ payload of 9.99 TBq of alpha activity ($9.99 \times 10^{12}$ Bq, equal to 270.0 Ci)[4] translates to a limit of 78.4 g of $^{241}Am$ isotope or 89.2g of pure $^{241}AmO_2$[5]. The heat loading associated with the $^{241}AmO_2$ items is almost entirely due to the energies of alpha decay. A similar alpha activity constraint exists for the approved LANL storage/overpack (SAVY-4000) container utilized at LANL for transfer & storage of SNM outside a glovebox environment.

The LANL Detailed Operating Procedure (DOP) that limits Material at Risk (MAR) in individual SAVY-4000 containers outside the glovebox to 84 g net weight $^{241}AmO_2$ (74.2 g of $^{241}Am$ isotope) for the payload of $^{241}AmO_2$ in an individual container[6]. This constraint is slightly more limiting than the payload for the LANL Model II Source Capsule.

The most direct and simple way to ensure the limiting quantity of $^{241}AmO_2$ is not exceeded is control of the balance net weight. While the mass of the $^{241}Am$ is used for the certifying value for shipping purposes, the Project Team will be focusing on the mass of $^{241}AmO_2$. For these purposes, an operational limit weight limit of 83 g net weight maximum for the payload of $^{241}AmO_2$ in the innermost container would provide adequate certainty that neither limit could ever be exceeded. The LANL approved (SAVY) container also has a thermal limit of 25 watts per container. However, the individual listed activity limit on $^{241}AmO_2$ is more restrictive. The calorimetry measurement will provide verification that the alpha activity has not been exceeded.

### 2.1.6 Dose

A LANL modeling study was undertaken to better understand dose issues specific to the $^{241}AmO_2$ material packaged inside the nested containers. This study analyzed dose versus the constraints of the configuration for shipment. A portion of the modeling data generated is shown below and for two cases. The first case, in Table 3, represents modeling data for a nominal 30 g batch of 241Am (as oxide). The second case, in Table 4, represents modeling data is for 78.7 g

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[4] "IAEA Certificate of Competent Authority Special Form Radioactive Materials Certificate Number USA/0696/S-96, Revision 4", 2010.

[5] This assumes 100% isotopic purity and 100% chemical purity of the $^{241}AmO_2$ material.

[6] TA55-DOP-091, R2, "Nuclear Material Packaging for Storage at TA-55, PF-4", 11/17/2011

of 241Am (as oxide), the maximum allowable quantity for which the LANL Model II Source Capsule is currently approved.

Table 3. LANL dose rate estimates for 30 g of $^{241}$Am (as americium oxide) in containers.

| | Dose rate at container surface lower tally (mrem/hr) | | | Dose rate 30 cm from container surface (mrem/hr) | | | Dose rate 1 M from container surface (mrem/hr) | | | Dose rate at the container surface upper tally (mrem/hr) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Neutrons | Photons | Total | Neutrons | Photons | Total | Neutrons | Photons | Total | Neutrons | Photons | Total |
| LANL "inner" container only | 235.74 | 775.64 | 1038.24 | 1.21 | 3.97 | 5.16 | 0.12 | 0.39 | 0.51 | 28.73 | 47.99 | 74.68 |
| LANL "inner" container nested inside LANL "middle" container | 142.21 | 318.02 | 468.94 | 1.18 | 2.55 | 3.76 | 0.12 | 0.26 | 0.39 | 20.35 | 23.37 | 42.16 |
| LANL "inner"/"middle" assembly nested inside LANL Model II Source Capsule | 72.13 | 91.27 | 165.20 | 1.14 | 1.36 | 2.54 | 0.12 | 0.14 | 0.28 | 1.27 | 0.37 | 1.61 |
| LANL "inner"/"middle"/ Model II Source Capsule assembly nested inside Skolnik 10 gallon Type A-7A Drum | 4.05 | 4.83 | 8.95 | 0.58 | 0.67 | 1.26 | 0.10 | 0.11 | 0.21 | 0.47 | 0.23 | 0.69 |

Table 4. LANL dose rate estimates for 78.7 g of $_{241}$Am (as americium oxide) in containers.

| | Dose rate at container surface lower tally (mrem/hr) | | | Dose rate 30 cm from container surface (mrem/hr) | | | Dose rate 1 M from container surface (mrem/hr) | | | Dose rate at the container surface upper tally (mrem/hr) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Neutrons | Photons | Total | Neutrons | Photons | Total | Neutrons | Photons | Total | Neutrons | Photons | Total |
| LANL "inner" container only | 394.33 | 1032.10 | 1659.77 | 3.20 | 9.95 | 13.24 | 0.32 | 0.98 | 1.32 | 195.18 | 408.29 | 464.28 |
| LANL "inner" container nested inside LANL "middle" container | 264.33 | 544.03 | 866.29 | 3.12 | 6.48 | 9.65 | 0.32 | 0.66 | 1.00 | 113.21 | 158.47 | 222.78 |
| LANL "inner"/"middle" assembly nested inside LANL Model II Source Capsule | 152.01 | 184.37 | 348.68 | 3.02 | 3.88 | 6.91 | 0.33 | 0.43 | 0.76 | 3.97 | 0.72 | 4.57 |
| LANL "inner"/"middle"/ Model II Source Capsule assembly nested inside Skolnik 10 gallon Type A-7A Drum | 10.53 | 11.97 | 22.81 | 1.53 | 1.72 | 3.26 | 0.26 | 0.28 | 0.55 | 1.41 | 0.61 | 1.96 |

As shown in Table 4, the dose rate at the nearest sidewall surface of the 10 gallon Type A-7A (Skolnik) Drum is estimated at 22.8 mrem/hr radiation dose rate at for maximum allowable quantity to be shipped. Appropriate packing foam will be placed within the 10 gallon Type A-7A Drum to surround the LANL Model II Source Capsule to cushion and center the item within the drum. The use of this packaging material was not credited in the LANL modeling study.

The modeling data represented in Tables 3 & 4 shows that either quantity (nominal or maximum) of pure $^{241}AmO_2$ will not exceed the 200 mrem/hr radiation dose rate at the container surface exposure constraint for the shipment of radioactive items. If the surface of the 7A drum remains below 200 mrem/hr, then it can be shipped non-exclusive use. If the surface exceeds 200 mrem/hr, but is less than 1,000 mrem/hr, then it must be shipped exclusive use (i.e., enclosed vehicle, fixed position in the transport truck, and directly shipped to the receiver).

However, due to TA-55 security requirements, it is recommended that the product be shipped on an exclusive basis.

# 3.0 Quality Assurance

A Quality Assurance Plan (QAP), PA-PLAN-01042, has been written and is consistent & compliant with the Isotope Production & Applications Program (IPAP) along with LANL SD 330 (i.e., LANL QAP). This QAP takes advantage of the QA Programs at TA-55 and dovetail into the QAP for the IPAP Office. A graded approach was used to develop the Project QAP that is consistent with the other QAPs. All procurements, procedures, and standards followed for shipping will be consistent with the Project QAP.

### 3.1.1 Quality Assurance Plan (QAP)

A QAP (Quality Assurance Plan (QAP); PA-PLAN-01042) has been written and approved for this project. The purpose of this QAP is to describe how the $^{241}AmO_2$ Project meets the requirements of *SD330, Los Alamos National Laboratory Quality Assurance Program*, for establishing and executing a quality management program.

The integration approach for the various Quality Assurance plans is show in the diagram below.

This QAP has been developed as a management system, and this system uses a targeted, requirements-based approach intended to ensure applicable requirements are implemented. QA requirements are applied based on the general applicability of the work. The requirements from SD330 are applied to all work types, using a risk-based graded approach. The system is structured so that those performing work may readily identify the quality assurance requirements and the implementing documents to perform the work.

A Quality Implementation Plan (QIP) has been develop and describes how the quality criteria in PA-PLAN-01042 are implemented by the $^{241}AmO_2$ Project; and further identifies the specific mechanisms, tools, processes, and procedures used by the $^{241}AmO_2$ Project to execute the quality criteria.

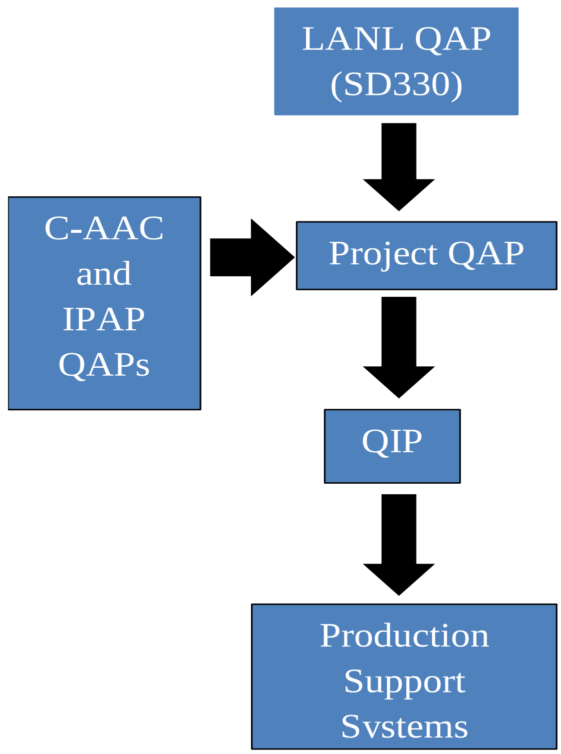



Figure 3. Chart showing integration of QA Program Docs.

### 3.1.2 Flowsheet

The flowsheet, depicts the movement of the americium-oxide from the sealing of the inner container inside the LANL glovebox, through the application of the Tamper Indicating Device (TID), performance of non-destructive assay (NDA) measurements, to shipping and the customer receiving the product with the QA documentation.

The flowsheet is discussed in more detail in the LANL paper, Shipping/Packaging Requirements and Methods for Americium-241 Oxide Production Operations (LA-UR-12-25118; Schulte, et al.) Key supplemental notes are listed below.

1. Authorization to produce is provided by the NIDC.
2. Product is delivered to the NIDC or NIDC designated customer/location.
3. The nominal amount of $^{241}$Am per container is roughly 30 grams – in the form of $^{241}AmO_2$. A precise amount is forgone as this effort leads to additional dose for LANL workers.
4. Custom amounts, less than 30 grams, are possible with appropriate notice – at least six months.
5. Customer pays for shipping.
6. LANL recommends that shipping be done on an exclusive basis to minimize risk.
7. LANL will not ship to international locations.
8. LANL will take credit for delivery at Freight on Board (FOB) stage.
9. LANL recommends shipments, especially initial shipments, sent directly to the NIDC.

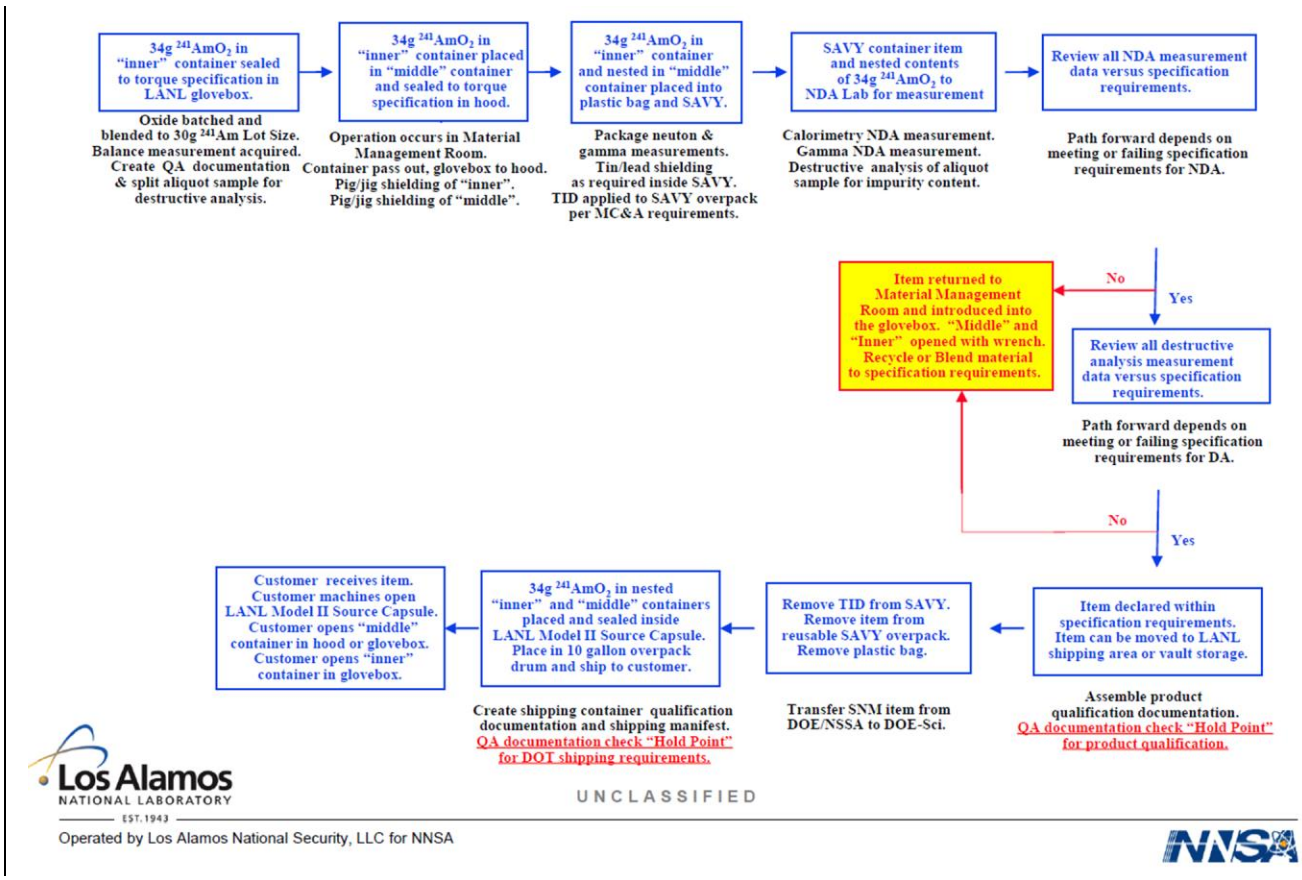



Figure 4. Flowsheet of activities for packaging, shipping, and customer receipt.

### 3.1.3 Customer Specifications

Customer specifications are noted in the Project Execution Plan (PEP). Americium-241 oxide ($^{241}AmO_2$) is not used for any medical applications. Therefore, the qualification requirements are less stringent than the requirements for use with medical patients. The material specifications for the $^{241}$Am, as requested by industry, are listed in Section 1.1.2 These specs are also listed in the Project Execution Plan (PEP) for the Am Project.

As described in the Am Project Quality Implementation Plan (QIP), whenever a program requirement of any type is not met, a nonconforming condition exists. The process for the identification, control, and disposition of nonconforming items that is used for the $^{241}AmO_2$ Project is documented in P330-6, *Nonconformance Reporting*. Nonconformance Report (NCR) activities for the $^{241}AmO_2$ Project are accomplished in the LANL-wide electronic NCR System.

The quality evidence generated as delineated in the Requirements Verification Matrix (Table 5) is the basis for the quality evidence package used to submit the product. Also included in the package are product-related Non Conformance Reports, the documentation defining the build history of product (Production Plan, Lot Plan, Travelers, etc.).

| ***Drawing/ Specification*** | ***Requirement*** | ***Method of Verification*** | ***Quality Evidence*** |
|---|---|---|---|
| $^{241}Am$ isotopic purity | 241Am > 99% of all Am by weight | Gamma NDA (primary)<br>TIMS (backup and "gold std") | Lab Report |
| $^{241}AmO_2$ Chemical Purity | 95% by weight from NDA methods | Calorimetry NDA (primary)<br>TIMS (backup and "gold std") | Lab Report |
| Pu Content | < 1.0% by weight from NDA methods | Gamma (primary)<br>TIMS (backup and "gold std") | Lab Report |
| Any other individual impurity measured | < 0.5% by weight of any other individual inert impurity measured, including Al, B, Be, Bi, Ca, Cd, Co, Cr, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Si, Sn, Zn, Zr, Np, and U by ICP-ACE and ICP-MS | ICP-AES<br>ICP-MS | Lab Report |

Table 5. Requirements Verification Matrix

It is important to note, certain non-destructive assay (NDA) methods are used to generate the quality evidence for regular production operations. For efforts involving the production of standards or the validation of production data (e.g., audits, assessments, peer review, etc.), certain radiochemistry methods such as TIMS, ICP-AES, or ICP-MS will be used.

### 3.1.4 Product Release

Product is authorized for shipment by the National Isotope Distribution Center (NIDC), which currently performs this service for the medical isotopes produced at LANL, under the Isotope Production and Applications Program (IPAP) office. Upon review of MC&A release from inventory, non-destructive analyses, and other production information evidence that provides validation of the product meeting customer specifications it is expected the production traveler will be reviewed by the following representatives.

1. Production Control (NPI-2) – Ensuring the instructions in the production traveler have been followed and in the appropriate order. NPI-2 also ensures production support systems are working within QAP definition.
    a. Production Process followed
    b. Production Data captured
    c. Production support information capture
    d. Material release from inventory by MC&A
2. Product Engineer (MET-1) – Ensuring the technical processes and procedures have been followed and the technical results are within customer specifications.

3. Manufacturing Quality Engineer (MQC) – Performs final certification and acceptance of product/documentation, prior to leaving LANL. Ensuring the quality program for the Am Project is being followed.

A Process Material Flow Diagram (PMFD) has been prepared for the Am Program, to track the americium and plutonium. The recovered plutonium will go back into NNSA-DP inventory stock and the recovered americium will be released to DOE-SC/NIDC. The MC&A Staff will approve this transaction.

The Manufacturing Quality Control (MQC) organization will perform final product acceptance for LANL, prior to shipment to the customer. MQC is in the best position to provide this service as they are most familiar with the quality program for the Am Program. It is expected that either LANL-QPA (Quality Performance Assurance) Division and/or the Los Alamos Field Office (NA-LA) Office of Quality Assurance could wish to assess some shipments. The DOE-SC and/or NIDC could also wish to sample/assess some shipment paperwork as well.

To meet customer specifications, a 100 percent test and inspection approach will be used. As production experience increases and a data set of production quantities, yield, and acceptance rates are established, a sampling approach may then be developed using statistical based random sampling methods. This approach will be developed, together with a business case, for consideration/approval by the NIDC.

### 3.1.5 Audits/Assessments

As per the Am Project QIP, independent assessments are conducted by the Independent Assessment group within the Quality and Performance Assurance (QPA) Division. Internal independent assessments are planned and conducted to evaluate item and service quality, evaluate the adequacy of work performance, and promote improvement.

Assessments by external organizations are encouraged as part of the LANL independent assessments program. NA-LA-00-OQA initiates a list of activities to ensure their oversight responsibilities each fiscal year. Any planned assessments of the $^{241}AmO_2$ Project by the Field Office are communicated to QPA and coordinated with ADPSM management.

Managing risk is an essential element of any project or program management approach. Mitigating risk can translate into improvements in efficiency, productivity, and quality. Risk, as defined in *SD330, Los Alamos National Laboratory Quality Assurance Program*, is based on the unmitigated consequence of the work failing to perform its function with respect to protecting the public, the worker, the environment, classified and strategic assets, and/or in supporting LANL mission requirements. There are two grading processes used to categorize risk: management levels (MLs) and software risk levels. Refer to section 3.1.2 of *SD330, Los Alamos National Laboratory Quality Assurance Program*.

# 4.0 Transfer Methods

Having a program that focuses on a material with three owners as it moves from NNSA residues, to a DOE-SC owned final product, that is sold to an industry consortium can have some complexity in both ownership and transfer. This section covers LANL's role in these transfers.

### 4.1.1 Ownership Transfer

While at LANL, the americium product will move from being under NNSA ownership to DOE-SC ownership. If LANL is directed to ship directly to the customer another transition should be assumed. However, although affixing a label and coordinating with a shipper for a commercial customer, the LANL does not view ourselves as a part of this transfer but rather acting at the diretion of the NIDC. Specifics of the ownership and transfer are listed below.

**NNSA**

Ownership Documentation

NNSA and LANL have well documented procedures for the control of Special Nuclear Materials (SNM). A Material Control & Accountability (MC&A) System controls the inventory, including amounts and locations of materials. Periodic reports are provided to the NNSA, NA-LA, and other oversight organizations. For the current feedstream materials (i.e., residues) an account has been established to note these materials are designated for the Am Project.

Ownership Transfer

Although (procedurally) the current feedstream is under the control of the Am Program, control of the material definitely comes under control of the Am Program when the material is requested from the PF-4 Vault.

**DOE-SC**

Ownership Documentation

Once the material is transferred from the PF-4 Vault to production operations, the material is still listed in the MC&A System, but under the Am Program. The material is also under the control of production support systems.

Ownership Transfer

Once processed through the production and the collection of documentation is completed/reviewed/approved and the material is ready for shipment, the material is ready to be transferred to the NIDC. The material is considered transferred to the NIDC (or customer as directed by the NIDC) once the shipment has left LANL. LANL will not ship outside the United States.

**Commercial Customer**

Ownership Documentation

LANL does not interface with the customer and can only track shipments to the NIDC, so it is assumed another entity will track ownership.

**New Feedstream Materials**
The Am Team is pursuing opportunities to locate new feedstream materials for the CLEAR Glovebox Line. Once located, it is expected the Am Program will follow a similar approach, as noted above, to manage the transitions from the owner to LANL to the commercial customer.

### 4.1.2 Authorizations
The authorization to produce americium-oxide comes from the DOE-SC. This authorization process is expected to be similar to the authorization process followed by the LANL Isotope Program. Authorizations are expected to note production amounts, customers (potentially), schedules, and funding.

### 4.1.3 MC&A
The Material Control & Accountability (MC&A) system used by LANL consists of procedures and a tracking system called LANMass.

### 4.1.4 Liabilities/Responsibilities
As a government-owned contractor-operated (GOCO) - providing an americium-oxide product to established specifications, authorized to produce by DOE-SC, shipped in qualified/certified containers by qualified shippers, and delivered to the NIDC or an NIDC-directed address/customer – LANL does see a reduced exposure in liabilities/responsibilities.

LANL does have extensive control over the materials, while these materials are on-site. LANL has very strict controls for the handling and processing of americium, americium-oxide, and similar materials – dictated by the DOE and NNSA and overseen by the Los Alamos Field Office. These controls work very well in limiting liability on-site. However, these controls have a limited capability to mitigate liability off-site. LANL must rely on other government organizations for support on this front.

The americium-oxide produced by LANL is not used in medical applications, thus further limiting liability. Therefore, if the – 1) americium-oxide product is produced to established specifications; 2) LANL is authorized by the DOE-SC to produce americium-oxide; 3) shipped in qualified/certified containers by qualified shippers, and; 4) delivered to the NIDC or an NIDC-directed address/customer – LANL cannot bear liability.

### 4.1.5 Safety/Security
The TA-55 site provides extensive security – physical, material controls, and cyber – for both personnel and materials. This security program does mitigate risk of the release of material by unauthorized methods. The specification for plutonium is from the discard limitations established by the Environmental Management Program.

The measurement for neptunium enables a security related tracking feature to note where/when the americium was produced. While americium is not as tightly controlled as actinide materials, there is a benefit to the americium program if a graded-approach to security can be applied.

Shipments from TA-55 are tightly controlled and shipping protocols are very strict. Trucks are screened/inspected using various criteria. It recommended that shipments be sent on an exclusive basis to the NIDC and then received or redirected. LANL cannot make international shipments.

# 5.0 Financial

There are some financial requirements the program is expected to follow once production operations start.

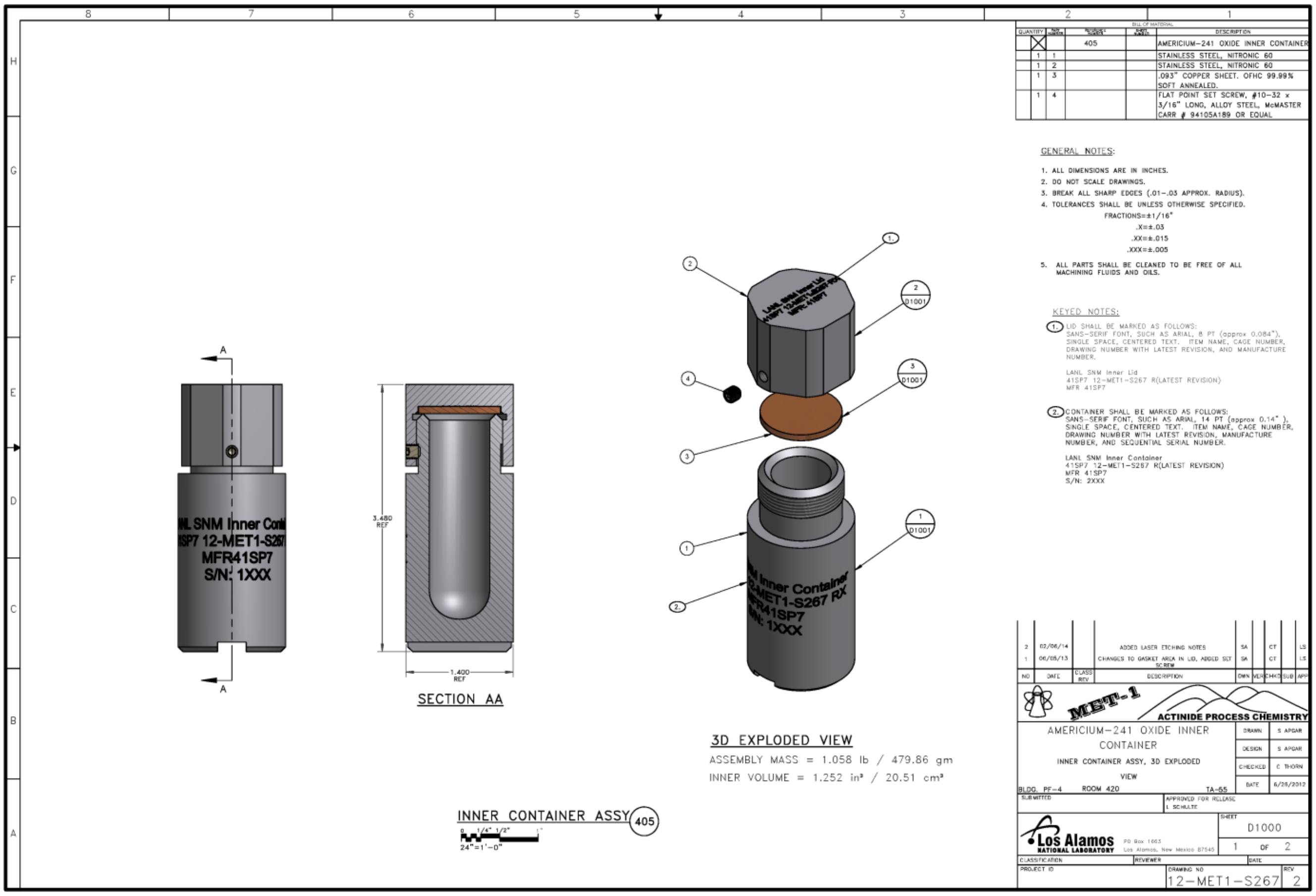
### 5.1.1 Cost Accounting

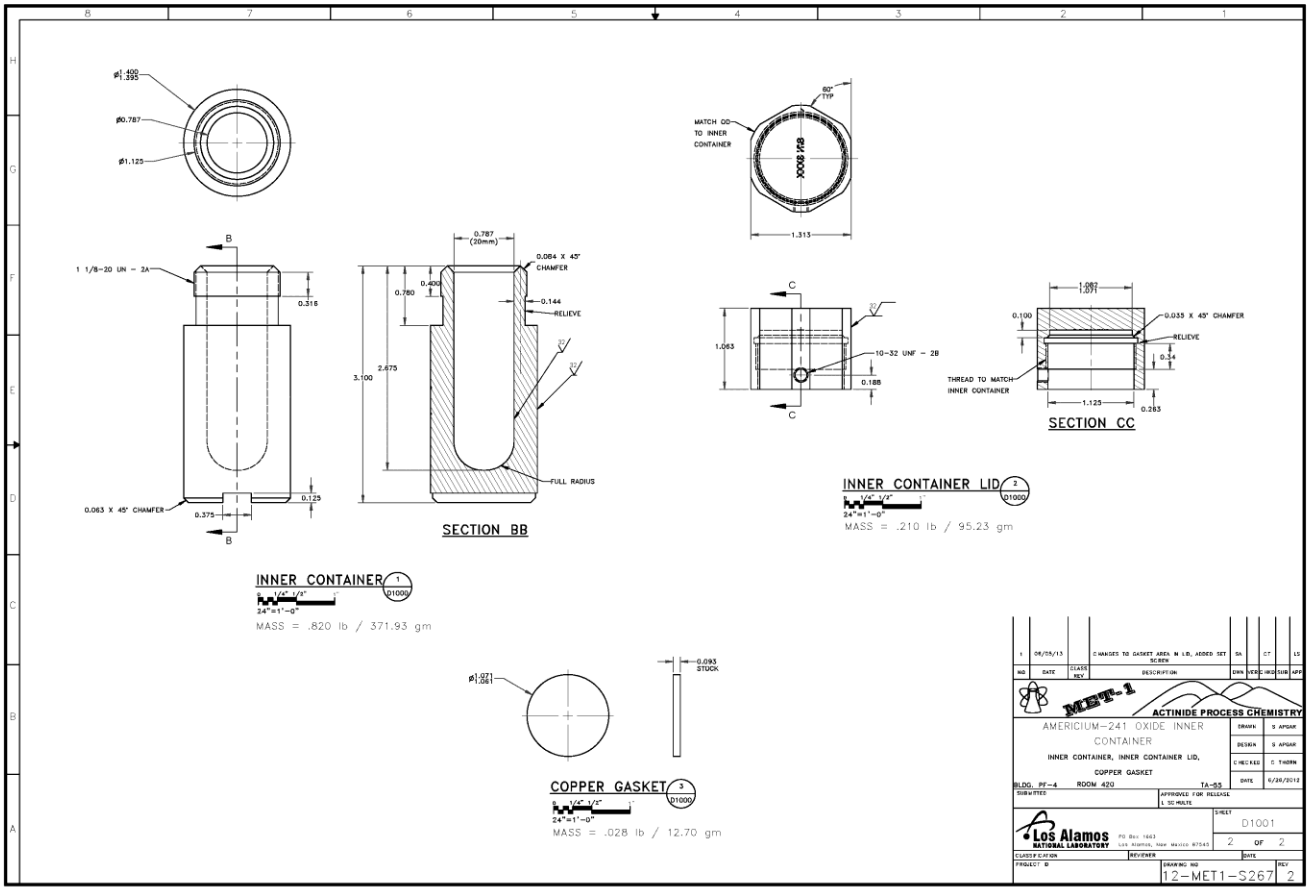
The Americium Program expects to follow a similar approach as the Isotope Program in cataloging costs once production operations start. This cost accounting effort is expected to follow an approach (i.e., standards) used in industry for cost accounting.

### 5.1.2 MC&A (Decay)

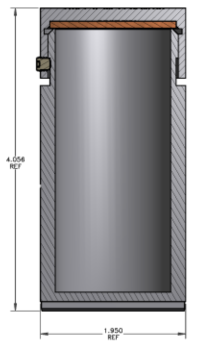
With a half-life of 432 years, americium-oxide has little risk exposure to the decay issues that complicate the inventory tracking of some medical isotopes. Ironically, because the residues tend to have amounts of Pu-241, which decays to Am-241, the amount of Am-241 can actually increase while the residues are waiting processing. Future feedstream materials will need to be evaluated for americium in-growth potential.

# Appendix A – Container Drawings

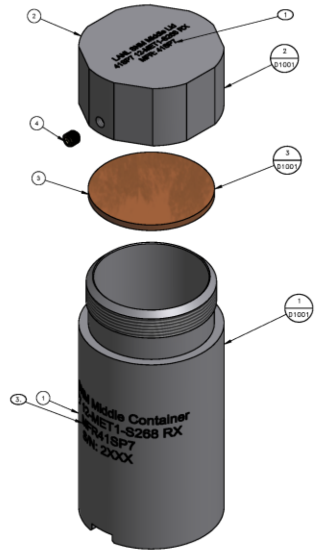




ø1.400
1.395
ø0.787
ø1.125
1 1/8-20 UN - 2A
0.318
0.063 X 45° CHAMFER
0.375
0.125
0.787
(20mm)
0.064 X 45° CHAMFER
0.400
0.780
0.144
RELIEVE
3.100
2.675
FULL RADIUS
SECTION BB
INNER CONTAINER
24"=1'-0"
MASS = .820 lb / 371.93 gm
MATCH OD TO INNER CONTAINER
60° TYP
1.313
1.063
10-32 UNF - 2B
0.188
1.082
1.071
0.100
0.035 X 45° CHAMFER
RELIEVE
0.34
THREAD TO MATCH INNER CONTAINER
1.125
0.283
SECTION CC
INNER CONTAINER LID
24"=1'-0"
MASS = .210 lb / 95.23 gm
ø1.071
1.061
0.093 STOCK
COPPER GASKET
24"=1'-0"
MASS = .028 lb / 12.70 gm
1 08/05/13 CHANGES TO GASKET AREA IN LID, ADDED SET SCREW SA CT LS
NO DATE CLASS REV DESCRIPTION DWN VER CHKD SUB APP
MET-1
ACTINIDE PROCESS CHEMISTRY
AMERICIUM-241 OXIDE INNER CONTAINER
INNER CONTAINER, INNER CONTAINER LID, COPPER GASKET
BLDG. PF-4 ROOM 420 TA-55
DRAWN S APGAR
DESIGN S APGAR
CHECKED C THORN
DATE 6/26/2012
SUBMITTED
APPROVED FOR RELEASE L SCHULTE
Los Alamos NATIONAL LABORATORY
PO Box 1663 Los Alamos, New Mexico 87545
SHEET D1001
2 OF 2
CLASSIFICATION
REVIEWER
DATE
PROJECT ID
DRAWING NO 12-MET1-S267
REV 2

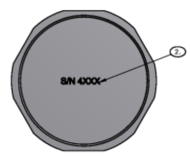

SECTION AA




3D EXPLODED VIEW

ASSEMBLY MASS = 1.418 lb / 642.77 gm

INNER VOLUME = 6.68 in³ / 109.48 cm³




MIDDLE CONTAINER LID BOTTOM VIEW

LANL MIDDLE CONTAINER (406)

SCALE: 24"=1'-0"

24"=1'-0"

BILL OF MATERIAL

| QUANTITY | | [illegible] | [illegible] | [illegible] | DESCRIPTION |
|---|---|---|---|---|---|
| | X | | 406 | | LANL MIDDLE CONTAINER |
| | 1 | 1 | | | STAINLESS STEEL, NITRONIC 60 |
| | 1 | 2 | | | STAINLESS STEEL, NITRONIC 60 |
| | 1 | 3 | | | .093 COPPER SHEET. OFC 99.99% SOFT ANNEALED |
| | 1 | 4 | | | FLAT POINT SET SCREW, #10-32 x 3/16" LONG, ALLOY STEEL, McMASTER CARR # 94105A189 OR EQUAL |

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN INCHES.
2. DO NOT SCALE DRAWINGS.
3. BREAK ALL SHARP EDGES (.01-.03 APPROX. RADIUS).
4. TOLERANCES SHALL BE UNLESS OTHERWISE SPECIFIED.
   FRACTIONS=±1/16"
   .X=±.03
   .XX=±.015
   .XXX=±.005
5. ALL PARTS SHALL BE CLEANED TO BE FREE OF ALL MACHINING FLUIDS AND OILS.

KEYED NOTES:

(1.) OUTSIDE TOP OF LID SHALL BE MARKED AS FOLLOWS: SANS-SERIF FONT, SUCH AS ARIAL, 8 PT (approx 0.084"), SINGLE SPACE, CENTERED TEXT. ITEM NAME, CAGE NUMBER, DRAWING NUMBER WITH LATEST REVISION, AND MANUFACTURER NUMBER.

LANL SNM Inner Lid
41SP7 12-MET1-S267 R(LATEST REVISION)
MFR 41SP7

(2.) INSIDE TOP OF LID SHALL BE MARKED AS FOLLOWS: SANS-SERIF FONT, SUCH AS ARIAL, 8 PT (approx 0.084"), SINGLE SPACE, CENTERED TEXT. SEQUENTIAL ITEM SERIAL NUMBER ONLY. NOTE: LID SERIAL NUMBER SHALL BE 4XXX

S/N 4XXX

(3.) CONTAINER SHALL BE MARKED AS FOLLOWS: SANS-SERIF FONT, SUCH AS ARIAL, 14 PT (approx 0.14"), SINGLE SPACE, CENTERED TEXT. ITEM NAME, CAGE NUMBER, DRAWING NUMBER WITH LATEST REVISION, MANUFACTURER NUMBER, AND SEQUENTIAL SERIAL NUMBER. NOTE CONTAINER SERIAL NUMBER SHAL BE 2XXX.

LANL SNM Middle Container
41SP7 12-MET1-S268 R(LATEST REVISION)
MFR 41SP7
S/N: 2XXX

| NO | DATE | CLASS REV | DESCRIPTION | DWN | VER | CHKD | SUB | APP |
|---|---|---|---|---|---|---|---|---|
| 2 | 02/06/14 | | ADDED LASER ETCHING NOTES | SA | JT | CT | | LS |
| 1 | 06/05/13 | | CHANGES TO GASKET AREA IN LID, ADDED SET SCREW | SA | | CT | | LS |

MET-1 ACTINIDE PROCESS CHEMISTRY

LANL MIDDLE CONTAINER

MIDDLE CONTAINER ASSY, 3D EXPLODED VIEW

BLDG. PF-4 ROOM 420 TA-55

| | |
|---|---|
| DRAWN | S APGAR |
| DESIGN | S APGAR |
| CHECKED | C THORN |
| DATE | 6/26/2012 |

SUBMITTED

APPROVED FOR RELEASE L SCHULTE

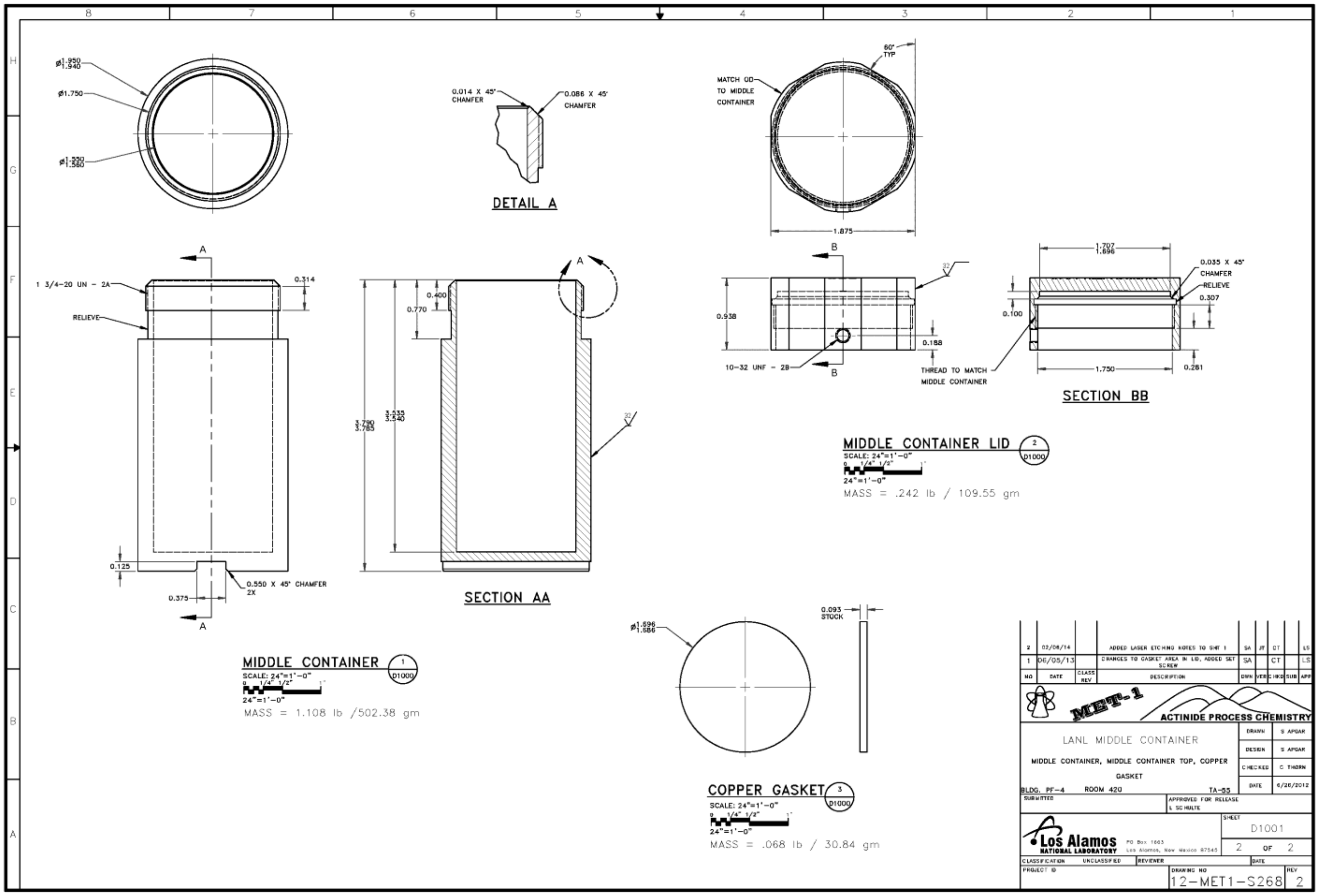
Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET D1000 1 OF 2

CLASSIFICATION UNCLASSIFIED REVIEWER DATE

PROJECT ID

DRAWING NO 12-MET1-S268 REV 2


DETAIL A
0.014 X 45° CHAMFER
0.086 X 45° CHAMFER
MATCH OD TO MIDDLE CONTAINER
60° TYP
1.875
1 3/4-20 UN - 2A
RELIEVE
0.314
0.400
0.770
0.125
0.375
0.550 X 45° CHAMFER 2X
SECTION AA
MIDDLE CONTAINER
SCALE: 24"=1'-0"
MASS = 1.108 lb /502.38 gm
0.938
0.188
10-32 UNF - 2B
THREAD TO MATCH MIDDLE CONTAINER
0.035 X 45° CHAMFER
0.100
0.307
1.750
0.281
SECTION BB
MIDDLE CONTAINER LID
SCALE: 24"=1'-0"
MASS = .242 lb / 109.55 gm
0.093 STOCK
COPPER GASKET
SCALE: 24"=1'-0"
MASS = .068 lb / 30.84 gm
2 02/06/14 ADDED LASER ETCHING NOTES TO SHT 1 SA JT CT LS
1 06/05/13 CHANGES TO GASKET AREA IN LID, ADDED SET SCREW SA CT LS
NO DATE CLASS REV DESCRIPTION DWN VER CHKD SUB APP
MET-1
ACTINIDE PROCESS CHEMISTRY
LANL MIDDLE CONTAINER
MIDDLE CONTAINER, MIDDLE CONTAINER TOP, COPPER GASKET
BLDG. PF-4 ROOM 420 TA-55
DRAWN S APGAR
DESIGN S APGAR
CHECKED C THORN
DATE 6/26/2012
SUBMITTED
APPROVED FOR RELEASE L SCHULTE
Los Alamos NATIONAL LABORATORY
PO Box 1663 Los Alamos, New Mexico 87545
SHEET D1001
2 OF 2
CLASSIFICATION UNCLASSIFIED
REVIEWER
DATE
PROJECT ID
DRAWING NO 12-MET1-S268
REV 2

# Appendix B – SARP

O U.S. Department of Transportation

Pipeline and Hazardous Materials Safety Administration

1200 New Jersey Avenue, S.E. Washington D.C.20590

**IAEA CERTIFICATE OF COMPETENT AUTHORITY**
**SPECIAL FORM RADIOACTIVE MATERIALS**
**CERTIFICATE NUMBER USA/0696/S-96, REVISION 6**

This certifies that the source described has been demonstrated to meet the regulatory requirements for special form radioactive material as prescribed in the regulations of the International Atomic Energy Agency[1] and United States of America[2] for the transport of radioactive materials.

1. Source Identification - Los Alamos National Laboratory (LANL} Model II Source Capsule (formerly QSA Global Inc. Model II Source Capsule).

2. Source Description- Cylindrical single over-encapsulation consisting of a capsule body, sealing plug, impact plug, snap ring, and cap made of stainless steel that provides a metal-to-metal seal when assembled. Approximate outer dimensions are 76.2 mm (3.0 in.) in diameter and 298.5 mm (11.75 in.) in length. Minimum wall thickness is 7.62 mm (0.3 in.). Final assembly shall be in accordance with either attached LANL Drawing 90Y-219998, Rev. H or AEA Technology QSA, Inc. Drawing No. R20047, Rev.B.

3. Radioactive Contents - The capsule described by this certificate is authorized to contain any one of the following single radionuclides, the sole pair of radionuclides, or either one of the two sets of six (6) radionuclides, in the chemical forms identified, and limited to the activities shown, in the table below. The radioactive material is limited to solid form in stainless steel capsules, between layers of non-radioactive stainless steel, or affixed to non-radioactive stainless steel by electroplating or other means. The maximum mass of the contents is limited to 2,500 grams.

| Radionuclide(s) | Maximum Activity(ies) | Chemical/Physical Form |
|---|---|---|
| Americium-241 | 9.99 TBq (270.0 Ci) | Oxide or oxide incorporated into a ceramic enamel |
| Americium-241:Target (Be, Li, C, F, or B) | 9.99 TBq (270.0 Ci) | Oxide mixed with target material pressed into a solid pellet or intermetallic |
| Americium-241:Be AND Cesium-137 | Am-241 - 37.0 GBq 1.0 (Ci) Cs-137 - 7.4 GBq (200.0 mCi) | Am-241 - Oxide mixed with beryllium powder pressed into a solid pellet or intermetallic Cs-137 - Cesium in silicate glass matrix, sulfate pellet, compressed anhydrous chloride pellet or aluminosilicate ceramic pellet |

[1] "Regulations for the Safe Transport of Radioactive Materials, 1996 Edition (Revised)", No. TS-R-1 (ST-1, Revised), published by the International Atomic Energy Agency (IAEA), Vienna, Austria.

[2] Title 49, Code of Federal Regulations, Parts 100 - 199, United States of America.

| Radionuclide(s) | Maximum Activity(ies) | Chemical/Physical Form |
|---|---|---|
| Californium-252 | 199.8 GBq (5.4 Ci) | Oxide or oxide in sintered palladium metal to form a cermet |
| Cesium-137 | 200.0 TBq (5405.4 Ci) | Cesium in silicate glass matrix, sulfate pellet, compressed anhydrous chloride pellet or aluminosilicate ceramic pellet |
| Cobalt-60 | 40.0 TBq (1081.1 Ci) | Metal |
| Curium-244 | 20.0 TBq (540.5 Ci) | Oxide or oxide incorporated into a ceramic enamel |
| Iridium-192 | 37.0 TBq (1000.0 Ci) | Metal |
| Neptunium-237 | 20.0 TBq (540.5 Ci) | Metal, alloy, or oxide |
| Plutonium-238 | 9.99 TBq (270.0 Ci) | Oxide or oxide incorporated into ceramic or refractory composite plate metal |
| Plutonium-238:Target (Be, Li, **C**, F, or B) | 9.99 TBq (270.0 Ci) | Metal or oxide mixed with target material pressed into a solid pellet |
| Plutonium-239 AND Plutonium-238 AND Plutonium-240 AND Plutonium-241 AND Plutonium-242 AND Americium-241 | Pu-239 - 3.7 TBq (100 Ci)<br>Pu-238 - 9.99 TBq (270 Ci)<br>Pu-240 - 9.99 TBq (270 Ci)<br>Pu-241 - 40.0 TBq (1081.1 Ci)<br>Pu-242 - 9.99 TBq (270 Ci)<br>Am-241 - 9.99 TBq (270 Ci) | Oxide incorporated into a ceramic, refractory composite, metal foil, or metal plated to substrate |

| Radionuclide(s) | Maximum Activity(ies) | Chemical/Physical Form |
|---|---|---|
| Plutonium-239:Target (Be, Li, C, F, or B) AND Plutonium-238 AND Plutonium-240 AND Plutonium-241 AND Plutonium-242 AND Americium-241 | Pu-239 - 3.7 TBq (100 Ci) Pu-238 - 9.99 TBq (270 Ci) Pu-240 - 9.99 TBq (270 Ci) Pu-241 - 40.0 TBq (1081.1 Ci) Pu-242 - 9.99 TBq (270 Ci) Am-241 - 9.99 TBq (270 Ci) | Metal or oxide mixed with target material pressed into a solid pellet |
| Strontium-90 | 37.0 TBq (1000.0 Ci) | Strontium titanate, strontium fluoride, oxide in ceramic enamel or fluoride in aluminum or tin antimony metal matrix |
| Radium-226 | 370.0 GBq (10.0 Ci) | Sulfate, chloride, or halide carbonate |
| Radium-226:Be | 370.0 GBq (10.0 Ci) | Sulfate, chloride, or halide carbonate mixed with beryllium target material |

4. Special Conditions –

a. Capsule assembly shall be conducted in accordance with either LANL procedure OSR-OP-190, R.1, Assembly Procedure for LANL Special Form Capsule, or QSA Global Inc. H1070, Rev. 6, Assembly Procedure for the Model II Special Form Capsule.

b. Capsule components must have been obtained from either LANL or QSA Global Inc.

c. A copy of either the applicable, completed Traveler Sheet required by LANL procedure OSR-OP-190, R.1, Assembly Procedure for LANL Special Form Capsule, or the Record Sheet required by QSA Global Inc. H1070, Rev. 6, Assembly Procedure for the Model II Capsule, shall be attached to this IAEA Certificate of Competent Authority in order to demonstrate the regulatory requirements for special form radioactive material have been met.

5. Quality Assurance -

a. Each assembler of the Model II Source Capsule shall register their identity, in writing, and provide evidence of a Quality Assurance program based on international or national standards to the Office of Hazardous Material Technology (PHH-23), Pipeline and Hazardous Materials Administration, U.S. Department of Transportation, Washington, D.C. 20590-0001.

b. Assembly of the Model II Source Capsule shall be performed under the Quality Assurance program registered with the U.S. DOT.

c. Records of Quality Assurance activities required by paragraph 310 of the IAEA regulations[1] shall be maintained and made available to the authorized officials for at least three years after the last shipment authorized by this certificate. Consignors and consignees in the United States exporting or importing shipments under this certificate shall satisfy the requirements of Subpart H of 10 CFR 71.

6. Expiration Date - This certificate expires on November 30, 2015.

This certificate is issued in accordance with paragraph 804 of the IAEA Regulations and Section 173.476 of Title 49 of the Code of Federal Regulations, in response to the petition and information dated December 3, 2010 submitted by the U.S. Department of Energy, Washington, DC, and in consideration of other information on file in this Office.

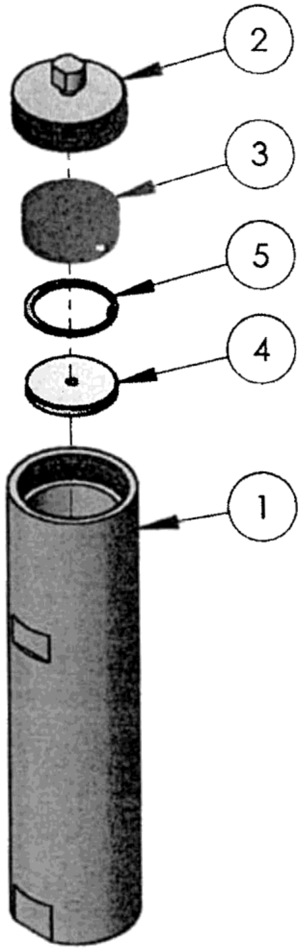
Certified by:

Dr. Magdy El-Sibaie
Associate Administrator for
Hazardous Materials Safety

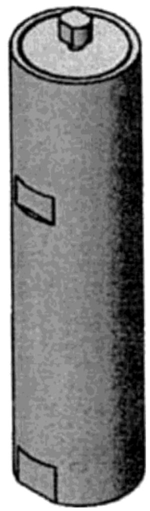
DEC 28 201

(DATE)

Revision 6 - Issued to extend the expiration date.

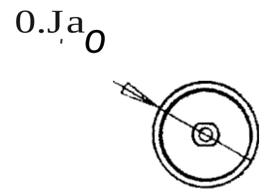


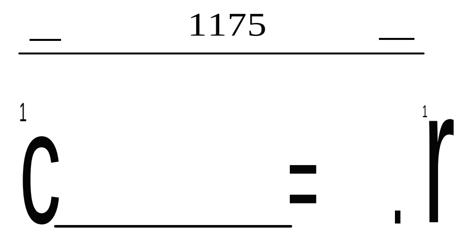

EXPLODED VIEW
SCALE: NONE



ISOMETRIC VIEW
SCALE: NONE

LOS Alamos
NATIONAL LABORATORY




NOTES:
1. THREAD DEPTH .750.
2. THREAD, 2 1/2-10 ACME 2G.
3. ITEM {4) LUBRICANT, DUPONT, KRYTOX LVP FLOURINATED GREASE.

| ITEM NO. | PART NUMBER | MATERIAL | Default/ QTY. |
|---|---|---|---|
| 1 | CAPSULE CYLINDER, LANL P/N 90Y-219998-2 | STAINLESS STEEL | 1 |
| 2 | 219998-1_AF0Copy | | 1 |
| 3 | 219998-3_AF0Copy | | 1 |
| 4 | IMPACT_PLUG_AFOCopy | | 1 |
| 5 | RET_RING-N5000-206_AF0Copy | | 1 |

SIMPLIFIED SKETCH DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOI£RANCES:
FRACTIONAL
ANGULAR: MACH! BEND!
TWO PLACE DECIMAL
THREE PLACE DECIMAL
INIERPRET GEOIIETRIC TOIERANG PER:
MATERIAL
FINISH

NEXI ASSY USED ON
APPUCAIION

DO NOT SCALE DRAWt<G

| | NAME |
|---|---|
| DRAWN | MIKE HOOD |
| CHECJ(fD | MIKE HOOD |
| ENG APPR. | DANNY MARTINEZ |
| MFGAPPR. | |
| Q.A. | |
| COMMENTS: | |

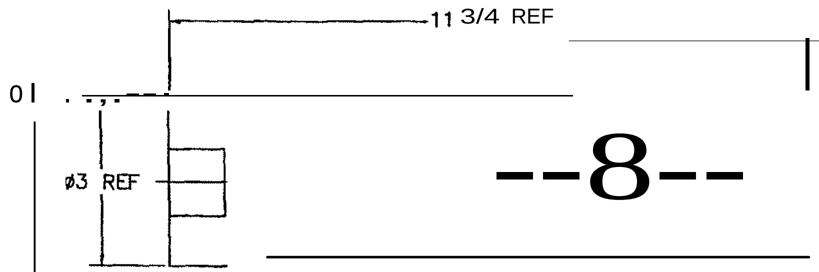
POINT OF CONTACT
CRISTY ABEYTA
505 667 4711

TITLE: AET-1 OSR SOURCE CONTAINMENT CAPSULE MODULE II

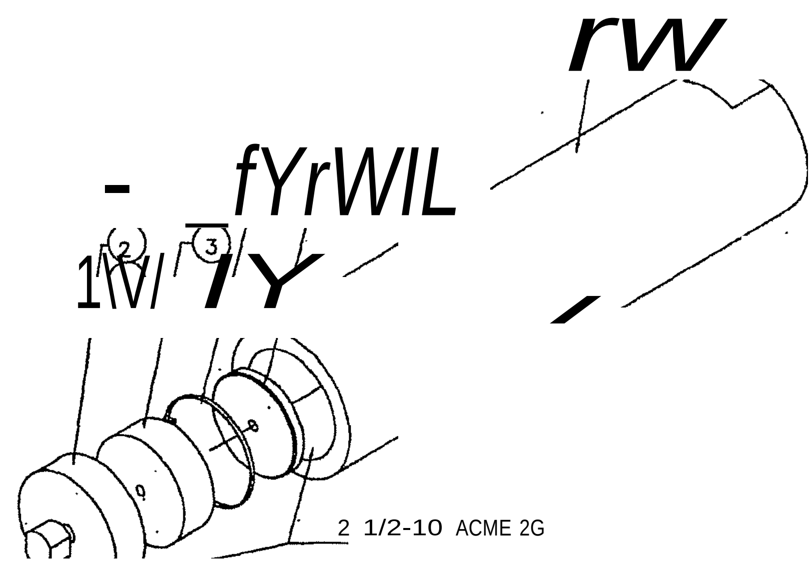
SIZE A DWG. NO. 90Y_219998 REV H

SCALE: NONE SHEET 1 OF 1

5 4 3 2




CAPSULE AFTER ASSEMBLY
(KNOB SHEARED OFF)




| ITEM NO. | PART NAME | Q1Y. | DESCRIPTION |
|---|---|---|---|
| 6 | LUBRICANT | AR | Dupont Krytox LVP Fluorinated Gf13ose |
| 5 | IMPACT PLUG | 1 | ST.STEEL |
| | SNAP RING | 1 | ST.STEEL |
| 4 | SEAUNG PLUG | 1 | ST.STEEL |
| 3 | CftP | 1 | ST.STEEL |
| 2 | | 1 | ST.STEEL |
| 1 | BODY | | |

NOTES:
1. CAP AND BODY THREAD DEPTH 3/4•

| APPROVALS | DATE |
|---|---|
| [signature] | 2/10/05 |
| [signature] | 10/5/05 |

UNLESS OTHERWISE SPECIFIED
1.ALL DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONS ± 1/8
X.X ± 0.12
X.XX ± 0.06
X.XXX ± 0.020

AEATECHIliCito
DESCRIPTIVE DRAWING
mu: SPECIAL FORM CAPSULE MODEL II

ERF# 991
SIZE B
DWG. NO. R20047
REV
SHEET 1 OF 1
SCALE: NTS

U.S. Department
of Transportation

East Building, PHH-23
1200 New Jersey Avenue SE
Washington, D.C. 20590

Pipeline and
Hazardous Materials
Safety Administration

**CERTIFICATE NUMBER:** USA/0696/S-96, Revision 6

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