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Title: Glovebag Processing of High Purity Neptunium Oxide to Minimize Cross Contamination of Pu-239 and Np-237

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Glovebag Processing of High Purity Neptunium Oxide to Minimize Cross Contamination of Pu-239 and Np-237

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Background and Scope

A large sample of high-purity neptunium oxide (believed to be one of the purest of its kind) needed to be split and recontainerized for sampling, testing, and storage for future use. The lot ID of this sample was ERP6749CF2. The sample was enclosed inside an intrinsically sealed, welded container. LANMASS reported that ERP6749CF2 had a net material weight of 623.0g with a SNM mass of 530.0 g. The objective of this project was to gain access to this material, and perform the required splits in a clean environment in a glovebox in PF-4.

Work Authorization and Location Selection

This work was performed under the Detailed Operating Procedure (DOP) PMT2-MPK-DOP-039 "Evaluating, Consolidating, and Discarding Nuclear Material". This document was revised to include a section on processing intrinsically sealed items. A dose rate measurement was performed on the item to determine if a high radiation Radiological Work Permit (RWP) and Radiological Control Technician (RCT) assistance would be required. The dose rate of ERP6749CF2 was found to have a Beta/Gamma dose rate of 750 mr/hr. The neutron dose rate was quite low. This dose rate does require a high radiation RWP. RWP-0023-2009 was revised to include the selected mass location and the process radioactive isotope (Np-237). ERP6749CF2 was placed in pewter shielding to reduce the radiation field in the process glovebox.

Mass location G201 was selected to be the process glovebox. This box can be an inert gas flush box using either helium or argon, and thus already had the required exterior gas line and flow meter installed. Additionally G201 was already equipped with a calibrated Teldyne Oxygen Analyzer. This box is also kept relatively clean and thus further reduces the chance of cross contamination of plutonium with the neptunium samples.

Glovebag and Interior Manifold Design

In order to create a clean environment to open the neptunium sample a commercially available glove bag was used. The glovebag would then be connected to the facility argon line with an interior gas manifold. The glovebag selected for this task was a Glas-Col 108D SS-30-20H-6. The glovebag material is a low density polyethylene blown film and has a thickness of 2.5 mils. The glovebag was equipped with two equipment sleeves, and has dimensions of 30"x 20"x 14".

The size of this glovebag was determined by the available working area in the process glovebox. One of the equipment sleeves can be converted to an airlock for entry into the glovebag. Some modifications were made to the glovebag for this application. Larger sturdier TRIonic cleanroom gloves with better grip were attached using Glas-Col 108D R-425 adapter coupling rings. HEPA filter cartridge was added for bag inflation and deflation.

An interior gas manifold was designed to flow argon gas from the facility supply into the glovebag. The manifold consisted of a half inch NPT fitting, a self sealing quick-connect adapter, a 0.5 micron filter, a 36 inch flexible stainless steel hose, and an adapter to fit the glovebag gas inlet port. A model of the manifold is shown in Figure 1.

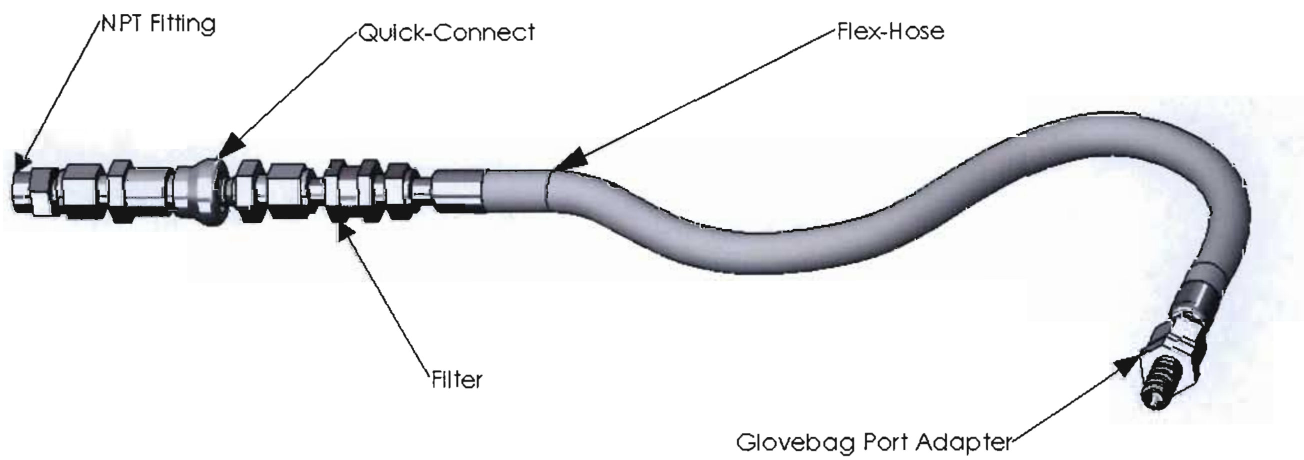

Figure 1 Interior Gas Manifold

The functionality of the glovebag and manifold were tested in a non-radiological laboratory using argon as the process gas. It was determined qualitatively that a flowrate of 50 – 75 cfh would suffice for keeping the bag inflated while working in the glovebag.

Container Selection

ERP6749CF2 was to be divided into six daughters with net weights as shown in Table 1. The first consideration was the type of container. The decision was made to go with conflat containers with copper gaskets. The lid of these containers is a flange type lid with bolts to compress a copper gasket. The containers were readily available and provide a robust seal ensuring sample and atmosphere integrity. Ideally the minimal number of containers would be in the glovebag at the time of the job, and for this reason sizing of the containers is critical. The actual density of the sample was not known. Conservatively the density of the oxide was approximated to be 25% of the theoretical density for neptunium oxide. The theoretical density of NpO2 is 11.11 g/cm^3. Therefore the volume required for the samples is represented by the following equation:

$$V_R = 0.25 \cdot TD \cdot m_{samp} \qquad (1)$$

Where, TD is the theoretical density of NpO2, and m_{samp} is the desired mass of the sample. The required volumes for the 6 daughters are shown in Table 1.

Sample Name	Desired Net Weight (g)	Sample Volume (cc)
ERP6749CF2-S1	40	111.1
ERP6749CF2-S2	40	111.1
ERP6749CF2-S3	5	13.9
ERP6749CF2-S4	10	27.8
ERP6749CF2-S5	50	138.9
ERP6749CF2	475	1319.3

Table 1 Target Net Weights and Estimated Volumes

Since the conflat containers are cylindrical their volumes are calculated by the following equation:

$$V_C = \frac{\lambda \cdot D^2 \cdot h}{4} \qquad (2)$$

Where *D* is the internal diameter of the conflat cylinder, and *h* is the height of the conflat cylinder. The volumes of a variety of conflat containers were determined. Six containers with adequate volumes were selected for use.

Glovebag Preparation and Loading

As was mentioned earlier, the glovebag and manifold were set up and tested in a non-radiological laboratory. An inventory of tools was prepared, acquired, and loaded into the glovebag. Table 2 displays the equipment that was loaded into the glovebag and the function of each piece of equipment. Mass labels were created and placed on their respective conflates prior to being introduced into the glovebag.

Equipment	Purpose
6 Conflat Containers w/ Gaskets	Container for Daughters after Split
Tube Cutters w/ Stainless Steel Cutting Wheel	Open Sealed Container
Digiweigh DW-100AX Pocket Scale	Estimate Sample Mass
50 g Check Weight.	Verify Scales Accuracy
Crescent and Allan Wrenches	Seal Conflat Containers
Light Trays	Containing Material while on Scale
Scoopula	Move Small Amounts of Oxide
Small Funnel	Fill Small Conflats with Oxide
11 X 17 Paper Mat	Workspace to Collect any Spilled Material
Small Tweezers	Working with Small Parts
Small Telescopic Magnet	Collecting Small Parts
Yellow Tape	Covering Sharp Edges

Table 2 Glovebag Equipment

The Digiweigh DW-100AX has a maximum readout of 100 g (this is more than enough for the required sampling. It is important to note that this scale is not an MC&A certified balance. The scale was used as an aid to estimate sample mass. This method of sample distribution will have better results then the alternative (splitting based on volume) since the density of the sample is not accurately known. The conflats with their labels, and respective bolts and washers were weighed on a LANMAS verified scale prior to their introduction into the glovebag. After the completion of the job the conflats will be re-measured on a LANMAS verified balance with the mass gain being verified net weight of the sample.

The work to be done was simulated in the non-radiological laboratory. Several mock cylinders were cut using the tube cutters so workers could gain familiarity with environment and tools. The flow-rate discussed previously was also determined at this time. Prior to the glovbag and equipment being introduced into the glovebox the two glovebag sleeves were crimp-sealed. One sleeve was to be used for equipment storage, and the other was double-crimp-sealed to create an airlock. To minimize contamination the introduction of the glovebag, equipment, and manifold was done just prior to the date of the job.

Radiological Work

The opening and separation of ERP6749CF2 was done on the morning of December 7th 2010. The required introductions and glovebox set up were done the afternoon prior. The original container was cut out of its plastic bag and decontaminated using damp cheesecloth. After the

The material, as is apparent in the figures above, was brown in color. The consistence was that of a dense powder. After the conflat bolts were torque the containers were removed from the glovebag and weighed on an active MC&A balance for final weight determinations. One sample remained in line, and was sent for use in the LANL fuels program. The remainder was removed from the glovebox line. Several of the samples were transferred to The Chemistry and Metallurgy Complex for chemical analysis. The remainder of the material was stored at the TA-55 Special Nuclear Material Vault to await future use.

Figure 3 NpO_2 Sampling

Figure 4 NpO_2 in Large Conflat

wet wipe-down the item was further decontaminated with dry cheesecloth and introduced into the glovebag through the airlock sleeve discussed earlier. Once inside the glove bag the tube cutters were set and a top section of the original intrinsically sealed container was severed. The process of opening the original container took approximately 20 minutes.

After the container was opened several samples were taken, weighed and placed into their appropriately sized conflat containers. A conflat container has a lid that is bolted to the body with a copper gasket to insure a robust seal. Photographs of this work were taken and are shown below. Details of the work being performed on the interior of the glovebag were difficult to capture due to both the glovebox windows and glovebag transparency, and reflectivity.

Figure 2 Images of Glovebag Setup and Work